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The Future of the British Patent Office.

I.

THE British patent system suffers from certain rather serious defects which prevent it from fulfilling adequately its function as a stimulus to invention and as an incentive to the development of new manufactures. It is the purpose of the present article to discuss one of these defects, namely, the restricted character of the investigation for novelty which is carried out by the Patent Office, and to direct attention to the need for fresh legislation on this subject. Wide differences of opinion are likely to exist as to the form the remedy should take, since the relative cost of any schemes which may be put forward will depend on the degrees of thoroughness characterising the searches for which they respectively provide. The view here advocated is that an extremely high degree of thoroughness will repay the expenditure which it involves, but we shall have served our purpose if we succeed in directing attention to the principal questions on which a decision will have to be taken when the present state of the law comes to be amended.

At the present time the situation in Great Britain is as follows. When a capitalist proposes to work a given patent, it is necessary for him to expend a certain outlay in plant, buildings and business organisation. Before taking the financial risk involved, he naturally desires to have some degree of assurance that he can uphold his patent in the courts, that it will not be invalidated after he has committed himself irrevocably to his venture. In the present state of the system, quite apart from the possibility of "prior user," which plays a small and diminishing part in such matters, and of "lack of subject matter," which does not entitle the patentee to much sympathy, he cannot have any such assurance. For at any time after a patent has been granted by the Patent Office, it may be invalidated on the ground that, unknown to the patentee, an invention similar to his had previously been "made available to the public in some document published in the United Kingdom," such as a foreign patent specification or a technical journal.

This state of affairs is keenly felt in manufacturing circles at the present time. It discourages the investment of capital in new manufactures at a time when unemployment and foreign competition demand the fullest exploitation of new means for creating wealth, and it hampers inventors in turning to advantage their patent rights. It is true that as regards anticipation by prior British specifications of the previous fifty years, the Patent Office does make a search which is marked by characteristic British thoroughness, but that search is a good thing spoiled, for it covers only a

fraction of the documents from which anticipations may afterwards emerge.

Various remedies for this state of things might be proposed. For example, if the Comptroller were simply to be empowered to enforce amendment to meet what are now called "extra-statutory citations," probably some sort of an extended search would be evolved in the course of a few decades, in an attempt to give fuller effect to these new powers. Or again, as Mr. W. J. Tennant once suggested,[1] the British search might be abandoned and the staff might devote itself to the formation of a universal index, in which applicants or their agents could search for themselves over a wide field. Or if the present examining staff were to be diluted with personnel of inferior qualifications working under its direction, a comprehensive search of moderate cost and low efficiency could be instituted within a reasonable time. We suggest, however, that the thing is worth doing well, and that means of a practicable character can be found to meet the cost of a far more ambitious scheme. We propose that the Patent Office should undertake to search over substantially the whole area in which anticipating documents may be found, and that it should carry out this investigation with the same thoroughness that at present characterises its search amongst British specifications.

In order to help in reducing the gap between the area covered by the search and that contemplated in the legal grounds for invalidation, the latter might be contracted somewhat. For example, it is only in the most academic sense that an invention can be said to be anticipated by an identical invention published twenty-five years ago in German and then forgotten. In fact, invalidation by publication might reasonably be restricted, in the case of foreign specifications, to a period of twenty years, at all events during the experimental stage of the extended search. The effect of publication in periodicals might be restricted to a like period, since their essential subject matter passes in the course of time into text-books. It might even be considered reasonable to rule that prior publication in any language other than English, French or German should not be deemed to invalidate a patent; and, again, it is by no means certain that the present law with regard to prior user gives the fairest balance between the rights of all the parties concerned.

All the points referred to above require careful consideration by the patent lawyers, and if their decision be favourable, the scope of the extended search can be narrowed accordingly without defeating the object of the latter. For our present purpose we shall assume that for all practical ends it will be sufficient to search amongst the patents published in the Dominions, France, Belgium, Germany, the United States, and Switzerland for the preceding twenty years, and to search for a like period all the relevant periodicals at present taken by the Patent Office Library, together with up-to-date text-books. It would also be desirable for the Patent Office examiners to visit works regularly and make notes of standard practice; for apart from the utility of such notes, this plan would keep the outlook of the Office essentially practical and prevent it from becoming too academic.

The advantages to be gained by instituting an extended search are many and important: a few of them may be pointed out here. As has already been argued, the confidence which it would establish would stimulate invention and the development of new manufactures, for it would remove the principal cause of the uncertainty which at present hangs over the patentees of obviously useful and ingenious inventions. There is no need to labour this point, which will readily appeal to manufacturers; but it is important to note the effect of any step of this kind in reviving industry and so helping employment. Then again, at the present time, inventors who wish to protect their inventions abroad have actually to make application in the countries they have selected before they can have any idea of the anticipations which are likely to be cited against them there, and the process of amending to meet the requirements under this head of the American or the German Patent Office is a troublesome and expensive one, which could largely be avoided if the specification had originally been drawn up in the light of full knowledge. Internationally, too, the value of the British patent would be so much enhanced that it would acquire a dominating position in the patent systems of the world. Applications which at present are sent from all parts of the world to Germany or the United States in order to obtain the results of a universal search might then come to Britain, provided that the present standard of thoroughness were maintained intact.

It has been suggested that patents should be granted for the British Empire as a whole, so as to avoid the expense and labour which are incurred when a separate application has to be made in each of the component countries of the Empire. A conference on this subject was held in 1922, but none of the technical staff of the Patent Office was present, and those who advised the chairman on behalf of the mother country were without personal knowledge of the essential work of examination and search. As might be expected in these circumstances, the conference failed to handle successfully the extremely delicate technical question of an Empire search, in which the dignity of the

[1] W. J. Tennant, Presidential Address, Transactions of the Chartered Institute of Patent Agents, 1917–18, vol. 36, p. 41.

Dominions was concerned; in consequence, proposals were adopted which failed to win over the Dominion Governments, and the conference has proved sterile. To some small extent, however, the advantages which would have been gained by the institution of a competently planned Empire patent would be conferred by an extended search; at all events, a patentee who thought of protecting his invention in the Dominions would be able to find out beforehand whether any prior Dominion patent stood in his way.

The extended search would also make possible certain innovations which would cheapen patent litigation in the same way that the institution of Quarter Sessions cheapens criminal procedure. It would make it practicable to empower the Patent Office to deal with certain issues which at present are reserved for the courts, and in particular to grant suitably restricted certificates relating to the validity of patents, having an effect on costs similar to that of the certificates of validity at present granted by the courts. For during the five years 1920–1924, when the Patent Office sealed 83,166 patents and the Comptroller (together with the senior members of the scientific staff who share his judicial duties) gave decisions under the "novelty sections" (7 and 8) of the Patent Acts in 8831 hearings, there were only 7 successful and 3 partly successful appeals against those decisions. Hence no hesitation would be felt in entrusting the Patent Office with wider powers, provided that its Hearing Officers were given access by means of an extended search to the requisite range of facts. The effect of cheapening patent litigation in this way would be to protect poorer inventors against intimidation by the wealthy owners of bad patents, since the latter's bluff depends for its effect on the costliness of patent actions.

The last advantage of an extended search to which we need refer is one that especially concerns research workers. At present there is no very easy way of finding out the precise state of any technical art before embarking on research in connexion with it, and as a result labour is sometimes wasted in repeating work which has been done before, while investigators and inventors are deprived of knowledge which might be of the greatest value in solving for them various problems of design incidental to their main objectives. Now if the Patent Office were to undertake the kind of search we have indicated, it would become an encyclopædic source of information as to the current state of invention in all parts of the world, and the examining staff would become a body of experts able to supply, at short notice, fully documented information as to the methods which have been proposed and the problems that have to be solved in every kind of manufacture. If this information were to be available on payment of a suitable fee *before* the filing of a complete specification, it would enable inventors to put their inventions into the best practicable form.

In this connexion, considerable interest attaches to an article in *La Propriété Industrielle*, May 31, 1925, p. 93, urging the formation of an international classification, so that indexes should have the same sub-headings in all countries. That this in itself is not practicable can best be seen by means of an example. About 450 different varieties of the ordinary tumbler switch are comprised under the appropriate British sub-heading, and in order to determine precisely which switches shall and which shall not be included, a rigorous definition is necessary. The definitive heading adopted is:

Electric switches, etc.,
kinds, etc.,
snap-action switches (springs during a single on or off operation are first strained and then relaxed, to assist or to produce the switching movement) (*including* like snap action switches with gravity action, and snap action details of switches of all types)
with operating levers and turn members having limited stroke.

In the United States, on the other hand, most tumbler switches would go into the file 200 (67), the heading of which is snappy rather than definitive, namely:

Electricity circuit makers and breakers
snap
oscillating contact
double snap.

It will be clear at a glance that these two files, though they overlap, do not necessarily cover the same ground. Now it sometimes happens that while attending an interview in an overcrowded room an inventor will overhear two examiners wrangling about classification. Let any one who has had this experience picture to himself an attempt to secure mutual agreement, by correspondence between the 160 patent offices of the world, as to (*a*) a definition of what is to be included in the file for tumbler switches, and (*b*) the manner in which that file should be subdivided. However, we may concede the main contention of the article referred to—which is that a universal index would be of the utmost value to the whole world—while at the same time we hold that a single nation must give effect to it.

We have now only to show that the scheme that has been outlined is practicable and that the cost can be met in an acceptable manner. For that purpose an examination of published statistics has been made, and the results will be described and considered in a further article.

Meteoric Astronomy.

Meteors. By Prof. Charles P. Olivier. Pp. xix+276+23 plates. (Baltimore: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1925.) 30*s.* net.

A GREAT part of the most valuable work in recent years on meteoric astronomy has appeared in periodicals published in different countries. As many of these are inaccessible to the average reader, Dr. Olivier's book reviews a number of the most important of the articles appearing in the various journals; the more mathematical parts are segregated, so that the non-mathematical reader can omit these without losing the continuity of the work. The researches of Dr. Olivier and the American Meteor Society for several years on meteoric astronomy, the results of which are included in the book, render it both valuable and interesting, though probably differences of opinion will arise, especially amongst English meteor observers, on some of the conclusions attained.

In the first chapter, "Historical Introduction," we have a brief account of the fall of meteors from the earliest times, the first record being found in the Book of Joshua, chap. x. The author believes that the narrative describes the fall of meteorites rather than hailstones. We may remark, however, that Josephus affirms that thunder and lightning accompanied the phenomenon, which may indicate a fall of hailstones of unusual size, not meteorites. The second chapter describes the methods for observing meteors, including those depending upon photographic work. The mechanical apparatus of Rev. M. Davidson, referred to on p. 14, and stated to have been described in the Journal of the British Astronomical Association, 30, p. 92, is not, however, used for observing meteors, but for determining their real paths from the results of a double observation.

Five chapters are devoted to discussing some of the chief showers, the Leonids, Perseids, Lyrids, Andromedids, Aquarids, and the meteors associated with the Pons-Winnecke comet. In connexion with this first shower and its well-known relation to Tempel's comet, there is an obvious error on p. 40, where it is stated that the orbit has a major axis of 10·34 astronomical units, and the aphelion point is 18 from the sun, but due to the inclination of the plane of the orbit to that of Uranus—about 16°—the meteors could never approach the planet within 5 astronomical units. The *semi* major axis is 10·34, and though the inclination is 16°, yet at the ascending node the comet is about 18·8 from the sun, so that the meteors could come quite close to Saturn at times. It appears as if Dr. Olivier considered the axis major to be inclined at 16°, and then concluded that the comet would be 18 sin 16° from the plane of Saturn's orbit when at aphelion. A very important point is discussed in connexion with the Perseid shower—the shift of the radiant by about 1° in longitude each night. Denning was the first to show that there was this undoubted movement from July until about August 20, but Brédikhine held the view that the radiants observed in July and those probably after August 19 belonged to other streams or were partly chance accordances. The work of the American Meteor Society, however, substantiates the existence of radiants in the positions assigned by Denning to the Perseid radiant from July 28 until August 18, though from July 21 until 27 the data are insufficient to affirm or deny Denning's positions. It seems strange that some European observers should find little or no evidence of a regular motion of the Perseid radiant: English observers have not generally disputed Denning's results.

In Chap. viii. it seems to us that some of Dr. Olivier's criticism is unfair. In 1910 he announced, from observations of the Aquarids, that the connexion between Halley's comet and the η Aquarids was first definitely proved. The radiant is not given in this chapter, but in a previous work, "175 Parabolic Orbits deduced from over 6200 Meteors," published in 1911, the radiants are given on the dates May 4, 6, 11, as 334°-3°·4, 337°·7-0°·6, 342°-0°·6 respectively. In the British Association Report for 1874, p. 349, Herschel pointed out the probable connexion, and also in the Monthly Notices of the Royal Astronomical Society, 1876, though Tupman's radiant 325°-2°·5 on May 1-3 was a considerable distance from the theoretical position, 337°-0° on May 4. In the Mon. Not. R.A.S., 1886, Denning states, from his radiant 337°-2°·5, April 30-May 6, "... the identity of the two orbits seems placed beyond doubt." The fact that Denning in 1899 was cautious enough to use the expression "probably associated with Halley's Comet," scarcely justifies Dr. Olivier in claiming priority by saying he "definitely proved" the connexion in 1910. Again, on p. 76, in discussing eight radiants, the author submits that Tupman's are the only scientifically observed ones, yet on April 29 Tupman's radiant is 329°-2°, and on May 2-3 it is 325°-2°. Now, as Dr. Olivier holds that the radiant moves about 1° in longitude each day, then Tupman's radiant on April 29 should correspond closely to 332°±0° on May 3, a position far from 325°-2° found then. One cannot describe this as one of "the only thoroughly scientifically observed radiants." Indeed, Nos. 4 and 7 by Denning and Corder correspond far more closely with the theoretical position for Halley's comet. In addition to the points raised concerning the Aquarids, this chapter also discusses the meteors of Pons-Winnecke's comet, but the orbits published in the Monthly Notices of the Royal Astronomical Society, 77, 1916, are not

reproduced, as it is thought that the elements might be improved by another treatment and by having certain corrections applied. In the paper referred to, it is thought that the shower extended from May 20 until July 10, though to the present writer this seems very doubtful, and possibly the author may modify his views later when he hopes to make this the subject of a new research.

A considerable amount of discussion takes place on the question of stationary radiants, and a summary of the works of Von Neissel, Tisserand, Turner, Herschel, Brédikhine, Pickering, Plummer and Davidson is given. Dr. Olivier, as is well known, does not believe that stationary radiants as a rule exist, though the researches of those just mentioned show the possibility of such under certain conditions. He admits, however, that approximately stationary radiants near the ecliptic may exist for considerable periods of time, but does not think that the same applies to radiants with high latitudes. Denning was convinced of the existence of stationary radiants before any theoretical justification for them was advanced, and though most of these apply especially to radiants near the ecliptic, there is the possibility of reasons being given for others in the future.

Those possessing elementary mathematical knowledge will find much interesting reading in such subjects as meteor orbits, real heights, perturbations of orbits of streams, formation of meteor streams from comets, etc. The methods of computing orbits are almost identical with those published by Lehmann-Filhès, and many sections of Schieparelli's "Sternschnuppen" are reproduced. The real heights of meteors are found by Schaeberle's method, and an example is given in Chap. xv. It seems to us that it is unnecessarily laborious, and the use of a celestial globe saves much time in this work. Extreme accuracy cannot be attained, especially in finding the height of the beginning of a meteor, as the observers in different places do not usually see its commencement exactly at the same instant. By taking the azimuth and altitude of the beginning and ending on a celestial globe and then using a good map, paths of meteors can be quickly found. Davidson's apparatus described in the Journal of the British Astronomical Association, 30, p. 92, is useful where one of the observers is doubtful of the position of the beginning or ending, but the direction of flight is well known. The instrument itself automatically adjusts the ill-defined position.

Dr. Olivier's work covers practically every branch of meteoric astronomy, and should be extremely useful to those interested in this department. The frequent use of split infinitives may irritate some readers, but this literary defect cannot be said to detract from the scientific value of the book.

Cults and Customs in San Cristoval.

The Threshold of the Pacific: an account of the Social Organisation, Magic, and Religion of the People of San Cristoval in the Solomon Islands. By Dr. C. E. Fox. (The History of Civilisation Series.) Pp. xvi+379+14 plates. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, Inc., 1924.) 18*s.* net.

IT was a more than fortunate chance that threw together the late Dr. W. H. R. Rivers and Dr. Fox while on a voyage to San Cristoval in the *Southern Cross*. It was then that the interest of the latter in anthropology was aroused by Rivers's genealogical investigations. These he regarded at first with some amusement, but as time went on he came to be drawn to the study of the customs and beliefs of the people among whom his work lay as a missionary, with as serious a purpose as that which inspired Rivers himself.

Anthropologists have long been aware that this book was in preparation. The manuscript was in Rivers's hands at the time of his death; but the work of editing was still unfinished, and the task of completing it has devolved upon Prof. Elliot Smith with the assistance of Mr. W. J. Perry. The expectations which had been aroused by the publication of part of Dr. Fox's material in the Journal of the Royal Anthropological Institute are fully justified by the completed work, which, it is no exaggeration to say, will take high rank among the works which record first-hand study of primitive peoples. Dr. Fox writes with the intimate knowledge which comes from careful inquiry as well as long acquaintance with the subject matter; yet he retains a freshness of observation undimmed by familiarity, which serves to carry his reader through a mass of detail without even a suggestion of weariness.

San Cristoval, which lies at the south-eastern end of the Solomons, is divided into several large districts, which differ considerably from one another both in social organisation and in beliefs and custom. Broadly speaking, the west end of the island, which Dr. Fox, extending the strict geographical application of the name, calls Arosi, and Kahua — the eastern end — together with the outlying small islands, differ from the central area Bauro in that they are organised on a totemic basis. Bird clans occur in the west in Arosi, aquatic clans to the east in Kahua, and both are found along the coast of the central part. In the district of Bauro, of which, however, Dr. Fox knows part only, the people of the interior have a dual organisation. Although there are some totemic clans on the coast of this district, as mentioned above, it is clear that the dual organisation underlies them, as might perhaps be expected.

The relationship terms in this district appear to differ from those in any other part of Melanesia in that all the terms and all names have prefixes to distinguish sex, the term used depending upon the sex of the person to which it is applied.

Dr. Fox has paid special attention to the very interesting serpent cult, which has its home in the Bauro district. This cult has many peculiar features, well brought out in the legends connected with the snake which he quotes. Pools, rocks, and waterfalls or large trees are thought to be the abode of *hi'ona, higona,* or *figona,* the last being the term Dr. Fox prefers to use throughout. These spirits are never seen; but others, the chief *figona,* had a serpent incarnation only. In this they differ from the *Adaro,* some of whom are ghosts; others, spirits who have never been men. These could take the form of men, dogs, birds, snakes, trees, or clouds. The *figona,* however, seem to be connected with stone worship in addition to their serpent incarnation, for they could take the form of, or withdraw into, stone. Of these serpent incarnations, Dr. Fox regards one known as Agunua as "almost like a supreme spirit" and partaking in some sort of the nature of a divine demiourgos. It would appear that particular *figona* are regarded as local representations of Agunua. Dr. Fox is also inclined to the view that the worship of Agunua was once widespread. On the whole, however, although the legends of Agunua are connected with the creation of certain things, as, *e.g.*, the coming of fire, he scarcely functions in the rôle of creator, and the evidence upon which supremacy is attributed to Agunua appears to be too slender for any positive conclusion.

Dr. Fox has naturally paid considerable attention to the system of relationship—a study for which Rivers's genealogical method has done so much. His results, however, are an illustration both of the strength and weaknesses of that method. He gives a very candid account of the difficulties into which he was led until he discovered the discrepancies introduced into his information by the practice, which Rivers himself noted, of marriage and adoption out of the correct generation. One result of the custom of adoption—amusing enough to us, although it offers nothing incongruous to the native mind—is that a boy may be adopted as a father or a grandfather, and thus stand in either of these relations to those who are his coevals.

"The Threshold of the Pacific" can be considered under two aspects. On one side, Dr. Fox records the results of his observations, and in this his work is deserving of the highest praise. On the other, he seeks to draw ethnological conclusions from his material; and what is really unfortunate, these two aspects are not kept rigorously asunder as they should be. The reader, therefore, may perhaps be pardoned if he has an uneasy feeling that Dr. Fox, in dealing with certain remarkable features in the culture of the San Cristoval, such as the custom of embalming, the modes of burial, the winged serpent belief, etc., has allowed his judgment to be unduly influenced by analogies which undoubtedly may be found in ancient Egypt. He argues that San Cristoval has been peopled by four distinct groups: (1) The Amwea moiety of the dual organisation; (2) the Atawa moiety of that organisation; (3) the Abarihu, part of whom constitute the Araha ruling group; and (4) the people who practise cremation. So far this would seem a not improbable interpretation of the evidence. Dr. Fox, however, goes further and points out that many customs of the Araha exhibit similarities to the cultural complex which has been attributed to the people of the "archaic civilisation" of Indonesia as described by Prof. Elliot Smith, and make strongly for their identification with that hypothetical culture. This, as will be seen from a careful perusal of Dr. Fox's final chapter, has involved him in considerable difficulties, owing to the fact that certain elements of that culture are entirely absent, while others, though present in San Cristoval, do not attach particularly to the Araha. The discrepancy is apparent to Prof. Elliot Smith, who suggests an alternative explanation in his introduction.

It is not proposed to enter here into a discussion of the significance of the similarities of the Araha culture to those of the "archaic civilisation," such as embalming, the burial mounds (called "mastaba" in a diagrammatic illustration of a burial mound, but not in the text) with superimposed dolmens, the winged serpent Hatuibwari, the "double" which goes into a stone statue, and the like. It is well known that Dr. Rivers and Prof. Elliot Smith were both greatly impressed by the evidence collected by Dr. Fox which appeared to point to the culture of ancient Egypt as the nearest analogy. How far Dr. Fox's judgment may have been influenced by that fact it is impossible to estimate, but in the preface it is stated:

"Rivers was virtually Fox's only channel of communication with the ethnological world. Hence it is no matter for surprise that the isolated worker in distant Melanesia was profoundly swayed by Rivers' views, even in some cases when his own evidence came into conflict with them. In respect of these points of difference, it is unfortunate that Dr. Fox is so far away as to make discussion even by letter virtually impracticable. Hence I have felt obliged to leave certain of his statements in a form which I feel sure he would have agreed to modify, had discussion been feasible."

This statement is a little perplexing and might, with advantage, have been made more precise.

X-rays in Research.

La technique des rayons X. Par Dr. A. Dauvillier. (Recueil des Conférences-Rapports de documentation sur la Physique, vol. 10, 2e série. Édité par la société *Journal de Physique.*) Pp. 195. (Paris: Les Presses universitaires de France, 1924.) 22·50 francs.

DURING the first seventeen years after the discovery of X-rays in 1895, the development of apparatus for their production was chiefly influenced by the requirements of medical radiologists. Progress was rapid, and attempts at standardisation were swept away by a flood of ideas, applications, and devices. In the year 1912, however, a great advance in a new and purely physical direction was made possible by the work of Laue. Following this lead and under the inspiration of Rutherford, Moseley, Bragg, de Broglie, Duane, and others, physical research in which X-rays play a conspicuous part has now become of outstanding importance.

Since the immediate questions opened up by this work and by the problems ever before the medical radiologist differ somewhat in their scope and aim, it is not surprising that the appliances evolved in the laboratory for X-ray research work should have come to be very different from those used to-day in medical practice. This evolution is traced out by Dr. Dauvillier in his book. It is essentially a work for those who are already somewhat familiar with the subject, and to whom the general information given at the beginning will serve as a useful reminder of the progressive steps by which our present knowledge has been attained. On p. 35, however, the author is in error in attributing the first X-ray tube with slanting anticathode to Mr. A. A. Campbell Swinton instead of to Sir Herbert Jackson, who, in fact, actually made it with his own hands.

After referring to the construction of "gas" tubes and their mode of regulation, we reach the section of the work dealing with the hot cathode device due to Lilienfeld and Coolidge. It is here that the value of the book is most apparent, for the author has brought together much valuable information which was previously scattered, and therefore only accessible with difficulty. The applications of the hot cathode idea are considered in detail, and the modification of the usual radiographic type of tube to suit the special requirements of the laboratory is explained and illustrated. We thus have the advantage of studying the design of the modern tubes employed in X-ray spectroscopy, with full notes of the difficulties to be met with in their use and the means of overcoming them, written by one who is himself an accomplished experimenter. Incidentally, since most of these tubes require to be continually exhausted of gas while in action, the author refers to the latest pumping methods, and gives an interesting description of a tube with liquid anticathode and also of one with a gaseous target.

The medical radiologist is, of course, gaining valuable data from the purely physical work on absorption and scattering of X-rays under various conditions, as well as from the study of the energy distribution in X-ray spectra, and he is also beginning to realise the desirability of utilising for his work a type of electrical plant that will provide a constant current at a pressure of, say, 200,000 volts. Apparatus of this kind was first set up in the United States for careful physical work on X-ray spectra, and a modification of the plan then adopted, and due largely to Dr. Dauvillier himself, is now being developed in France. Germany, too, is actively manufacturing constant current high voltage plant for X-ray work. The author has therefore wisely devoted a whole chapter to this important matter.

With regard to protection, there is no mention of the recommendations of the X-ray and Radium Protection Committee which were issued in 1921, and the author is perhaps too definite (p. 114) in referring to what he considers a safe minimum radiation intensity. It is felt by many that we are not yet quite sure as to the biological effects of exposure to a very feeble radiation over long periods of time continuously.

The book deals towards the end with the vexed question of X-ray measurement, a subject to which Dr. Dauvillier has himself made some notable contributions. Finally, there are brief references to medical, industrial, or other applications of X-rays.

We recommend this work to all physicists who are engaged upon researches in which a technical knowledge of the subject is indispensable. It is clearly written, well arranged, and fully illustrated. Its use would be still further enhanced, however, by the provision of a more adequate index, or at least the revision of the existing "table des matières," where in several instances the page numbers do not agree with the references in the text. C. E. S. P.

The New Principia.

Principia Mathematica. By Prof. Alfred North Whitehead and Bertrand Russell. Second edition. Vol. 1. Pp. xlvi+674. (Cambridge: At the University Press, 1925.) 42*s.* net.

THE great achievement of the authors of "Principia Mathematica" is to have deduced mathematics by strict symbolic reasoning from a small number of logical propositions. This was previously attempted

by Frege in his "Grundgesetze der Arithmetik," but without success. For his axioms, like those of most logicians, were found to imply contradictory consequences, such as the famous paradoxes of the theory of aggregates. In particular, both the thesis and antithesis of the well-known contradiction about the class of all classes not members of themselves could easily be deduced from Frege's primitive propositions.

To escape this difficulty, Prof. Whitehead and Mr. Russell invented the theory of types, by which both the thesis and antithesis of such contradictions were ruled out as strictly nonsensical. By means of this theory they succeeded in constructing a system adequate for the deduction of mathematics and, apparently at least, free from contradiction. But this system was not entirely satisfactory: apart from the reductions in the number of primitive ideas and propositions, which have been effected by Sheffer and Nicod, the principal need for improvement was in connexion with the "Axiom of Reducibility." This axiom was introduced to justify a common form of mathematical reasoning, which would otherwise have been invalidated by the theory of types.

Unfortunately, the axiom is by no means obviously true, and was only put forward because no less objectionable assumption could be found which would justify the ordinary theory of real numbers and Dedekind section. This unsatisfactory state of things led Weyl and others to reject the theory of real numbers as groundless, and to try to construct a truncated analysis without using Dedekind section. Consequently the main interest of this new edition of "Principia Mathematica" lies in its treatment of the axiom of reducibility.

The authors have left the text of the work unaltered, to avoid the enormous labour of changing the references throughout three volumes, but have added a new introduction and appendices. The introduction contains a much simplified exposition of the theory of types, and the outlines of a new theory in which the axiom of reducibility is replaced by a new assumption suggested in the first place by Wittgenstein for philosophical reasons. This new assumption is entirely unobjectionable, because it is of such a form that it could be made a mere matter of definition. Unfortunately, it is not nearly so fertile as the axiom of reducibility, and whole branches of mathematics, such as the theories of infinite cardinals and ordinals, of mathematical induction, and of real numbers and Dedekindian series require a new treatment.

The authors have only succeeded with this new treatment in one of the important cases, namely, mathematical induction, of which a full account is given in one of the appendices; there with great ingenuity and arguments involving functions of the fifth order, all the usual theorems are established without using the axiom of reducibility. On the other hand, the authors confess that "There is, however, so far as we can discover, no way by which our present primitive propositions can be made adequate to Dedekindian and well-ordered relations. . . . It might be possible to sacrifice infinite well-ordered series to logical rigour, but the theory of real numbers is an integral part of ordinary mathematics, and can hardly be the object of a reasonable doubt. We are therefore justified in supposing that some logical axiom which is true will justify it. The axiom required may be more restricted than the axiom of reducibility, but, if so, it remains to be discovered." It seems, however, possible that the whole trouble really arises from defective philosophical analysis, and that if the theory of types were suitably modified all need for any such axiom would disappear. But this possibility is not considered by the authors, in spite of the fact that the work of Wittgenstein, for which Mr. Russell has expressed such admiration, appears to point in that direction.

The three new appendices deal with the "Extension of the Theory of Deduction," of which a new account is given based on the work of Sheffer and Nicod, with the new theory of mathematical induction, and with the new and paradoxical philosophical assumption that all functions of propositions are truth-functions, which is defended by various subtle distinctions. We may regret the absence of any reference to the question of identity, or answer to the criticisms of Wittgenstein, "from which," Mr. Russell wrote in his introduction to "Tractatus Logico-Philosophicus," "there seems no escape." A useful addition has been made in the form of an index of definitions.

Although it still achieves no final solution of the difficulties, "Principia Mathematica" is likely to remain for many years the standard work on the subject, and its republication is a most important event.

Oats.

Oats: their Varieties and Characteristics; a Practical Handbook for Farmers, Seedsmen, and Students. By Herbert Hunter. (Practical Farming Series.) Pp. 131. (London: Ernest Benn, Ltd., 1924.) 8s. 6d. net.

IT is a matter of some significance that this book is addressed to the seedsman equally with the farmer and student, for in the past it has not been sufficiently realised to what a large extent successful crop production is determined by the suitability, genuineness, and quality of the seed employed. The manner in which Mr. Hunter has treated his subject should of itself be

valuable to the seedsman and to the farmer, as showing that the problems of both are in many details essentially the same, and are only to be solved to the mutual advantage of the two interests by painstaking and accurate methods of research.

The origin of the cultivated oat is briefly discussed, and the author does not accept it as definitely proved that the varieties of *Avena Sativa* have originated from the wild oat (*Avena Fatua*), although he would seem to regard the appearance of "false wild oats" amongst the cultivated varieties as an indication of "degeneration" towards the wild type. In this connexion it may be remarked that false wild oats occur equally amongst the oldest varieties like Welsh sprig and the newest like Victory, and in fact probably occur amongst all the cultivated varieties of *Avena Sativa*. The botanical characters of the oat, particularly such as are valuable for discriminating between one variety and another, are adequately dealt with in simple language.

The body of the book is devoted to a description and classification of the chief varieties of oats, and the economic value of each variety is briefly discussed, while in a concluding paragraph the reader is reminded that varieties with a distinctly early ripening habit are not recommended for normally early districts. The descriptions of the varieties have been based on material grown under the author's supervision, and he has used the various characters of panicle, grain, straw, growth habit, and time to reach maturity in a manner very similar to that of Marquand and others, who have also critically studied the varieties of oats.

Distinction is made between *Avena Sativa Orientalis* and *Avena Sativa* proper; the latter is divided into the following five sub-groups, which can be easily and satisfactorily differentiated: "winter hardy," "semi-winter hardy," "potato," "abundance," and "early ripening." Keys are given to the different varieties in relation to the groups and to the varieties of *Avena Sativa Orientalis*. The value of this section of the book would have been enhanced had the author dealt with the question of synonyms, and since in practice the greatest difficulties occur in the recognition of the varieties of the "abundance" division and between some of the newer of the Tartar-like varieties, it is to be hoped that in a subsequent edition of the book such varieties will be described in greater detail.

A comparatively long chapter is devoted to the chemical composition of the oat grain, in which the researches of Brenchley, Brenchley and Hall, Berry and others are faithfully discussed. Although valuable to the student, this chapter is likely to prove wearisome to the seedsman and the farmer. Excellent chapters on seed selection and the production of pure seed conclude the book. The text is supported by eighteen extremely good figures, which are very typical of the varieties they represent.

No mention is made of the diseases of oats, although the reaction of varieties to disease must at the present time be regarded as one of their most important characters.

Output of Scientific Papers.

Catalogue of Scientific Papers. Compiled by the Royal Society of London. Fourth series (1884–1900). Vol. 19: T—Z. Pp. vi+877. (Cambridge: At the University Press, 1925.) 168*s.* net.

WITH the publication of the volume before us, the indexing of the scientific papers of the nineteenth century under their authors' names has been successfully brought to a close. It is unnecessary to reiterate the high opinion which we have previously expressed of the practical utility of this monumental undertaking and of the high standard of accuracy maintained by its successive editors and their staffs. The "Catalogue of Scientific Papers" is an indispensable tool for the research student and historian of science alike.

Its value for statistical purposes, however, has not been equally recognised. No statistics were published in the prefaces to the first three Series and their Supplement; but a rough estimate made from a calculation of the average number of entries on a page gives the following results:

Period.	No. of Author Entries.	Yearly Average.
1800–63	195,120	3,097
1864–73	80,070	8,007
1874–83	100,750	10,075
Supplement	26,560	320
1884–1900	384,478	22,616

After 1900 the work of the Royal Society was continued on a greatly extended scale in the International Catalogue of Scientific Literature. Approximate figures of the output of this body were published by the present writer in a work reviewed in NATURE on October 20, 1923, pp. 585-6. The figures are as follows:

Year.	No. of Author Entries.	Year.	No. of Author Entries.
1901	43,440	1908	75,034
1902	49,896	1909	70,030
1903	49,264	1910	85,519
1904	50,741	1911	74,773
1905	73,034	1912	69,323
1906	74,877	1913	62,799
1907	74,327		

These figures suggest a curious parallelism between the movements in western science and civilisation in the first thirteen years of the twentieth century. Coupling the two sets of statistics it will be seen that the output of scientific papers showed continuous progress from

1800 until 1910—the rate of progress accelerating rapidly between 1884 and 1910—the peak year of scientific activity.

These figures, imperfect as the basis for their compilation admittedly is, deserve the attention of statisticians, and it is to be hoped that in future consolidated author indexes published by the Royal Society, the statistical value of the data contained therein will be kept in view. E. W. H.

Our Bookshelf.

Living Organisms: an Account of their Origin and Evolution. By Prof. Edwin S. Goodrich. Pp. 200. (Oxford: Clarendon Press; London: Oxford University Press, 1924.) 6*s.* net.

PROF. GOODRICH has written a wholly excellent introduction to biology. The opening chapters deal with the elementary principles of biophysics and biochemistry, and with the nature of life, reproduction and death. The remainder of the book is taken up with an exposition of the facts and theories of evolution, and the author has here given a very clear account of the present state of knowledge of heredity and allied problems, and of the latest advances which have been made in this field, both from the experimental and cytological aspects. The book is intended mainly for the general reader, and the author has therefore been meticulously careful to define exactly the terms which he uses. There can be no doubt at all in the mind of the reader as to what he means by such terms, for example, as inheritance, variation and character. This clarity of meaning is particularly emphasised in his treatment of the vexed question of the inheritance or not of so-called acquired characters. Reiterating the view of Sir Ray Lankester that the characters of organisms are in the nature of responses to environmental stimuli acting on a complex of germinal factors and must be made anew at every generation, he advocates, with the late Prof. Sedgwick, that the popular distinction between acquired and not acquired characters is illusory, and pleads for the abandonment of the expression "acquired" character altogether.

There is much to be said in favour of this view. The true Lamarckian theory of evolution demands the production of changes in the germinal factors of inheritance as the result of environmental stimuli, and of this there is at present no convincing evidence. At the present time, when the Lamarckian position is receiving so much attention at the hands of scientific workers, it is particularly desirable that the general reader should have before him a clear and simple explanation of the situation which will enable him to understand the problem and appreciate the nature of the evidence brought forward for or against the theory. The student of science, too, will find much that is helpful in this excellent little book.

The New Decalogue of Science. By Edward Albert Wiggam. Pp. 287. (London and Toronto: J. M. Dent and Sons, Ltd., n.d.) 7*s.* 6*d.* net.

SCIENCE has its natural enemies—it has also its unnatural friends. Nothing could be more distasteful to a genuine student than this hymn to science—a sort of Main Street Nietzscheanism. The writer assures us that it is "no extravagant assumption, but the surest deduction from science itself, that science only can supply mankind with the true technology of the will of God." This Will is brought down to us in the New Decalogue, written down mainly for the statesman who, we are told, decides "who shall survive and who shall perish in the struggle for existence," who "in a real sense . . . determines the very trend of human evolution." The belief in Divine Will, in science and in statesmanship leads to such views as the following: "that the advanced races are going backward," "that medicine, hygiene and sanitation will weaken the human race," "that morals, education, art and religion will not improve the human race"—all these are chapter headings.

We are ready to admit that "pauperism is as distinctly inherited as the capacity to create wealth" or perhaps even more so. But the author's proof sounds like insufficient induction: "I know one family in which in a hundred and fifty years not a single member has saved up five hundred dollars." We are at first shocked to hear that "Vice and disease purify a race. Wickedness, folly, sin, are all nature's methods of racial purgation." But we acquiesce when we are told that "the old Hebrew statesmen saw this principle of nature as clear as day. They constantly said in substance: 'The children of the wicked are cut off,' 'The fool shall perish by his own folly,' . . . 'The wages of sin is death.'" All this apparently shows that modern biology could be taught from the Old Testament.

The worst of it is that the book, written in a thoroughly unscientific spirit, yet advocates many good things such as eugenics, biometric research, application of biological conclusions to sociology and politics—all of which are bound to suffer from such advocacy. No wonder that a professional, though not very dangerous, enemy of science, Mr. Bernard Shaw, has easy play with the book in a letter which the author has proudly appended to the volume. It is both unpleasant and difficult to safeguard the interests of science from such benevolent and enthusiastic propaganda of its self-appointed apostles. B. M.

Adventures of Exploration. By Sir John Scott Keltie and Samuel Carter Gilmour. Book 1: Finding the Continents. Pp. iv+128+4 plates. 1*s.* 6*d.* Book 2: Central and South America. Pp. iv+156+4 plates. 1*s.* 8*d.* Book 3: Asia. Pp. iv+164. 1*s.* 10*d.* (London: George Philip and Son, Ltd.; Liverpool: Philip, Son and Nephew, Ltd., n.d.)

"TRAVAILE," said Bacon, "is a Part of Education. . . . Let Diaries, therefore, be brought in use." The authors of these books on adventures of exploration have ransacked the diaries of the world's greatest travellers to describe in simple language some of the outstanding expeditions by which the world has been discovered by and for Europeans. The stories range in "Finding the Continents" from the epoch-marking voyages of Columbus to those of Barents and Cook in the northern and southern seas. South America forms the scene of exploits from Cortes in Mexico and Pizarro in Peru to Fitzgerald's magnificent failure on the height of Aconcagua and Roosevelt's voyage on the River of Doubt. In Asia, between the romantic

journeys of Marco Polo and the tragic struggles to conquer Everest, there are a dozen stories of adventure and daring, not merely to lay bare the secrets of Nature, but to inquire into the habits and the life of man. De Lesseps in Siberia, Manning at Lhasa, Layard in Persia, Garnier on the Mekong, Burnaby at Khiva, and Doughty in Arabia, these are some of the adventurous travels sketched lightly and interestingly in this book. Useful sketch maps, recalling in their style and ornament the old maps of travel, make the narratives of special value and justify the authors' hope that these "supplementary readers" will quicken interest in geography by stories of adventurous travel. The selection has been well made, and the narratives not only afford an idea of some of the main steps by which knowledge has been gained, both of the world as a whole and of the separate continents other than Europe, but show also how many place names owe their origin to explorers, and recall incidents of exploration.

A Brief History of Civilization. By John S. Hoyland. Pp. 288. (London: Oxford University Press, 1925.) 3*s.* 6*d.* net.

WE ought to welcome the efforts, which are now becoming so frequent, to present the history of mankind as one, a progressive thing, culminating in a unity of which the League of Nations is the symbol and organ. Mr. Hoyland's little book is the best we have seen at the size and price, and it is published by the Oxford Press, which is distinguishing itself for works tending in that direction. Kant's prediction of the course of history-writing, made in 1782, is beginning to be realised in our day; that part and type of history is being most studied and commemorated which tends to the general good of mankind. Mr. Hoyland is possessed by this idea, and consequently gives us an appreciative account of China and a full, though discriminating, judgment of the contributions of Greece and Rome. There is also more, though not so adequate, allusion to the rôle of science in history than would be found in most books of earlier date.

The less effective part of the book is the last third, where the facts are so multitudinous as to occasion more compression and generalisation, and we think the general treatment suffers by the emphasis on the evils of nationalism and the discussion of problems raised by the growth of internationalism. It is really better, from the author's own point of view, to describe sympathetically what the various nations have done towards the common end than to dilate on the underlying problem. In practice this means more space *all through* to the triumphs of science, invention, and various forms of international association, rather than relegating all these topics together to one concluding chapter. But the book on the whole is sound and useful, and a great advance on anything of the kind yet attempted, and it is admirably illustrated and produced. F. S. MARVIN.

Essentials of Scientific Method. By Prof. A. Wolf. Pp. 160. (London: G. Allen and Unwin, Ltd., 1925.) 5*s.* 6*d.* net.

PROF. WOLF'S delightful book should be in the hands of every teacher of science. It is written with an admirable lucidity, and treats its subject in such a plain and straightforward way that no previous knowledge of logic or psychology is necessary for its comprehension. Most science teachers are interested in the philosophy of scientific method, but comparatively few have the leisure to make a thorough study of it. To the busy majority Dr. Wolf's book will prove of great interest and value, and for the others it will provide a convenient epitome.

The author does not go deeply into the fundamental question whether the world which science describes is a world of reality, and in this he is wise. He confines himself to a description of the methods actually employed by science to obtain those results which are familiar to every one. His treatment of "Order in Nature and Laws of Nature" is a particularly skilful exhibition of skating upon thin ice, but there can be little criticism of the position he adopts. "On the whole," he says, "experience has shown that there is some order in nature, even if nature be not orderly through and through." We cannot agree with him, however, when he says (p. 126) that it is not very likely that Boyle's Law and similar generalisations would be assumed to hold good of newly discovered substances without experimental verification. E. J. H.

La matière vivante: organisations et différenciations, origines de la vie, colloïdes et mitochondries. Par Prof. J. Kunstler et F. Prévost. Pp. 253. (Paris: Masson et Cie, 1924.) 18 francs.

THIS rather curious booklet contains an exposition of the authors' views on the structure of protoplasm. Their main contention is that the structural organisation of protoplasm is as important for the processes of life as is its chemical composition. With this few would disagree, especially after the remarkable experiments of Warburg and others upon the rôle of structure in such fundamental activities as respiration.

The book, however, is uncritical and one-sided. All sorts of structures are lumped together, and the work of others is very unequally treated. Little attention is paid to the views of such authorities as E. B. Wilson, R. Chambers, and others, that the visible structure of protoplasm may readily change in accordance with change of physiological state, nor is there any proper discussion of modern work on micro-dissection or physiological cytology.

The work will be of some interest to the specialist, but can scarcely be recommended to the general biological reader.

The Annual Register: a Review of Public Events at Home and Abroad for the Year 1924. Edited by Dr. M. Epstein. (New Series.) Pp. xv+326+171. (London: Longmans, Green and Co., 1925.) 30*s.* net.

THIS admirable survey of the year's history is planned on the lines which have been long familiar. An account of British history, followed by foreign and imperial history arranged under the headings of the various states, occupies two-thirds of the volume. Then come a tabular chronology of events, a survey of literature, art, music, science, law and finance, and obituary notices of the year. These surveys are necessarily very condensed, but lack neither lucidity nor critical estimates of the field of survey. Some of the more important treaties and agreements of the year are printed in full.

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.*]

Ether-Drift and Relativity.

DR. SILBERSTEIN'S deductions from Prof. D. C. Miller's surprising optical experiments, as contained in NATURE for May 23, are equivalent to stating that there is a drift of the ether with respect to the earth, and the horizontal component velocity of this drift is very small at ordinary ground level but rapidly increases with height z, so that it reaches about 10 km./sec. at the height of Mt. Wilson (1·731 km.); whence $\delta u/\delta z = 5{\cdot}7$ sec.$^{-1}$ approximately for the intermediate zone. The mere existence of this measurable drift would be in conflict with the very foundations of relativity.

Objection against these conclusions is raised in NATURE for June 6 by Prof. Eddington, who remarks that the described ether-flow being strongly rotational, it could not satisfy Stokes's condition for non-influence on astronomical aberration; and the consequences would be in disagreement with the measurements made every day in astronomical observatories.

I think that from the mathematical point of view this objection may be removed on remarking that it takes into account only the horizontal component of the drift. If x is the co-ordinate in the direction of this component, and w is the vertical component of the drift, the full expression for the *curl* of the drift-velocity in the xz plane is $\delta u/\delta z - \delta w/\delta x$, and therefore the flow might be everywhere irrotational, even with a high value of the term $\delta u/\delta z$, provided there is a corresponding $\delta w/\delta x$ to match it.

It is true that in the light of the first theory given by Stokes and expressed by Lorentz in his standard book "The Theory of Electrons," Ch. v., 147-148, the irrotationality of the flow would not be sufficient to destroy the influence on aberration, and certain additional conditions ought to be satisfied by the velocities of the ether near the stars and near the earth. But a careful consideration shows that the aberrational effects as observed by astronomers do not depend on the differences between the directions on the wave normals at the origin and the end of the light-ray, as considered in the above theory, but exclusively on the paths of the light-rays themselves. Therefore, the right theory to be employed is the second one given by Stokes with Challis's corrections, and further developed by Larmor in "Aether and Matter," iii. 22, according to which the irrotationality is the only condition required.

In the light of this conclusion, Planck-Silberstein's hypothesis of an irrotational and extremely compressible ether with a negligible drift at ground level might be sufficient to secure agreement with all standard astronomical measurements at all heights, and with terrestrial geodesic observations (absence of geodesic aberrations); but it requires a compression so high as 60,000 at sea-level; and it further requires that the "grip" of the earth on the ether be purely gravitational, according to Silberstein's vivid expression, because Michelson and Gale's experiment has shown that the ether does not follow the daily rotation of the earth. Even a broader theory might be adopted, since the latter experiment, performed inside an iron pipe, shows that the pushing forward of the ether by the earth, if any, is not due to impenetrability or to adhesion to material surface, and therefore Planck's condition that the vertical flow of the ether at ground level be zero may be discarded.

Three points of difficulty are, however, to be considered, namely:

(1) To show that an irrotational distribution of flow can be effectively mapped out, which numerically agrees with the various values of the horizontal velocity found by Prof. Miller at different heights and times.

(2) To explain why, since the grip on the ether is not due to material surface adherence, its horizontal drift is reduced so nicely to zero at about sea-level and not to any other level whatever.

(3) Since $\delta w/\delta x$ requires to be so high as 5 or 6 sec.$^{-1}$, it follows that if the vertical drift be zero at a certain point, it will be about 500 km./sec. at some point at 100 km. distance at the same level. If there is a vertical ether flow of this magnitude, it will be revealed at once by very common electromagnetic experiments or by a quite unrefined repetition of Prof. Miller's experiment in a vertical direction.

In the present condition of things it will be advisable not to draw any conclusion from Prof. Miller's experiments until results of further experiments are available, and until, finally, we are able to examine whether some unknown phenomenon has affected the results.

GIOVANNI GIORGI.
University of Rome
(Regia Scuola d' Ingegneria),
June 29.

P.S.—Since writing the above, I have seen Prof. Miller's article which appears in the issue of NATURE for July 11, giving further and very interesting particulars on his experiments. My conclusions are not modified by it. G. G.

Experimental Study of the "Soaring" of Albatrosses.

THE letter by M. Idrac, under the above title, in NATURE of April 11, was one constituting an earnestly important contribution to the fascinating subject of soaring flight; for it is undoubtedly the case, that so far as the sea considerably impedes the lower strata of the wind, an albatross must be able to soar in the manner recorded. The methods of energetics (having regard to the internal energy of the air) may certainly be employed to indicate this, but the less often used acceleration-of-headway method may be employed as a simple, precise, kinematical alternative. For example, when the bird in its relationship to the enveloping air is gliding upwards at an angle α degrees above the horizontal, at a headway of V feet per second, and against a wind from the north, it is tending to lose headway gravitationally at the rate of $g \sin \alpha$ feet per second per second. It may also be regarded as tending to lose headway frictionally, at the rate of g/n feet per second per second, where n is the ordinary lift/drag ratio. On the other hand, if the higher strata of the wind are travelling faster southwards, to the extent of v feet per second for each foot of vertical height, the bird tends to gain headway at the rate of $Vv \sin \alpha \cos \alpha$ feet per second per second, because $v \cos \alpha$ feet per second is the component of increment of wind velocity head on to the bird, per foot change of height, and $V \sin \alpha$ feet per second is the vertical rate of gain of height. Accordingly, for the bird to continue gliding upwards at steady or increasing headway it simply needs to have

$$Vv \sin \alpha \cos \alpha - g \sin \alpha - g/n \lessdot 0, \quad . \quad . \quad (1)$$

that is to say, not negative.

From (1) is deducible for calculation,

$$v \lessdot \frac{g}{V}\left(\sec \alpha + \frac{2}{n}\operatorname{cosec} 2\alpha\right). \quad . \quad . \quad (2)$$

For every angle α at which the bird may choose to steer upwards there is therefore a certain v of the air which will keep the bird gliding without losing headway; but the particular angle α that allows v to have its minimum serviceable value, and in which therefore we are most interested, is ascertainable from (1) or (2) to be governed by the condition that

$$(2 \operatorname{cosec} \alpha)/(\sec 2\alpha - 1) = n, \quad . \quad . \quad (3)$$

quite independently of what the V of the bird may be.

For the following values of n—

0, 1, 5, 10, 15, 20, 30, 50, ∞,

formula (3) determines these corresponding approximate values of α,

45°, 38°, 28°, 24°, 21°, 20°, 17°, 15°, 0°,

or about twenty degrees for the whole range of values of n usually found in practice. In particular, the birds with $n = 18$, observed by M. Idrac, have the comparatively steep angle of 20·4 degrees as the best angle α up which they should prefer to steer in this kind of soaring. Inserting therefore this value of α in formula (2), and also inserting the observed value of 72 feet per second for the value of V, it transpires that those birds may soar steadily upwards against the wind when v, the increment of wind velocity per foot of height, is not less than 0·552 feet per second. If v exceeds this the bird will not merely not lose headway, but actually be able to gain headway, even for a range of upward angles α a little greater and a little less than the best angle of 20·4 degrees of this case. This width of range of angles, less than and greater than the best, increases when v is increased, according to values deducible from formula (1) or formula (2).

It is notable that in formula (2), v is inversely proportional to V, quite confirming the observations made, that the birds of greater headway more easily perform this kind of soaring; but at very great headways and for the whole soaring manœuvre this rule tends to reverse, when the energy-wasting reactions of sharp turns, up and down as well as sideways, with large birds and especially with large aeroplane appliances, are taken into account. As regards rules, this seems the place to recall that the best angle of ascent has no connexion with V but only with n, and that the best angle of ascent is not very sensitive to ordinary differences in even n, nearly always wanting to be about twenty degrees—a simple rule for bird or man.

For the return or southward journey we may use the same expression (1), but with the sign of the gravitational middle term made positive, and with the angle α measured downwards from the horizontal; and we can insert the minimum value of v just found and supposed to be prevailing, that is, 0·552 feet per second. The angle α so determined for a steady glide for the bird of headway 72 feet per second is then a mere 1·4 degrees downwards from the horizontal. Truly it is downwards and not upwards, but as it is only about half the ordinary gliding angle, the bird evidently obtains some soaring assistance even on the return journey.

The whole indicated procedure of the bird, then, as viewed from the east, and entirely corresponding to observations made, is to glide to the right and steeply upwards from the surface of the sea, until it reaches the height where v ceases to be so great as 0·552 feet per second. If this height is 100 feet, the bird takes $100/(72 \sin 20{\cdot}4°)$, or about 4·0 seconds to arrive. There the bird wheels round and takes a long flat glide to the left, of duration $100/(72 \sin 1{\cdot}4°)$, or 56 seconds, down to the surface of the sea, where it again wheels round and proceeds to repeat the whole cyclic process every 60 seconds. But it is to be noticed that each brief ascent of the bird takes place much farther down-wind than the last ascent, so that the bird may drift rapidly southward through the seascape; even nearly as rapidly as the headway of the bird plus the velocity of the wind at a height of about 50 feet, and that may easily be so great a total as 60 to 70 miles an hour. It becomes, therefore, a debatable point to consider how much or how little the bird may depend on *this* particular cycle of soaring, and yet preserve its position in the seascape, outside a headland or bay or close to a slow ship, so well as it sometimes does.

But the fact which just for an instant can occasion a little surprise, is that the bird need not turn round, but may continue northward against the wind. It may not soar higher, and it cannot even continue to glide level without losing headway, but it may, and indeed must direct itself steeply downwards to proceed at steady headway. The negative value of α that satisfies formula (1) is 42 degrees, and at that slope the bird may descend 100 feet in $100/(72 \sin 42°)$, or 2·1 seconds, after previously taking the 4·0 seconds to ascend at the slope of 20·4 degrees. The procedure of the bird is now to execute a series of deep hollow swoops, northwards against the wind, pointing down at 42 degrees for 2·1 seconds and then up at 20·4 degrees for 4·0 seconds, the whole swoop being then repeated every 6·1 seconds. The progress northwards is at the rate of $(2{\cdot}1 \times 72 \cos 42° + 4{\cdot}0 \times 72 \cos 20{\cdot}4°)/6{\cdot}1$, or 62·5 feet per second, or 43 miles an hour relatively to the air at the mean 50-foot level; so that to the extent that the wind at the 50-foot level is less than 43 miles an hour the bird can actually advance northwards through the seascape, against the wind. When it has so progressed for a mile or so in a number of swoops, *then* it may wheel round and take the pleasant, long flat glide with the wind, and continually repeat such a grand combination process in a way to keep to one locality in the seascape.

Nevertheless, the above presents the case as a pure case, artificially arranged so, and of necessity, for the purposes of calculation and abstract reasoning. The strata of the actual wind must refuse to shear smoothly over one another without breaking into a turbulent state, and especially into small and large eddies rotating around horizontal cross-wind axes. These turbulences offer other opportunities of soaring, that are also to be expounded in the form of pure, abstract cases; and so great an artist as the albatross may not be wholly negligent of, and unthankful for, such opportunities, although *stratified structure-gust soaring* (if that name be allowed) may be the bird's great favourite. The name "stratified structure-gust soaring" may be understood to refer to the fact of the wind being supposed to be stratified in its velocity structure, and also to the fact of the bird soaring by a head gust that is present, not as an actual acceleration of the air particles themselves, but by reason of the bird judiciously crossing the velocity structure of the air in such manner as to develop for itself a useful "structure-gust" effect. This term was similarly proposed in 1913, in the book "Aeroplanes in Gusts and Soaring Flight," by the present writer.

Now, so far as an albatross can soar in the way observed and described, there would seem little reason why a small and fast aeroplane, manned by an interested pilot, should not immediately soar to some extent in a like manner, by facing the wind blowing

over the sea or a large lake, or possibly over a large flat plain, and quickly swooping down and up close to the surface—pointing down at about 40 degrees and then up at about 20 degrees, or at about half these angles if the propeller is allowed to be of some assistance. At suitable intervals it may take the long flat glide with the wind. In any case, however, independently of soaring, aviators may have need to consider that in starting off against the wind it may be convenient to point up at an angle approaching 20 degrees, and so endeavour to continue; and in the event of being compelled to point their aeroplanes down they may have need to be prepared for the lowest strata of the air near the sea seeming to refuse proper support. Indeed, some experiences of this character already seem to confirm M. Idrac's observations of the wind near the surface of the sea.

S. L. WALKDEN.

London, June 8.

Science and Intellectual Freedom.

IT is with considerable amusement that I have read the collection of opinions published in NATURE upon the recent action of the State of Tennessee in forbidding the teaching of what we believe to be the established facts of human evolution in schools supported by public funds. There is an admirable undertone of contempt and condemnation in most of these contributions and a scorn that spreads at moments from Tennessee and Oklahoma to things American in general. Yet the British Government is at the present time in an almost parallel position to the Government of the benighted State of Tennessee in regard to a closely similar body of knowledge. At present if a medical officer of health or a health visitor in public employment gives information about contraceptives to a patient publicly paid for, he or she is liable to dismissal, and several cases of dismissal have occurred. The Minister of Health in both the previous and the present governments has refused to allow these officials the freedom, at their discretion and with all circumstances of privacy, to give this sort of information to adults asking for it from them. There is no question of propaganda here or of forcing this kind of knowledge upon those unwilling to receive it. But British adults of the poorer classes wishing to know this much about their own bodies and to have this much of control over them, cannot get it in a private, seemly and proper manner from their publicly supplied and duly qualified medical advisers, but must resort to the one or two overworked privately supported clinics that exist, or to furtive expedients, to quacks and underhand and dubious sources of information. This is mainly a concession made by these successive Ministers of Health to the Roman Catholic vote. They plead that taxpayers of that persuasion might object to their money going to supply such knowledge to people with different views. But that is precisely the argument of the Tennessee legislators. They plead that a respectable body of old-fashioned Christians regard the doctrine of human evolution as a dangerous and sinful heresy and that therefore they may object quite reasonably to their money being spent upon its diffusion.

In all these matters I am for open and accessible knowledge and free and frank discussion everywhere, in Britain as in Tennessee, but I submit that the *élite* of British science have no case against the State of Tennessee until they have done something to put our own house in order. Perhaps later you will give us another Supplement of a rather wider scope and raise the whole problem of intellectual freedom in relation to these modern publicly endowed systems of education in which the teacher is at any time liable to the irruptions and direction of the government and the politician. The bulk of our educational organisation at every stage and much of current research could not exist without State support and subsidies, and the riddle of receiving maintenance without sacrificing freedom is a very fine and subtle one, which is not disposed of by damning Tennessee.

H. G. WELLS.

Easton Glebe, Dunmow,
Essex, July 16.

On the Presence of a Perennial Mycelium in *Pseudoperonospora Humuli* (Miyabe & Takah.) Wils.

IN a recently published article (*Annals of Applied Biology*, 12, p. 121, 1925) we have given a description of the downy mildew of the hop (*Pseudoperonospora Humuli*), a disease until recently unknown in England or in Europe, but now beginning to cause considerable damage in Kentish hop-gardens. The object of this note is to record certain new facts, of scientific and economic importance, which have been lately discovered in the life-history of this fungus.

The occurrence of diseased, stunted, "spike"-like shoots arising from the root-stock of the hop so early as April led to a search being made for mycelium in the perennial underground parts. Examining during May one- and two-year-old diseased nursery "sets," by means of hand-sections stained with azo-blue, the existence of mycelium was ascertained in the pith and cortex of one-year-old portions of the "crown." The mycelium was not traced lower than this, but there is a possibility that it may be even deeper-seated. The presence of a hibernating mycelium in certain members of the Peronosporaceæ has already been recorded; in the case of the beet mildew (*Peronospora Schachtii*), by Kühn, in 1873; and in the onion mildew (*P. Schleideni*), by Dr. P. A. Murphy, in 1921 (NATURE, 108, Nov. 3, p. 304).

The alarming feature of the outbreaks of the hop downy mildew which are now taking place for the first time in hop-gardens in England is their epidemic nature and the early attack on the young stems ("bines"). Under the influence of the disease the tips of normal, healthy-looking bines, when these are 5-7 feet high, are suddenly arrested and transformed into a tufted or "spike"-like growth. As many as seventy per cent. of the hop-plants ("hills") in a garden may show the disease, and in some cases all the stems ("bines") trained up may prove to be diseased. While in the case of the shorter basal "spikes" the mycelium appears to be continuous throughout their length, this is not necessarily the case with the longer diseased bines, where the mycelium may be absent from certain nodes, with the result that healthy lateral shoots may be produced. Within the stunted "spike" of the longer stems the mycelium is present close behind the growing point of the apical bud and extends along pith and cortex commonly for a foot or more. The extent of the mycelium within the pith is marked by a brown discoloration; in internodes where the pith is hollow the fungus has been found to accumulate hyphæ which form a lining for the hollow cylinder. These hyphæ give rise to oogonia and antheridia, and the pith eventually becomes lined with masses of oospores. These oospores, which hitherto have been reported as occurring only in the leaves, have been found in abundance within stems so early as mid-June, and in one case in May. The occurrence of oospores in "spikes" renders imperative the destruction of the latter, when they have been removed by the grower.

In several cases it has been found that the mycelium in the cortex penetrates the epidermis and produces masses of conidiophores on the outside of the stem, which is rougher and coloured light-brown in those areas.

On rare occasions a few conidiophores with conidia are found projecting into the pith cavity, in regions where formation of oospores is taking place.

E. S. SALMON.
W. M. WARE.

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Seed Dissemination of Nematoda.

RECENT American workers have directed attention to the fact that Nematoda attacking certain plants are regularly disseminated in the seeds of their host.

Whilst working on the relation of *Tylenchus dipsaci* Kühn to one of its common host plants, namely, the oat, the occurrence of various Nematoda between the pales was observed. Some correlation between such occurrence and a relatively poor development of the plant was also observed. Various genera were identified, notably Tylenchus and Diplogaster, but the forms most commonly present were small larvæ so immature that accurate identification was not possible.

Seeds known to be so infected and germinated under sterile conditions were, on later examination, found to harbour numbers of Nematoda of a species of the genus Cephalobus. It seems, therefore, that dissemination in seed must be accepted as one at least of the normal methods of spread of the species in question. Special interest attaches to this, for so long ago as 1906 Marcinowski showed that *Cephalobus elongatus* Sch. was capable of injury to cereals, while Steiner has recently shown that the species *C. subelongatus* Cobb. may cause damage to the foliage of Phlox plants.

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Observed Stark Effect Patterns in Helium.

RECENTLY I have taken photographs of the Stark effect in helium which show quite clearly that the parhelium principal series line λ3965 has the pattern 1/1 (*i.e.* one component plane polarised parallel to the field, and one component circularly polarised perpendicular to the field) instead of the complex pattern 3/3 reported by T. Takamine and N. Kokubu (Mem. Coll. Sci., Kyoto, 3, 275, 1919). With improved experimental conditions, the new spectrograms prove that the simple displacements (1/1) reported by Stark and Nyquist for the members of the sharp and principal series are correct, and that the complex analyses claimed for some of these lines by Takamine and Kokubu were due to insufficient control over the Lo Surdo tube.

A further point of interest is the appearance of a new weak perpendicular component of the parhelium combination line λ4384. In a field of 40 kv./cm. this line has two components with wave numbers 22832·8 and 22839·0. This completes the pattern 2/2 for all members of the combination series $2P - mP$, $m = 4$ to 7 inclusive.

Two examples of the pattern 2/3 have been brought to light in this investigation. (1) The parhelium diffuse series line λ4922, in an electric field of 45 kv./cm., is found to have components with the following wave numbers:

par. 20293·9, 20295·8
perp. 20293·9, 20295·8, 20302·3; densities 4, 5 / 1, 2, 7.

(2) The accompanying photograph (Fig. 1) shows two orthohelium lines in electric fields. As usual, a double image prism has been used to separate the parallel (upper) and perpendicular components. At the top of the photograph there appears to be but one line—the diffuse series doublet λ4472. Since this is not resolved, the analysis shown here is assumed to be that of the stronger component. In high fields, near the cathode, this line is deflected toward the left and split into two components. A very faint line in the normal undisplaced position is due to stray light not emitted by the main source. It is useful as a line of reference. Immediately at the right may be seen the combination line $2p_1 - 4b$ making its appearance in a very low field (Harry Nyquist, *Phys. Rev.*, 10, 226, 1917). This line has the pattern 2/3. Most of the components are over-exposed in order to show the new perpendicular component. The insert is a photograph of the perpendicular component of Heλ3965 in fields up to about 50 kv./cm.

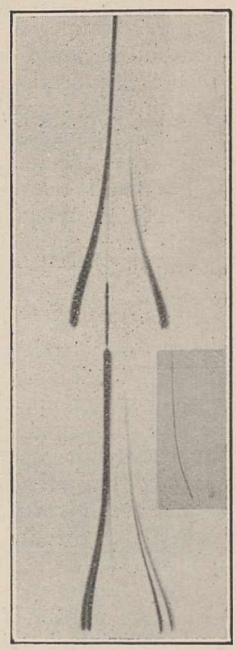

FIG. 1.—Orthohelium group λ4472 in electric field, and, on right, perpendicular component of He λ3965.

These patterns for helium series lines are identical with those claimed for the corresponding hydrogen fine structure components in the theory given by H. A. Kramers (*Zs. f. Phys.*, 3, 199, 1920).

J. STUART FOSTER.

McGill University, Montreal, Canada,
June 15.

The Word "Australopithecus" and Others.

WHEN Dr. Bather hints (NATURE, June 20, p. 947) that the word "Homosimiidæ" is not correctly compounded, he probably means that the compounding stem of *homo* is *homi-*, as in the Latin *homicida*. But "Australopithecus" is also incorrectly formed, for the compounding stem of *australis* is *australi-*.

Why will people venture to invent new names without consulting an etymologist? Neglecting this precaution, even a good classical scholar may flounder.

F. J. ALLEN.

8 Halifax Rd., Cambridge,
June 28.

Cancer Research.

REFERRING to the recent work on cancer by Dr. W. E. Gye, the statement in NATURE of July 18, p. 107, that Dr. Gye was "assisted by Mr. J. E. Barnard and Dr. J. A. Murray," which has also appeared elsewhere, attributing to me a direct participation in the work of Dr. Gye and Mr. Barnard, requires correction.

The very generous acknowledgment in Dr. Gye's paper in the *Lancet* sums up all my association with his researches. I should be lacking in candour if I permitted the suggestion of a closer collaboration to pass without a disclaimer.

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The Natural Classification of Ferns as a Study in Evolutionary Methods.[1]

By Prof. F. O. BOWER, F.R.S.

IN the light of evolutionary theory the object of a natural classification of living things has ceased to be a mere catalogue, useful primarily for the recognition and accurate designation of genera and species. Such a classification is now understood to express, at least in some degree, the evolutionary relations of the organisms classified, though still it may be far from fulfilling its theoretical end. Kin will take place near to kin, and if the relationships be truly apprehended, the whole grouping of different forms will be such as to seriate them, so that those earlier in historical origin should precede those of later appearance. The series would lead from presumably primitive to presumably derivative types. But naturally a simple linear series, such as any catalogue must show, cannot adequately portray the highly complex relations of any well-represented group. Moreover, such relations are apt to be so obscured by the extinction of intermediate forms that, though this might at first sight appear to simplify the problem, it at the same time increases greatly the difficulty in recognising affinities, and often makes any definite opinion on relationship highly problematical.

In the face of such drawbacks many are disposed to regard the problem of natural classification as hopeless: and the results attained may appear to be mere expressions of personal bias. Moreover, the divergences of opinion expressed by different experts in the investigation of the same group are sometimes so great as to forfeit confidence in their methods. The critic may then conclude that the materials available for inductive argument are too disconnected, and positive data too deficient to lead to any satisfactory result. However true this may actually be, the demand may still be made that at least the classification adopted for any given group shall not violate, but rather accord with such settled conclusions of affinity as are founded upon an adequate field of observation comparatively treated. The wider the area of observation the more probable will it become that the grouping based upon it will be correct. This is indeed the theoretical basis of any classification that can be regarded as natural.

Many groups of plants, comprising at the present day numerous genera and species, appear so highly standardised as to give little scope for such treatment. The differences that they show are relatively minute, while in the absence of a consecutive geological record of their past history it may appear impossible to rank those differences in any probable phyletic sequence. This is the condition of the Angiosperms as a whole: consequently little headway has yet been made in their phyletic grouping: while opinions are by no means in full accord as to what characters are to be held for them as primitive, or as derivative. But it is otherwise with the Filicales. There are many thousand species of living ferns, distributed in more than a hundred well-marked genera. The range of variable characters which may serve for their comparison is wide: while the class is represented with a more or less consecutive history back to the Palæozoic age. These facts at once suggest that the class of ferns would provide material suitable for a searching experiment in the methods upon which a natural classification may be based.

We have seen that in order to obtain a stable result it is desirable to extend the comparison over a wide area of fact. The weakness of early groupings for the ferns has been that the area of comparison was too narrow. It involved chiefly the external form, and the sorus and sporangia, while anatomy and the characters of the gametophyte were scarcely used at all; nor was the palæontological evidence taken into account. Though naturally the features of the sporophyte, being more elaborate and also more varied, still take the prior place, all variable features should be used. In respect of each the limits of variability must be defined, and the question considered whether one extreme or the other should be regarded as primitive. Here a comparison with related fossils becomes important, and often indeed it is decisive, as in the conclusion that the Eusporangiate type is more primitive than the Leptosporangiate.

There are already twelve criteria of phyletic comparison in use in ferns, and others may probably emerge later. They are: (1) external form of the shoot; (2) architecture and venation of the leaf; (3) initial constitution as shown by apical segmentation; (4) the vascular system; (5) dermal appendages; (6) position and structure of the sorus; (7) indusial protections: (8) character of the sporangium; (9) spore-output; (10) morphology of the prothallus; (11) the position and structure of the sex-organs; (12) embryology. In respect of all of these, but naturally in varying degree, it is possible to distinguish a type that is held to be relatively primitive, from that which is derivative; moreover, so far as comparison with related fossils is possible, the palæontological sequence may be taken as a check upon conclusions, since its data are drawn from the most positive source that is available in comparative morphology. Further, it is found in the Filicales that the results of comparison, thus checked, run substantially parallel in respect of the several criteria upon which the comparisons are based. Exceptions do as a matter of fact occur; but the marked preponderance of parallel progression in respect of features so dissimilar as, for example, sporangia and antheridia, dermal appendages, conducting tissue, and spore-output, gives added confidence to the application of a comparative method so broadly based and so adequately checked.

From materials such as these it has been possible to draw up a verbal specification of a type which would embody all the relatively primitive features, and thus it might be visualised as a common archetype, which should represent something like that source from which we may presume that the class of ferns may ultimately have sprung. The specification would comprise an upright radial shoot, perhaps rootless, and forking equally if it branched at all; the distinction of axis and leaf ill-defined; the leaf, if recognisable as such, long

[1] Substance of three lectures delivered at the Royal Institution, May 21, 28, and June 4.

stalked, forking, with its segments narrow, and separate one from another; the general cellular construction robust, and without a single initial cell in the several parts; the conducting system consisting of simple tracts with solid xylem-core; the surface bare, or with simple hairs; the sporangia solitary, distal, and relatively large; the spores numerous in each sporangium, and all alike; and the opening mechanisms of the sporangia not highly organised. Naturally, since the prothalli are not as a rule preserved as fossils, little help is derived in checking the comparisons of the gametophyte; and it is omitted in the specification, which applies only to the sporophyte.

If the above specification be compared with the actual features displayed by the fossils of the Rhynie Chert, so beautifully revealed by Dr. Kidston and Prof. Lang, it will be seen that a substantial similarity exists. It is not suggested that any one of the Rhynie fossils itself represents an ancestor of the ferns. What does appear is that, among the vegetation of the earliest adequately known land flora, there existed plants which shared those leading features of the sporophyte which wide comparison of the ferns, living and fossil, has led us to regard as primitive for them.

Starting from such a source, which is not, as a matter of fact, far removed from what is actually seen in the extinct Botryopterideæ, a general advance may be traced through the ages, culminating in the modern Leptosporangiate ferns. The leading features of progression consist in departure from the upright habit, and equal dichotomous branching of axis and leaf; progressive webbing of the leaf-segments and adoption of netted venation; elaboration and progressive disintegration of the conducting tracts; substitution of flattened scales for simple hairs; transit of sori from distal or marginal to superficial positions; passage from the simple sorus with sumultaneous sporangia, to a gradate or a mixed succession of them; elaboration but often also a final abortion of indusial coverings; a progressive diminution of the individual sporangium, with corresponding increase of their numbers, and of the precision of their ejaculating mechanisms; finally, a diminution of the spore-output from each, from many thousands to definite numbers such as 64, 48, 32, 16, 8, or even in extreme cases to a single one. These progressions run substantially parallel, and accompany a progressive fining down of structure from the grosser Eusporangiate to the more delicate Leptosporangiate type.

Such evolutionary progression, traced by wide comparison in respect of many criteria, and checked by reference to the palæontological record, which in the ferns is both ample and consecutive, may be expected to yield material for argument as to the methods of evolution. In particular it makes possible views involving the essential factor of geological time, so often omitted or wholly forgotten in the evolutionary discussions of the moment. Between the Devonian Period and the present day there is spread out before us the whole drama of fern-evolution, including the changes profusely polyphyletic, embodied in the previous paragraph. We may fix our attention especially upon two marked features upon which the series throws light, namely, the slide of the sorus from the margin to the surface of the widening leaf, and the progressive elaboration of the vascular tissue with increasing size of the part it traverses. Evidence of progress in respect of both of these may be traced not only in the race, where the results are found to be hereditarily fixed, but also in some degree in the individual life, where they are seen to be still plastic.

The shifting of the sorus from the margin to the surface of the expanded leaf gives the biological advantage of protection from direct insolation during development. In some families, such as the Marattiaceæ, Gleicheniaceæ, and Cyatheaceæ, and in Todea, it happened early in geological history, and became hereditarily fixed with a high degree of uniformity. In others, as in the Schizæaceæ, Hymenophyllaceæ, and Dicksoniaceæ and in Osmunda, the primitive marginal position was retained. In some the transition from a marginal to a superficial position may be seen actually in progress, as in the Dennstædtiinæ and Pteridaceæ. The transition may be held as adaptive, and the steps of the adaptation may actually be followed in the individual development in such genera as Dennstædtia or in Pteridium. Such facts, the details of which will be found fully described elsewhere,[1] suggest that a widespread and polyphyletic phenomenon of adaptation is before us. It may be described as a slide of the sorus from the margin to the lower surface, which is clearly a biological adaptation. The genera quoted show that it is actually progressive in the individual development. The evidence suggests very strongly that there has been a widespread inheritance of a character primarily acquired by biological adaptation in the individual, and that it has become fixed as a heritable character not once only but repeatedly. The whole period of geological time from the Devonian onwards has been available for the process, which has happened in some phyla early, in others late, and is in some individual living ferns caught actually in the plastic or nascent state.

A similar argument may be advanced in relation to the progressive expansion and disintegration of the conducting tracts in ferns, which appears to be closely connected with the limiting factor of size, and the adjustment of the proportion of surface to bulk in an enlarging organism. The progressive expansion, elaboration, and even disintegration may be traced in perfection in the ontogeny of such ferns as *Gleichenia pectinata*, *Pteris podophylla*, or *Plagiogyria*. The elaborated result has become hereditarily fixed with characteristic differences in detail in many distinct races of ferns. The resulting structure provides features sufficiently stable to serve for far-reaching comparison.

Such arguments and such conclusions will of course be met by the objection that they traverse the doctrine of the non-inheritance of acquired characters. But it needs to be stated that the structural basis for this doctrine, however it may apply in animals, has no validity in the plant-body. In them there is no early segregation of somatic from propagative cells. These remain indistinguishable until a late state of individual development. In the absence of such structural segregation for plants, and in view of the positive evidence above advanced, we appear to be justified in concluding that in plants the distinction between fluctuating variations and mutations is not absolute.

[1] Bower, F. O., "The Ferns," vol. i., Cambridge University Press, 1923.

In other words, characters that are seen to be adaptive in the individual life are apt to become hereditarily fixed; and in the progress of geological time this has happened repeatedly.

The impressive address of Sir Francis Darwin as president of the British Association in 1908 in Dublin should be recalled. The observations and conclusions relating to ferns which have been acquired in recent years appear to be susceptible of interpretation only through some form of mnemic theory, such as he there disclosed. It is not only in the moral world, but perhaps also in the physical frame of living things that the methods of the importunate widow produce their result; and this will become the more plain where, as in the study of the ferns, the whole period of geological time from the Devonian Period onwards is available for the method to produce its structural effect. In recent discussions, too much stress has been laid upon the failure or success of laboratory experiments, which have extended at most over only a few years. Here in the ferns we see evidence derived from experiments carried on naturally and continuously since the Palæozoic age: and they indicate that adaptive characters are heritable. Preference should surely be given to those results which appear without any narrow time-limit. These show that, in the language of the mnemic theory, engrams are imprinted upon the propagative cells. The impress of an engram in ordinary life may be, and probably is, a relatively rare event. The difficulty in producing satisfactory evidence of the inheritance of acquired characters in brief laboratory experiments in itself indicates a high resistance of germ-cells to their reception. But prolonged comparative study of ferns, with their long geological history taken into account as a check upon its results, appears to justify the view that in them the difference between fluctuating variations and mutations is not absolute. It indicates rather that characters acquired by adaptation in the individual life may become hereditarily fixed if secular time be available.

The International Research Council.

THE International Research Council held its third meeting at Brussels in the Palais des Académies on July 7 and the two following days. The first meeting took place six years ago, in July 1919, when the statutes of the Council were adopted, and steps were taken to form the Unions of Astronomy, Geodesy and Geophysics, Chemistry, Mathematics, and Radiotelegraphy. The second meeting was held in July 1922, when some additional countries were invited to join the Council, and the formation of the Unions of Geography, Physics, and of the Biological Sciences was agreed to.

Since the second meeting nine countries have joined the Council, so that the number of adhering countries up to the present time is twenty-nine, to which Latvia and Tunis have now to be added, having been admitted at this meeting: thus the total membership is now thirty-one. Of this total membership, however, only seventeen were represented on this occasion at Brussels, namely: Belgium, Czechoslovakia, Denmark, Egypt, France, Great Britain, Holland, Italy, Japan, Morocco, Norway, Poland, the Union of South Africa, Spain, Sweden, Switzerland, and the United States. The votes assigned to each country depend on its population, and the total number of votes controlled by the delegates was 52.

It was reported to the Council that the former International Seismological Association had been dissolved, with the assent of all the countries who were members of the Association. It was proposed that the Council should accept responsibility for such of the property of the Association as had been taken over, and this was approved. The work which this Association formerly carried out is now undertaken by the Section of Seismology in the International Union of Geodesy and Geophysics.

The most important business that was before the Council related to certain modifications of the statutes which had been proposed by Australia, by Denmark and Holland, by Sweden and by Switzerland. All of these, though differing slightly in form, had for their object the removal of the restrictions which now limit the membership of the Council and the Unions related to it to those nations who joined in 1918, and others who have since been invited to join or have been elected under the existing statutes; these embrace only the Allies and neutrals of the War period, 1914–1918, the Central Powers being excluded. At the second meeting of the Council in 1922 a proposal was made to remove this restriction, but at that time it was not considered advisable to amend the statutes, and no action was then taken.

The procedure to be followed in modifying a statute lays down that "no change shall be made in the terms of the Convention except with the approval of two-thirds of the votes of the adhering countries." According to the president's calculation, the rule required 53 votes, so that even if a unanimous vote of all the delegates present had been obtained for any of the proposals, it would not have effected a valid change of statute. Thus although there was a majority of votes in favour of the changes proposed by Holland and Sweden, the statutes could not be altered. The situation, therefore, must remain as it was until the Council at another meeting comes to a different decision on this question, or agrees to modify the statute which requires a two-thirds majority of the votes, not merely of the countries present but of all the countries which belong to the Council. In the meantime the Executive Committee may by correspondence obtain a more representative opinion from all the adhering countries, for the statutes permit a country not represented by a delegate to vote by post.

The further proposal, submitted by France and Belgium, that membership of the League of Nations should qualify a country to be elected was not generally acceptable, and was therefore not adopted.

This result is in every way most unfortunate for international science: not only does it postpone the time when the Research Council will be truly international, but it also raises the question whether, as things stand, it will be possible to carry out the modification of any statute until the end of the present Convention in 1931. A full attendance of all the countries belonging to the Council at any meeting can scarcely be counted upon, though the votes of all of

them have to be taken into account in determining the two-thirds majority, so that a small group of dissentient votes may suffice to prevent a resolution being carried; or, as in the present case, a unanimous vote of those present may be insufficient to obtain the necessary majority. The serious inconvenience of this state of things was emphasised by several of the delegates at the present meeting, and the Executive Committee was requested to consider the situation, which must increase in difficulty as the membership of the Council is more widely spread over the world, with the view of suggesting a remedy.

The Council was not in favour of a proposal to rescind a resolution adopted at the meeting in 1922 requiring a country to join the Research Council before becoming a member of a Union.

A Committee which had been nominated provisionally by the Executive Committee in order to study the relations between solar and terrestrial phenomena was formally appointed by the Council for a period of three years, with power to add to its membership. The Committee will enter into communication with scientific men who are interested in the subjects to be studied by the Committee, especially those of countries which are not represented on the Committee. The constitution of the Committee is: Prof. S. Chapman (chairman), Prof. G. Abbetti, Dr. C. G. Abbot, Dr. C. Chree, M. H. Deslandres, General G. Ferrié, Dr. C. E. St. John, Dr. G. C. Simpson, and Prof. C. Störmer. The Committee held several meetings at Brussels on the present occasion. The Council had also before it a proposal from the International Mathematical Union advocating intimate co-operation between the Union and the Committee of Intellectual Co-operation of the League of Nations. As probably affecting other Unions also, the proposal was referred to the Executive Committee of the Council for consideration and report.

The period for which the president of the Council, M. E. Picard, had been elected having come to an end, his re-election was proposed by Prof. Lorentz and was unanimously agreed to. Dr. G. E. Hale and M. Lecointe being unable for reasons of health to serve on the Executive Committee, Dr. V. Kellogg and M. P. Pelseneer were elected to fill these vacancies.

The Union of Pure and Applied Physics, and that of the Biological Sciences, held meetings at Brussels during those of the Research Council. In the Union of Physics the desirability of full internationality being attained at the earliest possible date was urged, and a resolution to this effect was passed unanimously.

Industrial Chemistry at Wembley.

THE visitor to the British Empire Exhibition who takes it *au sérieux* will find a plethora of good things to stimulate his mind, and if his bent is towards science or its applications he will revel in the exhibits of the Government Pavilion and in many of the attractions of the Palace of Industry. In the latter the signs and portents of chemical enterprise should convince him that the days of "dogmatic slumber" are fast disappearing, and that although British chemical industry cannot compare in magnitude with such industries as engineering, mining, shipping, and textiles, they are nevertheless of equal fundamental importance. As in 1924, the chemical exhibits have been organised by the Association of British Chemical Manufacturers, and the same commanding position in the Palace of Industry has been utilised.

Comparing the chemical section with that of last year, the visitor will notice the same excellent lay-out, though he may regret the absence of exhibits from a number of well-known manufacturers. This absence does not, however, seriously impair interest, and in some ways is an advantage, because undue multiplication of similar exhibits is avoided, and there is more space available for effective display. On the other hand, the presence of rather an excessive number of vendors of "cures," perfumes, hair-washes, and other proprietary toilet articles is apt to confirm the man in the street in his prepossession that chemistry begins and ends with pharmacy. Another noticeable absence, both this year and last year, is that of chemical exhibits from the Dominions Overseas. Nowhere in the Exhibition do we find any tangible evidence that our sister nations are striving to realise their war-time aspirations of industrial independence and of security against physical aggression through the medium of a well-organised and effective chemical industry.

Although many of the exhibits are the same as those shown last year, there are a number of interesting novelties. The exhibit of Messrs. Burroughs Wellcome and Co. is a model of clear and attractive presentation, and its educational value is very high. Not only are medicinal and photographic chemicals displayed in artistic form and, where possible, in logical array, but concise information is also given concerning raw materials, methods of extraction, and preparation by synthetic methods; manufacturing operations are outlined, intermediate products are described, and miniature models of apparatus are exhibited. To attract the public there are crystals of various substances illuminated by coloured lights; and there is a very interesting display of historical relics—medicine-chests and first-aid outfits—carried by famous explorers, as well as dioramic views of the scenes of their activities.

Acids, alkalis, and other main products of the heavy chemical industry are so familiar that it must be difficult to devise new modes of display. Messrs. Brunner, Mond and Co., with their associated firms, have overcome this difficulty, partly by means of an attractive setting, and partly by exhibiting some up-to-date applications of well-known substances. Thus a number of new uses have been found for sodium silicate (of various composition), which has long been used in large quantities as a filling for soap (though it is said to have a slight detergent action). When mixed with powdered limestone it is now successfully used for hardening the concrete surfaces of roads, and the soft porous chalky limestone, which has hitherto been found useless for road-construction, has now found a valuable application. The mixture is sprinkled on to the prepared surface and then worked in with a soft broom. Three coats are applied, and the surface of calcium silicate so produced is more durable and more free from dust than surfaces made with the aid of coal-tar. Messrs. Brunner, Mond and Co. are also showing specimens of "grey pressed bricks," made of calcium silicate, which, though relatively heavy, are stronger and much less

pervious to water than common bricks, whilst their prepared surface renders unnecessary the use of plaster. Sodium silicate is coming into use as a means of preventing corrosion of water-pipes and cisterns, and of enabling aluminium utensils to withstand the action of hot solutions of soda. It is also used as an adhesive. Calcium chloride, a heavy chemical which for long awaited an adequate market, is used, *inter alia*, for spraying rubble tennis-courts to prevent the rising of dust.

The firm, Synthetic Ammonia and Nitrates, Ltd., shows a small case containing specimens of the products made in the nitrogen factory at Billingham-on-Tees. These consist of calcium nitrate, sodium nitrite, ammonium nitrate (not yet marketed), ammonium sulphate, and "agricultural chalk," which is calcium carbonate containing two per cent. of ammonium sulphate. In view of the enormous potential importance of this industry, the exhibit is disappointing. The mere display of products, most of them very familiar, gives the public no idea of the nature of the nitrogen problem and how chemists in all civilised countries are trying to solve it; and it should be possible to give the student and the technical man satisfying information without disclosing vital secrets of manufacture.

An interesting feature of the Brunner-Mond display is a continuous automatic-lantern exhibition depicting bird's-eye views of factories, the loading and unloading of goods, methods of transport, offices, etc., connected with this firm's world-wide activities. Messrs. Chance and Hunt, Ltd., are showing, in addition to their staple products, specimens of ferrous chloride, which is now used in making jointless magnesite flooring. The Castner-Kellner Alkali Co. has a small exhibit relating to the use of liquid chlorine and of chlorine derivatives of ethane and ethylene, bleaching agents, etc., whilst Electro-Bleach and By-products, Ltd., makes a special point of its sesquicarbonate of soda, which is a very concentrated form of soda for cleaning and other purposes.

Messrs. Albright and Wilson, Ltd., well known for their manufactures of phosphorus, show interesting exhibits relating to the fire-proofing of wood and the preservation of stone. By means of the "Oxylene" (secret) process, owned by the Timber Fire-proofing Co., Ltd., of Market Bosworth, wooden safes and their contents can now be protected from the effects of exposure to high temperatures. A deal fire-proof door is shown, one side of which became covered with adherent non-conducting charcoal on exposure to flames at a temperature above 900° C., whilst the other side barely became hot. The merits of Prof. A. P. Laurie's "silicon ester" as a means of preventing decay of building-stone are effectively indicated by specimens of treated and untreated materials. "Silicon ester" is made by the interaction of alcohol and silicon tetrachloride, and it acts by depositing silica in the pores of the stone, thereby strengthening it but not affecting its permeability. One of the chief attractions in the stand of the United Alkali Co. is an educational exhibit of "intermediates" derived from coal-tar, so executed as to bring out their genetic relationships. The Salt Union, Ltd., shows that it is moving with the times by displaying a table-salt which, as the name "Salodine" suggests, contains an iodine compound; and the British Cyanide Co., Ltd., exhibits a new colourless and odourless synthetic resin, made from thiourea, which is well adapted for making insulating materials and moulded articles like cups and saucers.

This year the dyestuff-makers have largely discarded strictly technical exhibits, and have co-operated in presenting artistic displays and colour schemes. Instead of being met with the usual array of bottled products, the eye is at once attracted by two large tents, with revolving tops, and a long corridor, all draped with coloured fabrics. Around are displayed articles, from carpets to candles, coloured with British dyes. Fine chemicals are well represented by Messrs. A. Boake Roberts and Co., the Graesser-Monsanto Chemical Works, Ltd., the Clayton Aniline Co., Ltd., Thomas Tyrer and Co., Ltd., B. Laporte, Ltd., and a number of others. In the exhibit of the first-named there is a good model of a three-column distilling plant by Messrs. Blair, Campbell and McLean.

Our two largest gas companies are, as usual, to the fore with luxurious displays, and there is an attractive co-operative exhibit by tar-makers of a rustic scene with an inn, garden, bridge, a tree with mechanical singing-birds, and a country road made up with "Tarmac." Unfortunately, the recent report of the Standing Committee on Rivers Pollution has severely condemned the use of tar on roads, because the washings are toxic to fish, particularly when the road surface is broken up, and it enjoins the use of bitumen instead. By way of counterblast there is shown in the scientific section a shallow tank containing live fish and plants supplied by water running over channels prepared with "specially refined" tar. Although the conditions in the tank are scarcely comparable with those in a stream, the exhibit is ingenious and attractive to the passer-by.

The scientific section is hidden away in the midst of the industrial chemistry exhibit. Its position may perhaps be justified as indicating that scientific research is the "heart" of chemical industry. The exhibit this year is devoted to educational exhibits relating to coal, salt, and food. The coal exhibit is the most comprehensive, containing excellent models of plant, but all are good. A small exhibit illustrating the properties, etc., of viscose and cellulose "silks," and that of some products obtained in the "Berginisation" of coal, increase the interest of this valuable section.

In the above account it has not been possible to mention more than a few of the exhibits, but there are many more of a high order. Those who are responsible for the success achieved during the two sessions will doubtless use the experience gained to do even better in the future. The tendency, already shown, to find substitutes for "bottled" products should be encouraged; there should be more models of plant and apparatus, and—what is entirely lacking in the present exhibition—economic information conveyed in the form of charts and diagrams. Those who stand for science in industry appreciate the fine efforts which so many chemical manufacturers have made in connexion with this exhibition; they would be even more appreciative if their thirst for knowledge could be assuaged by conversation with a few technical men who might be specially detailed to explain or demonstrate the processes and products displayed.

Recent Researches on the Causation of Tumours.

By Prof. WILLIAM BULLOCH, F.R.S.

A WEEK or two ago it was rumoured that remarkable additions had been made to our knowledge of tumours by Dr W. E. Gye, of the scientific staff of the Medical Research Council. Instantly, almost every newspaper took the report up, some of them announcing with sensational headlines that the problem of cancer was solved and that the disease was due to a small germ. Dr. Gye's collaborator, Mr. J. E. Barnard, F.R.S.—a well-known scientist—was said to have secured photographs of the virus, and it was alleged that it had actually been cultivated. What the real facts were, was only the property of a few, because the papers of Gye and Barnard were not published until some days later. In the absence of details, a short note appeared in NATURE of July 18—the day of publication of Gye's paper—giving a general statement of the results said to be claimed, and so far as they were known. It is now possible to write more fully and with greater confidence as a result of the study of the papers just published (*Lancet*, July 18).

Unlike many fantastic hypotheses which have been proposed to explain the cause of tumours, the present one comes from a scientific worker who has the very highest credentials and is known not only in England but also all over the scientific medical world. Behind him is a wide experience, particularly of the kind of work on which he now reports, and he is known for his imaginative and critical powers, his sober judgment, and his high technical skill.

William Ewart Gye is a man about forty years of age who graduated M.D. Edinburgh in 1913 and came to London to be assistant in the laboratories of the Imperial Cancer Research Fund about a dozen years ago. His appearances in scientific gatherings stamped him at once as a quite unusual man, modest but efficient, full of scientific enthusiasm, but temperate and cautious in the estimate of his own work and that of others. During the War he carried out very important investigations which cleared up several of the mysteries in the pathology of gas gangrene and lockjaw and secured him a post on the staff of the Medical Research Council. When the Council inaugurated a scheme for the study of the unknown viruses of certain infective diseases, like distemper, Gye took his part, but early struck out on his own lines and, working by himself, has completed the research just published. This work is of the greatest interest and, if confirmed, will be found to open up entirely new fields not only in what has hitherto been a veritable slough of despond—cancer—but also in connexion with many other diseases, of unknown causation, affecting man and animals. Gye's paper in the *Lancet* is entitled "The Ætiology of Malignant New Growths" and is prefaced by a short paragraph quoted from a leader on the subject in the same issue. It is unusual and often unwise to attempt to forecast what the ultimate value of a scientific paper will be, but the *Lancet* is of opinion that the two papers of Gye and Barnard "mark an event in the history of medicine." This may or may not be so, and we may note that the leader writer, in the next sentence, is more moderate when he states that they may present a solution of the central problem of cancer.

The critical study of Gye's paper leads one to the conclusion that, if his results are confirmed by independent workers, he has made a discovery of the greatest interest and possibly of the highest importance to the well-being of man. Before dealing with his data as presented, and as the subject is one which will be followed by scientific as well as non-scientific readers, it would appear well to clear the ground and state what was commonly accepted on the subject of malignant disease before Gye's publication, and it may be affirmed at once that but little of this knowledge has been controverted by his work.

It is known that all races of man and animals are liable to the development of tumours or swellings—now called blastomata—which possess certain common and constant features. No tumour has yet been seen that was not composed of some tissue of the body of the individual in which it arose. For some unknown reason a tissue begins to grow in excess, and this growth, barring operation or accident, is unlimited in extent. There is an infinite variety in the structure of tumours arising from different or even from one and the same tissue, and quite early an important line of demarcation was drawn on practical grounds between tumours that were clinically or histologically benign and those which were malignant and destructive of life. The differentiation is, however, not always easy, or indeed always possible. From remote times, two special malignant tumours have attracted interest on account of their deadly character. These tumours—sarcoma and cancer—start in a particular tissue but early burst into other tissues. Invading blood-vessels and lymph vessels, and being swept away in the circulating blood, the cells are carried throughout the body, halting in numerous backwaters to produce secondary tumours or metastases. There is an irrefutable body of evidence, confirmed daily, that the secondary tumours are composed of cells which are the descendants of the cells of the primary tumour.

The central problem of tumour formation is to find out what has caused this aimless growth of cells previously—so far as one can judge—perfectly normal. It is this problem which Gye has attempted and is reputed to have solved. There have, naturally, been many hypotheses on the subject of the cause of tumours, but two have gradually been accepted as the most probable. In one, evidence has been sought experimentally and otherwise that the purposeless growth of the cells is due to some kind of chemical irritant acting on normal, or possibly abnormal, cells. The other view, early held and long studied, attributed the cause of tumours, particularly malignant growths, to the action of some extrinsic parasite which, entering the body, stimulated the cells to unwonted activities. Many parasites of microscopic size have been incriminated at various times during the last forty years, but none has fulfilled the test of tumour production experimentally, and however much the study of malignant disease suggests an infection, the vast majority of those with special knowledge were compelled to reject a parasitic hypothesis on various grounds. No parasite, not even that said to exist by

Gye, has by its inoculation caused by itself the development of a malignant or other blastomatous growth. Further, there is a marvellous specificity in all growths whereby they copy, in every degree of variation, the tissue from which they arose. Those facts forced investigators to the conclusion that, when one remembers the extraordinarily wide zoological range in which tumours occur, the cause is some deep-seated mystery connected with the processes of birth, growth, and decay of the cells of the body.

In 1902, C. O. Jensen, of Copenhagen, discovered by accident a malignant tumour in a mouse, and worked it out so carefully that his paper has become a classic in the literature. He failed to find any evidence of a parasite either in the original growth or in those transmitted by transplantation to other mice. He showed that no growths followed the inoculation of tumour cells that had been crushed. Since Jensen's time, many similar tumours have been studied and transmitted in an unbroken series of generations, and Jensen's statements have been confirmed over and over again. Even before Jensen, several workers, among whom we may specially mention Bellingham-Smith and Washbourn in England, had shown that certain tumour-like formations were transmissible from dog to dog, but the exact nature of the growths was the subject of mush dispute.

In 1910, a new, and, as it proves, highly important, work was published by Peyton Rous, of the Rockefeller Institute, N.Y. He found a tumour growing in the breast of a barred Plymouth Rock hen. The tumour proved to be transmissible to other hens of the same setting, and in structure was regarded as a genuine sarcoma. Transmission, at first, was not easy, but in the course of passage from one fowl to another the growth became more malignant in its effects and lethal within a few weeks. In 1911, Rous made the further, highly important, discovery that when portions of the sarcoma were ground up and passed through filter paper, or even through a Berkefeld Kieselguhr filter, the cell-free *filtrate* contained some "agent" which could communicate the sarcoma disease to normal fowls. No microbe could be seen in, or be grown from, the clear filtrate, and Rous left it an open question whether it was to be regarded as containing a living microbe. "It is conceivable," he said, "that a chemical stimulant elaborated by the neoplastic cells might cause the tumour in another host and bring about in consequence a further production of the same stimulant."

The fact that the cell-free filtrates were capable of producing tumours was something quite new, but was soon found not to be unique, for between 1911 and 1913 Rous, in conjunction with Murphy, Tytler, or Lange, found two other fowl tumours transmissible in this way. He also showed in the case of the first tumour ("Rous sarcoma I.") that ultra-violet light rapidly destroys the activity of the sarcoma cells without destroying the filterable agent associated with them. From irradiation experiments he made out that in the sarcomatous tissue there are apparently two elements capable of producing the growth. One will withstand drying, the other will not. The latter is the living transplantable cells, whereas the former is the tumour-producing agent.

Coming to Gye's work, full credit is given to Rous for his admirable researches on the Rous sarcoma I. It is with this tumour that Gye has mostly made his experiments. His main thesis is that the "agent" is really a living virus. This virus is incapable by itself of producing a tumour. For the latter, there has to be the co-operation of a second factor—the "specific factor"—also incapable by itself of inducing a sarcoma, but which enables the living virus to attack the cells of the inoculated animal and transform them into malignant cells. The impression gained from a careful perusal of Gye's paper is that he has more facts than he has yet divulged. The experiments he has given us are carefully thought out and precisely described. A medium—probably not the best one—is indicated in which he obtains "primary cultures"—"a term of convenience," he says, applied to the result of placing a fragment of tumour in the medium. He found that in a tube of "primary culture" the supernatant liquor becomes infective, depending on various factors of which anaerobiosis is said to be the most important. That the "primary culture" contains something living is suggested by the definite acid reaction which ensues when glucose, maltose, or lævulose are incorporated in the medium. No such reactions occur in the presence of mannitol, lactose, or sucrose. It is believed that the "agent" of the tumour diffuses out in the medium and that it disappears slowly (days).

Of fundamental importance for the support of Gye's views are his experiments on the action of chloroform on the tumour agent. It had been previously shown by Rous that carbolic acid, toluol or chloroform destroys the power of the "agent" to induce tumours. In a series of experiments, repeated, it is stated, with constant results, Gye shows that a "primary culture" incubated aerobically for three days at 37° C. produced no tumour when injected into fowls. The clear tumour filtrate thoroughly treated with chloroform was also incapable of inducing growth. But the two inert fractions mixed together were found to produce typical sarcomata. The interpretation given by Gye is that the chloroform-treated filtrate contains a labile chemical substance which in some way, unknown, renders the cells susceptible to the supposed virus, presumed to be present in the other fraction, which was incubated at 37° C. for three days. Gye's conception of a double factor was also supported by centrifugation experiments, for although it was not found possible to drive the virus to the bottom of the tubes spun at high rates, some concentration in special lined tubes did appear to occur. Of the two factors necessary for the production of a Rous sarcoma, Gye believes that one is particulate and is therefore "probably a virus," the other, uninfluenced by centrifugation, being a chemical substance. Since the supposed virus is incapable of producing a tumour, and since the tumours when they originate are specific, Gye admits that the "specific factor" must be the important thing when the action of the two is considered.

Attempts were made to demonstrate that the "virus" actually multiplies in cultures. In one experiment, a fifth subculture in direct line from a "primary culture" produced no tumour, nor did a chloroformed filtrate, but when the two were mixed,

tumours were produced and were lethal in twenty-three days. As each subculture represented a dilution of 1000 fold, the dilution of the matter in the "primary culture" would be 10^{15} if it had not increased.

These remarkable results with the Rous sarcoma I. were followed up on other tumours of known origin and history. They included a spindle cell sarcoma "37/S," the Jensen rat sarcoma, carcinoma of mouse "No. 63," and a rat sarcoma known as "No. 9." Directly or indirectly, experiments with these tumours confirmed the results with the Rous sarcoma I. In each case the "specific factor" was the important one, the virus being less so. Thus a chloroform extract from Rous sarcoma was found to be incapable of producing the disease. A "primary culture" from mouse cancer "63" was also inert when tested on fowls. The specific factor of the fowl plus the "culture" from the mouse produced sarcoma in the fowl. This astonishing result was also obtained in the case of an adeno-carcinoma of the human breast. Inert "specific factor" from fowl tumour, plus inert "primary culture" from human tumour, caused sarcoma in the fowl.

That briefly and perhaps imperfectly represents the main results of Gye's published work. Of the proof of the "virus" he speaks guardedly. It is said to be "almost certainly a virus." The idea of two factors in the production of a disease is not a new one. It has, indeed, long been a commonplace of medical writers that the development of most diseases requires the co-operation of two sets of factors. On one hand, the organism within which the morbid process is to unfold itself must conform to certain conditions of structure and function. This is the so-called "internal" cause. On the other hand, some agent, the "external" cause, actually or functionally outside the organism, must exert an effect peculiar to itself, and a property of its own structure, upon the organism which is in process of becoming the seat of the disease. The revolutions in medical knowledge which came from bacteriological discoveries showed that for most infective diseases the specific agent was the external one. Thus the tubercle bacillus is the specific element in tuberculosis. In the case of tumours—if Gye's work is confirmed—it would appear that the specificity is not resident in the virus but in the "internal" cause—a new conception in connexion with infective disease. Gye's work may be the central point round which the cancer problem revolves. It is certainly a long way from the complete solution of tumour formation, although one must be frank and congratulate Dr. Gye on opening up a new field pregnant with possibilities.

With reference to Mr. Barnard's paper, this deals largely with the question of the microscopic examination of "ultra visible" agents. The agent chiefly described is the microbe of bovine pleuro-pneumonia, in which various morphological types are reproduced. Very little is said of the "virus" of Rous sarcoma and other tumours except that the same morphological types can be seen as occur in bovine pleuro-pneumonia. Attention is directed to the care necessary in excluding various "bodies" which are seen in uninoculated tubes. Finally, there is a combined note by Gye and Barnard. Their exact words may be here reproduced. "Our belief that the small bodies seen and photographed are the actual virus depends partly upon the fact that control uninoculated tubes of medium have been invariably blank and partly upon the correspondence between the microscopical findings and the results of experiments on animals. This correspondence—allowing for the real difficulties in both parts of the common task—has been so close that although final proof has not been attained we are convinced that our conclusions are sound."

Current Topics and Events.

PRIOR to the War, there was in force an Order of the Board of Agriculture compelling the slaughter of cattle discovered to be suffering from tuberculosis of the udder and giving partial compensation to their owners for this compulsory action. This Order is about to be renewed for all cattle suffering from tuberculosis of the udder or from tuberculous emaciation, one-fourth of the market value if the disease is advanced, or otherwise three-fourths, being given to the owner. In these circumstances it will be interesting to ascertain how many are certified as suffering from advanced disease. From the same date the use of any cow for producing milk which gives tuberculous milk will be prohibited, and owners and veterinary practitioners are required to notify tuberculosis in cattle so soon as recognised by them. The last paragraph of the circular letter announcing the matter briefly summarised above adds somewhat deprecatingly: "The new Order represents the most that is practicable at the present time in the direction of securing the eradication of bovine tuberculosis, and in contributing to the production at the source of a milk supply free from bovine tubercle bacilli."

THIS statement on the official attitude in Great Britain towards bovine tuberculosis is commendably frank, and adequately reveals the weakness of the situation and the action—or is it merely "gesture"?—directed towards remedy. Disease is allowed to continue to become obvious to the farmer, and so obvious that he can no longer conceal it, or until a veterinarian is called upon the scene, and then the local authority—hereafter three-fourths of the money probably will be paid out of Exchequer funds—will pay three-fourths or one-fourth of the value of the condemned beast. There are some hundreds of herds of cattle in Great Britain from which tuberculosis has been eliminated by well-known and practicable scientific methods. Is it not likely that the resumption of compensation to the owners of beasts with advanced tuberculosis will delay the multiplication of tuberculosis-free herds? Moreover, is it not arguable that, in the interest of the many thousands of young children in Great Britain who annually are made victims of tuberculosis from drinking infected milk, it might be better to save the millions sterling which will be paid in compensation for disease which

has already in large measure done its lethal work, and in lieu of this belated attack on disease, to issue an Order demanding pasteurisation under strictly regulated conditions of all cows' milk not derived from a tuberculosis-free herd ?

PRACTICALLY all the senior radio officials of every European State were present at the conference of radio engineers held at Geneva on July 6-8. The question of broadcasting has become one of great urgency as there are more than 110 stations in Europe which are sending out ether waves, the lengths of which in several cases are nearly identical. As a separation of frequencies of 20 kilocycles is desirable to prevent interference, and as the limits of broadcasting frequencies are narrow, it was found quite impossible to give to each station, existing and projected, an exclusive frequency. It was necessary, therefore, to give to some stations small in power the same frequency as other stations remote from them. Engineers, however, are not certain that when all the stations are in operation simultaneously there may not be serious interference in certain places. They therefore hope to make experiments about midnight in the early days of September, when it is arranged that all the European stations will broadcast simultaneously. Owing to the practical difficulties in the way of standardising frequencies within narrow limits, it is anticipated that in several places listeners will have difficulty in tuning out interfering stations. Plans have been made to meet again at Geneva to discuss the experimental results. It is proposed to transmit from a large European station signals of given frequencies so as to enable all the broadcasting stations to check their waves. It is interesting to notice that Great Britain has the largest number, 20, of existing stations, Germany comes next with 16, and then France, Spain and Sweden with 12 each.

AT the International Conference of Women in Science, Industry and Commerce, held at the British Empire Exhibition, Wembley, on July 15-17, Miss H. M. Davis read a timely paper on electricity in mines. Miss Davis pointed out that the main costs of mining coal are due to manual labour and mechanical power. The large and increasing use of electricity has enabled many economies to be made. The modern electrical coal cutter is highly efficient; although it stands on only a few square feet it is capable of developing 40 h.p. The conveyors are operated by specially constructed motors, and the tubs into which the coal has been loaded from the conveyors are taken to the bottom of the shaft by electric haulage. The winding equipment at the pit-mouth is often now operated electrically. In addition, electricity is used for pumping, ventilating, compressing air, coal washing and many similar purposes. Unfortunately, the colliery load factor, that is, the ratio of the actual energy consumed per week to the total energy that could have been consumed if the pit were always working, rarely exceeds 50 per cent. Increasing the number of pits supplied by a central station has little effect on the load factor, and hence supplying a large number of pits from a large common central station does not necessarily lead to increased economies. Miss Davis concluded that unless power can be supplied to the collieries at a price of about 0·7*d*. per unit, most colliery companies would be well advised to generate their own power. Provided, however, that the winding shifts could be arranged so that the load factor was reasonably constant, a great reduction in the power costs could be effected. If all the workers co-operated it would be possible to achieve this result in practice.

THE aim of the recently opened Research Institute in Animal Pathology, Royal Veterinary College, London, is to increase knowledge regarding the diseases of the domesticated animals, and the subjects selected for investigation from time to time will be those which appear to be of the greatest importance, either on account of the loss which they cause to agriculture, or because of their connexion with disease in the human subject. In the immediate future, investigations which have for some time been in progress will be continued with regard to Johne's disease, abortion in cows and mares, and quarter-evil. It is intended also to bring under investigation diseases caused by parasitic worms in lambs and calves, and calf diphtheria. Parasitic diseases are annually the cause of great loss throughout Great Britain, and there is evidence that few, if any, of the methods at present employed are efficacious for destroying the worms within the body. The cause of calf diphtheria has long been known, but in the present state of knowledge it is scarcely amenable to treatment. An effort will be made to discover a method of vaccination by which the disease may be prevented in young animals exposed to risk of infection. Although the Institute is well equipped from a scientific point of view, it is realised that laboratory investigations in order to be fruitful generally require the collaboration of stock owners and practising veterinary surgeons, and the Director wishes it to be widely known that the Institute is a place to which the members of both these classes may appeal for advice and assistance in connexion with any serious disease which appears to them to require investigation.

IT may be remembered that the protection of scientific discoveries which are not inventions and as such are incapable of being patented was the subject of a report to the League of Nations in 1923 by Senator F. Ruffini (NATURE, April 26, 1924, and May 3, 1924). The League has now published replies which it has received from the Government of Finland, the Irish Free State, and the Government of Hungary (League of Nations; C. 217, M. 74, 1925, xii). The Government of Finland, while acknowledging the injustice of the laws which deny protection to the intellectual work of the man of science, considers that the suggestions propounded by Senator Ruffini could usefully be applied in the case only of a few branches of science such as physics and chemistry, and to some extent physiology and medicine. It admits, however, that this restriction of the field of application of proposed protection is not a sufficient motive for rejecting the scheme. It points out that scientific

investigators do not work for economic profit as a direct result of discoveries, and that to some extent they are compensated by public recognition and by the conviction of having done work for the good of humanity. After enumerating difficulties in the application of the League's proposals, the reply adds that the matter is to be brought up at a Congress of Jurists to be held at Helsingfors in August next. The Irish Free State concurs in the opinion that the originator of a valuable scientific discovery is entitled to receive material recognition for his work, but it is not satisfied that the proposals outlined in the draft convention which accompanied Senator Ruffini's report are capable of satisfactory adoption.

THE Government of Hungary, referring to Senator Ruffini's report, states that while in the opinion of all nations inventions can only be effectively protected when their practical work has been demonstrated in concrete form, the proposals made aim at protecting inventions at a stage when they have not yet had an opportunity of proving their value. It points out, however, that an obligation of affording to intellectual work the legal protection asked for by the League has already been conceded by certain Provisional Rules of Jurisdiction laid down in 1861, although the law regarding authors' and inventors' rights does not give complete application to this principle. The Hungarian Government hails Senator Ruffini's proposals with the greatest satisfaction, but is not convinced that the methods suggested would in practice be the best. It considers that an agreement ought first to be arrived at between States, in virtue of which each country would undertake to amend and develop its own laws with the view of ensuring the most effective protection of intellectual work, and that when these changes have been made, the various countries should conclude an international convention under which they would mutually support each other in affording protection to intellectual production.

THE advantages of co-operation and fear of German and other foreign competition were the keynotes of the speeches made at the ninth annual meeting of the Association of British Chemical Manufacturers, held on July 9, in London. Mr. Milne Watson, the chairman, referred to the growing spirit of co-operation between the dyestuffs industry and other branches of chemical industry. This industry is in a difficult position, but the same may be said of the dyestuffs industries in the United States, Italy, France, and Japan, whilst even those of Germany and Switzerland have their troubles. British dyestuff manufacturers will have to double their efforts before the home industry can be said to be safely established on an adequate scale. The fine-chemical industry has had a fairly quiet time, but a strenuous year awaits it, for in 1926 the Safeguarding of Industries Act expires, and the Government will want to know what progress has been achieved during its duration. Our manufacturers are already taking stock of the position. Dr. E. F. Armstrong complained of the difficulty in finding suitable chemists possessing the necessary broad outlook, and he hoped the Association would induce the universities to alter their course of training. Several speakers emphasised the danger of increased competition from Germany, which, it was stated, is now more serious than it was in 1914. German manufacturers have eliminated competition at home, all the smaller firms have been absorbed in the large ones, plant that was not absolutely up-to-date or capable of reconstruction has been scrapped, reports on labour are uniformly good, the burden of overhead charges has been removed, and the only apparent trouble is lack of liquid capital.

MR. E. J. WAYLAND, director of the Geological Survey of Uganda, has sent us a further letter upon the subject of the paragraph on "Petroleum in Uganda," to which he took exception in a letter published in NATURE of June 27, with the contributor's reply to it. We are not publishing the letter, but it may be remarked that the correspondence has once again directed attention to the petroleum resources of Africa. By the modern school of geological thought it is now generally conceded that the most trustworthy basis of assessment of future resources is that of geotectonic and stratigraphical achievement, and that apart from manifold indices of bitumen (using the word in its widest sense), favourable prospects are alone deducible from the observed occurrence of suitable mother-rocks, reservoir rocks and externally impressed structures, while the problem of recoverable commercial supply rests ultimately with the drill. Now, excluding the Atlas region of the north, tectonically European (Alpine) in its affinities, and the Red Sea region of the north-east, Africa, by virtue of its great antiquity, the nature of its rocks and broad similarity to vast plateaux such as those of Brazil or the Indian peninsula, seems to lack those geological desiderata usually regarded as essential to the genesis, concentration and permanence of large oil-pools, comparable, for example, with those of Burmah, Persia or Rumania; thus arguing on first principles, by analogy, and also from the results of several past unsuccessful ventures in the search for petroleum along the east and west coasts, in the Transvaal, and in the interior (*e.g.* south of lat. 25° N.), many have been confirmed in their initial scepticism of the oil potentialities of this great continent, as in similar cases of northern Canada, Brazil, southern India, Arabia, Siberia, Australia, etc. It is none the less a welcome sign that certain African geological surveys include research for petroleum in their programme, and while some people may be sceptical of ultimate commercial results, the scientific importance of such work is unquestioned.

ON May 17–24, representatives of the geophysical institutions belonging to the numerous republics of the Soviet Union gathered in Moscow for the first scientific Congress of Geophysics. Beside scientific work this assembly had to deliberate on a number of questions of organisation in quest of the right way of resolving a most complicated problem, that of the co-ordination of the geophysical service in a country

so extensive as the Union of the Socialist Soviet Republics. The scientific work of the Congress was discussed by the following five sections: (1) meteorology, aerology, and general topics; (2) actinometry, electro-meteorology, atmospheric optics, and acoustics; (3) climatology; (4) dynamic and synoptic meteorology; (5) terrestrial magnetism, seismology, and graviometry. Beside these five sections a special commission for the study of drought and its peculiarities was organised. 335 reports were presented for the consideration of the assembly, 75 relating to questions of organisation and 260 scientific reports. There were no less than 511 delegates at the Congress.

THE third International Congress of Entomology opened its meetings at Zurich on Monday, July 20, after a reception of the delegates on the evening of Sunday, July 19. The first of these Congresses was held at Brussels, and the second at Oxford. In August 1914 the third was to have met at Vienna, but circumstances made this impossible. Science, however, is international, and "Time the Healer" suggested the resumption of these meetings, and Zurich was chosen as neutral ground. About 200 members are in attendance, 60 of them from Britain. Nearly all the European countries are represented—though there are significant exceptions—as also India, Canada, South Africa, and the West Indies. The United States is represented by Dr. L. O. Howard and others, while there are representatives from Egypt and Mexico. Switzerland is naturally well represented, and the president is Dr. A. von Schulthess. A very full programme has been arranged under the sections morphology, systematic entomology, biology and development, bionomics, and nomenclature. The social side has not been forgotten. In addition to evening meetings for social intercourse, an excursion has been arranged to the Uetliberg, one of the highest points in the neighbourhood of Zurich, from which good views of surrounding peaks may be had; and a sail round Lake Zurich. A banquet is being held on the night of July 24. On July 25, after some sectional meetings in the forenoon a general business meeting is being held, at which the time and place of meeting for the next Congress will be arranged.

THE Trustees of the late Sir William Dunn have made a donation to the Medical Research Council of 2000*l.* per annum for a period of five years to be used for the promotion of research work in medicine at the discretion of the Council. The Medical Research Council, in accepting this generous benefaction, has intimated that for the present this special Dunn Fund will be applied mainly to the furtherance of the organised studies of filterable viruses which it is supporting, and in particular to the recent developments of this work in relation to cancer by Mr. J. E. Barnard, Dr. W. E. Gye, and their colleagues. It will be recalled that the Dunn Trustees have already made many important benefactions for the advancement of medicine. They have endowed a chair of pathology at Guy's Hospital, London, and erected a School of Biochemistry and endowed a chair in biochemistry, now held by Sir Frederick Hopkins, at Cambridge; they have given a new building for the School of Pathology at Oxford, now being erected, and have provided equipment for the School of Pharmacology there. They have also built and equipped laboratories for the University Medical Clinics at St. Bartholomew's Hospital, St. Thomas's Hospital, and the London Hospital.

AT the annual general meeting of the Faraday Society, held on July 6, the following officers were elected: *President*, Prof. F. G. Donnan; *Past-Presidents*, Sir Robert Hadfield, Prof. Alfred W. Porter, Sir Robert Robertson; *Vice-Presidents*, W. R. Bousfield, Prof. C. H. Desch, Dr. W. H. Hatfield, Prof. W. C. Lewis, Mr. C. C. Paterson, Prof. A. O. Rankine, Dr. E. K. Rideal; *Treasurer*, Mr. R. L. Mond. During the past year general discussions on the following subjects were held: (1) "Fluxes and Slags in Metal Melting and Working," (2) "Physical and Physico-Chemical Problems relating to Textile Fibres," (3) "The Physical Chemistry of Igneous Rock Formation," (4) "Base Exchange in Soils." It is the policy of the Society to co-operate wherever possible with other scientific societies, and three of these discussions were held jointly. The policy of co-operation is also extended to the American Electrochemical Society, in that by a mutual arrangement the Transactions of each society are supplied to the members of the other society at a special rate. In addition to the general discussions, four ordinary meetings were held. One section of the Report refers to the convention that should be adopted as regards the sign of the potential on an electrode. The Council is not prepared to make an official pronouncement on the subject, and the opinion is expressed that such matters should be settled by international agreement. During the year thirty-three new members were admitted to the Society. There was an adverse balance of 293*l.* on the year's work, due to the great amount of material published. While loth to diminish the Society's activities, it has been decided to limit the general discussions for the time being to two a year, and it is expected as a result to balance income and expenditure during the present year.

ACCORDING to the annual report of the Trustees of the Beit Memorial Fellowships for Medical Research, there were last year 93 fellows on the Fellowship register and 23 Fellowships were occupied. Further elections have taken place as follows: Senior Fellowship (600*l.* per annum for 3 years), Mr. H. D. Kay; 4th Year Fellowships (400*l.*), Mr. E. B. Verney and Mr. J. L. Rosedale. Seven Junior Fellowships (350*l.* per annum for 3 years) were also awarded, and the nature of the proposed research and place where the fellowship is tenable appears after the name of the new fellow: Dr. G. H. Eagles, to study the specific agglutinogenic properties of streptococcus scarlatinæ and the possible further specific grouping of hæmolytic streptococci occurring in other pathological processes (The Lister Institute of Preventive Medicine, London). Miss D. M. Needham, (1) a study of the oxidation-reduction potential of various organisms and tissues; (2) a continuation of the study of the pancreatic factor inhibitory to lactic acid formation

in muscle (Bio-chemical Laboratory, Cambridge). Dr. E. N. Chamberlain, effects of the anterior lobe of the pituitary gland on the liver and other organs of the body; investigation of the relation of pituitary and other ductless glands to cholesterol metabolism and their inter-relationships (Johnston Laboratory of Bio-Chemistry, University of Liverpool). Mr. E. N. Allott, the growth of bacteria on artificial media: to attempt to grow bacteria on purely artificial media, consisting of simple compounds, such as simple sugars, amino acids, and salts (Bio-Chemical Laboratory, Cambridge). Mr. F. C. Kelly, to continue research on iodine metabolism, especially the iodine requirements of animals and the influence on nutrition of diets deficient in iodine (Bio-chemical Laboratory, Cambridge). Mr. D. E. Denny-Brown, to investigate spastic paralyses, decerebrate rigidity, and allied conditions, more particularly with regard to the influence of the sympathetic nervous system upon them (Physiological Laboratory, Oxford). Mr. B. S. Platt, the relationship existing between the formation of peroxides by bacteria and certain of the phenomena of immunity (Bacteriological Laboratory of the Department of Pathology, The School of Medicine, Leeds). Thus three of the new fellows of the seven will be at the Biochemical Laboratory, Cambridge.

WE regret to announce the death, on July 14, at the age of sixty-seven years, of Dr. F. E. Beddard, F.R.S., formerly prosector of the Zoological Society, London, and naturalist to the *Challenger* expedition, who was distinguished for his work on the Oligochæta and on the structure and classification of birds.

THE Civil Service Commissioners have appointed Mr. A. C. Stephen, at present a junior naturalist on the scientific staff of the Fishery Board of Scotland, to be assistant in the Natural History Department of the Royal Scottish Museum, Edinburgh, in succession to Dr. E. L. Gill, recently appointed Director of the South African Museum, Cape Town.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned: A lecturer in chemistry and physics at the Exeter Diocesan Training College for Schoolmasters—The Principal, St. Luke's College, Exeter (July 31). A botanist (temporary post) at the Royal Botanic Gardens, Kew—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (August 5). A resident tutor for mathematics and physics at the Borough Road Training College—The Secretary, British and Foreign School Society, 114 Temple Chambers, Temple Avenue, E.C.4 (August 8). Two junior engineers at the Forest Products Research Laboratories of the Department of Scientific and Industrial Research, South Farnborough—The Secretary, The Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (August 8). An evening lecturer in bacteriology at the Battersea Polytechnic—The Principal. A full-time lecturer for day and evening classes in engineering at the Erith Technical Institute—The Principal. A graduate master for physics and chemistry at the Andover Grammar School—The Director of Education, The Castle, Winchester. A lecturer in science, including biology, nature study or gardening at the Diocesan Training College, Ditchling Road, Brighton—The Principal.

Our Astronomical Column.

RETURN OF WOLF'S PERIODIC COMET.—The opening, on July 13, of the meeting at Cambridge of the International Astronomical Union was marked by the detection, by Dr. Stobbe at Bergedorf Observatory, of this interesting periodic comet, which has been observed at nearly every return since its discovery in 1884. Prof. Kamiensky, Director of the Warsaw Observatory, was present at Cambridge and received many congratulations on the brilliant success of his prediction; the error of his predicted place was only 4′, although the perturbations by Jupiter at the last return were so enormous, that the perihelion distance has been increased by an entire astronomical unit, the orbit having, in fact, reverted to its form of fifty years ago when Jupiter acted to reduce the perihelion distance. The perturbations during the whole fifty years have been investigated by Prof. Kamiensky, and the successful prediction gives evidence of his skilful and accurate work.

The comet was of magnitude 15 at rediscovery on July 13, and will remain too faint for ordinary telescopes throughout the apparition. It will, however, be brighter by a magnitude or two when it reaches perihelion on November 8.

Brooks' Comet, the perturbations of which have been investigated by Prof. Dubiago, also suffered large disturbances by Jupiter at aphelion, and is also due at perihelion on November 8. Search for it and for Faye's Comet (due at perihelion about August 6) is now being made. Borrelly's and Kopff's Comets are also due in a few months, so that comet searchers are being kept busy. Tempel's Second Comet has brightened considerably, and is now an easy telescopic object. It has a short tail.

NOVA PICTORIS.—*Astr. Nach.* 5379 contains an interesting note on this Nova by J. Hartmann, of the La Plata Observatory. The Nova had been under observation there from May 27 to June 5, during which time its brightness increased slowly, as the following table shows:

	Mag.		Mag.		Mag.		Mag.
May 27.	2·8	May 29.	2·5	June 1.	2·1	June 4.	1·9
,, 28.	2·6	,, 30.	2·4	,, 2.	2·1	,, 5.	1·8

(Dr. Spencer Jones states that it afterwards attained the first magnitude.)

The increase of light has been more gradual and has lasted longer than in most Novæ; and the changes in the spectrum were also more gradual.

Hartmann obtained photographs with a small single prism spectrograph. These showed a continuous spectrum of the first type, with numerous strong absorption lines, of which the *H*, *K* calcium lines were the strongest, followed by those of hydrogen, helium, magnesium, etc. The hydrogen lines H_β, H_γ, and several other lines, showed a faint emission line on the less refrangible side of the absorption one. He, like Dr. Spencer Jones, holds out hopes that the somewhat unusual behaviour of this star may add materially to our knowledge of the nature of the processes that give rise to these outbursts.

It is interesting to note that Mr. Watson, who discovered this Nova, appears to have been the first to detect the outburst of Nova Aquilæ in 1918, so that he, like Mr. Anderson, has the record of two brilliant Novæ. It is fortunate that this Nova is circumpolar at the southern observatories, so that it will be possible to follow its decline without any break through the time of its conjunction with the sun.

Research Items.

CU-CHULAINN AND TOTEMISM.—In *Man* for June, Dr. Géza Roheim, whose ingenious and suggestive psychoanalytic study of totemism in Australia has just been published in Great Britain, applies the same analytical method to the Cu-chulainn cycle of Irish legend with reference to its bearing upon the problem of totemic origins. Not only is the dog taboo of Cu-chulainn probably totemic, but also he becomes a dog by killing a dog. In other words, the legend contains more or less veiled references to the father-and-son conflict for the women of the Cyclopean family, from which, Freud holds, totemism and exogamy arose; of the animal symbol arising out of a feeling of guilt for the act of parricide; and of incest committed by the hero. Cu-chulainn slays the dog of Cu-lain the smith, and serves in its stead, as other Aryan heroes served a term of apprenticeship with a smith, from whom they usually obtained their terrific weapon. But the smith and his dog are to be regarded as identical and the former represents the father. The slaying is therefore parricide. Cu-chulainn fights with and kills his own son; but Lugaid, who deals him his death-blow, is probably also his own son by an incestuous union, although ostensibly the son of Curoi. Curoi, the archaic form of the Oak King, is also to be regarded as the father of Cu-chulainn by whom he is killed. If then the smith is equated with his hound, the combat is between two heroes of the dog clan, and when Cu-chulainn breaks the taboo he is slain by his son Lugaid, a parallel being the case of the Baja King, who eats his totem animal when death at the hand of his son and heir draws near.

MORPHOLOGICAL DIFFERENTIATION OF BACILLUS TYPHOSUS.—L. Nicholls and E. Burgess direct attention in the *Ceylon Journ. of Science*, Sect. D (Medical Sc.), vol. i. pt. 2, 1925, p. 47, to the discrepancies which occur in text-books between the sizes given in the text and the magnifications stated under the illustrations respecting certain micro-organisms. They believe that were more attention given to the accurate comparison of the size and morphology of different organisms, much help would be derived for purposes of differentiation and identification. As an example, they have compared the morphology of *B. typhosus* with that of 40 other bacilli isolated from water. The organisms were grown on three standard media: (1) ordinary nutrient agar, (2) salt (3 per cent.) nutrient agar, and (3) salt-free peptone agar. Stained preparations were made and photographed under similar conditions. It was found that the *B. typhosus* could be distinguished almost at a glance from any one of these 40 water organisms by its characters when grown on these media. As regards the 40 water organisms, these corresponded morphologically to about 30 species, which agreed well with the results obtained by an extended series of culture and fermentation tests.

THE BRITISH FRESHWATER PEARL MUSSEL.—Considering that it is still an article of economic value, although less so than formerly, it is remarkable how imperfect is our knowledge of the life-history of the British freshwater pearl mussel. What is known has been admirably summarised by Mr. J. Wilfrid Jackson, of the Manchester Museum, in the introduction to his address to the Conchological Society on "The distribution of *Margaritana margaritifera* in the British Isles" (*Journ. of Conch.*, 17, No. 7), a paper all the more valuable on account of the numerous references to original sources of information. The mollusc has a remarkably wide circumpolar distribution, and exhibits persistent specific characters. Nevertheless, although the glochidial stage is known, the transitional stages between that and the adult are unknown and unrepresented in collections save for four young shells, in Mr. Jackson's own possession, coming from the River Conway. What the habitat of the young shells may be is at present a mystery (cf. Prof. A. E. Boycott in NATURE, August 23, 1924, p. 276). One would infer that they resort to deep water, since in shallow they would have been found long ere this. At the same time it should be observed, although not emphasised by Mr. Jackson, that these young shells might easily be mistaken for the juveniles of a species of Unio, because they are not black like the adult, nor do they exhibit the characteristic concavity of the ventral margin, whilst they are furnished with a complete set of hinge teeth similar to those of Unio. The assertion has been made by Dr. Haas that Margaritana (or, as it should be called, Margaritifera) is intolerant of hard water, and certainly it obviously shows a preference for soft waters, which makes it difficult to explain the markedly thick shells of the species. Prof. Boycott's appendix to Mr. Jackson's address, however, shows that this question evidently requires further investigation. A very full account of the distribution of the single British species, accompanied by a most instructive map, forms the conclusion rather than the bulk of the author's very valuable paper, to which we are glad to note there is to be a second part dealing with the past history of the mollusc.

RED CLOVER.—Critical studies on the pollination, fertilisation, and breeding of red clover have led to conclusions of practical importance to agriculturists (R. D. Williams, Welsh Plant Breeding Station Publications, Series H, No. 4). Under ordinary conditions red clover is not self-fertilised, but a small number of plants are self-fertile if artificially self-pollinated, individual plants varying in the degree to which they are capable of this. The property of self-fertility is probably inheritable, and is greatly increased if pollination is effected before the flowers open, but so little seed is produced that it is doubtful if self-pollination can be of much practical use in the breeding of red clover. Humble bees are the chief agents in effecting cross-pollination at Aberystwyth and in Montgomeryshire, honey bees playing but a very small part. Six species of humble bees were observed on red clover, *B. agrorum* and *B. hortorum* being by far the most numerous and important, probably being responsible for 70 to 80 per cent. of the total yield of clover seed in these districts. The seed yields are to some extent reduced by robber bees, *B. terrestris* and *B. lucorum*, and it is suggested that their depredations might be reduced by growing small areas of *Vicia villosa* near the clover, as this is a most attractive bait for these insects. As the bees are most abundant in early August, the yield of seed is much increased if the flowering of the clover is postponed until that time by means of judicious cutting of early strains or by growing late flowering strains. Larger yields might be obtained if more bees were available, and investigations are in hand with the view of increasing their numbers by judicious encouragement. Various methods of artificially breeding red clover have been tried, hand cross-pollination and controlled cross-pollination by humble bees being the two most promising methods of attack. Hand pollination is useless when many seeds are required or several plants are being intercrossed, but humble bees confined in various types of cages prove to be

very efficient agents, especially *B. agrorum*, *B. hortorum*, and *B. helferanus*.

PRODUCTION OF ALCOHOL FOR MOTOR FUEL IN THE TROPICS.—The question of making an efficient motor fuel in the tropics, where imported spirit is expensive, is at present attracting considerable attention. Various materials have been suggested, and in some cases tried, as a source of power alcohol, such as starch-containing roots, and cellulosic residues from the sugar and other industries, but one of the most valuable appears to be the sap which may be collected from the flowering shoots of the Nipa palm of the Far East. Considerable work has been done in the Philippine Islands in ascertaining the suitability of this palm for the production of alcohol, and quite recently an experimental plant has been erected in the State of North Borneo. The plant is being run under the direction of the local Department of Agriculture, and an account of the results of the first year's working, based on a memorandum supplied by the British North Borneo Company, is given in the current issue of the *Bulletin of the Imperial Institute*, published by Mr. John Murray. There are about 300,000 acres of Nipa palm in North Borneo, occurring in nearly solid stands of 5000 acres or more. The sap flows for only six months in the year, but it is estimated that during this period 900,000,000 gallons of sap capable of producing nearly 60,000,000 gallons of alcohol could be obtained. The results of the first year's working of the experimental plant came up to expectations in every way. The still was only capable of producing 100 gallons of alcohol per working day of 12 hours, and the costs of running such a small plant were naturally somewhat high, but it is shown that a permanent plant producing not less than 1000 gallons per day should prove a commercial success.

FORMATION OF MALACHITE.—The May issue of the Journal of the Chemical Society contains a paper on the mechanism of the formation of malachite ($2CuO, CO_2$) from basic copper carbonate, by J. R. I. Hepburn. At ordinary temperatures the transformation appears to be caused through the intermediate agency of an aqueous solution of carbon dioxide or sodium hydrogen carbonate. In the former case normal malachite crystals are formed; in the latter, sphærocrystals are produced, probably through crystal growth in a colloid medium (unchanged basic copper carbonate). Gelatin retards the change. The formation of malachite at 100° (by thermal decomposition of the blue solutions prepared by dissolving the basic carbonate in saturated sodium hydrogen carbonate) occurs as a surface film of interpenetrating sphærocrystals, which is disrupted into individual crystals on further boiling. The direct cause of the change is attributed to loss of carbon dioxide from the sodium hydrogen carbonate at 100° with formation of the stable double salt Na_2CO_3, $NaHCo_3$, $2H_2O$ and malachite. Gelatin likewise retards this change.

THE SODIUM SPECTRUM.—The July issue of the *Philosophical Magazine* contains a short communication from Prof. F. H. Newman, describing a successful attempt to obtain the spectral lines of sodium vapour due to changes of orbit involving less energy than that necessary for ionisation. The sodium vapour was contained in a triode tube of quartz maintained at 350° C. in an electric furnace. The electrons were supplied by a dull tungsten filament, and between the filament and the grid an increasing electromotive force was applied, the spectrum produced being photographed by means of a quartz spectrograph. After applying a correction of 0·4 volt to the observed potential to get the potential corresponding to the energy with which the electrons pass through the grid, the author found that, in accordance with theory, at 2·2 volts the doublet 5896-90 only appeared, at 4·0 volts the doublet 3303-2, at 4·4 volts the doublet 6161-54, and at 4·6 volts the doublet 5688-3 appeared in addition.

MASS OF COMPOUNDS OF SILVER WHEN STRONGLY ILLUMINATED.—Messrs. P. P. Koch and B. Kreis describe, in the *Zeitschrift für Physik* of May 16, measurements made on particles of silver bromide and silver chloride, the mass of which was about 10^{-11} gr. The particles were made to float in air in the electrostatic field of a condenser, in which they were observed by means of a microscope. The particles were strongly illuminated by means of an arc lamp and a powerful condenser; the mass being determined before and after illumination by means of measurements of the condenser voltage and of the charge of the suspended particle. The intensity of illumination employed was so high as 67×10^6 metre candles; and it was found that in a short time the loss of mass was so great as 25 per cent. This loss appears to be due to separation of the halogens. Silver iodide under the same conditions showed only very small alterations in mass. The apparatus may be regarded as a very sensitive microbalance, in which particles of the same order of size as those in a photographic plate can be weighed, and the theory of photographic action can be directly tested.

LOUD-SPEAKERS.—The Marconiphone Co., Ltd., of Marconi House, Strand, now manufacture a loud-speaker which enables anyone to address an audience of many thousands and at the same time to be heard by equally large gatherings up to a distance of about 150 miles with the help of the Post Office land wires. The total equipment can be purchased outright or can be hired for 5*l*. per week. A powerful voice is no longer a necessity for a public speaker, and this ought to improve the quality of "orations" as the number of possible orators is largely increased. The distinguishing feature of the Marconi instrument is that it responds with equal sensitivity to all notes in the musical scale whether the sound originates 100 feet or 10 inches from its position. Recently a nightingale's song was broadcasted from the London broadcasting station, 2LO, by this device. The bird was singing about 100 feet away from the instrument, yet the song could be heard almost perfectly by broadcasting listeners. The apparatus has many points of difference from domestic loud-speakers. The construction is on the moving coil principle, and the diaphragm is of rubber and not of metal. As it has no natural or resonant frequency of its own, it is practically free from nasal defects, and there is no metallic timbre. The normal working range of one of these loud-speakers under reasonably silent conditions is approximately three-quarters of a mile.

SORPTION OF GASES BY GRAPHITE.—The sorption of oxygen by "activated" graphite forms the subject of a paper by D. H. Bangham and J. Stafford in the Journal of the Chemical Society for May. If s is the quantity of oxygen sorbed at time t after its introduction to the graphite, then the relation $s = kt^b$ holds, k and b being constants, both for ordinary graphite and for graphite containing hydrogen sorbed in a discharge tube. The results seem to indicate that the sorption of oxygen by ordinary graphite is due more or less directly to the hydrogen which it contained on manufacture. No water seems to be produced by the sorption of oxygen by graphite containing hydrogen; the sorbed gases may be pumped off as such.

The Nature of the Cell Membrane.

IS there a semi-permeable membrane to the cell? This question is examined by Prof. L. Lapicque in a review of very general interest which accompanies seven more technical contributions in animal, vegetable, or general physiology, in the first number of a new French journal, *Annales de Physiologie et de Physicochimie biologique* (Paris: Gaston Doin; annual subscription 45 francs outside France). The following, save for reference to some recent cognate American work, is based entirely upon Prof. Lapicque's stimulating and timely article.

Lapicque admits at the outset that he finds the conception of a semi-permeable membrane around the cell a hindrance rather than a help in the interpretation of the behaviour of the cell; he therefore critically examines the case for such a membrane as presented by Bayliss in his great text-book. The idea of a membrane arises naturally when it is realised that protoplasm, though behaving in many ways as a protein sol, can frequently exist in contact with water without dispersing in colloidal solution throughout the aqueous medium. Clearly there is then a protoplasm water interface, and probably every one would agree that protoplasm at this interface has different properties from those characteristic of the main mass of protoplasm. Do these properties, however, necessarily include a different penetrability to solutes which justifies its distinction as a semi-permeable membrane enveloping a mass of readily permeable plasm? Even the advocates of the membrane will probably agree it is a phenomenon of the surface and that particles of protoplasm may lose and regain these surface characteristics as they leave or enter the surface layer. Certainly the ease with which the protoplasmic surface changes in amœboid movement, leaving no collapsed membrane as the surface retracts, suggests that any change undergone as protoplasm enters the surface layer is reversible in nature. Whenever a permanent structural membrane can be identified at the surface of the cell, it is something distinct from the surface of the protoplasm, as is the cellulose wall of the plant, and is not the seat of any semi-permeable properties shown by the protoplast, so that in plasmolysis the plant protoplast withdraws itself inward from the permeable cellulose wall around it. The semi-permeable properties of the hypothetical membrane are usually interpreted as due to a sieve-like action. From this view-point no non-living semi-permeable membrane has been shown experimentally to be impermeable to molecules of less than about twenty atoms. The living membrane, however, is assumed to control the passage of inorganic ions. One may invoke the view that such ions move accompanied by a cluster of water molecules, but the fact remains that the non-living membranes fail to arrest their passage.

The distribution of ions upon either side of a semi-permeable membrane is now frequently attributed to the Donnan equilibrium, when a non-diffusible colloid on one side of the membrane forms ionisable salts with electrolytes. Consideration of the case of gelatin, however, shows that so long as the colloid is non-diffusible, no special membrane is required for the existence of a Donnan equilibrium.

Thus whilst for mathematical and physico-chemical argument the ideal semi-permeable membrane is a necessary concept, in experimental fact it has never been demonstrated, and there are considerable difficulties in assuming its existence. For example, botanists realise that inorganic salts must diffuse freely into the plant, and they interpret experimental observations of recovery from plasmolysis induced by external concentrations of inorganic salts as evidence that such diffusion is occurring. On the other hand, present data as to the entry of salts, as summarised recently by Stiles in his monograph upon permeability, do not support the assumption that salts will diffuse through the plant protoplast until the ratio of salt concentrations in external solution and in the vacuole will be unity.

Bayliss argued that the resistance of the cell to the electric current, in view of its content in free electrolytes, could only be explained on the assumption of semi-permeability. Lapicque points out that if this was the true explanation, the cell would behave as a condenser in an electric field, and that once the cell was fully polarised no more current would pass. Actually the high resistance may be explained equally well if protoplasm is regarded as a permeable but highly viscous medium.

Bayliss also stipulated the existence of a membrane on the following grounds: (1) In the presence of various electrolytes in solution the cell undergoes a permanent change in volume; (2) the electrolytes within and without the cell differ in kind and in concentration. Lapicque deals with these arguments at some length. The change of volume of the vacuolated cell is admitted, but so also is the fact of recovery from plasmolysis, which shows that we are dealing with slow penetration of salts, not semi-permeability.

In any case this phenomenon is exhibited by the whole thickness of the cytoplasm; there is no evidence of the special rôle of a surface membrane. In the normal non-vacuolated animal cell, contraction of volume also takes place in the presence of salt solution, but this phenomenon cannot be attributed to the osmotic withdrawal of water from a non-existent vacuole, and is paralleled by the behaviour of gelatin and many other colloids, without superficial semi-permeable membranes, when placed in similar salt solutions.

As to the difference in kind and in degree of the concentration of salts within and without a membrane, all through the life of a human being the red blood corpuscles circulate in a medium rich in sodium and poor in potassium, and yet themselves remain rich in potassium and poor in sodium. To maintain this relative difference in concentration a membrane would surely need to be impermeable, but, as Moore and Roaf said in 1908, if such a membrane thus imprisons the salts and prevents adjustments of concentration, how did the salts enter the prison?

Lapicque approves the general conclusion of Moore and Roaf that the ratio of concentrations of these ions within and without the living corpuscle depends upon a mobile equilibrium between cell constituents and surrounding liquid, and is not controlled by diffusion restricted by a semi-permeable membrane. Hamburger's experiments have shown these corpuscles to be very permeable to salts, so that any change in the medium produces an exchange of inorganic solutes between the corpuscles and the medium. Hamburger continues to regard the corpuscles as surrounded by a semi-permeable membrane, so that the loss of hæmoglobin in solutions hypotonic beyond a certain degree is explained as due to the bursting of the membrane. Lapicque points out that these laked corpuscles still change in volume with change in salt concentration, just like the original red corpuscles, so that if the membrane is destroyed, some of the properties still remain which it was postulated to explain.

Hoagland and other American workers have recently provided in plant physiology equally puzzling data as to the distribution of inorganic ions within and

without the vacuolated cell. Using Valonia and Nitella, marine and fresh-water algæ forms respectively, which have large enough cells to enable the sap to be collected from individual cells, they supply grounds for thinking that certain inorganic ions, for example potassium, are mainly, if not entirely, in solution in the sap of the vacuole, and yet retain a concentration much higher than that in the outside solution. The case of chlorides is particularly remarkable. Nitella will absorb practically every trace of chloride from the external solution, and will remain alive in distilled water for sixteen days without giving up any detectable trace of chlorine to the water, although containing very appreciable quantities in the vacuole. Hoagland concludes that Nitella under normal conditions possesses uni-directional permeability with reference to chlorine and potassium (*Journ. Gen. Physiology*, 5, pp. 629-646, 1923).

Lapicque concludes that the simple doctrine of the semi-permeable membrane, as employed to explain the salt content and swelling properties of the living cell, will soon appear as inadequate as the astrological conception of the firmament which makes it a crystal vault studded with stars. He adumbrates as factors, in a more adequate explanation, the distribution of salts according to the Donnan equilibrium between a non-diffusible amphoteric colloid and an aqueous membrane, with the great sensitiveness of such an equilibrium to hydrogen ion concentration, and also the hydrophilic behaviour of lipoids, which varies with the proportion of cholesterin to fatty acids or to lecithin. In view also of the modification reported in mitochondria with changes in external medium, he suggests that account may have to be taken of the physiological rôle of these structures, at present almost exclusively studied by the cytologist. Finally, he points out that the protoplasm is the seat of continuous transformation of energy, and that the phenomena under consideration will not admit of solution in terms of a passive semi-permeable membrane. To this last point the supporters of the membrane may reply that they have always assumed that a living cell owes its semi-permeable properties to a living membrane.

Maori Ethnography.[1]

FOR more than half a century the New Zealand Institute has published in its Transactions a vast amount of valuable information upon all aspects of the history of a group of the most interesting islands in the world. In the earlier years of the Dominion few of the colonists were intimately acquainted with the native language, and fewer still could penetrate the veil that hides the thoughts and ideas of the Maori mind. Many of these ethnological contributions, therefore, are of doubtful reliability. They are, nevertheless, often quoted by anthropological writers in other countries who are unable to discriminate between the wheat and the chaff. After the New Zealand University, with its highly cultivated staffs in its various colleges, began to liberate on the colony graduates trained to careful observation and exposition, it was soon recognised that the scientific study of the native race was an undertaking of the utmost urgency, for the day was already far spent for the garnering of what remained of their rapidly vanishing traditions and beliefs.

New journals were therefore necessary for recording exclusively these anthropological data. The chief of these are the Journal of the Polynesian Society, the Bulletins of the Dominion Museum, and the Records of the Canterbury and Dunedin Museums. It is the tenth volume of the Dominion Museum Bulletins, by Mr. Elsdon Best, that now comes under notice. The author emphasises the qualifications with which any investigator of primitive peoples should be endowed. "No traveller," he says, "or he of short sojourns may delve into . . . the inner strata of the mentality of barbaric man. . . ." [The Maori] "ever closely shields his true religion" [and] ". . . his inner mentality from the inquisitive gaze and analytical probing of inquiring outsiders. . . . In order to open the pages of the inner life . . . of such folks it is highly necessary to gain his confidence. A long residence in their midst, a good knowledge of their language. A quiet and non-critical bearing; a heartfelt sympathy with the feelings and prejudices of the people."

Just such are the qualifications possessed by the author, and consequently he has attained to the position of one of the most trustworthy interpreters of Maori psychology, and one of the highest authorities on their customs and beliefs.

[1] Maori Religion: Being an account of the Cosmogony, Anthropogeny, Religious Beliefs and Rites, Magic, and Folk-lore of the Maori Folk of New Zealand. Bulletin No. 10, Section 1. By Elsdon Best. (Dominion Museum, Wellington, N.Z., 1924.)

The section of the Bulletin we have before us, a closely printed report of 264 pages, incorporates a vast amount of new and valuable, but not easily compressible, matter. It is impossible to do more than summarise its parts (as Mr. Best superscribes his chapters). An introductory part deals with the definition, origin, and development of religion preliminary to a comparison with Maori religion; the second surveys Maori religion and mythology from the evidence of early writers. On this follows a lengthy account of Maori cosmogony, theogeny, and anthropogeny, and further, by a classification of their gods, correcting the mistakes of several ethnologists who have misunderstood the term god as applied to the Maori religion. The New Zealand natives, above all the Polynesians of the Pacific, recognise a supreme divinity—Io—possessing divine attributes more nearly akin to the European idea of godhead. Part five deals with the offerings, human sacrifices, and images by which their spiritual beings can be influenced. This is succeeded by 28 specially interesting pages on the functions of the priests, the sacred places, and divination. Many ethnologists will read with surprise the singular fact that the village latrine was a *tuaha* or sacred place. *Tuaha* is the word "applied to any place where men's hair is cut, where tapu food is cast away or offered to supernatural beings," . . . and where "rites connected with many matters were conducted." The final part is concerned with an explanation of Maori ritual performances and formulæ—karakia—"a survey of native mentality and its effects as seen in the performance of rites connected with religion and magic," the numerous particulars of which "would require a chapter of cumbrous length" Mr. Best tells us, and so in the present Bulletin he can supply only a few illustrations. His work "The Maori," just about to be published, will, we hope, supply anthropologists with fuller details.

One suggestion may perhaps be permitted, that the numerous ritual formulæ quoted in the native language throughout the book and in several pages of addenda, might, if impossible of verbatim translation, be paraphrased to afford the reader, unacquainted with Maori speech, a general idea of their meaning. This monograph is of exceptional importance. So doubtless will be the second section, which will include a description of Maori magic and many illustrations of native myths and folk-tales.

University and Educational Intelligence.

ABERDEEN.—At the summer graduation the honorary degree of LL.D. was conferred on Dr. J. J. R. MacLeod, professor of physiology at the University of Toronto.

The degree of D.Sc. was obtained by R. S. Clark for a thesis entitled "Rays and Skates" and by W. O. Kermack for a thesis entitled "Investigations of the Synthesis and Reactions of Indole Compounds."

BELFAST.—At the meeting of the Senate of the Queen's University held on July 15, a tender was accepted for the erection of buildings for the Department of Agriculture. It is hoped that these buildings will be completed in about 18 months at a cost of 46,000*l*. Of this sum, 34,500*l*. has been given by the Ministry of Agriculture for Northern Ireland, 5000*l*. was contributed by the late Miss Riddell, and 6000*l*. was provided from general University funds.

Applications are invited from British subjects for the Musgrave research studentship in physiology, value 190*l*. Particulars and application forms are obtainable from the secretary of the Queen's University.

BIRMINGHAM.—The following doctorates have been awarded: D.Sc.—W. E. Garner, for papers on gaseous explosions, heats of formation, detonation, crystallisation of organic substances, and other chemical subjects; J. D. Morgan, for papers on the ignition of explosive gases, and flame movements in gaseous explosions; and D. R. Nanji, for papers on chemical and biochemical subjects, mainly on the constitution of starch and the action of enzymes.

CAMBRIDGE.—Sir W. B. Hardy, Gonville and Caius College, and Dr. L. E. Shore, St. John's College, have been reappointed as University lecturers in physiology. Dr. E. K. Rideal, Trinity Hall, has been reappointed as Humphry Owen Jones lecturer in physical chemistry. The Wrenbury scholarship in economics has been awarded to H. C. B. Mynors, Corpus Christi College.

The following have been appointed Henry P. Davison scholars for the year 1925–26: H. H. Thomas, Sidney Sussex College, to Yale University; W. P. N. Edwards, Corpus Christi College, to Princeton University; and G. R. C. Eley, Trinity College, to Harvard University.

LONDON.—The following doctorates have been conferred: D.Sc. (in Chemistry) on Mr. Samuel Glasstone (King's College), for a thesis entitled "Studies of Electrolytic Polarisation"; and D.Sc. (Engineering) on Mr. R. G. Jakeman, for a thesis entitled "Alternating Current Wave-Windings," and other papers.

The University Studentship in Physiology for 1925–1926, of the value of 50*l*. and tenable for one year in a Physiological Laboratory of the University or of a School of the University, has been awarded to Dr. Isaac Cohen, who proposes to carry out research on tethelin under the direction of Prof. E. C. Dodds at the Bland-Sutton Institute of Pathology at the Middlesex Hospital Medical School.

The following are among the awards of the newly instituted University Postgraduate Studentships recently made: Travelling Studentships (value 275*l*.) to Mr. Reginald Percy Austin and Miss Helga Sharpe Pearson. Mr. Austin proposes to study archæology at the British School of Archæology, Athens, and to undertake excavations. Miss Pearson obtained the M.Sc. degree in zoology in 1924 (University College). She proposes to work on early Tertiary mammals in the continental museums among which this material is scattered.

ST. ANDREWS.—Mr. S. R. Kirk, assistant in geology, and Mr. John Williamson, assistant in mathematics, have submitted their resignations on appointment to the new Commonwealth Fund Fellowships, under which British students are enabled to carry on research work for two years in the United States. Six out of the total number of twenty fellowships available in the first year of the institution of the scheme have been awarded to the University of St. Andrews.

Principal John Yule Mackay has resigned the chair of anatomy in University College, Dundee, although he continues to hold office as Principal of the College.

SHEFFIELD.—The University Council has made the following appointments: Mr. I. C. F. Statham, to the chair of mining; Mr. N. M. H. Lightfoot, to be assistant lecturer in mathematics; Mr. Joseph Jenkins, to be assistant lecturer in civil engineering; Miss Esther Lowe, to be assistant in Zoological Department.

THE Busk Studentship in Aeronautics, founded in memory of Edward Teshmaker Busk, who lost his life in 1914 whilst flying an experimental aeroplane, has been awarded for the year 1925–26 to Mr. Stewart Scott Hall, of the Imperial College of Science, London.

BY the will of Sir Rickman Godlee, Bart., who died on April 20, the sum of 10,000*l*. is bequeathed, after his wife's death, upon trust for investment, the income to provide travelling scholarships for students of University College Hospital Medical School, London, who have held a resident appointment in University College Hospital. The ultimate residue of the estate is to be divided equally between University College, London, and University College Hospital, unless the latter is taken over by a public authority, in which event the whole will go to University College.

ROBERT BLAIR fellowships for this year have been awarded by the London County Council to Mr. N. P. Inglis and to Mr. A. B. Miller. The fellowships, which are worth 450*l*. each, are for one year's study abroad. Mr. Inglis, who is a fellow in the University of Liverpool, proposes to continue his studies on the fatigue of metals. Mr. Miller proposes to investigate the metal construction of aircraft with special reference to the materials employed and method of production.

THE Ramsay Memorial Fellowship Trustees have made the following awards for the session 1925–26, the place at which research is to be carried out being indicated in brackets: British Fellowships of 300*l*. to Mr. G. A. Elliott for two years (University College, London), and to Dr. H. R. Ing for one year (University of Manchester); Glasgow Fellowships of 300*l*. to Mr. T. C. Mitchell for two years (University of Cambridge); to Mr. J. D. Fulton for one year (University of Manchester); Canadian Fellowship to Dr. D. McKay Morrison (University of Cambridge); Japanese Fellowship of the value of 370*l*. to Dr. Seisi Takagi (University College, London). The following Fellowships have been renewed: Dr. S. W. Saunders (British Fellowship, University College, London); Mr. Kai J. Pedersen (Danish Fellowship, University of Bristol); M. M. Mathieu (French Fellowship, Davy Faraday Laboratory, Royal Institution, London); Dr. Nicolas Oeconomopoulos (Greek Fellowship, University College, London). Sir Robert Waley-Cohen has been appointed a Trustee of the Ramsay Memorial Fellowship Trust, in succession to the late Sir George Beilby.

Early Science at Oxford.

July 28, 1685. Mr. President presented ye Society with a Copy of his Algebra lately printed.

A letter from Mr. Aston dated July 23 was read; with it came Hevelius's *Annus Climactericus* presented to this Society by ye Royall Society.

Four Mathematicall papers drawn up by Mr. Tolet, were presented ye Society: three of these papers were concerning gunnery, and ye finding altitudes: the fourth mentioned a controversy between Mr. Tolet and Mr. Hern, concerning ye scituation of ye lines of Longitude; ye former affirming, that ye line of Longitude lies North and South, and ye line of Latitude East and West: ye latter affirmes that ye line of Longitude lies East and West, and ye line of Latitude North and South. Concerning which controversy Mr. Hern having appealed to ye Royal Society at London, and to this at Oxford for a determination; this Society on ye account of Mr. Hern's appeal, and at the request of Mr. Ash Secretary of ye Dublin Society gives their opinion, which is this; They conceive it has been generally received among mathematicians, that ye lines of Longitude ly North and South, and ye lines of Latitude East and West.

These papers gave occasion to some discourse concerning the motion of Projecta; it was thought not improbable both by Mr. President & Mr. Caswell, that the Air does make a greater resistance against quicker bodies, than against those, which are slower, *cæteris paribus*.

A Letter from Mr. Cole of Bristoll dated July 18 and correcting a mistake in a former letter of his concerning ye measure of a Virginia Catskin in his custody, was read.

A Letter from Mr. Ash dated Trin: Coll (Dublin) July ye 12th was communicated and read; it contain'd a letter of Sr R. Buckley's, which gave a full description of ye new Calesh used by him: this last letter is sent ye Royal Society.

Dr. Plot proved, that not onely Box of ye English woods sinks in water; for Elder, if you cut off ye pith & the rind, does ye same, as we saw; ye black Walnut of Virginia was seen to sink.

The measure of the hand of a monstrous Irish man, shewn lately at Oxford, was communicated by Dr. Plot; He was 7 foot 6 inches high, ye length of his span 14 inches, of his Cubit 2 foot 2 inches; of his Arm 3 foot 2 inches ½, from ye shoulder to ye crown of his head 11¾. His name Edmund Melloon, aged 19 years Anno 1684, born at Port Leicester in Meath. Upon this occasion Dr. Plot discoursed on ye extravagant proportion of parts in men of an extraordinary size, especially after sicknesse: concerning which he was desired to draw up his thoughts against ye next meeting.

July 29, 1684. An Account was brought in, of ye Ecclipse of ye Sun, on July 2, 1684; ye Observations were taken in ye University Observatory, by Dr. Wallis, Mr. Bernard, Mr. Caswell, and Mr. Rooke.

Dr. Plot presented ye Society with an Elf Arrow, brought from within two, or three, miles of Edinborough, where they are in great plenty. He shewed also some naturall gold of Scotland in a pepin, or great grain, and he also communicated an account of Black Lead found onely in Keswick in Cumberland, and there called Wadt, or Kellow.

Mr. Musgrave acquainted ye Society, that he had lately repeated ye experiment mentioned in ye Minutes of June 24th. 1684, tying and cutting of, ye externall Jugulars of a dog, with ye same success as formerly; ye dog in neither of these experiments being any way concerned at ye stoppage of ye circulation in these veins.

Societies and Academies.

LONDON.

Geological Society, June 10.—L. R. **Cox**: The fauna of the basal shell-bed of the Portland Stone of the Isle of Portland. On the western coast of the Isle of Portland the basal bed of the Portland Stone is a highly fossiliferous shelly limestone, on the surface of which fossils weather out in an extremely good state of preservation. The specimens described were collected by Lieut.-Col. R. H. Cunnington and include about 80 species of mollusca, of which 18 lamellibranchs and 9 gastropods are new to science, and several others have not before been recorded from Great Britain.—H. L. **Hawkins**: Echinoidea from the Portland Stone and the Purbeck Beds. Before last year only one species ("*Echinobrissus*" *brodiei* Wright) was known from the Portland Stone. A species of *Hemicidaris* from the sands was the only other echinoid recognised in the British Portlandian. The work of Lieut.-Col. Cunnington has revealed three specimens of "*E.*" *brodiei* in the basement-bed of the Portland Stone (and one from the overlying Whit-Bed); and material for the study of four other species, with indication of a sixth. Prof. Hawkins has also found *Hemicidaris purbeckensis* Forbes in the Middle Purbeck Series of Durlston Bay, near Swanage, which was collected from that locality about 75 years ago but not since, and specimens of an apparently new form referable to "Pseudodiadema" *sensu latissimo*. The irregular distribution of echinoids in these and other Jurassic strata may be due to the known tendency of echinoids to live in restricted clusters (comprising several species of similar ecological quality), which seem to migrate wholesale in successive generations.—E. **Spencer**: On some occurrences of spherulitic siderite and other carbonates in sediments. The spherulites occur in association with fine-grained sediments of carbonaceous, muddy, or silty type, often with comminuted plant-tissue, and are fairly uniform in size locally. The deposits seem to be of freshwater origin and devoid of calcareous shelly remains; the carbonate material in most cases consists of nearly pure siderite. The occluded sediment is similar to that in which the spherulites are embedded; where "zoning" of the sediment occurs, it is subordinate to radial structure. The spherulites probably formed from iron-carbonate solutions held within the gradually settling and consolidating sediment. The reactions resulting from the presence in sediments of humate compounds, salt, calcium carbonate, etc., are considered. The iron compounds present in solution in fresh water were probably adsorbed by the fine-grained and partly colloidal sediments, and carried down with them during deposition. Supersaturation would result from the settling and flocculation of the sediment, and from the gradual upward expulsion of the more readily diffused water-molecules. Crystallisation would then commence at a number of centres simultaneously.

Optical Society, June 11.—E. F. **Fincham**: The changes in the form of the crystalline lens in accommodation. According to Helmholtz, the lens swells and increases in convexity during accommodation because the tension upon it is relaxed when the ciliary muscle contracts. In order to explain the change of the anterior surface of the lens to a hyperbolic form in accommodation, Tscherning states that the tension of the lens is maintained when the muscle contracts, and the forms of the surfaces are altered by a pressure by the vitreous humour exerted

upon the periphery of the posterior lens surface. The radii of curvature of both anterior and posterior surfaces of the lens, and also the movement which the apices of these surfaces make in accommodation, have now been measured. In two selected cases of men of the same age and having the same refractive error, considerable differences in the behaviour of the lens in accommodation were found. For a given amount of accommodation, whereas the lens surfaces in one case are more increased in curvature than in the other, their apices suffer less movement; the surface which was most altered in curvature showed the most pronounced hyperbolic form in both relaxed and accommodated conditions. The results can be explained by the Helmholtz theory, by taking into account the properties of the lens capsule.—C. V. **Raman** and K. **Banerji**: The optical properties of amethyst quartz. A section-plate of amethyst cut normal to the optic axis, when viewed under suitable conditions, without a polariser or analyser, shows coloured diffraction fringes of the Fresnel type, arranged periodically and running parallel to the lines of the structure. The diffraction effect is due to the periodic change of phase produced by the structure and not to any periodic variation of transparency. The diffraction spectra of the Fraunhofer type due to the structure may also be observed. The plate is thus in effect a phase-change diffraction grating.—R. S. **Clay** and T. H. **Court**: A Lucernal microscope by Samuel Washbourn, London. The instrument, which was probably made in 1800, has adjustments for focussing and for moving the object in two directions at right angles to one another. The objectives, consisting of single lenses, are mounted in a vertical slide so that different powers may be used. All the adjustments can be made from the eyepiece end. The instrument can readily be taken to pieces and the parts fit into a case, suggesting that it was originally used by a peripatetic lecturer.

Physical Society, June 12.—G. **Temple**: On mass and energy. It is assumed that variations in the potential energy of a body (gravitational or electrostatic) are always accompanied by proportionate changes in its mass. Continuing this assumption with the theories of Newtonian dynamics and Maxwellian electrodynamics, it has been found possible to predict all those phenomena, which are usually regarded as the crucial tests of the theories of relativity, both "special" and "general."—E. **Tyler** and E. G. **Richardson**: The characteristic curves of liquid jets. Continuing the work of S. W. J. Smith and H. Moss upon the relation between the length of a capillary jet and its velocity of efflux from a cylindrical orifice, further examination has been made of the causes to which the main features of the curves obtained by these authors are due. Such curves consist of two main branches. In the first, with increasing velocity, the jet length rises until a critical point is reached. In the second, which begins at this point, the jet length diminishes rapidly with further increase of velocity. The results now obtained indicate that, while surface tension is of prime importance in the first parts of these curves, viscosity is the dominating factor in the second.

Royal Statistical Society, June 16.—F. **Shirras**: Taxable capacity and the burden of taxation and public debt. The national income of Great Britain and Northern Ireland in 1924 is estimated at 3850 millions sterling. At the end of 1919 it was between 4000 and 5000 millions sterling. The national income of France for 1924 is estimated at 164 milliard francs; of Germany, for the end of 1924, at least 30 milliards of gold marks; of the United States in 1924, 60,900 million dollars. Taking the percentage of taxation to the total net income the following figures are for 1923 or 1924, those in brackets being the pre-War year figures: Germany, 26 per cent. (11·8 per cent.); Great Britain and Northern Ireland, 22·1 (11·4); Japan, 21·8 (18·2); Canada, 19·2 (13); Australia, 18·4 (10·4); France, 17·8 (13·8); Austria, pre-War, 15 per cent., and the 1924 figure indicates that taxation is probably heavier than before the War; United States, 10·5 (6·5); and India, 5·1 (4·4).

DUBLIN.

Royal Irish Academy, June 8.—J. J. **Nolan** and J. **Enright**: Preliminary account of observations on the size of raindrops. Raindrops of radii from 2 to 45×10^{-3} cm. have been accurately measured. This range covers the interval between the observations of Defant on raindrops and those of Köhler on mist-particles. The smaller drops are found in very great numbers. Certain sizes appear to be specially prominent, but further observations are necessary to test the reality of this prominence.

EDINBURGH.

Royal Society, June 8.—Sir Alfred **Ewing**: A ball and tube flow-meter. The device provides a visible measure of the rate of flow of a liquid through any pipe system without interfering with the flow. It consists of a slightly tapered, straight glass tube to which a scale is attached. Within the tube is a ball which is a loose fit at the bottom, and round which there is a considerable clearance as the ball is forced up in the tube. The tube is placed in a sloping position with the narrow end down, and the liquid flows up towards the wider end. The stream carries the ball up along the tube until a position is reached where the clearance round the ball is such as to suit the particular rate of flow. The position of the ball is read off on the scale, and from that position the rate of flow is determined. The sustaining action of the moving stream upon the ball is due to two causes: an inertia effect caused by the development of turbulence in the region above the ball, and an effect of viscosity by which the stream produces an upward drag in passing over the ball. By experiments with two fluids the relative magnitude of the two effects was determined. The device is being adapted by the Engineering Committee of the Food Investigation Board to indicate the circulation of the working fluid in the cycle of a refrigerating machine.—Général **Ferrié**: Maintenance of clocks by means of photoelectric cells. The pendulum to be maintained in oscillation is mechanically entirely free. A small mirror is attached near the top of the rod and a permanent horseshoe magnet to the foot. Light falling on the mirror is reflected in the vertical position of the pendulum to a photoelectric cell. The electron current is amplified, and passes round a solenoid which engages one arm of the horseshoe magnet attached to the pendulum in a suitable position, and maintains the motion. Complete syntony is thus realised.—W. **Peddie**: A spectrometer designed specially for investigations regarding colour vision. A single slit is used and the collimator lens, being divided into halves diametrally, gives two images which are formed on a diffusion plate and so act as the two slits with a single source. A second split lens parallelises the light from these images and gives, by suitable sliding of the halves,

on passage through a prism and an object glass of a telescope, four partially superposed spectra, two of which can be exactly superposed. A slit at the focus of the telescope allows a portion of the three independent spectra to pass through, and the wavelengths transmitted may be adjusted suitably for compounding red, green, and blue lights. With weaker illumination the diffusion plate is omitted and a biprism is placed behind each half of the second split lens.—J. **Forrest**: A new method of discriminating the arrangement of the molecules in a crystal. High magnetic fields are used. Theory gives an estimate of the variations of the internal magnetic force in a crystal when the external magnetising field takes all possible orientations about the substance, which is regarded as composed of a regular array of molecular magnets. The components of force parallel and transverse to the field are dealt with, and positions of maxima and minima of these are predicted in any convenient plane of the crystal for any possible lattice arrangement of the centres. Some weakly magnetic crystals were investigated experimentally and give good agreement with the results of X-ray measurements. Different lattices can be compared with respect to their stability, dealing with the internal magnetic energy of regular arrangements of molecular magnets which are co-directed or randomly oriented.—D. A. **Fairweather**: The electrosynthesis of *n*-duotriacontane dicarboxylic acid. This acid, containing a chain of thirty-four carbon atoms, is the highest member of the series of normal dibasic acids so far prepared. Its di-ester was obtained by electrolysis of sodium ethyl hexadecane dicarboxylate.—W. L. **Ferrar**: On the cardinal function of interpolation theory. The relation of the series defining the function with other types of expansion is considered; in particular, its relation with the Gauss formula. The convergence of the latter implies the summability of the former (by de la Vallée Poussin's method) to the same sum.

PARIS.

Academy of Sciences, June 22.—G. **Bigourdan**: The systematic errors which may affect the pendulum corrections employed at the B.I.H. — V. **Grignard** and R. **Escourrou**: The catalytic hydrogenation of the nitriles under reduced pressure. A method for the synthesis of the aldimines. The activity of the catalyst is reduced by working under reduced pressure. With oxide of platinum on pumice as catalyst, at 200° C. and under a pressure of 220 mm., benzyl cyanide is completely reduced to the aldimine $C_6H_5CH_2-CH-NH$ at one passage. Benzonitrile undergoes a similar reduction.—C. **Sauvageau**: The naturalisation in France of the Australian *Asparagopsis armata*. Its iodine reserves. There would appear to be some free iodine in this plant.—Léon Guillet was elected a member of the division of the applications of science to industry in succession to the late Charles Rabut.—J. **Haag**: Certain asymptotic probabilities.—C. **Valiron**: Meromorph functions which are exceptional relatively to the theorem of M. Julia.—V. **Romanovsky**: Certain mathematical expectations and on the mean error of the coefficient of correlation.—E. **Huguenard**, A. **Magnan**, and A. **Planiol**: A method of studying the inertia effects resulting from the operations of steering aeroplanes.—A. **Lafay**: The deviations of the thrust of the wind, on a cylinder, produced by a sheet of air impinging tangentially to the surface of this body.—F. **Zerner**: The entanglement of the ether and the aberration of the stars.—P. **Chofardet**: Observations of the Tempel II. comet (1925*d*, Stobbe) made at the Besançon Observatory with the 33-cm. equatorial. Positions of the comet and comparison stars are given for June 15, 16, 18, 19. It was seen as a rounded nebulosity of about the 12th magnitude with a small central nucleus.—G. **Rougier**: Observations of the Tempel II. comet (1925*d*) made with the 49-cm. equatorial of the Observatory of Strasbourg. Position given for June 16.—Mlle. **Bérenger** and A. **Tian**: Heats of solution and heats of incomplete reactions.—C. **Gutton** and E. **Pierret**: The harmonics of oscillators with very short waves.—G. **Foex** and L. **Royer**: The diamagnetism of nematic substances.—A. **Dufour**: The classical calculation of the Michelson experiment on the hypothesis of an immobile ether.—Mlle. J. **Liquier**: The variation of the rotatory power of solutions of asparagine as a function of the hydrogen ion concentration. Whatever acid be added the rotation is the same for a given hydrogen ion concentration. On the hypothesis that there is present a mixture of non-dissociated molecules and the corresponding ions, the rotatory power can be expressed quantitatively as a function of the hydrogen ion concentration and the two dissociation constants of asparagine. The theoretical curve so derived coincides closely with the experimental figures.—Th. **Vautier**: The secondary waves produced by an aerial wave. — Th. de **Donder**: The calculation of specific affinity.—Jean **Barbaudy**: The boiling-points of mixtures of water, benzene, and ethyl alcohol under a pressure of 760 mm. of mercury. The whole of the experimental results are shown on a triangular diagram. The minimum boiling-point given by Young is confirmed.—P. **Chevenard**: The dilatometric anomaly of the α solid solutions of copper and aluminium.—T. **Batuecas**: Revision of the weight of the normal litre of methyl chloride gas. The methyl chloride was prepared by two independent methods, the interaction of phosphorus trichloride and methyl alcohol and by the pyrogenic decomposition of tetramethylammonium chloride. The mean of seventeen determinations is 2·3084, appreciably greater than the value given by G. Baume, 2·3045.—P. **Job**: The spectrographic study of the formation of mercuric complexes.—E. **Rouyer**: The association of the polyphenols.—J. **Bardet** and C. **Toussaint**: The separation of celtium, and the arc spectrum of this element. In the separation of zirconium and celtium a good method can be based on the difference of the solubility of the phosphates in sulphuric acid.—Pierre **Auger**: The experimental study of the directions of emission of the photo-electrons.—N. **Delbart**: Study of the corrosion of cold drawn steels in sulphuric acid of varying degrees of concentration.—J. **Bougault**: Phenyl-α-oxycrotonamide. An example of ether-oxide of the hydrate of a ketone.—Charles **Dufraisse** and Henri **Moureu**: Phenylbenzylglyoxal.—R. **Weil**: The microscopic study of the $\alpha\beta$ transformation of natural cristobalite.—Pierre **Sève**: An arrangement for measuring the optical constants of crystals in the ultra-violet.—L. **Cayeux**: The existence of diatoms in the millstone grit in the neighbourhood of Paris. The organic origin of the silica.—Ch. **Maurain**, E. **Salles**, and G. **Gibault**: The conductivity and electric currents of the atmosphere.—René **Souèges**: The embryogeny of the Rutaceæ. Development of the embryo in *Ruta graveolens*.—Ad. Davy de **Virville**: The action of light on the mosses. The appearance, size, colour, form, and structure of the mosses are modified by the intensity of the light to which they are exposed. With diminution or suppression of the light, the distinctive characters from which several species take their names disappear.—Mlle. France **Gueylord** and P. **Portier**: The ionic reaction

of the different constituents of the egg of the fowl. Its modifications in the course of incubation. In the early stages of incubation the white is alkaline ($P_H = 8$) and the yolk is acid ($P_H = 5{\cdot}5$). In the course of development the reactions of the two constituents converge towards neutrality, which is reached on the tenth day.—J. **Nageotte**: The morphology of striated muscle in a state of chloroform contraction, in the frog.—E. **Kayer** and H. **Delaval**: Contribution to the clarification of apple musts.—Maurice **Nicloux** and Jean **Roche**: The amount of oxygen in methæmoglobin. New experiments confirming the views of G. Quagliariello, that the oxygen in methæmoglobin is half that in oxyhæmoglobin.—C. **Levaditi**: The curative action of basic bismuth acetyloxyaminophenylarsinate in experimental syphilis. Stovarsol mixed with an aqueous solution of sodium and potassium bismutho-tartrate forms a new compound $(OH)(NH \cdot CO \cdot CH_3)C_6H_3 \cdot AsO_3H - Bi(OH)_2$. In oil suspension this compound cures experimental syphilis in the rabbit.—L. **Fournier** and A. **Schwartz**: The curative action of basic bismuth acetyloxyaminophenylarsinate in syphilis. An account of the treatment of twenty cases of syphilis with the compound described in the preceding communication. The injections cause none of the inconveniences usual with the ordinary bismuth treatment: the curative effect is as rapid as any of the best antisyphilitic preparations.

ROME.

Royal Academy of the Lincei, April 19.—Guido **Fubini**: The modular group in four-dimensional space.—O. M. **Corbino** and E. **Persico**: The oscillating current diagram.—N. **Parravano** and G. **Malquori**: Solubility of oxygen in silver. Absorption of oxygen by molten silver is very slow, and is complete only after some days. The velocity of absorption appears to be a function of the velocity with which the gas diffuses into the interior of the metal.—Secondo **Franchi**: The great variety of the lithological complexes of the metamorphic Trias of the Western Alps.—A. **Carrelli**: Tyndall's phenomenon.—P. **Bertolo**: Genesis of artemisic acid from desmotroposantonin.—L. **Fernandes**: Co-ordination valency of two hydroxyl groups in the ortho position. I. Complexes of pyrocatechol and pyrogallol with acids of the molybdenum group.—P. **Leone**: Metallo-organic compounds of aluminium. IV. Action of chlorides of acid radicles. The action of benzoyl chloride on aluminium ethyl iodide in ethereal solution yields αα-dibenzoylethane, together with a very small proportion of propiophenone; ethane is also liberated, probably as a result of decomposition of the aluminium ethyl iodide by the hydrochloric acid formed during the condensation.—G. **Malquori**: Thermal behaviour of hydrated barium aluminates. Barium aluminate, $BaAl_2O_4,5H_2O$, prepared by dissolving the calculated amount of alumina in boiling saturated baryta solution, loses $3H_2O$ at 190° and $5H_2O$ at 310°, and shows breaks in the heating-curve at 725° and 1040°, corresponding with decompositions of the compound.—Carlo **Sandonnini**: Certain physico-chemical properties of mixtures of water and acetone. The variation of surface tension, heat of mixing, specific heat, and viscosity of water-acetone mixtures with the composition renders probable the existence of complex molecules of the two compounds.—E. **Remotti**: The immediate physical factors which may co-operate in determining the vertical migrations of fishes.—Enrico **Sereni**: Certain peculiarities of the action of sodium chloride on the muscles of frogs.

Official Publications Received.

Report for 1924 on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool and the Sea-Fish Hatchery at Piel. Edited by Prof. James Johnstone. Pp. 136. (Liverpool.)

Experimental and Research Station, Nursery and Market Garden Industries' Development Society, Limited, Turner's Hill, Cheshunt, Herts. Tenth Annual Report, 1924. Pp. 104. (Cheshunt.)

Meteorological Office: Air Ministry. Advisory Committee on Atmospheric Pollution. Report on Observations in the Year ending March 31st, 1924: Forming the Tenth Report of the Committee for the Investigation of Atmospheric Pollution. (M.O. 270.) Pp. 53. (London: H.M. Stationery Office.) 4s. net.

Annual Conference of the Universities of Great Britain and Ireland, 1925. Report of Proceedings. Pp. 60. (London: Universities Bureau of the British Empire.) 1s.

Conseil Permanent International pour l'Exploration de la Mer. Publications de Circonstance No. 86: A Recording Current Meter. By H. J. Buchanan-Wollaston. Pp. 14. Publications de Circonstance No. 87: L'emploi de l'eau normale dans l'océanographie. Par Martin Knudsen. Pp. 11. (Copenhague: Andr. Fred. Høst et fils.)

Proceedings of the Royal Society of Edinburgh, Session 1924-1925. Vol. 45, Part 3, No. 21: Rejuvenation of the Aged Fowl through Thyroid Medication. By F. A. E. Crew. Pp. 252-260. Vol. 45, Part 3, No. 22: L'Entretien des pendules au moyen de cellules photo-électriques. Par M. le Général G. Ferrié. Pp. 261-268. (Edinburgh: R. Grant and Son; London: Williams and Norgate, Ltd.) 1s. each.

Forestry Commission. Fifth Annual Report of the Forestry Commissioners, Year ending September 30th, 1924. Pp. 43. (London: H.M. Stationery Office.) 1s. net.

The Society for Promoting Scientific Knowledge. A Review of Activities during 25 years 1900-1925, and Twenty-fifth Annual Report. Pp. 46. (Lahore.)

United States Department of Agriculture. Department Bulletin No. 1328: The Flight Activities of the Honeybee. By A. E. Lundie. Pp. 38. 10 cents. Department Bulletin No. 1332: Emulsions of Wormseed Oil and of Carbon Disulfide for destroying Larvae of the Japanese Beetle in the Roots of Perennial Plants. By B. R. Leach and J. P. Johnson. Pp. 18. 5 cents. (Washington: Government Printing Office.)

New South Wales. Department of Mines: Geological Survey. Bulletin No. 6: The Coal Resources of New South Wales. By the Staff of the Geological Survey. Pp. 154+12 plates. 2s. 6d. Bulletin No. 9: Limestone, Dolomite, Lime, and Hydraulic Cement. By Leo J. Jones. Pp. 37+7 plates. 2s. 6d. Bulletin No. 16: Barytes, Ochres, and Oxides. By H. G. Raggatt. Pp. 16+2 plates. 1s. (Sydney: Alfred James Kent.)

Memoirs of the Indian Museum. Vol. 8, No. 2: Revision of the Indian Ampullariidae. By Dr. B. Prashad. Pp. 69-89+plates 13-15. (Calcutta: Zoological Survey of India.) 3 rupees.

Aeronautical Research Committee. Reports and Memoranda, No. 962 (Ae. 178): Discontinuous Flow around the Edge of a Bluff Obstacle. By L. W. Bryant and D. H. Williams. (A.1.b. Photographic Work, etc., 9.—T.2008.) Pp. 4+11 plates. (London: H.M. Stationery Office.) 1s. net.

Cornell University Agricultural Experiment Station. Memoir 68: The Lepidoptera of New York and neighboring States; Primitive Forms, Microlepidoptera, Pyraloids, Bombyces. By William T. M. Forbes. Pp. 729. (Ithaca, N.Y.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 58: The Survival of Pink Boll Worm Larvae in Buried Seed during the Winter in Egypt. By C. B. Williams and Ibrahim Eff. Bishara. Pp. 7+2 plates. (Cairo: Government Publications Office.) 5 P.T.

Report of the Aeronautical Research Institute, Tōkyō Imperial University. Vol. 1, No. 10: The Inertia Forces and Couples and their Balancing of the Star Type Engine. By Keikichi Tanaka. Pp. 247-304. (Tokyo: Maruzen Kabushiki-Kaisha.) 1.10 yen.

Field Museum of Natural History. Botanical Series, Vol. 4, No. 4: South American Plants, by J. Francis MacBride; also New Euphorbias, by C. F. Millspaugh, and Canavalias, by C. V. Piper. (Publication 231.) Pp. 79-95. (Chicago.)

A Cotton Research Station for the British Empire: Being a Summary of a Report to the Empire Cotton Growing Corporation. By Prof. J. B. Farmer and L. G. Killby. Pp. 23. (London: Empire Cotton Growing Corporation.)

The Faraday Society. Report of the Council and Statement of Accounts to be presented at the Annual General Meeting, July 6th, 1925. Pp. 11. (London: The Faraday Society.)

Smithsonian Miscellaneous Collections. Vol. 75, No. 3: Cambrian Geology and Paleontology, V. No. 3: Cambrian and Ozarkian Trilobites. By Charles D. Walcott. (Publication 2823.) Pp. 59-146+plates 15-24. (Washington: Smithsonian Institution.)

Diary of Societies.

SATURDAY, JULY 25.

ARISTOTELIAN SOCIETY, MIND ASSOCIATION, AND OXFORD PHILOSOPHICAL SOCIETY (Joint Session) (at Balliol College, Oxford), at 10 A.M.—C. R. Morris, Dr. Dorothy Wrinch, and Prof. L. J. Russell: Symposium: The Concept of Energy.—At 2.30.—Dr. Ivy Mackenzie: The Biological Basis of the Sense of Time.—At 8.30.—Prof. J. A. Smith, Prof. A. D. Lindsay, and Dr. F. C. S. Schiller: Symposium: Croce's Theory of the Practical Nature of Science.

SUNDAY, JULY 26.

ARISTOTELIAN SOCIETY, MIND ASSOCIATION, AND OXFORD PHILOSOPHICAL SOCIETY (Joint Session) (at Balliol College, Oxford), at 2.30.—P. E. More, Prof. W. D. Ross, and Prof. G. Dawes Hicks: Symposium: Plato and Aristotle.—At 8.30.—J. MacMurray, C. E. M. Joad, and A. H. Hannay: Symposium: Is Art a form of Expression or of Apprehension?

MONDAY, JULY 27.

CAMBRIDGE PHILOSOPHICAL SOCIETY, at 4.30.