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River Pollution.

ONE does not need to have read the "Compleat Angler" to know that fishing is among the most humanising of crafts. Up and down the country in all possible — and in some impossible — places, gentle patient citizens will be found practising the art. If they catch fish, so much the better: if not, they have been in pleasant places and communed with peace; like the small girl whose pet pigeon had flown away, fishermen "adore hope," and no one can doubt that they are the better for it. With them we have to think of the other gentle men, the field naturalists, who, whether their particular pursuit be rotifers, or snails, or plants, or what not, have one of their happiest hunting grounds in and by our rivers and streams, and steadily go on adding up our sum of natural knowledge.

Besides these craftsmen there are the people who find in the activity of running water the rest and comfort that their souls need and walk by the river just because it is beautiful, and they find that it does them good. They may all well wonder why fish and animalcules and peace should be allowed to disappear together in the filthy sewers which stand for the Wear in the gorge at Durham, or for the Mersey in the lovely Marple valley. Incidentally too, as we learn from the "Report of the Proceedings under the Salmon and Freshwater Fisheries Acts for the years 1922 and 1923,"[1] the salmon caught in the Herefordshire Wye in 1923 had a selling price of 15,000*l.*, those from the Tees of 28,000*l.* It is not suggested that all the rivers in Great Britain are potential salmon fisheries, but there are evidently commercial considerations in favour of biologically clean streams.

The problem of river pollution is one of the problems of industrialisation. Pollution comes mainly from two sources—domestic sewage and industrial wastes. The former is seldom now discharged into rivers in a crude state except from quite small communities: modern methods of sewage purification are efficient and quickly increasing in efficiency as the principles of biological defæcation become better known, and if domestic sewage were all there was to deal with, clean rivers would appear to be well within reach. But a town's sewage often contains, in addition, trade wastes and effluents which hamper and retard the purification of the domestic excreta by poisoning the live things on which that depends, and they act equally harmfully on the flora and fauna of the rivers into which they find their way. Often, too, large works of one kind or another will pour their undiluted wastes into a stream and kill everything that is alive in it. In milder cases these

[1] Ministry of Agriculture and Fisheries (H.M. Stationery Office, 1924). 3*s.* The Ministry has also published a useful booklet, "River Pollution and Fisheries," price 3*d.*

effluents may produce surprisingly large effects by their action on some specially sensitive member of the fauna or flora: in this way the self-regulation of the aquatic communities is upset and deterioration spreads all through the ecological complex.

Among the more sensitive of the large and familiar animals are salmon and trout, which demand a very high degree of purity and oxygenation in their water: in the hotter months, indeed, it seems that trout must often be living near the margin of the oxygen supply that they will tolerate, and under these conditions a slight degree of extra pollution may turn the scale against them. There is, however, too great a tendency to think of the question in terms of these "sporting fishes": they are the pastime and refreshment of the few, and in reality coarse fish are a good deal more important, if only because there are many more of them and many more people anxious to take their chance of catching them.

What is being done to purify the foul rivers and prevent further contamination? The old pollution Acts have evidently failed even to stop matters getting rapidly worse in recent years. In 1921 a Standing Committee on Rivers Pollution, composed mostly of persons directly interested in fisheries, was set up, and in 1922 it commenced, under the energetic superintendence of Dr. E. C. Jee, of the Ministry of Agriculture and Fisheries, a survey of selected rivers in Great Britain.

A good deal of progress has already been made with this survey, and valuable information has been obtained as to the actual degree of pollution, its sources and effects. Specific tests of the poisonous action of effluents on fish are also carried out at the Ministry's little station at Alresford, where the problem of tarring roads with safety to the neighbouring watercourses was so successfully solved. More immediately useful still, committees have been got together in the different fishery districts where the local interests and knowledge of anglers and manufacturers are combined to deal directly with local problems. To aid the Standing Committee in the more technical chemical and biological questions which arose, a Scientific Advisory Committee was added in 1924.

Through this organisation the most essential step towards reform has been taken and much has been done to rouse general interest in the subject. In 1923 a new pollution Act, after many vicissitudes and delays, received the Royal assent. Under this, it is an offence to cause pollution of any waters containing fish of any kind so as to render such waters poisonous or injurious to fish or to their spawning grounds, spawn or food. It is an obvious defect that the Act permits the unrestrained pollution of waters which do not contain fish, and it also allows as a defence of existing pollution the plea that "the best practicable means within a reasonable cost" have been employed to prevent it.

Legislation, in short, follows the lines to which we are accustomed in Great Britain. We do not say, as does New York, "smoke is forbidden" and make that the beginning and end of it: we prefer to dally with discussions of "brown" smoke and "black" smoke and put up with dirty towns. In the end, perhaps, we get the right result on a permanent basis backed up by a convinced public opinion, but this takes a long time. More drastic powers might well have been obtained to deal with difficult manufacturers who naturally affirm, to begin with, that any steps towards purification would ruin them, though they may end up by finding that cleansing their effluents may yield saleable products more immediately remunerative than the blessings of the community.

In these several ways, then, the *ad hoc* problems are beginning to be dealt with. But we feel that progress will soon get slow unless steps are taken to promote our knowledge of the fundamentals of river life. It needs no scientific training to be sure that the Tyne in its lower parts is not what it should be, and no more than a sanitary inspector's acumen to trace the trouble to its sources. But all experience tells us that empiricism of this sort will take us only a certain way. Even now it can make no serious attempt to explain why in the smaller Hertfordshire rivers, for example, fish of all kinds have almost disappeared in the last ten years, leaving the streams to casual inspection reasonably clean, bright and weedy.

Fresh water ecology has scarcely been thought of in Great Britain, and it offers an open field to workers of many kinds to help to work out how the complex communities of plants and animals live and move and have their being, and what are the conditions which determine their stabilisation at different levels. To take the crudest example, the foods of fishes and the foods of this fish food are simply not known any more than, until recently, were the foods of our birds known. There is also great ignorance as to what exactly various degrees of pollution of different kinds do, what chemical changes are produced in the water, and which components of the fauna and flora are affected and how.

Beginnings in a small way are being made in various places, but what is most deeply needed is an institution round which this work could centre. There are a few marine biological stations, but there is no corresponding focus for fresh-water work. No one interested in fishing or in the amenities of the countryside could do better than to provide such a station for investigating the conditions of life in the rivers and streams of Great Britain.

Physiological Optics.

Helmholtz's Treatise on Physiological Optics. Translated from the third German edition. Edited by Prof. James P. C. Southall. Vol. I. Pp. xxii+482. (Published by the Optical Society of America, 1924. To be obtained from Prof. F. K. Richtmyer, Cornell University, Ithaca, New York.) 7 dollars.

Let us now praise famous men.
The Lord manifested in them great glory,
Even His mighty power from the beginning.
Such as did bear rule in their kingdoms:
And were men renowned for their power,
Giving council by their understanding:
Such as have brought tidings in prophecies;
Leaders of the people by their councils,
And by their understanding men of learning for the people.
Wise were their words in their instructions.

Ecclesiasticus, 44, 1-6.

THREE years ago the Optical Society of America celebrated the centenary of the birth of Helmholtz and decided that a lasting commemoration should be established by the publication of an English translation of his great book on physiological optics. So at last a deep reproach has been lifted from the record of English scientific literature. "The very existence of this book in English," says the editor of the translation, "should lead to new treatises and new text-books, which are sorely needed at present." The third German edition, containing the text of the first edition with supplements added later by Helmholtz himself, by the late Prof. Nagel, and by Profs. Gullstrand and v. Kries, was chosen for translation. The present volume is enriched by six of Helmholtz's supplements, three of Gullstrand's notes, and six appendices by Gullstrand. Special interest is given by the inclusion, as the sixth appendix, of a chapter on ophthalmoscopy taken from Prof. Gullstrand's work on dioptrics. This is one of the features which gives distinctiveness to the English edition, for it did not appear in the third German edition.

The name of Helmholtz is outstanding in science as that of an original investigator and breaker-out of new paths in several directions, and as that of a man of rare genius whose work was of epoch-making quality. In this respect his "Physiological Optics" stands amongst such works of the last century as the magnificent fragment known as Thomson and Tait's "Treatise," or Maxwell's "Electricity and Magnetism." It is well that it should be placed alongside them in its English garb. The stamp of endurance marks it out as the work of one who, to use his own words regarding Young, was "leaping before his time." The present volume teems with examples of the permanence of its value and the manner in which modern work forms its fitting development.

No new treatise, say the German editors, has superseded Helmholtz's work—it

"bears the stamp of a genuinely classical treatise which will always retain its value, even if new investigations lead to some modifications here and there of the points of view which Helmholtz himself entertained." "In the theoretical and for the most part solid territory belonging to the physiology of both the sensations and the perceptions of vision, the editors considered . . . that even where it was necessary to record a notable advance of scientific investigation since the date of the appearance of the first edition of the Physiological Optics, a natural outcome of this kind should not involve at all an adverse attitude towards the theories of Helmholtz."

The foremost reason given for the decision to republish the text of the first edition

"was the consideration that the whole imperishable significance of Helmholtz's achievements in the domain of the physiology of vision, the elegant physical methods which he adopted and improved, his painstaking observations of the sensations themselves and the allied psychical phenomena, the mathematical analysis and philosophical and critical discussion, all these characteristic features are essentially interwoven with the first edition of the Physiological Optics. It is the classical work which marked the dawn of a new era in the science of the physiology of the senses."

Another reason which is also given does not apply to the subject matter of the first volume. Whatever exception may be taken to the view involved in it, there will probably be no difference of opinion regarding the wisdom of the conclusion. The great extent and invaluable nature of the supplementary work included in the third German edition left to the translators no other choice than that of its adoption by them. The bulk of the new matter published in the first volume almost equals that of the original matter, and it deals with every division of the subject.

The aim and the hope of Helmholtz in undertaking his work was clearly stated by him in his first preface. "An effort had to be made to introduce law and order in this region and to rid it of the curious contradictions which have heretofore impeded progress. I have proceeded on the conviction that law and order, even if they are not fundamentally sound, are better than contradictions and lawlessness." "I trust that competent judges will bear in mind the difficulty and intricacy of the problem to be solved when they are disposed to find fault." These defects were the rank growths against which he raised his axe: and in pioneer work "a man was famous according as he had lifted up axes against the thick trees." The true pioneer possesses the sense of direction; he rarely misses his aim or even takes a wrong detour. The

extent to which this was true of Helmholtz is apparent throughout this volume.

Helmholtz treated the whole subject under three headings: (1) the theory of the path of the light in the eye, (2) the theory of the sensations of the nervous mechanism of vision, (3) the theory of the interpretation of the visual sensations. It is with the first of these that this volume deals. The magnitude of the new work in dioptrics is so great that its limitation to nearly the same bulk as that of the original treatment has only been attained by the omission of the mathematical proofs. For these the reader has to refer to Prof. Gullstrand's original papers. Yet that will perhaps be found by the majority of readers to be no disadvantage. In this way the line of argument is more lucid and the presentation more concise. It suits the requirements of most ophthalmologists and is not without advantage to the student of physics. The editor of that subject

"has endeavoured to limit himself mainly to the essential facts in the region where notable advances have taken place, and to present these modern ideas in as simple a form as possible for a reader who is not versed in higher mathematical analysis. An outline of the new theory is given here for the first time, including the previously unknown laws of optical imagery in media of variable index of refraction which could not be omitted because, first of all, they are essential for finding the data of a schematic eye that will agree with the facts as they are now known, and also because these considerations are of importance in connection with the effort to substitute a new theory of accommodation in place of Helmholtz's theory, whereas undoubtedly this attack as well as others of a similar kind are to be regarded as affording new supports to the author's views on this subject."

In practical ophthalmology, Helmholtz's instrument, improved no doubt, is still the one in use. "The ophthalmologist who uses the ophthalmoscope every day . . . knows best how to estimate Helmholtz's immortal service to mankind." Its use in various forms and for various purposes is treated fully by Gullstrand. One of his notes refers to the solution of a problem, "which could not even have been proposed at the time when the ophthalmoscope was invented." The advantages and disadvantages of the several modifications are discussed.

The value of Gullstrand's contributions may be judged from the fact that, previous to his work, the optical laws of the formation of images were only worked out under highly limiting conditions which prevented the results from having application to the problems of imagery in the eye. Very high approximation to correct results could be got by laborious calculations, so that the construction of optical instruments possessing axial symmetry was highly developed. But physiological optics requires, for the sufficiently accurate solutions of its problems, that the conditions shall be much wider than those imposed in normal optical construction. Therefore Gullstrand determined the general laws of optical imagery, and then, applying them to the practical problems of vision, gave a fresh illustration of the further development of one science in consequence of the expansion of another. The beautiful tale is told in his appendices. His work is worthy of a position beside that of the master.

All through this volume may be found references to the value of the master's work.

"If the form of the cornea is to be calculated by means of relations that are true for an ellipsoid, undoubtedly the best way is to go about it regularly and to calculate the constants of the ellipsoid by the method given by Helmholtz."

"Although more recent investigations tend to give rather lower values, there hardly appears to be any sufficient reason as yet for modifying Helmholtz's schematic value beyond merely discarding the figure in the fourth decimal place as not being at all certain."

"Unless a Blix ophthalmometer is available, Helmholtz's method of ascertaining the positions of the surfaces of the crystalline lens is still to-day the best method."

"If the sources of error are taken into account, depending on the asymmetrical flattening of the cornea, on the unknown form of the anterior surface of the lens, and on using a total index for the index of refraction of the lens, there can be no doubt that Helmholtz's number is within the possible limits of error." "The same conclusion has been reached also concerning the radii of curvature of the two surfaces of the lens."

"Modern investigations have established that the theory of the mechanism of accommodation remains unchanged, in all essential features, just as Helmholtz, by a real inspiration of genius, considering the state of knowledge of that time, conceived it."

An example of misconception of Helmholtz's view is discussed in the fourth appendix.

"Helmholtz's own words are: 'Stretched elastic membranes which contain an invariable volume of an incompressible fluid, and which are attached by a circular margin, as the zonule is to the choroid, tend to approach the form of a segment of a sphere in proportion as its tension increases. . . .' To infer from this that the anterior surface of the lens, as it bulges forward with a decrease of tension in accommodation, is obliged to approach the form of a sphere, so that an increase of curvature can be produced by the increase of tension, involves conceptions that are incompatible with the mathematical knowledge of a Helmholtz."

A second misconception is considered.

"Helmholtz's famous dictum, that the monochromatic aberrations of the eye are such as would not be tolerated in any good optical instrument, is sometimes construed to mean that the eye is a very badly constructed optical affair—which Helmholtz never said

and certainly did not mean. But another question that this statement raises is whether these aberrations are not serviceable and what is their purpose. . . . The monochromatic aberrations are a witness for the perfection of the eye, if what is meant by the perfection of an optical instrument is good convergence of the rays to the degree that is needed to obtain the greatest useful sharpness of image, anything in excess of this being sacrificed in order to gain some other end."

Unfortunately, these two misconceptions regarding Helmholtz's views do not stand alone.

The American Optical Society, the editor with his collaborators, and the printers are alike to be congratulated on this issue of an epoch-making book, worthily worked up to the level of modern knowledge. It is the most suitable memorial which could have been raised to the memory of Herman v. Helmholtz, physicist, physiologist, and mathematician. The reward of the contributors to the German and the American issues will be forthcoming if the response for which the editor hopes comes in the way of new advances. This volume should be at the disposal of every worker who is specially interested in optics in its purely physical, its physiological, or its ophthalmological bearings.

W. PEDDIE.

Phylogeny as an Independent Science.

Geschichte der Organismen. Von Prof. Victor Franz. Pp. xiii+948. (Jena: Gustav Fischer, 1924.) 36 marks.

THE author of this ponderous work is the occupant of a chair of "phylogeny" in the University of Jena, and in this volume he has apparently attempted to justify his position, for he treats of the evolutionary history of every phylum both in the animal and in the vegetable kingdom! Both the title of the chair and of the book must awaken amazement in simple British minds. What is phylogeny apart from zoology and botany? Is not the specialist in botany or in zoology the only person competent to construct even a plausible phylogeny in either science? But perhaps we might expect in a volume like this to find the foundations for phylogenetic hypotheses critically examined: we might hope to have the value and the limitations of the evidence from fossils discussed; the theory of recapitulation explained and its validity determined. Such questions seem suitable for a book by a professor of phylogeny in general. If such were our expectations we should be bitterly disappointed. The book opens with a chapter devoted to a sketch of the physical geology of the globe and the changes which sea and water have undergone since the Cambrian. Then follows an account of the Darwinian theory of evolution with references to De Vries's mutations, Mendelism, and to direct adaptation and Lamarckism. The discussion on evolution is succeeded by a section on "Body and Soul" (Körper und Geist) in which we are informed by Prof. Franz that when the body dies, the "ego" is dissolved (how does Prof. Franz know this?), but that the "psychical" (whatever this may mean) persists. After this we reach a section dealing with the supposed characters of the first living beings and the manner in which they were derived from inorganic matter. Then we plunge into the detailed phylogenies of the various classes, first of plants and then of animals.

Now, no reviewer—least of all the present one—could possibly claim to be a competent judge of the plausibility of all these hypothetical phylogenies, and so we have tested their general value by looking critically at those in which we were most familiar with the evidence, namely, those contained in the invertebrate section of the animal kingdom. We may, however, remark in passing that some of the botanical theories seem to us extraordinary. Because its sexual germ-cells (oospores and antherozooids) resemble the ova and sperm of animals, the brown alga Fucus is regarded as closely resembling the original primitive organism from which all the rest, both animals and plants, have sprung. Consequently the unicellular protozoa are regarded as secondary degenerations of multicellular ancestors, and isogamy or the union of similar gametes is derived from the fertilisation of an egg by a spermatozoon. Verily all things are possible to him that believeth! We can only say that Prof. Franz's taste in these matters is widely different from our own. We might remind Prof. Franz that amongst the most primitive type of animal, namely, Amœba and its allies—the Foraminifera—isogamy is the rule, and that typical ova and spermatozoa are not encountered until we reach the sponges. But perhaps the most relevant criticism of theories such as these is that until the postulates underlying the construction of phylogenies are discussed and explained, one theory is really as good as another.

Turning now to the account given of the phylogeny of the principal invertebrate stocks, we can only characterise most of them as most unsatisfactory and based largely on lack of knowledge of the most recent researches. Thus the Turbellarian worms are termed "cœlomate" because they possess distinct genital organs and a cellular mass termed "mesoderm" between skin and gut lining, though no vestige of a true cœlom can be detected at any stage in their life-history. Not a word is mentioned of Lang's brilliant theory of their derivation from Ctenophora, though this theory has acquired strong support from

the discovery of creeping Ctenophora like Ctenoplana, and of a true ctenophore larva in the life-history of Coeloplana which in its adult condition closely resembles a turbellarian worm. When we turn to the chapter dealing with the phylogeny of the Crustacea, we find the Nauplius larva, which appears in the life-history of so many Crustacean stocks, and evidently represents in some disguise or other a common ancestor, regarded as representing a "metatrochophore" stage of the annelidan ancestor. But Walcott in his account of the mid-Cambrian fauna of British Columbia has described primitive arthropods which may well have been the actual "Nauplius" ancestor in the flesh. Such is "Marella," which in general structure is a shortened trilobite carrying attached to the hinder part of its body the foliaceous appendages characteristic of Trilobita; but the first three segments carry elongated limbs corresponding to the Nauplius appendages. Prof. Franz, in seeking for light on the ancestry of a group in the structure of a larva, neglects altogether to discuss the *simplification* of ancestral structures in the larva and its meaning and significance, so that in regarding one structure as primitive and another as secondary, he seems to proceed in an altogether arbitrary manner.

As another good example of superficial and crude reasoning based on lack of knowledge of recent work, we may refer to Franz's account of the phylogeny of the Echinodermata. The cystids are regarded as the ancestors of the whole group. It is admitted by all that the cystids developed into the crinoids, which they resemble in possessing a dorsal stalk and a lateral anus. But Franz derives from them also the whole of the Eleutherozoa (starfish, sea-urchins, and sea-cucumbers) in which the place of the aboral stalk is occupied by the anus. Of these the sea-cucumbers, supposed to be the most primitive, are stated to have branched off earliest from the cystidean ancestor, then the sea-urchins, and lastly the starfish. But if a cystid (of the internal anatomy of which we of course know nothing) really was like a crinoid in its soft structures, then it must have been widely different from the common ancestor of the Eleutherozoa. For in all three divisions of these, the central axis of the genital system, the so-called "genital stolon," is closely associated with the primitive stone-canal, whereas in crinoids these two structures are entirely separated and have no relation to each other whatever. The anus in primitive Eleutherozoa is always close to the aboral pole, and the course of the alimentary canal shows no resemblance to the spiral gut of crinoids.

Prof. Franz refuses to accept the identification of the "sucker" of attachment of many of asterid larvæ with the attachment of the stalk of the crinoid. Here again is evidence of unawareness of modern work, for, as Bury first showed, the Crinoid larva exhibits a rough correspondence in its organs with the Bipinnaria larva of the Asteroidea. Now in both larvæ the "sucker" of fixation is of exactly the same form and is developed at the same place. It comes to occupy totally different positions in the adult bodies of the two groups on account of the different character of the metamorphosis in each case. These different metamorphoses point strongly to a primitive divergence in habits between the ancestors of the two groups which led to their separation long before even the simplest cystoid form had been attained. If we now turn to the development of the sea-urchins, we find that the young sea-urchin begins its post-larval life in a form which is to all intents and purposes that of a starfish, and that the globular form is only gradually attained as growth proceeds. Thus we see how ill-founded is Franz's comparison of the cystid and the echinoid because both have a spherical shape.

When we reach the part of the book dealing with vertebrata, there is of course less opportunity for the presentation of crude ideas since the palæontological history of the vertebrate is relatively so well known. Yet even here the author seems totally unacquainted with recent embryological work which tends to establish the lateral fold theory of the paired limbs beyond all reasonable question; and commits himself, though with some hesitation, to the exploded theory of Gegenbaur that the limbs arose from displaced gill-arches.

Whilst, however, we regard Prof. Franz's methods of dealing with phylogeny as mistaken, and lament the absence of any attempt to set forth and defend the principles on which phylogenetical reasoning must be founded, yet the reader will find—especially in the part devoted to vertebrata—a large collection of useful facts amongst which the data which have been brought together throwing light on the origin of our domestic animals are particularly valuable. E. W. M.

The Electricity of Thunderstorms.

Die Elektrizität der Gewitter. Von Dr. K. Kähler. (Sammlung Borntraeger, Band 3.) Pp. 148. (Berlin: Gebrüder Borntraeger, 1924.) 4*s.* 9*d.*

ONE must congratulate German science on the large number of useful monographs which are constantly being published in Germany. When a branch of science has been advanced by independent original research in all parts of the world, it is highly desirable that every now and then we should be able

to review the progress made, and a monograph which collects all the threads together and sets them out as a more or less completed fabric not only achieves this but also gives an extremely pleasant form of reading to those working at the subject. The book before us is a good example of this type of literature, and is therefore to be welcomed.

The contents of the book are divided into two parts: Part I. deals with the observational facts and Part II. with the various explanations which have been offered from time to time of the electricity of thunderstorms. Throughout full references to the literature are given, and this alone makes the book of great value to the original worker in this field of science. Although the literature is now very large, we have not noticed any important omissions except in one case, namely, the omission to mention C. T. R. Wilson's outstanding paper, "Investigations on lightning discharges and on the electric field of thunderstorms," which appeared in the Philosophical Transactions in 1920. We feel sure that the author has not seen this paper, otherwise he could not have failed to quote many of the important results contained in it.

There is not much to say about the first part of the book, as it deals mainly with facts which are now fairly well known and generally accepted. Mohn's classification of thunderstorms as *Wärmegewitter* and *Wirbelgewitter* is shown to be well founded. In *Wärmegewitter*, which are called heat-thunderstorms in Great Britain, the energy is derived from temperature instability in the vertical direction, generally produced by intense solar radiation warming up the lower layers faster than the ordinary processes of convexion and turbulence can distribute the heat to the upper strata, although a similar effect can be obtained when air passes over a relatively warm sea surface. In the second type, the energy is derived from warm and cold currents which are brought side by side, generally in consequence of the circulation associated with cyclones. The thunderstorms associated with "line-squalls" are typical of this class, but we have no special name by which to describe them in English.

Besides a fairly full discussion of the meteorology of thunderstorms, Part I. contains a description of the electrical conditions observed, together with short accounts of the different forms of electrical discharges.

While the first part is probably the most valuable, the second part will, we think, be read with the most interest by many physicists. In it Dr. Kähler reviews some of the explanations which have been put forward to account for the origin of the electricity in thunderstorms. To discuss all would of course be impossible, for they are literally legion. It is interesting to see the large number of physical processes which have been used at one time or another in theories which are now finally abandoned, at least by most meteorologists, if not by their authors. Amongst these are cosmical dust; electrical influence from the sun, moon, and stars supposed to be electrically charged; cathode rays from the sun; ultra-violet light from the sun acting on ice crystals; friction between water and ice; differential condensation on positive and negative ions, and absorption of negative ions by falling precipitation. At the present moment there remain only three physical processes which are considered worthy of serious consideration: (*a*) the separation of electricity which takes place when drops of water are broken up in the atmosphere; (*b*) a similar effect produced when solids are brought into contact and then rapidly separated, the electrification of dust being a good example; and (*c*) influence charges produced on the precipitation by the electrical field.

In 1909 the reviewer put forward the theory of thunderstorms based on (*a*), which he extended in 1915, making use of (*b*) to explain the electrical phenomena of snowstorms and of thunderstorms in which there is no liquid precipitation. He is still of the opinion that these two physical processes are able to account for all the electrical effects associated with atmospheric precipitation. Dr. Kähler will not go so far as this, but while admitting that both may play some part, he considers that the influence effect is the chief factor at work. Elster and Geitel were the first to suggest an effect due to influence charges, but Dr. Kähler is not satisfied with their scheme and puts forward a modification of his own. This, we think, is the weakest part of his book. The modification of Elster and Geitel's theory which he introduces unfortunately results in a process which can only reduce an existing field; surely a process of this kind is not likely to be the explanation of the high electrical fields which are associated with thunderstorms.

Before closing this review we should like to direct attention to a pleasing aspect of Dr. Kähler's writing. Instead of using the long involved sentences so characteristic of German writings, Dr. Kähler expresses himself in short clear sentences. The average length of the seventeen sentences on a page opened quite at random is only eighteen words. We do not know whether this would be commended by a German of literary taste, but it is certainly very welcome to non-German readers.

G. C. SIMPSON.

Our Bookshelf.

Plants Poisonous to Live Stock. By Harold C. Long. (Cambridge Agricultural Monographs.) Second edition, revised. Pp. vii+120. (Cambridge: At the University Press, 1924.) 8*s.* 6*d.* net.

THE second and revised edition of Mr. Long's book on plants poisonous to live stock contains on the whole but few alterations. There are, however, several additions in the description of individual species, ragwort and bracken in particular, and some minor alterations in the concluding chapter on the classification of poisons.

In the introduction, the poisoning of live stock is dealt with from various points of view. Different species of stock often appear to be affected quite differently by the same plant, and poisonous effects may also vary with the individuality and age of animals of the same species. Some plants do not lose their toxic properties on drying, and therefore cannot be safely fed even with hay. Some also are poisonous in all their parts, such as meadow saffron, whereas in others the toxicity is confined to one part only, such as the seed in corn cockle. Further, soil, climate and cultivation may affect the toxic properties of a given species.

Most of the plants described are British, but foreign species such as "Java" beans, which may be used in feeding stuffs, and some common garden shrubs are also included. Fungi, with the exception of ergot, are not dealt with, though the toxicity of darnel seeds is stated to be due to the presence of a symbiotic fungus. The species are described under their natural orders, examples of poisoning, the toxic principle, symptoms, and references to the bibliography at the end of the book being given in each case.

As in the previous edition, the author also deals with plants suspected of being poisonous, and those affecting milk or causing mechanical injury to animals.

Theoretical Metallurgy. By R. S. Dean. Pp. vii+246. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1924.) 15*s.* net.

SCHENCK'S "Physikalische Chemie der Metalle," first published in 1909, broke new ground in metallurgical literature, since it described the application of physical chemistry, not only to the constitution of alloys, a task which had been attempted often, but also to the reactions of the smelting processes and to other technical metallurgical operations. The author of the present work translated Schenck's book some eleven years later, by which time some of the information was out-of-date. In place of preparing a second edition, he has preferred to re-write the book, whilst retaining the main features and many of the details of the original, including illustrations, so that the volume on opening has a familiar look. New subjects, including the structure of metallic crystals as revealed by X-rays, have been introduced, and the work now covers a field of great and general interest.

Unfortunately, the execution is not always equal to the design, and the text is very frequently inaccurate. Mathematical formulæ have suffered badly, as well as proper names, and although the number of references to papers is large, many of them seem to have been selected somewhat at random, investigations of equal or greater importance being overlooked. The sections which deal with steels are inaccurate, especially in regard to hardening. Many subjects receive such brief treatment that the student will derive little from reading those sections. It may be said that the experienced metallurgist will gain many useful hints from the reading of this book, which deals with interesting matters and is simply expressed, but he will need caution, whilst the inexperienced student is likely to be puzzled and confused by its numerous errors.

C. H. D.

The Deluged Civilization of the Caucasus Isthmus. By Prof. R. A. Fessenden. Pp. ix+139. (Boston, Mass.: T. J. Russell Print; London: F. and E. Stoneham, Ltd., 1923.) 25*s.* Large paper edition, 5 guineas.

PROF. FESSENDEN is an ardent advocate of the urgent necessity of archæological exploration in the Caucasus. While archæologists will agree that investigations in this area are likely to afford evidence which will help in the elucidation of a number of problems in the ethnology and archæology of prehistoric and early historic times, they will scarcely be prepared to endorse Prof. Fessenden's arguments, although they may wish him all success in his research. He holds that the Caucasus is the cradle of mankind; that it was there that the flood to which early records refer took place, and that it was thence that the races of mankind dispersed after their differentiation. By an elaborate analysis of Semitic, Egyptian and Greek traditions and of local names, he seeks to show that not only was this the site of Eden, but also that on his assumption it is possible to unravel the inconsistencies in the geography of the Greek legends and explain why, for example, the search for the lost pillars of Hercules towards the west was unsuccessful. The rise of water level in the Caspian area and the formation of an Atlantean Sea of 1800 miles breadth east of the Black Sea were responsible for the disappearance of the country to which the traditions referred and the consequent dislocation of the ancient geographical system. Prof. Fessenden has worked out his case in great detail and with considerable ingenuity. His arguments will be more convincing if, and when, he can produce archæological evidence to support them.

Fluxes and Slags in Metal Melting and Working: a General Discussion held by the Faraday Society and the Institute of Metals, with the Co-operation of the British Non-Ferrous Metals Research Association and the Institute of British Foundrymen, April 1924. Pp. 109-208. (London: Faraday Society, 1924.) 7*s.* 6*d.*

LIKE other general discussions arranged by the Faraday Society, this collection of papers on fluxes and slags brings together a most useful mass of facts known to a limited number of persons, and at the same time brings into relief the need for systematic investigation. In spite of the importance of fluxes in the working of non-ferrous metals, such knowledge of them as exists is almost entirely empirical, and very little has been done to determine the factors on which their efficiency

depends. The fact is brought out in several papers that the interfacial tension between slag and metal determines the separation of non-metallic inclusions, but only in the instance of the formation of metallic "fogs" when fused metals are in contact with their halogen salts have any actual determinations of this important factor been made. In welding and soldering, the efficiency depends on the wetting of the metal by the liquid, as well as on the solvent power of the flux for oxides, but neither the chemical nor the physical factor has been studied in any systematic way. Aluminium, the oxide of which is very difficult to eliminate, has received more attention than most metals, but much of the work remains merely qualitative. The papers, although technical in character, should be of interest to chemists and physicists who are concerned with problems of solubility and of surface tension. The importance of non-metallic inclusions is shown by a study of their influence on the resistance of metals to fatigue, and any work which would tend to lessen the frequency of these undesirable constituents would be of great value to the metallurgical industries.

Tulum: an Archæological Study of the East Coast of Yucatan. By S. K. Lothrop. (Publication No. 335.) Pp. vii+179+27 plates. (Washington: Carnegie Institution, 1924.) n.p.

IN this volume, Dr. Lothrop has placed on record the results of three expeditions of the Carnegie Institution of Washington to the east coast of Yucatan under the leadership of Dr. Sylvanus G. Morley in 1916, 1918, and 1922. The main objective was Tulum, the most important ruin in this region, but other sites also were visited. Dr. Lothrop, however, has not confined himself to the work of these expeditions, but aims at giving a complete account of present knowledge of the archæology of this area by summarising previous publications covering sites not visited on these occasions. The Maya culture of this part of Central America presents certain peculiarities in architecture, art, and religion which mark it off from the rest of Yucatan. Such are, for example, an absolutely new type of building—the shrine, and the sanctuary, the latter occurring in structures here called "palaces," as they appear to have served as residences rather than as temples. The frescoes, of which a large number have survived, are comparable with the drawings of the codices and are regarded by Dr. Lothrop as but little inferior to the Dresden codex which is the high-water mark of Maya art. Dr. Lothrop's detailed and lavishly illustrated account of this localised development of Maya civilisation, and his analysis of its cultural and ethnical affinities, is a contribution to American archæology which will rank high.

Outlines of Medical Zoology: with Special Reference to Laboratory and Field Diagnosis. By Prof. Robert W. Hegner, Prof. William W. Cort, and Francis M. Root. Pp. xv+175. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1923.) 11*s.* net.

THE "Outlines of Medical Zoology," which has recently been published by Prof. Hegner and his colleagues in the Johns Hopkins University, is a convenient little book for the use of medical men in the field, and for teachers of zoology in schools and universities where the economic applications of the science are included in the curriculum, but it is too concentrated for the elementary student and not sufficiently detailed in description for those who are seriously engaged in the study or the practice of the subjects. There is, perhaps, some danger lurking in these little books that the student, who has not much time to devote to it, may imagine that he has mastered the subject by learning off the tables and diagnoses by heart. They should only be used after or associated with a course of practical work in the laboratory accompanied by some further instruction in the morphology of the animals described.

We must acknowledge, however, the great care and skill with which the authors of the three parts—on protozoology, helminthology, and entomology—have condensed their wide knowledge and practical experience of their subjects, and recognise that the book will prove to be extremely valuable to many zoologists and medical men.

Theories of Memory. By Dr. Beatrice Edgell. Pp. 174. (Oxford: Clarendon Press; London: Oxford University Press, 1924.) 7*s.* 6*d.* net.

THIS admirable and valuable little book brings together in short compass, but in clear and comprehensible terms, the leading theories of memory, in particular the attempts to give precision and definition to the term "memory-image." Theories of memory, like theories of colour-vision, are baffling to the student in their numerical variety and diversity of principle. Miss Edgell reviews the biological theories of Hering, Butler, Semon, and Jennings, the behaviourist theory of J. B. Watson, and Lloyd Morgan's variation of it; she gives a general outline of philosophical treatment of the problem from Hobbes to the present day, discusses the views of Alexander, Bertrand Russell and Holt, criticises Bergson, and finally offers what she terms a psychological conception of retentiveness. Although it is a brief account of sometimes elaborate theories, the book bears throughout the mark of long and earnest study of the problem.

Exercises and Problems in Practical Physics: with Notes on the Theory. By G. N. Pingriff. (Bell's Natural Science Series.) Pp. xxii+199. (London: G. Bell and Sons, Ltd., 1924.) 4*s.*

MOST of the practical work, with the exception of the most elementary, likely to be carried out in school physics laboratories is covered by this little volume. It is no mere compilation of recipes for securing "results," although of course adequate directions are given for performing the experiments, some of which are refreshingly original while evidently practicable and instructive. Most valuable, however, are the accompanying comments, suggestions, and queries, which are well calculated to arouse the interest of the student and encourage him to think for himself. There is in addition a good deal of useful information of a practical nature which is evidently the fruit of a wide experience in teaching physics. In short, the book may be confidently recommended to student and teacher alike.

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.*]

Absorption Spectrum and Constitution of Sulphur Vapour. Predissociation of Molecules.

THE vapour of sulphur consists of a mixture of S_8, S_6 and S_2 molecules; the quantities present vary with the pressure and temperature (Preuner, *Zeit. Phys. Chem.* 68, 1910).

We have studied the ultra-violet absorption spectrum of sulphur vapour at temperatures between 100° and 1000° and pressures from 0·5 to 53 mm. The temperature of the vapour in an absorption tube of clear quartz, 50 mm. long, with plane parallel optically clear windows, was always higher than that of a communicating magazine containing sulphur. Thus the temperature of the latter determined the total pressure of the vapour, whereas the temperature of the absorption tube gave the partial pressures of S_8, S_6, S_2.

The spectrum was photographed with a Hilger E_1 spectrograph (system Littrow), the source of light being a condensed high frequency (10^6 p. sec.) spark between copper electrodes under water (Victor Henri, "Études de Photochemie," 1919, Proc. Roy. Soc. 105, 662, 1924). The spectrum of this source is continuous down to 2300 Å, except for a series of weak water-bands at 3064 Å. The measurements of the lines are exact to 0·02-0·1 Å, depending on the type.

The following principal results were obtained.

At temperatures and pressures, where only S_8 and S_6 molecules are present ($t < 250°$, $p < 10$ mm.), a general absorption without any structure is observed, beginning at about 2700 Å and increasing continuously up to 2300 Å (limit of our measurements).

By raising the temperature in the absorption tube, so that the partial pressure of S_2 attains about 0·05 mm., five sharp groups of bands appear with fine structure at 2798, 2829, 2861, 2892, 2927 Å, and three or four broad bands at 2768, 2739, 2713 and 2678 Å.

At higher pressures of S_2, the number of groups of bands increases towards the red and ultra-violet end. For example, at 550° and 0·55 mm., where only S_2 exists, there is no trace of general absorption, and the spectrum consists of 18 groups of bands from 3114 to 2592 Å. At 550° and 20 mm. (also S_2 alone) we obtain 26 groups, and at 750° and 53 mm. (still S_2 alone) more bands towards the red appear, the last one being at 3700 Å.

The intensity and the number of these bands are always determined by the partial pressure of the S_2 molecules; the presence of S_8 and S_6 produces only a general absorption at the ultra-violet end of the spectrum.

This spectrum of the S_2 molecules can be divided into three very distinct portions; they appear in exactly the same positions under all conditions.

First portion: from 3700 *to* 2794·2 Å. *Bands with fine structure—the rotational movement of the molecule is quantified.* In this portion we obtain 14 groups of bands between 2794·2 and 3300 Å with a constant frequency interval of $\Delta \frac{1}{\lambda} = 397$ cm.$^{-1}$, and 9 groups from 2950 to 3700 Å with an interval of $\Delta \frac{1}{\lambda} = 700$ cm.$^{-1}$. Each group of bands consists of 3-6 series of bands and each band of this series is made up of numerous sharp lines. In every band the lines are very sharp and near together $\left(\Delta \frac{1}{\lambda} = 0{\cdot}1 \text{ Å}\right)$, specially at the origin of the Q branch (ν_0) and at the head of the R (positive) branch, the distance between ν_0 and the head being 20·9 cm.$^{-1}$; the head is towards the ultra-violet. This means that the moment of rotation of the activated molecule, I_1, is greater than that of the normal molecule, I_0.

All these groups and series of bands with their fine structures overlap each other and the resulting aspect of the spectrum is very puzzling. In this portion of the spectrum there are more than 5000 fine absorption lines.

We have systematically studied the spectrum while slowly increasing the pressure of S_2. We were thus enabled to arrive at a successive development of it. The bands appear in a regular order and the fine structure of each band can be analysed. At the first appearance of a band its structure is absolutely classical, formed of three branches R, P, Q. At higher pressures the same band gets very complicated owing to the overlapping with the next one and by the appearance of other branches R′, P′, Q′.

By studying the bands at the lowest pressures at which they appear, we found that the lines could be distributed into three branches:

$$R(m): \nu = \nu_0 + c_1(2m+1) + c_2 m^2 \qquad \text{positive branch } m \to m+1$$

$$P(m): \nu = \nu_0 - c_1(2m-1) + c_2 m^2 \qquad \text{negative ,, } m \to m-1$$

$$Q(m): \nu = \nu_0 + c_2 m^2 \qquad \text{zero ,, } m \to m$$

with

$$c_1 = \frac{h}{8\pi^2 c I_1} = 2 \text{ cm.}^{-1}, \quad c_2 = \frac{h}{8\pi^2 c}\left(\frac{1}{I_1} - \frac{1}{I_0}\right) = -0{\cdot}2 \text{ cm.}^{-1}.$$

This gives for the moment of rotation of the normal molecule of S_2, $I_0 = 12{\cdot}6 \times 10^{-40}$, and for the activated one, $I_1 = 13{\cdot}8 \times 10^{-40}$. The distance between the nuclei of the two S atoms is therefore 0·7 Å in the normal and 0·73 Å in the activated molecule of S_2.

Second portion: from 2794·2 *to* 2592 Å. *Narrow continuous bands without fine structure.* Below 2794·4 Å the absorption spectrum of the S_2 molecules changes abruptly. The fine structure disappears entirely, the absorption spectrum consists of 8 groups of bands with a frequency interval between the groups of 360 cm.$^{-1}$. Each group consists of about 20 narrow bands having a width of 1 to 2 Å; these bands are absolutely continuous, containing no sharp lines. *This means the disappearance of the quantified rotation of the* S_2 *molecule,* and is a special case of a general result observed by one of us for many different molecules (Proc. Roy. Soc. 105, 662, 1924).

Third portion: from 2592 *to* 2475 Å. *Broad continuous bands.* At 2592 Å we observe a new change in the absorption spectrum. The narrow bands disappear abruptly and we obtain about 6 broad bands (width 15 Å) with an interval of 300 cm.$^{-1}$.

The analysis of the absorption spectrum shows two abrupt changes in the structure of the S_2 molecule: the first one at 2794·2 Å, corresponding to an increase in the internal energy of 102100 cal. p. gm. mol., thus causing a decrease of the frequency interval of oscillation of the two S atoms from 397 to 360 cm.$^{-1}$. This proves that the distance between the two S atoms in the S_2 molecule increases, which means that the bonds are weakened, the rotation of the molecule is *not* quantified. It is important to note that in this case, where the molecule absorbs rays < 2794 Å, its chemical activity is increased, as results from the interesting experiments of Norrish and Rideal, which we propose to follow in further detail.

The second change of the S_2 molecule at 2592 Å corresponds to an increase of the internal energy of 110000 cal. = 4·77 volts. It is very interesting to note that this limit corresponds exactly to the resonance potential of sulphur vapour 4·78 volts = 110400 cal. = 2582 Å (Foote and Mohler). This shows that by increasing the internal energy by 110000 cal. the valency electrons jump into higher orbits. The vibration frequency of the atoms is still more decreased (300 cm.$^{-1}$), the distance of the nuclei in the S_2 molecule is therefore still larger than in the foregoing case.

These interesting results obtained for the sulphur molecule lead us to a general discussion of different kinds of transformations of any given molecule. We know by the electronic impacts that at a certain minimum potential the impacts are no longer elastic; this occurs at the resonance potential of the molecule. It means that certain electrons jump from the normal orbit into the next one. But now we see that before this state is reached the molecule can be modified in its internal structure: the atoms are driven apart, the bonds are weakened, the molecule becomes more reactive, and the rotational movements are no longer quantified. This first modification is a preliminary preparation of the molecule for its total dissociation, and it is necessary to introduce a new term for this change. We propose to denote it by the term *predissociation* of the molecule.

For each molecule we can distinguish, therefore, the following successive states: *normal, predissociated, resonance, ionised,* and finally the *dissociation* of the molecule. In each of these states the molecule can be activated. By studying the absorption spectra of vapours we determine the limits of these different states of the molecules.

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Constant Differential Growth-ratios and their Significance.

A STUDY of the growth of the abdomen in the shore-crab *Carcinus maenas* (Huxley and Richards, unpublished) showed that whereas in the male the ratio *abdomen-breadth : carapace-breadth* remained constant, in the female it increased continuously during the whole of post-larval life.

Similar types of growth during the whole or part of life have been frequently recorded. Pézard (1918) has styled the growth of such an organ *heterogonic*, Champy (1924) *disharmonic*, as opposed to isogonic and harmonic respectively.

It seemed desirable to investigate this form of growth in a case where accurate weight-measurements were available: accordingly, advantage was taken of a visit to the United States to study the growth of the chelæ of Fiddler-crabs at the Marine Biological Laboratory, Wood's Hole. As is well known, the chelæ of females in these animals are small and equal throughout life, while those of males are unequal, one being similar to the female's, while the other is much enlarged. Morgan (1923 and 1924) has recently given us much information as to the time at and mode in which this asymmetry is determined.

The weights of whole animals of every size, and of their autotomised chelæ, were taken in *Uca* (*Gelasimus*) *pugnax*. The female and small male chelæ remain throughout life equal to ±2 per cent. of total weight.

For the large male chelæ, some 400 specimens were weighed, and divided into 25 classes by total weight. Let y = weight of large chela, w = total weight, $x = w - y$. It was then found that when $\log y$ was plotted against $\log x$, a remarkably straight line was obtained:—

$$\log y = k \log x + \log b,$$

where k and b are constants, $k > 1$, $b < 1$.

This was empirically established for total weights of 60 mgm. to more than 3.5 gm., and it can be deduced satisfactorily that it holds from the moment heterogonic chela-growth begins, which is at about 6-8 mgm. total weight.

The only complication lies in the fact that the slope of the line changes at a point corresponding to about 30 per cent. of maximum total weight, k here decreasing slightly to a new value, but remaining > 1. This change is probably coincident with sexual maturity, and would then be explicable through the gonad making a greater drain on the food-supply.

The simplest mathematical expression of the facts is $y = bx^k$. This implies that if during any given period, p is the fractional increase of x (total weight less chela), then that of the large chela in the same time is p^k. This would receive a biological explanation if the rate of cell-division were greater in the large chela than in the rest of the body throughout life, the two rates being as $k : 1$.

Since the *relative* growth-rates of organ and rest of body thus remain constant during long periods, I propose the term *Constant Differential Growth-ratio* for the phenomenon. Where the constancy of the ratio has not yet been ascertained, it is best to retain *heterogonic* as a more general term.

These facts have various corollaries: (1) The development of secondary sex-characters in Crustacea need stand in no relation with the gonad, or at least to maturity. (2) The male Fiddler-crab and the female Carcinus (and many other Crustacea) have *no definitive form*, their shape, as determined by the proportion of their parts, being a function of their absolute size. Thus even for purely morphological and systematic purposes, it will be needful to take measurements on large series of specimens, and to determine k in the above formula as one of the more important distinguishing marks of the species.

(3) Finally, we have the corollary, pointed out by Geoffrey Smith in 1905, that if this type of developmental mechanism holds throughout a group for any organ, the absolutely larger species of the group should possess this organ of relatively larger size than do the smaller. This relation has been shown to exist in Stag-beetles and many other Coleoptera, in Crustacea, and in Ungulata (G. Smith, 1905, Champy, 1924, etc.). It was tested out by us quantitatively on two species of Uca, with the following results:

	Uca pugnax.	*Uca minax.*
Maximum total weight	3·6 gm.	17·8 gm.
k, 1st period . .	1·61 – 1·64	?
k, 2nd period . .	1·32 – 1·35	1·58 – 1·66
Maximum ratio $y : x$, per cent. . .	65 per cent.	77 per cent.

Only a few *U. minax* were available, and those clearly all in the 2nd period.

It is interesting to find k near to 1·5 in all cases. If it were exactly 1·5, the surface of the chela would be increasing in direct proportion to the volume of the rest of the body. It remains to be seen whether this is a mere coincidence or not.

The greater absolute size attained by *U. minax* led to the largest large chela in this species attaining a

relative weight 12 per cent. greater than in the small *U. pugnax*. Our expectations are thus fulfilled.

This has an important bearing on evolutionary and genetic theory. If (1) a mechanism for the heterogonic development of any character occurs throughout a group, and (2) the evolution of the group has been on the whole from small to large size, we shall get apparent orthogenesis of the character. There is proof of (1) in the antlers of Cervidæ (Rörig, 1901, Champy, 1924), and strong probability of it for all horns and other bony excrescences in mammals. As regards (2), this size-increase has occurred in almost every group of mammals, and is probably to be accounted for by the biological advantage conferred (up to a certain limit) by increased size.

If so, then the apparent orthogenesis of horns, etc., in mammals, especially urged for Titanotheria by Osborn (1918, etc.), is no true orthogenesis at all, in the sense that it is not caused by determinate variation of the hereditary constitution. On the contrary, it would be automatically brought about by the increase of absolute size of the whole animal (which in its turn is probably effected by natural selection plus random variation, and not by determinate variation), together with the existence of the same type of developmental mechanism for horn-growth throughout the group. That is, orthogenesis would mean nothing else but directional evolution, and had better be dropped in favour of that term, because its past use has often implied directional evolution which is also determinate owing to internal causes.

Sturtevant (1924) has recently expressed somewhat similar ideas, but in a very general way, and without any numerical data. Champy (1924) has expressed still more similar views, but again without accurate measurements on large numbers of animals, which, in view of the degree of normal variability, are necessary to establish any quantitative law for the growth of heterogonic organs.

Full details will be published in due course. I have to thank Dr. Lillie for the hospitality of the laboratory at Wood's Hole, Mr. F. N. Ratcliffe for assistance in the work, and the Royal Society for a grant.

JULIAN S. HUXLEY.

New College, Oxford,
November 27.

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Theories of Growth and Senescence.

IN the thoughtful and stimulating criticism of my book, "The Chemical Basis of Growth and Senescence," which appeared under the above title in NATURE of August 23, there occur one or two statements in which my actual views are not correctly represented, due, no doubt, to inadequacy of expression upon my part. I desire to seize the opportunity created by the appearance of this criticism to express my views more clearly without entering into a detailed discussion of numerous other matters in which the reviewer and I chance, for the moment, to differ in opinion.

The reviewer states, "The evidence that the autocatalyst [of growth] is soluble and diffusible is based, not upon any evidence from the higher animals but solely on studies of infusoria, bacteria and yeasts." This is not quite the case even if we confine our attention to the evidence contained in the book and disregard that which, since its publication, has appeared elsewhere. It was inferred that the autocatalyst of growth must be soluble and diffusible in the higher animals, as well as in protozoa, for the following reasons:—(1) That Wildiers and others have found growth-accelerating agents in extracts prepared from a diversity of tissues, and these agents resemble in their properties (thermostability and solubilities) and behaviour (effects upon cell-multiplication) the accelerative agents which may similarly be extracted from yeasts and infusoria themselves. (2) That the fusion of the separate autocatalytic syntheses occurring in all the cells of the body into an autocatalysed curve representing the growth of the organism as a whole, could not possibly occur if all of the separate syntheses pursued their own independent paths. They must therefore be regulated by a product which is interchangeable between the various cells comprising the tissues of a higher organism. To be interchangeable between widely separated cells this product must to some extent, however slight, possess properties equivalent to solubility and diffusibility.

Since the publication of my book, however, this deduction has received direct experimental confirmation from two independent sources. A. Fischer (*Journ. of Experimental Medicine*, vol. 38, p. 667) has shown that contiguous fibroblasts in a circumscribed volume of culture medium mutually accelerate each other's multiplication, and M. T. Burrows has shown that the same phenomenon occurs in cultures of cancer-cells (*Southern Medical Journal*, April, 1924). The principle of allelocatalysis has thus been shown to apply to vertebrate tissue-cells no less than to cultures of yeasts or infusoria. In consequence of this effect the growth of the organism as a whole displays the time-relations of an autocatalysed reaction, nor does this interpretation of the curve of growth imply, as the reviewer supposes, that the syntheses which underlie and determine the rate of growth must necessarily occur in homogeneous solution, for, as Nernst has shown, reactions which occur at the surface of two immiscible phases may display the same time-relations as reactions which occur in homogeneous solution.

The reviewer very properly directs attention to the omission of any reference in my book to the important work of Dr. E. J. Allen on the growth of marine algæ (Jour. Marine Biol. Assoc., vol. 10, 1914, p. 417). My attention was directed to Dr. Allen's work, unfortunately too late to permit its inclusion in the book. Naturally, I would not advertently have omitted reference to experiments which afford such a remarkable illustration of the widespread occurrence and importance of growth-accelerating agents.

I do not regard regeneration as "an irreversible process of senescence," and am at a loss to understand how the reviewer could possibly have formed such an impression. I assert that lost parts tend to be replaced by a more (physiologically) differentiated type of tissue and that such growth of tissue must increase in some measure the senescence of the organism as a whole (that is, abbreviate its "expectation of life"). This, however, is very far from instituting an identification of regeneration and senescence. In regard to the nature of the stimulus which starts growth after injury, I have suggested that it may be in part the local increase of nutrient level. Obviously, the nutrient level in a circulating medium, such as blood, must be quickly equalised all over the body, but in the pericellular fluids, which really constitute the nutrient medium inhabited by the cells, such equalisation must be relatively slow. The nutrient level in these fluids at any particular point will therefore be determined, on one hand by

the rate of supply from the circulating medium, and on the other by the rate of local consumption. The latter factor must obviously be reduced by the removal of normally adjacent cells by injury.

I am surprised to learn that I have treated Child's theory of rejuvenescence and senescence " with silent contempt." This was very far indeed from my intention, for, on the contrary, I regard this theory as the necessary complement of my own. My presentation of Child's opinions may have been inadequate, but it was not intentionally so, and I must absolutely decline to view Prof. Child as an " opponent," even if for no better reason than because his demonstration of the existence of metabolic gradients in the tissues of the metazoa is one of the most important pieces of evidence upon which I base my interpretation of differentiation. To put the matter upon a crudely quantitative basis, however, the fifteen citations from Child's publications which my book contains should surely have sufficed to protect me from this accusation.

I am glad to avail myself of this opportunity to clear up an obscurity to which the reviewer directs attention in his final criticism. He credits me with the statement that " variation always takes place by loss of characters," and I must admit that my phraseology is open to this one-sided interpretation. My meaning, however, was this :—Since every new type of tissue which appears during development does so as a result of physiological differentiation, *i.e.* the omission from the new cells of certain nuclear constituents, it follows that the appearance of a character which depends upon the development of a new type of tissue must occur in consequence of a tendency of the germ-plasm to become deficient. Such a mutant, which undergoes more extended development and differentiation than that which occurred in the parent-type, must be recessive. Any mutation involving premature *arrest* of development and differentiation must, for the converse reason, be dominant. In my desire to make clear the first consequence of my hypothesis I omitted to elaborate adequately the second, which, indeed, appeared to me to be obviously implied in the first. Thus both dominant and recessive varieties may arise, but those which represent a positive gain of a new type of tissue cell must be recessive. Of course in any individual example, in the present state of our knowledge, it may be a very difficult matter indeed to decide whether a given external character is really attributable to the development of a new type of tissue or to the non-development of tissue-cells which occur in the parent-type, for, in general, the omission of any particular stage of differentiation must create opportunities for the development of other cells which would normally be denied to them.

If, however, devolution of the nucleo-cytoplasmic ratio (" physiological differentiation ") can occur, it will, since this affords the only means by which the constituent cells of the organism can continue to propagate themselves, and the selection of lower nuclear ratios, to which the struggle for existence among the cells must lead, will ensure the appearance and multiplication of cells possessing lower nuclear ratios, if that is possible. Since " cellular selection " is always operating in a direction favourable to their appearance, new varieties which are recessive should, in the terms of this hypothesis, appear much more frequently than new varieties which are dominant, and the facts, as the reviewer himself admits, are absolutely in accordance with the theory.

T. BRAILSFORD ROBERTSON.
The Darling Laboratories of Physiology and Biochemistry, University of Adelaide,
October 5.

The Word " Scientist " or its Substitute.

IT will probably be agreed that language was made for man as a means of expressing his thoughts and feelings. It would seem to follow that the first duty of a word (or, to be precise, a noun) is to express an object or an idea definitely and uniquely. When this duty is fulfilled, the demands of philology and beauty might, and indeed should, be considered, but their importance is clearly secondary, except perhaps in poetry of a certain type.

It does not appear that any of the suggested alternatives to the word " scientist " fulfil this primary requirement. " Man of science " is anything but definite and unique. It might mean a Robot, or any of a large number of unintelligible things (cf. " men of stone," " man of sorrows," " men of Athens," " man of mark," etc.), the preposition " of " being perhaps the most indefinite word in the language. " Natural philosopher " is no better. It does not tell us whether it is the philosophy or the philosopher that is natural, nor does it distinguish between the various meanings of the word " natural," to say nothing of the word " philosopher." Nor is " rationalist " satisfactory. It includes, for example, both Galileo and his opponents, and totally fails to distinguish between the kinds of data on which they exercised their reason.

Sir Ray Lankester's suggestion, that " *we* must be content to be anatomists, zoologists," etc., does not seem to be practicable. If the collective word " science " is necessary, then, on precisely the same grounds, a collective word equivalent to " scientist " is necessary also. The fact that these collective words are necessary is exemplified by the front page of NATURE, where the paper is described as " A weekly illustrated Journal of Science "—not " A weekly illustrated Journal of Anatomy, Zoology, etc." Unless a collective word is used for the investigator, how, for example, is Dr. Jeans to be described ? Are we to call him an astronomer-mathematician-physicist, placing the terms in alphabetical order to avoid suspicion of partiality and praying devoutly the while that he do not undertake psychical research ?

It would appear that a word equivalent to " scientist " is necessary, and until one is suggested which expresses equally definitely and uniquely the idea implied, I cannot see any justification for rejecting " scientist " in the columns of NATURE or elsewhere. Since clear expression is so intimately bound up with clear thought, the question has more than an æsthetic interest.

HERBERT DINGLE.
Imperial College of Science and Technology, South Kensington,
December 9.

MAY I offer some general observations in connexion with the question as to the use of the word "scientist."

Language appears to be our way of expressing ideas by posture and gesture of the tongue, lips, etc. These gestures are recognised by the musical effects produced when air is blown through the vocal cavities as they perform their symbolic movements.

The perfect language would be one in which all ideas were expressed by the simplest series of gestures, and in which each separate gesture or series of gestures always bore one and the same meaning.

Up to the present time, language has grown up without conscious human guidance ; it is therefore full of inconsistencies, ambiguities, omissions, and redundances.

From this point of view, it would be well to review

our forms of speech wherever the present words appear to fail in their purpose.

"-ist" is a concise termination (my only objection to it would be that it contains the unvoiced hiss "s," and the unvoiced explosion "t," which are both inartistic and phonetically ineffective sounds). It is shorter than "-ian" (as in mechanician, etc.), and it already bears a different meaning from "-er" as in runner, singer, etc.

I would therefore plead not only for "scientist" as being a concise and expressive word for one who is skilled in science, but also would go further and suggest the more general use of the termination "-ist" to denote one who is an expert on the theory as well as the practice of the art which he practises.

Thus, we might have *chemicist* (and distinguish him from the "chemist and druggist," and *electrist* to run in parallel with "physicist." If "maths" has come to stay, "mathist" would be an obvious improvement on "mathematician."

There are good reasons why an art, so important to human welfare as language, *should* be rationally developed and improved for human use; it should not be compelled to remain for ever in the neolithic stage.

R. A. S. PAGET.

East India House,
74 Strand, London, W.C.2,
December 3.

YOU cannot help it; scientist is an established term, and you can no more suppress it than you can suppress bigamist. But if NATURE maintains its policy on the subject, I am sure we shall not grudge the Editor this little tyranny.

My belief is that objection comes almost entirely from the fact that the word scientist is cacophonous. If the word had been as well lubricated as its near neighbour "sciolist" I am convinced that we should never have heard any serious objection to it, unless perhaps Fate by some caprice had briefed Sir Ray Lankester for the prosecution.

There are already "Rationalists." I was taken to see one not long since, and I should like to be there when Sir Ray Lankester was seeing him. Natural philosophy is still physics in Scotland, and "naturalists" are everywhere students of natural history (sometimes nowadays confused with natural science). A real object of pity is the man who still has to indicate his calling to the public by styling himself

A CHEMIST.

Very Intense Magnetic Fields.

IN previous letters which appeared in the issues of NATURE for April 19 and September 20 respectively, I gave some details of a method for producing very intense magnetic fields.

I now give in Fig. 1 an oscillogram of the condenser current discharge through a solenoid wound with 25 turns per cm. length. The scale of this oscillogram is such that the second peak represents a current of 23,100 amperes in the solenoid winding. It follows, therefore, that the intensity of the magnetic field at the central part of the solenoid core was 730,000 gauss.

Apart from the very high value of the magnetic intensity thus obtained, an examination of the oscillogram of Fig. 1 yields some further very interesting results:

(i.) The frequency of the discharge current as given by the first half-wave of the current is very much higher than that of the rest of the wave. The frequency of the first half-wave about corresponds to the value as calculated from the static constants of the circuit.

(ii.) The current represented by the second peak is greater than that denoted by the first peak.

(iii.) The current values actually obtained are very much greater than those calculated from the constants of the circuit.

A full explanation of these effects is not yet clear. There is one factor, however, which has an important bearing on the phenomena, namely: The intense mechanical force developed between the neighbouring turns of the solenoid causes them to move relatively to each other, and in this way a back e.m.f.

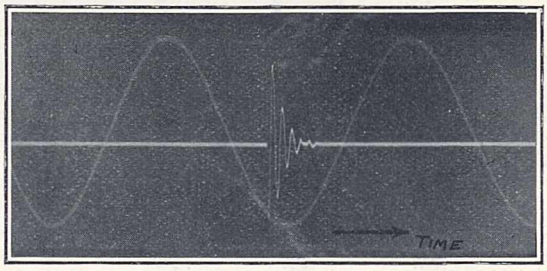


FIG. 1.

is induced in the solenoid winding which is equivalent to a change in the static constants of the circuit. The large wave shown in the oscillogram is a 50 frequency wave.

Magnetic fields of an intensity of 1,400,000 gauss have been obtained already by the method described, and there is definite evidence that the magnetisation curve of steel is changed after having been subjected to these very intense fields.

Further modification of the apparatus is now being effected by means of which it is expected that magnetic fields of an intensity of about 10,000,000 gauss will shortly be available.

T. F. WALL.

Edgar Allen Research Laboratory,
University of Sheffield,
November 29.

Chemical Reactions at High Pressures.

IT is generally recognised that under high pressures many chemical reactions which take place only slowly under ordinary conditions may be greatly accelerated, and new reactions, hitherto considered impossible, may reach a considerable velocity. This opens up a very interesting and important field of study, and there is little doubt that there may result many important industrial developments and even the creation of new industries. Before, however, the chemist can adequately discharge his functions in connexion with this work, it will be necessary for the engineer to provide him with the special tools which will be required in connexion with it. For example, new means will have to be found for the development and control of pressures of a much higher order than has hitherto been used. New methods for the handling of solids, liquids, and gases will have to be devised; heat interchange under new conditions will have to be studied. In fact, the technique of high pressure work generally will have to be developed.

May I suggest that, if Great Britain is to keep abreast of the advances which are being made in this field abroad, it is very necessary that the serious attention of our engineering schools and laboratories should be turned to the need of the chemist in this connexion.

WM. RINTOUL.

Nobel Research Laboratories,
Stevenston, Ayrshire.

Neanderthal Man and Grimaldi Man: their Rôle in the Evolution of Mankind.[1]

By Prof. RÉNÉ VERNEAU, Muséum national d'Histoire naturelle, Paris.

THE important discoveries in the domain of human palæontology which have been made in recent years, and those, far greater in number, which may be referred to the Neolithic period, have now made it possible for us to venture on an inquiry which seems to me not without interest. What, it may be asked, is the rôle that the nigritic element has played in the ethnology of the world in the past?

Wherever Neanderthal man occurs, he displays a remarkable homogeneity in character. It is no longer possible to regard him as physically or mentally diseased. He represents a primitive ethnic type which still retains a certain number of simian characters, as Schaafhausen and Huxley maintained, and as is acknowledged by all scientific workers of to-day who are free from prejudice. It is also incontrovertible, in my opinion, that Neanderthal man, taking his characters as a whole, can be brought into relation only with the nigritic group—a point which, I hold, it should not be difficult to demonstrate. But what is the rôle that he has played, and how great is its importance in the evolution of mankind? This is a point upon which there is complete disagreement among men of science. It is a question which appears to me to be sufficiently interesting to be discussed in some detail.

When it is admitted with Huxley, de Quatrefages, and Hamy, to mention a few only of those who have held this view, that there still exist in Australia representatives of the Neanderthal type who, however, in the course of ages, have undergone certain modifications under the influence of environment, the answer is simple. This type must have played a part of some note, since it has been able to perpetuate itself to this day in a country in which, as all agree, the environment has remained relatively stable. In Europe, so far as our present knowledge goes, the evidence for its existence is more difficult to follow. At the same time, de Quatrefages and Hamy held that certain characters observed in Neolithic crania and even in modern crania were atavistic manifestations of an ancestral state. On this view Neanderthal man should be regarded as one of our ancestors.

This theory, which is accepted by a number of anthropologists including myself, has been violently opposed by those who are unable to bring themselves to include in our ancestry a type which retained simian characters.

To-day, a whole school, which includes a number of eminent workers to whose knowledge and sincerity I render the fullest homage, and who for the most part call themselves evolutionists, maintains that Neanderthal man has bequeathed no single drop of his blood to modern man, and that *Homo Neanderthalensis* is a distinct species which has been replaced by *Homo sapiens*. To dispute a theory which is in the fashion is always an ungrateful task, especially when one appreciates the great merit of one's antagonists. Nevertheless, I may perhaps be permitted to set out the arguments of those who uphold these new ideas and the reasons which forbid me to agree.

[1] Translated from the Huxley Memorial Lecture for 1924 of the Royal Anthropological Institute, delivered on November 25.

The palæontologists, relying for their argument upon the extinction of various species of animals during the geological ages, maintain that man is no exception to the general rule. I agree without the slightest qualification that human beings are subject to the great laws which govern other forms of organic life. But we must discover which of these laws is responsible for the disappearance of those species which have become extinct. To me there can be no doubt that that law is the adaptation of the organism to the environment. When the environment undergoes profound modification, as was the case in past geological ages, the organism, being no longer in harmony with the new conditions of existence, which it is unable to modify and to which it cannot adapt itself, must perforce disappear. In the case of man, however, the facts must be looked at from a different point of view. Although it is true that from the beginning of the Quaternary, that is to say from that point of time from which we can follow up man with certainty, changes in the environment have taken place, they have not been so considerable as to make it impossible for man to adapt his organism to the new conditions. There is proof of this in the remains of man's handiwork which are found at every level. There is another consideration which is not taken into account: the emigration or extinction of the Pleistocene species, whether they belonged to the warm or the cold fauna, takes place in close relation to climatic conditions, against which man, even of the most primitive type, is able to struggle in virtue of his intellectual powers. It follows then that while man is to a certain degree subject to the influence of his environment, he is able through progressive adaptation to evade the violent shock which brings about the disappearance of other species.

Among those who receive new ideas with their eyes closed and attach more importance to words than to facts, there are some who may object—and this has actually happened to myself—that it is not proved that Neanderthal man was an intelligent being. Their doubts are raised by the nomenclature applied to primitive man—or, at least, to one of his branches, now said to be extinct—and to modern man, who is known as *Homo sapiens*. The term *sapiens* is quite inappropriate, as it is applicable only to moral or intellectual qualities, and there is no specific reason for applying it to *Homo sapiens* to the exclusion of *Homo Neanderthalensis*. As regards the moral qualities of the latter we can only advance pure hypotheses; but it is quite another matter in regard to his intelligence. Here I may leave the argument to one of the most eminent and at the same time one of the most firmly convinced upholders of the theory that *Neanderthalensis* became extinct at an early date, my learned colleague and friend, Prof. M. Boule. After having stated in his great work "Les Hommes fossiles" that certain backward peoples of the present day, whom nevertheless he classifies as *Homo sapiens*, are to be brought into relation with Neanderthal man, "if not from the point of view of physical characters, at least from the point of view of moral qualities" and by their mode of life, he adds, "the latter is already man, notwithstanding

the morphological inferiority of his brain, and is in no way the precursor of man, since we find mingled with his bones the implements of stone that he knew how to make and the ashes of the fires he knew how to light and how to tend. Already his actions are those of modern savages; and if naturalists, abandoning their usual practice, were to base their classification of the beings they study upon intellectual qualities, they would have no specific ground for a separate classification of Neanderthal man and modern man; while, as we have already seen, it would not be possible to refuse him this distinction on the ground of his physical characters."

That is how the question stands. *Homo sapiens* is not marked off from *Homo Neanderthalensis* by his intellectual qualities, as we might be led to suppose from the specific title which has been bestowed upon him. It is by his physical characters that he is separated from modern man, even in the case of peoples of the most primitive type. This is well shown by an examination of the cranial characters of Neanderthal man and comparison with modern types such as Australian, Bushman, etc.

From what has been said, it emerges that there is no character which has been observed in *Homo Neanderthalensis* which is not to be found in modern man, though principally among the nigritic races. But, as Prof. Boule has very rightly said, it is not the existence of an isolated character which is of interest to us from this point of view. "It is the presence, the conjunction, the accumulation of these characters in *each* of a whole series of crania" which has value. Each skull in the Australian series of this type with which I have dealt presents such an accumulation of characters of the Neanderthal race that it is impossible for me not to accept a close relationship between the two groups. To my mind, the Neanderthaloid Australian skulls prove that the Neanderthal race has not "died out without leaving any descendants." It follows that this nigritic race, which played an important part in antiquity, has also made its influence felt in man of to-day.

But if the Neanderthal type [Rhodesian man] persisted in Africa, why could he not have persisted in Australia, and why should he not have submitted there to the influence of environment as he did in Rhodesia? Could he not have been modified as Rhodesian man was in some degree when he acquired the upright attitude? When we consider the enormous distance in space and time which separates the Neanderthaloid Australians from our Mousterians, it is difficult to conceive that the type could have perpetuated itself in New Holland without modification. This would be a denial of the influence of environment which I could not accept.

On the other hand, it may be argued that, judging by its flora and archaic fauna, the Australian environment does not appear to have undergone any great change. It is this which explains precisely how it is that the characters of the southern tribes have only suffered some attenuation. To maintain that the conditions of existence of these natives have remained absolutely stable, and to hold that the Australians have not progressed, is an untenable hypothesis. The main characteristics of the material culture of the Australians show that this is not the case. All this denotes that, however backward they may be, the Australians have evolved and they no longer stand where stood the Mousterians in Europe. It would not be credible that while their intelligence developed their physical characters remained immutable. But their evolution has been very slow and they have preserved a group of Neanderthal characters sufficiently well-marked to lead me to regard them, as Prof. Boule has done elsewhere, as derived from the same source as *Homo Neanderthalensis*. These characters are beyond question nigritic, and it is difficult to refuse to admit that this nigritic element, which played a part in Europe in the first part of the Quaternary age, has not bequeathed its blood to modern man, notably the South Australian and apparently in a lesser degree to other Melanesians.

Let us now see if traces of it can still be found in Europe at the present day. There have been found on many occasions in prehistoric, historic, and modern burials, skulls which reproduce in part the characters of the ancient fossil race of which we are speaking. There are specimens in many museums and since 1882 the authors of "Crania Ethnica" have described a number of examples. Additions are being made to these observations continually. In 1914, for example, Verworn recorded two skeletons found at Obercassel, near Bonn, in a hearth of the Reindeer age. He noted that they presented certain resemblances to the races of Cro-Magnon and Chancelade, and, in addition, showed Neanderthal characters. Beside this nigritic bestial type there is another, more highly developed, representatives of which are to be found dating from the Quaternary epoch. This is the negro type which I have called the race of Grimaldi, as the first examples were found near the Italian frontier in the territory of a commune bearing this name. The physical characters of Grimaldi man show close resemblances to the negro type.

In the presence of so many characters which are frankly nigritic, and of which some indeed recall those of *Homo Neanderthalensis*, it must be recognised that, at one point in the Quaternary period, negroid individuals lived in Europe. It may, however, be asked whether the two subjects from Baoussé Roussé were not negroes who arrived there accidentally and disappeared without exercising any influence in Europe. My researches on this problem have led me to discover in several museums in Southern Italy modern crania with characters which incontestably recall those of the Grimaldi race. I have even found two living subjects who came from the Graian Alps, where it is difficult to believe that any negro could have penetrated in recent times; these showed a number of the cephalic characters of the Baoussé Roussé negroids. When once attention was directed to this point observations multiplied. Skeletal remains of negroids have been found in collections from France, Switzerland, Italy, and North Africa. Some dated from the Upper Palæolithic (a series of crania from the rock shelters of La Mouillah on the frontier of Western Algeria), others from the shell heaps of Tebessa, of which the age is disputed, and others from the Lower Neolithic of the Province of Oran. In North Africa, the negroid element must have formed the ethnic substratum of the whole of the Berber country. In Europe we find it in the Neolithic age in Brittany, in Switzerland, in Illyria, the Balkans, etc.; in the Bronze and early Iron ages in

Switzerland, in Southern Italy, and so on. It is plausible to attribute to atavism the prognathism, often very pronounced, and the retreating chin which is to be observed to-day among certain individuals who do not otherwise exhibit nigritic characteristics, either in the hair or in the coloration of the skin. As I wrote in 1906, "since we still find to-day so many traces of an ethnic type with characters which recall those which I have observed in the Grimaldi race, we are compelled to believe that this race was formerly represented among us by a whole group." I might add, however, that the same type must have been equally strongly represented in North Africa.

To sum up, the division of mankind into two entirely distinct species, *Homo Neanderthalensis* and *Homo sapiens*, the first long extinct and leaving no trace behind, does not appear to me to be justified. The Neanderthaloid characters of the Australians indicate a close relationship with our Mousterian man, while on the other hand, certain features in Neolithic or modern skulls found in Europe are to be explained as due to atavism. The race of Neanderthal, thoroughly nigritic in type, has continued to play its part among us, as it has in Africa, Australia, and elsewhere. Observations made on the Pleistocene skeletons of Wadjak and on remains from the mounds of Nebraska lead me to believe that the same element has entered into the ethnology of Java and the New World.

In the case of Grimaldi man, no doubt is possible. The traces can be followed in Europe almost step by step from Aurignacian times to our own day. In North Africa its existence is equally apparent though it may not be possible to fix the date of its appearance with precision. Another nigritic element, the Papuan, has just been noted in Tonkin by M. Mansuy on sites which take us back to a Neolithic period of very high antiquity. In 1879, A. de Quatrefages observed similar characters in a fossil cranium from a cave near Lagoa Santa in Brazil. P. Rivet has found the type represented in some abundance in the rock-shelters of Paltacalo in Ecuador; and it appears among the Pericues, an extinct tribe of Lower California, which H. ten Kate had already recognised to be clearly related to the Melanesians. I myself have pointed out the existence of this strongly marked type among the Tunebos of Colombia. From California to the extreme south of America the nigritic element has played a part of sufficient importance to leave its traces everywhere.

From all these facts I conclude that mankind in the beginning was represented by one or more nigritic types of marked bestiality and retaining several simian characteristics. These primitive elements have evolved and have given rise to the great negro stocks of to-day, the African and the Melanesian. This evolution has been progressive. We have a proof, in my opinion, in the intermediate types found at Talgai and Wadjak. These intermediate types, while evolving in some degree, have perpetuated themselves to the present day in special conditions, as, for example, among the non-Neanderthaloid Australians and the New Caledonians. Our Grimaldi negroids are too far removed from Neanderthal man to allow us to suppose that they are immediately descended from him, especially if the interval separating them is relatively small. Where could this type have become established? I do not know. On *a priori* grounds we think of North Africa; but the negroids of North Africa appear to be more recent than those of Baoussé-Roussé.

The conclusions which emerge may be summed up in a few lines:

(1) Primitive man exhibited simian characters pointing to relationship with the anthropoids. This archaic type has not become extinct; it has evolved in accordance with its environment. Traces of it occur very sparsely in Europe, but are readily discernible in South Australia.

(2) This primitive type was followed by a more developed type in which the simian characters have gradually disappeared, but in which the nigritic characters are retained in a marked degree. Although it plays only a very insignificant part among ourselves, this is not the case in other parts of the world.

(3) Recent discoveries lead us to suppose that a nigritic element has everywhere preceded the yellow and white races.

In truth, there are too many gaps in our knowledge for it to be possible to follow step by step the evolution of man in time and space. The links which are needed to establish the filiation of the races are missing. Yet it seems to me that my view of the question is more nearly in accord with the facts than that which accepts a gap between early man and man of to-day.

The Biological Action of Light.

THE beneficial action of a change of climate, especially when a sunny place is chosen, is well known: why the change is so frequently more effective than other therapeutic methods is a question which has only recently been investigated scientifically—one of the many examples of the lag in the acquirement of scientific knowledge behind popular opinion. Apart from the mental effects of a change of scene, benefit may be derived from both the cooling power of the air and also the incidence upon the body of the sun's rays. C. Lee Pattison (*Lancet*, October 18, 1924) has recently given an account of the therapeutical effects of ultra-violet radiations, while C. Dorno (*Naturwissenschaftliche Umschau d. Chem. Zeitung*, October 1924) has considered the subject more from the physical aspect. The effects of the different parts of the spectrum are not the same, the ultra-violet rays being the most active therapeutically. They are present in the atmosphere to a much greater amount, relatively to the infra-red heat rays, in summer as compared to winter, but their activity is confined to the superficial layers of the skin, since they have only a low penetrating power. It must be remembered also that these rays are largely absorbed by glass, and therefore exposure must be made in the open air or directly to a source of ultra-violet light.

It appears possible that rays of a shorter wave-length than 290 $\mu\mu$, which do not occur in the solar radiation, may be still more effective than the latter. The skin pigment absorbs chiefly the visible yellow and green rays, with the production of heat, which is then radiated outwards by the skin, while the red and short

infra-red penetrate still more deeply. In this way, in a cold atmosphere, the body temperature is higher in the deeper parts but falls, from radiation from the skin, towards the surface. If this radiation from the skin is mostly prevented, as in a warm damp tropical atmosphere, the surface of the body tends to have a higher temperature than the deeper portions: hence arises the enervating influence of the tropics, whilst in a colder (and sunny) climate the conditions are invigorating.

The increased loss of heat from the skin in a cool atmosphere, as at a high altitude, appears to be greater than the increase in the temperature from the absorption of light and heat rays, since, as Leonard Hill has shown, the metabolism of the body at rest is increased from 50 to 100 per cent. under these conditions, and to this increase is due a great deal of the benefit which ensues. Further, a cool atmosphere is usually drier than a warm one, and this promotes an increase in the evaporation of aqueous vapour from the lungs, with a resultant increase in the flow of fluid through the respiratory membranes, thus aiding in the healing of any lesions of the respiratory system which may be present.

Apart from alterations in metabolism and temperature, various changes in the constitution of the body under the influence of light have been described. Thus, there is an increase in the bactericidal power of the blood: whilst the formation of the blood platelets has been found to be stimulated (Cramer and Drew). The now well-known beneficial effect of sunlight in rickets appears to be due to a mobilisation of any vitamin A which is still in the body, without, however, causing its synthesis: light, therefore, enables normal growth to continue on diets which are relatively deficient in vitamin A. The body changes in rickets depend on a disturbance in the metabolism of calcium and phosphorus and are accompanied by a reduction in the amount of inorganic phosphorus in the blood. The addition of vitamin A to the food or exposure to light, especially ultra-violet rays, produces an increase in the blood phosphorus together with increased retention of this element and calcium (Orr, *et al.*). It must, however, be remembered that light, like other therapeutic agents, should be used with caution, since in certain cases it may produce a depressing effect, impairing, instead of strengthening, the body's resistance.

Obituary.

PROF. J. I. HUNTER.

BY the sudden death of Dr. John Irvine Hunter, Challis professor of anatomy in the University of Sydney, while on a visit to England, British anatomy has lost its youngest and most promising recruit. In our issue of December 6, p. 842, it was stated that a course of free public lectures on "The Anatomy and Physiology of the Sympathetic Innervation of the Striated Muscle" would be given at University College at five o'clock on December 8, 10, and 12, by Prof. Hunter. On Monday, December 8, when an audience assembled, it was Prof. Elliot Smith's painful duty to announce that Prof. Hunter had fallen ill on Saturday and was then lying in University College Hospital. Typhoid fever was diagnosed, from which he had evidently suffered for some time before giving in. On Wednesday, December 10, the date on which his second lecture was due, he sank and died from heart failure at the early age of twenty-seven, having occupied his chair for only three brief but brilliant years, leaving a young widow and a wide circle of friends in England and Australia to mourn the loss which had so suddenly and so unexpectedly overtaken them. He was buried in North Finchley cemetery on Friday, December 12, after a brief but impressive service in St. Pancras church.

It is given to few men to be elected to a senior chair in their twenty-third year and in four short years to establish a reputation which places them amongst the leaders of their chosen profession. When we seek to discover how success came to Prof. Hunter so early and so rapidly, we recognise that credit must be given to his master—Prof. J. T. Wilson. On relinquishing the Challis chair of anatomy in the University of Sydney on his appointment to the chair of anatomy in the University of Cambridge in 1920, Prof. Wilson urged the appointment of Dr. Hunter as his successor—although the latter had only just completed his medical studies. Dr. Hunter was duly appointed and given a year's leave to study in Europe, spending most of this period with Prof. Elliot Smith at University College, London.

In his later years in Sydney, Prof. Wilson was keenly nterested in the nerve supply of voluntary muscles and impressed upon his pupils the importance of discoveries made in Holland by Boeke, de Boer and Langelaan—namely, that voluntary muscles have a double supply of motor nerve fibres; they receive not only the myelinated fibres from the somatic system but also non-myelinated from the sympathetic system. It was the functional significance of this double nerve supply which Prof. Hunter made his own subject. He set himself to master the wide and intricate literature of his chosen subject and found guidance and inspiration in the researches of Sir Charles Sherrington. The theory which he formulated and sought to prove was that all kinds of muscle, both voluntary and involuntary, have a double nerve supply because they have a double function. A muscle must have the power of assuming a new form; it must also have the power of maintaining the new form thus assumed. Prof. Hunter's theory is that the somatic or myelinated nerves have to do with the first power; the sympathetic or non-myelinated with the second.

On his return to Sydney, Prof. Hunter found that another pupil of Prof. Wilson—Dr. Norman D. Royle—was also interested in the same problem but from a different point of view. Dr. Royle wished to relieve those soldiers who, as a result of wounds of the brain, suffered from the condition known as spastic paralysis—a condition of muscular spasm which renders easy movement of the limbs an impossibility. Prof. Hunter and Dr. Royle proceeded, after a preliminary series of experiments on animals, to treat these maimed soldiers on the assumption that the spastic condition of the muscles must be due to the action of their sympathetic nerves. Dr. Royle operated and cut off the sympathetic supply, with the result that the spastic condition disappeared and the patients gained an improved control of their limbs.

By the summer of 1923, Dr. Royle had treated some sixty cases with varying degrees of success, while Prof. Hunter had carried out a series of new experiments to elucidate the share taken by sympathetic nerves in regulating muscular action. A sentence from an address which Prof. Hunter gave at this time to an association of Australian medical men illustrates his native modesty and his methods of investigation. "It is the purpose of this address," he said, "to show how this work enables us to correlate for the first time with a sufficient measure of confidence two lines of anatomical and physiological research which have been pursued in various laboratories throughout the world and chiefly have remained as independent observations." Prof. Hunter claimed to play the part of a mere "honest broker" in science. He was doing much more than this. His constructive brain was busily fitting into place the disjointed fragments of an eminently workable hypothesis; and he knew how to devise experiments to elicit evidence.

When these researches were well under way, Australia was visited by the two eminent American surgeons—the Mayo brothers. They were so impressed by what they saw in Prof. Hunter's laboratory and Dr. Royle's wards in Sydney that on their return to the United States they urged the College of Surgeons of New York to invite the Sydney workers to give the Murphy Oration—the highest honour in its gift. The invitation was given and accepted, and in October last Prof. Hunter gave the Oration in New York. This over, he hastened to England to revisit his friends, bringing with him his recently wedded wife. He visited Cambridge and lectured there and then returned to London to lay his discoveries before his old colleagues at University College, when there followed swiftly and unexpectedly the fatal event which has just been told.

Prof. Hunter's investigations were by no means confined to nerves and muscles; he was an anatomist in the widest sense. He was a student of human races, and in co-operation with Prof. Elliot Smith produced a new reconstruction of the Piltdown skull and assisted in the interpretation of the brain of Rhodesian man.

The students of the University of Sydney lose a born teacher and a leader who had gained a place in their hearts. Nor is it too much to say that British science has lost a recruit who carried a marshal's baton in his knapsack. We should convey a totally wrong impression of John Irvine Hunter if we lay stress merely on his power of application, his scholarship, his gift of easily disentangling evidence and of recognising "key" facts, and his mastery of technique. He felt the joyousness of youth and life; he entered into all the pursuits of ordinary men with zest; his interests were wide and he carried himself with a modesty which was natural as it was sincere. In recent years death has robbed science of some of its youngest and most promising votaries but in few cases is there entwined so deep a sense of loss and of tragedy as clings round the death of young Prof. John Irvine Hunter.

DR. C. F. NEWCOMBE.

DR. C. F. NEWCOMBE, whose death on October 19 is just reported from British Columbia, went out to that country about thirty-five years ago from the English Lakes. The lovely coast of the north-east Pacific inspired in him a passionate devotion. With scarcely any scientific companionship, he followed with wonderful singleness of heart the pursuit of knowledge through the rest of his life. He was the moving spirit in the Natural History Society of Victoria, which did much, in the short period of its activity, to reveal, by dredging, the almost incredible riches of the Strait of Juan de Fuca. He himself worked out extensive collections of mollusca and crustacea from this and many other localities.

At the same time Newcombe acquired an exact knowledge of the flora of the coast and made valuable palæontological collections from many parts, but he will always be remembered for his wide and intimate acquaintance with the Indian tribes, especially the Haidas of the Queen Charlotte Islands, whom he regarded with a deep but discerning affection. He made countless journeys from Victoria northwards, often in an undecked motor-boat, and taking great risks. On the last of these he took the chill which caused his death.

Quite early in his work Newcombe marked out a policy from which he never deviated. The decay of the culture and handicrafts of the gifted peoples of the coast could not, he felt, be arrested. The best that could be done for the benefit of posterity was to see that these should be adequately represented in museums by such memorials as their totem-poles, their boats and their carvings. The museums of the United States were not slow to profit by his disinterested efforts. Very many totem-poles, obtained by him only after settling difficult and complicated claims, and snatched, in some cases, from destruction at the hands of their owners, are now the most impressive objects in great anthropological collections. For his trouble he never claimed more than out-of-pocket expenses. Latterly he succeeded in kindling a local interest in these riches, and the museum at Victoria contains many important accessions obtained by him, as does the National Collection at Ottawa. It was a genuine source of regret to him that the Canadian and British Governments and scientific authorities were not sufficiently alive to the importance of these native relics, for he would have vastly preferred to enrich the museums of his own country.

Newcombe never published any accounts of his experiences and observations amongst the coast Indians. No one who had ever talked to him for long could doubt how valuable such accounts would have been. His diffidence and high critical sense dissuaded him, however, from premature publication, and in 1911 the early failure of his eyesight made prolonged writing impossible.

In 1913 Newcombe was placed in charge of a commission to report on the sea-lions of British Columbia and their relations to the fisheries of the Dominion, the report of which embodies his experience through many seasons. It shows his characteristic respect for careful observation and his disinclination to arrive at conclusions except on the strongest evidence, and is a valuable account of the natural history of the animal and its place in native life. Nor can we close this notice without mentioning his intense interest in and laborious research into the records of the discovery of British Columbia. In 1914 the Provincial Government published as a memoir his account of "The First Circumnavigation of Vancouver Island."

To those who enjoyed Newcombe's friendship it cannot but be regretted that such a many-sided, humorous and charming personality has been lost to us without leaving an adequate memorial, and to those who are interested scientifically in the Pacific coast of Canada, the closing of so rich a storehouse of knowledge of a dying race is an unparalleled disaster.

DR. JOHN BEARD.

WE regret to record the death of Dr. John Beard, who was lecturer in embryology and in comparative anatomy of vertebrates in the University of Edinburgh from 1890 until 1920. Beard was born in 1858 and received his early scientific training in the Owens College, Manchester, and in the Royal College of Science, London, where he studied under Huxley. He also spent periods of study in the Universities of Würzburg and Freiburg, and became thoroughly conversant with the German literature of zoology—especially in embryology—as well as with that of British and other workers. On his return to Great Britain he was for a time in the service of the Scottish Fishery Board as naturalist at the Marine Laboratory at Dunbar, and it was from this post that he was invited to succeed the late George Brook as lecturer in embryology in the University of Edinburgh. He was soon afterwards appointed also lecturer in comparative anatomy of vertebrates, and he was for some twenty years or more senior assistant to the professor of natural history, Prof. J. C. Ewart.

Beard was most at home in his course of embryology, and in his best years, before his health began to fail, he was a stimulating teacher, one who aroused the true spirit of investigation in his pupils, and of his published work the most enduring is likely to be that which deals with certain features—the nervous system, the thymus, the germ-cells—in the development of elasmobranch fishes. About seventeen years ago he reached the conclusion, largely on embryological grounds, that tumours, benign and malignant, should be treated by means of pancreatic ferments, and the remaining years of his working life were chiefly devoted to the discussion of this question. It eclipsed his interest in his earlier lines of work, but his co-workers in zoology always continued to hope, until his breakdown, that his profound knowledge of the details of development of elasmobranchs, and especially of the skate (Raja), would be made available by publication to future workers.

Beard had a keen mind and was a forceful writer. He had great skill in zoological technique and he formed a large collection of microscopical preparations—chiefly complete series of sections—for the study of the development of Raja. In his later years at the University he was not in good health, and a breakdown in 1920 brought about his retirement from the staff. During recent months his health had distinctly improved, but on November 22 he had a stroke and died in Edinburgh on December 2.

MR. J. A. WHELDON.

AN active and accomplished botanist passed away on November 28, at Aintree, Liverpool, in the person of Mr. J. A. Wheldon. James Alfred Wheldon was born at Northallerton in 1862, and was educated at Cleveland College, Darlington, and the Westminster College of Pharmacy. He qualified as a pharmacist about 1884 and started in business at York, but four years later a disastrous fire robbed him of all his collections. In 1891 he was appointed pharmacist at H.M. Prison, at Walton, Liverpool, a post which he held for thirty years. Until he received this appointment, Mr. Wheldon's botanical studies were chiefly concerned with phanerogams, but from this point he devoted much of his time to mosses. He was one of the founders of the Moss Exchange Club, which afterwards became the British Bryological Society, and during its latest season distributed nearly 5000 specimens, for which Mr. Wheldon acted as referee. In 1907 he published his most extensive botanical work, the excellent "Flora of West Lancashire," in conjunction with Mr. Albert Wilson, but his pen was constantly busy, especially on mosses. In 1901 Mr. Wheldon was elected a fellow of the Linnean Society of London, and withdrew in 1918 upon his retirement; but last year he was elected an associate of the Society, a distinction he greatly valued. He received the honorary degree of M.Sc. from the University of Liverpool in 1922. His botanic collections were extensive and embraced practically every group of cryptogams; they would be a worthy accession to some institution.

B. D. J.

PROF. FRANZ SCHRADER.

THE death of M. Franz Schrader, formerly of the Ecole d'Anthropologie of Paris, which occurred in October, removes one of the most eminent of French geographers. Born at Bordeaux in 1844, Schrader travelled widely in Europe in his youth and served in the Franco-German war. By the influence of Elisée Reclus he turned to geography, his interests lying in the human rather than the physical aspect. But it is for his cartographical work that Schrader was best known. He completed and published in 1893 the "Atlas Universal de Géographie" begun by Vivien and Saint-Martin many years earlier. The last edition of this atlas was published in 1922 and is the principal French atlas of the time. Other notable works of Schrader were "Atlas de Géographie moderne" (1890) and "Atlas de Géographie historique" (1896). He was the editor of the annual publication entitled "L'Année cartographique," which records all new publications in cartography and exploration. As a keen alpinist, Schrader found much interest in devising his tacheograph by the use of which he produced his "Carte des Pyrénées centrales."

WE regret to announce the following deaths:

Dr. J. F. W. Tatham, formerly Superintendent of Statistics at the General Register Office, on November 8, aged eighty.

Dr. T. L. Watson, Corcoran professor of geology at the University of Virginia and director of the Geological Survey of Virginia, who was known for his contributions to mineralogy, petrology, and economic geology, on November 10, aged fifty-three.

Current Topics and Events.

IT is a pleasure to record that Sir James Mackenzie, honorary physician to the King in Scotland, has been awarded the Charles Mickle Prize offered by the University of Toronto for the best work to advance sound knowledge of a practical kind in medical art or science during the last ten years. Sir James Mackenzie is a typical Scot, possessing in a remarkable degree the qualities which have made Scotland famous the world over. These qualities, native ability, imagination, conscientiousness, and dogged perseverance, have raised him from the rank of an ordinary general practitioner of medicine to a high position as an investigator and pioneer in connexion particularly with diseases of the heart. Although there was a very considerable mass of knowledge on the heart long before his time, Sir James had the merit to approach the subject in his own original and thinking fashion, and by following up the histories of his patients in a personal and kindly way he amassed a great amount of knowledge of the fate of patients with cardiac disease, and was able to write on the subject with first-hand knowledge.

LONG a practitioner in Burnley, it was here that Sir James Mackenzie wrote his remarkable work on the pulse and appreciated more than any one of his time that the only real test for a heart is its capacity to deal with the daily work which it has to do. In the course of his work he investigated the irregularities of the heart, classified them on a sound physiological basis, and studied their prognostic significance and their rational treatment. This, we think, is the work by which he will best be remembered. Associating himself with physiologists like Hill, Keith, Flack, Cushny, MacWilliam, and Lewis, he was also largely instrumental in applying physiological work to the needs of practical medicine, and he founded the new branch of cardiology. The later work in which he tried to elucidate the early symptoms of disease by ordinary methods of clinical observation does not appear to have been so successful. Not the least of his merits has been the encouragement which he gave to a band of young workers who have done admirable work in filling up the lacunæ in the cardiological fabric.

ALTHOUGH the valuable material obtained by officers of the Indian Archæological Department on the sites at Mohenjo Daro and Harrappa in the Indus Valley referred to in NATURE of October 18, p. 584, and October 25, p. 623, will need to be supplemented by further investigation, it now appears to be generally agreed that these discoveries have nearly doubled the period covered by our knowledge of Indian antiquities, taking it back to at least 2500 B.C. It is also clear that the finds belong to a widespread culture which must have flourished for many centuries. The peoples of Sind and the Punjab were then already living in well-built cities and were in possession of a mature civilisation. According to a report from Sir John Marshall, quoted in the *Times* of December 10, a careful examination and comparison of the antiquities found leaves no doubt that they are closely connected with, and approximately contemporary with, Sumerian antiquities from Southern Mesopotamia which date from the third or even the fourth millennium B.C. The origin of the Sumerians is obscure, but it is held by many that they were entirely distinct, both linguistically and otherwise, from other races in Mesopotamia, and were an intrusive element from the outside, possibly originating to the east in India. Sir John Marshall, therefore, regards it as a reasonable hypothesis that India was the cradle of the Sumerian civilisation which lay at the root of the Babylonian, Assyrian, and Western Asiatic cultures generally. It is highly desirable that the exploration of Indian sites on an extended scale should be pushed on with as little delay as possible, especially with the view of the elucidation of the pictographic script, which appears to be so closely related to the Sumerian system.

DURING the transcontinental excursion of the British Association and the International Mathematical Congress, after the meetings in Toronto in August last, Sir Richard Paget designed an amusing totem pole representing the various sections of the Association. A reproduction of this drawing, in colour, has been prepared, and will be obtainable from the secretary of the British Association, Burlington House, London, W.1, price 2*s*. (postage 1½*d*.). By Sir Richard Paget's permission the drawing is here reproduced, in black-and-white, reduced by one-third linear dimensions. At the top of the pole is the head of the British Ass. with balancing scales in its teeth. Below it are symbols of the thirteen sections in descending order, namely, astronomy, mathematics, and physics; chemistry; geology; zoology; geography; economics; engineering; anthropology (man looks in a mirror); physiology (a heart and microscopes); psychology (studying a dream); botany (trees and flowers); education (reading a book); and agriculture. There are probably many members of the

FIG. 1.

Association, as well as others, who will like to possess this humorous and apt memento of a notable meeting, in addition to those who ordered it during the excursion.

AT a meeting of the Royal Society of Edinburgh held on June 7, 1920, H.R.H. the Prince of Wales was elected an honorary fellow in accordance with the terms of Law VIII., which provides that "Personages of the Blood Royal may be elected Honorary Fellows at any time on the nomination of the Council." A special meeting of the Society was summoned on December 3 last, at which His Royal Highness was admitted to the honorary fellowship. As in the case of the sister and older Society, the Royal Society of London, the patronage of the reigning King was solicited as soon as it came into being, and a Charter of Incorporation was granted in March 1783. Since then the head of the Royal House, down to and including H.M. King George, has always been an honorary fellow of the Society. The first president was Henry, third Duke of Buccleugh, who communicated in 1785, to Volume I. of the Transactions, an abstract of the register of the weather for ten years kept at Branxholm, near Hawick, a residential seat of his family. The Duke wrote, in this first issue, a dedication to the King and Founder, George III., prefacing the papers published. "If they," he says, "shall be found worthy of the approbation of a Monarch who has distinguished his reign by the utility of his institution for improving the elegant Arts, as well as by the splendour and success of his undertakings to extend the knowledge of Nature, the Royal Society of Edinburgh may hope to occupy a respectable place among those bodies of learned men who, by their united efforts, have contributed so eminently to the progress of Science and of Taste in Europe." The Society now numbers on its roll some 650 fellows.

SERIOUS psychical research has been handicapped so often by the pretences of charlatans that the integrity of an investigator has to pass vigilant scrutiny before his testimony is accepted. It is therefore peculiarly interesting when men like Prof. Gilbert Murray and Lord Balfour give evidence of their first-hand experiences in telepathy. At a meeting of the Society for Psychical Research on December 12, Mrs. Henry Sidgwick described some instances of telepathy shown by Prof. Murray, and she stressed the fact that far from Prof. Murray desiring to prove a preconceived theory, he discovered his telepathic gifts when he was still a sceptic, and, even now, regards his demonstrations more as "parlour-tricks" than as serious investigations. The demonstrations were conducted in the following manner: some one, acting as "principal agent," thinks of the matter—a real or fictitious scene or quotation—which he wishes to convey to Prof. Murray, and describes it aloud to the other people in the room. Prof. Murray is then fetched from another room or some distance in which he has been waiting, and, lightly touching the principal agent's hand, attempts to reproduce the description. His percentage of successes (59 per cent.) and wealth of detail seems to preclude the possibility of coincidence. Mrs. Sidgwick also gave evidence against the view that hyperæsthesia is an explanation of telepathy, showing that no auditory hyperæsthesia could have enabled Prof. Murray to describe incidents, previously unknown to him, which were thought of, but not spoken of, by the agent. Sir Oliver Lodge and Lord Balfour supported the view that telepathy is more than strong sensory activity, and the latter described some successful instances in which he himself had acted as principal agent. The chairman (Mr. Piddington) described the experiments as "the most remarkable experiences of telepathy that the Society had ever had."

FOG under its worst conditions prevailed over England with unusual persistence for three days from Tuesday night to Friday morning, December 9-12. In London and the suburbs the smoke mixing with the fog greatly aggravated its intensity, and both for density and continuance the fog was the worst experienced for many years past. Thick fog was also reported from the midland, eastern, southern, and western districts of England, and from northern France, Belgium, and Holland. Few winters of late have been specially foggy, although there have been some instances of dense fog. In the winters of 1879–1880 and 1890–1 fog was both frequent and dense. Most winter fogs occur in otherwise fine weather with anticyclonic conditions, which are similarly characteristic of fine, dry, and hot weather in the summer. Registration of atmospheric pollution during the fog shows very distinctly its unhealthy and dangerous character. Fogs have often been discussed by meteorological authorities, but that in no way tends to lessen their occurrence or harmful character. The only known purifier is the springing up of a steady or strong wind, by which it is quickly dispersed.

DR. ARTHUR W. HILL, Director of the Royal Botanic Gardens, Kew, attended a meeting of the Jamaica Standing Committee of the West India Committee on December 10, when the question of deforestation was discussed. Dr. Hill directed attention to the grave effects which deforestation is having on the climate and cultivation of Jamaica, and it was decided to urge the Government of the Colony that effect might be given to the recommendations contained in the report of Mr. E. D. M. Hooper, of the Indian Forestry Department, upon the forests of Jamaica, which was published in 1886, so far as they were applicable to the present situation. It was further decided to urge that the existing laws in respect of the prevention of bush fires might be rigidly enforced.

DR. ALEXANDER RUSSELL has been elected president of the Junior Institution of Engineers for the session 1924–25. His inaugural address will be delivered at the Royal Society of Arts on Wednesday, January 7, at 7.30.

THE Right Hon. James Ramsay MacDonald and Sir David Prain, formerly Director of the Royal Botanic

Gardens, Kew, have been elected trustees of the British Museum in succession to the late Sir Archibald Geikie and the Right Hon. E. S. Montague.

THE annual meeting of the Mathematical Association will be held at the London Day Training College on Monday and Tuesday, January 5 and 6, when the following communications will be presented: on Monday evening, "The Mathematical Laboratory: its Scope and Function," Prof. H. Levy; on Tuesday morning, "The Neglect of Arithmetic in Schools," Prof. J. E. A. Steggall; "An Application of the Bessel Functions to a Problem in Optical Resolution," A. Buxton; and a discussion on "Tangency and Limits in Geometry"; on Tuesday afternoon, "What is Geometry?" Prof. G. H. Hardy (Presidential Address), and "The Reform of University Mathematics," Dr. H. B. Heywood.

THE annual exhibition of the Physical Society of London and the Optical Society is to be held on Wednesday and Thursday, January 7 and 8, at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, from 3 to 6 P.M. and from 7 to 10 P.M. Mr. F. Twyman will lecture on "Some Experiments with Interferometers" at 4 P.M. on January 7 and at 8 P.M. on January 8, and Mr. C. F. Elwell on "Talking Motion Pictures" at 8 P.M. on January 7 and at 4 P.M. on January 8. These lectures will include demonstrations. More than fifty firms are exhibiting scientific apparatus, and a number of experimental demonstrations have been arranged. Invitations have been given to the Institutions of Electrical and Mechanical Engineers, the Chemical Society, the Radio Society of Great Britain, the Röntgen Society, and the Faraday Society. Admission in all cases will be by ticket only, and members of the above societies should apply to the secretary of the Society to which they belong. Others interested should apply direct to Prof. A. O. Rankine, hon. secretary of the Physical Society, Imperial College of Science and Technology, South Kensington, S.W.7.

MR. CHARLES W. J. TENNANT, writing from the office of the district manager of the "Christian Science Committees on Publication for Great Britain and Ireland," says that the references to "Christian" science in letters in NATURE of December 6 are misleading. We are afraid we cannot enter into a discussion of the basis and meaning of Mrs. Eddy's work or the use of the term "Christian scientist" to denote a disciple of it, but it is of interest to give the following extract from Mr. Tennant's letter: "Christian Science is a perfectly legitimate term; it is the Science or knowledge of Christ, Truth; it is exact Science, and can be demonstrated as certainly as mathematics. One of the many definitions of the word 'science' in the Oxford Dictionary is 'organized body of the knowledge that has been accumulated on a subject.'"

THE Imperial Forestry Institute at Oxford started work on October 13, temporary accommodation having been provided in the School of Forestry building until arrangements can be completed for the erection of new buildings on another site. The board of governors of the Institute is now fully constituted as follows: Lord Clinton, Forestry Commissioner (chairman); the Vice-Chancellor of Oxford University, Mr. J. Wells; the President of Magdalen, Sir Herbert Warren; Prof. W. G. S. Adams; Mr. R. L. Robinson, Forestry Commissioner; Major R. D. Furse, Colonial Office; Col. G. L. Courthope, Empire Forestry Association; Prof. R. S. Troup. The following staff has already been appointed: Director, Prof. R. S. Troup; Secretary, Mr. P. S. Spokes; lecturers—economics of forestry, Mr. W. E. Hiley; silviculture, Mr. H. G. Champion; mycology, Mr. W. R. Day; structure and properties of wood, Mr. L. Chalk. The Institute will, in addition, have the assistance of the following members of the staff of the School of Forestry: forest management, Mr. R. Bourne; surveying and engineering, Mr. N. F. MacKenzie. The Forestry Commissioners have agreed to station at the Institute certain of their research officers.

THE Division of Medical Education of the Rockefeller Foundation has decided to collect and publish from time to time brief descriptions of clinics, laboratories, and methods of teaching in different parts of the world in order that the information in convenient form may be brought to the attention of those interested, and the first of these reports has been recently issued (Methods and Problems of Medical Education, First Series, 1924). It includes descriptions, with plans and illustrations, of seven anatomical institutes, including that at University College, London, of two departments of obstetrics (Harvard and Peking), and of the pathological institute at Graz. In each case a sketch is given of the courses of instruction and method of teaching.

PROF. HORST OERTEL, of McGill University, contributes to the *Scientific Monthly* (Nov. 1924, p. 512) an interesting and learned article on the relation of philosophy to medicine. He points out that pathology, for example, the science of disease, has not yet learned to distinguish fully between what is scientifically established and what is assumed. When we speak of bacteria as *causes* of disease, we are, strictly speaking, not correct, and all sorts of indefinite, largely hypothetical conceptions have been introduced, such as virulence, attenuation, variability, resistance, strains, individual susceptibility. All these cover up deficient knowledge of causal relations, and are, at the best, heuristic. Prof. Oertel pleads for a return to Immanuel Kant, to whom we owe so much as a pathfinder of correct scientific thought and reasoning.

THE Department of Health, Canada, has issued a striking pamphlet (Publication No. 32) on "Smallpox and Vaccination," by Dr. J. J. Heagerty. The symptoms and history of smallpox are briefly described, a few statistics of its incidence and mortality are given, and the nature of vaccination detailed. But the salient feature, apart from scarlet covers, is the number of excellent reproductions of photographs,

some showing the disease at its worst, others mild cases and after-effects. But the two most striking illustrations depict, one a smallpox mother nursing with impunity her vaccinated baby, the other three children of the same family, the middle one of the group unvaccinated and covered with the smallpox eruption, while on either side is a child vaccinated a year previously, neither of whom took smallpox though living in the smallpox ward for several weeks.

THE Bulletin of the Imperial Institute, Vol. 22 No. 3, 1924, contains a very full account of the cultivation and propagation of the banana, its transport to the British market, and also its possible utilisation as "flour" or dried slices, "figs." An account is also given of the more usual fungus and insect pests which the banana cultivator has so far had to struggle against. Provided rainfall or irrigation can supply sufficient water in a tropical climate, the banana can be grown successfully on many soils if labour is available; and as at present the greater part of the imports to the United Kingdom come from foreign countries, it is suggested that tropical areas within the Empire might take a greater share in the production of this crop, particularly perhaps West African regions within a comparatively short distance of the home markets. Two species of banana are grown on the commercial scale, a variety of *Musa sapientum* known as "Gros Michel," the principal banana grown in Central America and Jamaica, and *Musa Cavendishii* or *M. sinensis*, a native of Southern China, which was introduced into the Canary Islands, a smaller form than "Gros Michel," of less robust habit, and therefore requiring protection in crates when exported; this is now usually known as the Canary Islands banana.

THE library of the Chemical Society will be closed for the Christmas holidays at 1 P.M. on Tuesday, December 23, and will reopen at 10 A.M. on Monday, December 29.

READERS on the look-out for book bargains should obtain a copy of Catalogue No. 244, just issued by Messrs. W. Heffer and Sons, Ltd., Cambridge, which gives particulars of nearly four hundred "remainders" now offered at greatly reduced prices. Many works of scientific interest are included.

MESSRS. W. Watson and Sons, Ltd., 313 High Holborn, London, W.C.1, have recently sent us a copy of a new edition of their Catalogue of Microscopic Objects. The list is divided into sections, each of which is limited to preparations referring to a particular subject, and in each section related specimens are conveniently grouped under sub-headings. There are also several special educational sets of representative slides. The list covers botany, geology, histology, pathology and zoology, and accessories for microscope technique.

Our Astronomical Column.

THE JOHANNESBURG REFRACTOR.—Dr. Innes was able to give the welcome news at the R.A.S. on December 12 that the object glass of the 26½-inch refractor at the Union Observatory, Johannesburg (made by Messrs. Sir Howard Grubb and Sons, Ltd.), was at last on its way to Africa. It was ordered fifteen years ago, but the War brought work to a standstill. The flint lens is not quite perfect, being slightly veined, but the effect on its optical performance is fortunately trifling.

Dr. Innes spoke of the difficulty of finding sufficient workers to man the large telescopes in the southern hemisphere. After describing the arrangements made for interchange of observers with Leyden Observatory (Mr. Van den Bos is going to observe double stars), he implied that there was still room for further volunteers if the telescope was to be worked to its full capacity.

The fact of there being more than 300 fine nights each year makes a number of observers desirable.

COMBINED OBSERVATIONS OF THE MOON.—At Prof. E. Brown's request, an international plan of intensive observation of the moon during the three months December, January, February is being undertaken, in order to fix the errors of the new tables as accurately as possible. The total eclipse of the sun which occurs in January in the United States will fill in the gap which usually occurs at new moon; it enables the moon's latitude to be fixed with great accuracy. Amateur observers can help by observing occultations, accurate time being now easily obtainable by wireless signals.

Dr. H. Spencer Jones, H.M. Astronomer at the Cape, has just communicated to the R.A.S. a valuable discussion of the occultations observed at the Cape during the last 40 years. They give a value of the solar parallax practically identical with that deduced from observations of Eros in 1900–1, namely 8·806″. He also found a value of the semidiameter of the moon 15′ 32·70″, which is only 0·05″ in excess of that deduced by Struve from numerous observations during lunar eclipses.

THE BAADE PLANET.—The orbit of this body is now accurately known, the following elements having been deduced by Dr. Stracke, of the Berlin Rechen-institut, from observations extending over 32 days.

Perihelion passage, 1924, Sept. 28·38252 G.M.T.

$$\left.\begin{array}{ll} \omega & 130^\circ\ 35'\ 43.8'' \\ \Omega & 216^\circ\ 26'\ 19.0'' \\ i & 26^\circ\ 9'\ 4.0'' \\ \phi & 32^\circ\ 37'\ 35.5'' \end{array}\right\} 1924.0.$$

Period, 4·35326 years.

Least distance from sun, 1·22867: greatest, 4·10353.

Three periods are very close to 13 years, and it is just 13 years since Albert was discovered, the orbit of which resembles it in everything except inclination; but that is only 11° instead of 26°. Also the new body is 4 magnitudes brighter than Albert, implying a diameter of some 20 miles instead of 3 miles, so identity seems impossible (though it was suggested by Dr. Stracke), but there may be some connexion between the bodies. It should be possible to photograph the new body even in aphelion oppositions. It will then be of about the 16th mag.

The least distance from Jupiter's orbit is about 2 units, being increased by the large inclination. The perturbations are considerable, but not excessive, and could not explain the change of inclination from 11° to 26°.

An interesting point is that the orbit approaches that of Mars within 3½ million miles, which is near enough to produce sensible perturbations.

Research Items.

THE PEARL IN OCEANIA.—The prominence given to pearls by Prof. Elliot Smith and Mr. W. J. Perry in their theories relating to the diffusion of culture, has led Dr. A. C. Haddon to make a careful examination of the evidence. The result is published in *Man* for December. Prof. Elliot Smith founded his argument upon the word *Margam*, which he stated meant in Ancient Persian "pearl" and "giver of life"; whereas it means "coral," and the interpretation "giver of life" is based upon an impossible etymology. Mr. Perry accounted for the activity of the colonisers of Oceania in certain areas by attributing it to the love of the islanders for pearl and pearl shell. An examination of the earliest writers on the Pacific shows that of all the natives of the Pacific, the Society Islanders alone had any enjoyment of pearls. When pearls are mentioned elsewhere they appear to have been obtained for the purpose of barter with the Spaniards. In Otaheite, early travellers bear witness that the women wore an ear ornament consisting of three pearls strung together. There is no evidence, however, that pearls had any special significance beyond that. Nor is there in Polynesia any general word for pearl in current use as would have been expected on Mr. Perry's view. The pearl-shell was the essential object, and the pearls were named from it. If the pearl were the prime object of interest to the "archaic" colonisers, it is difficult to see why the original name should have been lost and a derivative name substituted. In Malaysia the terms for pearl and shell suggest that the use was introduced by the Hindus. Pearl shell was both worn and used by Papuans and Melanesians when first we hear of them. There seems to be only one reference to its magico-religious significance. This is recorded by the Rev. Dr. C. E. Fox.

BEISAN FROM THE AIR.—Mr. Clarence S. Fisher has published in the *Museum Journal* (Philadelphia) for June last three photographs, taken from the air, of the excavations of the expedition of the University of Pennsylvania to Beisan. These photographs are part of a series taken by the XIVth Squadron of the Royal Air Force with the permission of the General Officer Commanding in Palestine, which forms a valuable addition to the permanent records of the expedition. The first of the photographs reproduced shows the citadel of Beisan from the east and gives an idea of the magnitude and symmetrical shape of the hill which cannot be obtained from the ordinary photograph. The second view shows the extent of the excavations up to the present, while the third gives a survey of the whole country between Mount Gilboa and the River Jalud which runs at the foot of the main hill of the site. This last is a striking example of the value of the aeroplane in archæological work as it shows how this isolated fortress dominated the area once famous for its fertility, but now mostly occupied by swamps, in a way that would not be possible either in a verbal description or in a photograph taken on ground level.

BIRD-MARKING IN AMERICA.—We have received a paper by Mr. F. C. Lincoln on "Returns from Banded Birds, 1920 to 1923," forming Department Bulletin No. 1268 of the U.S. Department of Agriculture. It consists mainly of tables giving particulars of 1746 records of marked birds recovered in a period of three and a half years, from which figures it is apparent that this method of studying migration has been greatly developed in the United States since the War and is now being exploited on a larger scale. It is of interest to note that this is largely due to its having been taken up officially by the Bureau of Biological Survey of the Department of Agriculture, an organisation which has for long paid much attention to bird-migration, as is witnessed by the well-known work of another of its officers, the late Wells Cooke. One may judge, accordingly, that the importance of seasonal movements in the study of economic ornithology is fully realised. (A parallel is to be found in Hungary alone among European countries.) The new method has evidently been applied with efficiency and thoroughness, and the form adopted for preliminary publication is a useful one. Future papers may be expected to give some analysis of the results and conclusions drawn therefrom, but here this is not attempted. There is, however, a map showing the recovery localities of a large number of mallard marked in Illinois in the spring, autumn and early winter; these are spread over a vast region from the mouth of the Mississippi to Saskatchewan. The results are interesting for purposes of comparison with those already obtained for the same species in Europe, and notably in the British area.

THE MARINE FISHES OF PANAMA.—In an important and exhaustive paper (Field Museum of Natural History, Zoological Series, vol. xv.) S. E. Meek and S. F. Hildebrand give an account of the marine fishes collected during the biological survey of the Panama Canal Zone. They make the review of the fishes of this district complete by including all previously recorded species. The collections were made on both sides of the Isthmus, and the authors find that the Pacific fauna, on the whole, is the richer. They agree that the ichthyological evidence is overwhelmingly in favour of the existence of a former open communication between the Atlantic and the Pacific, sufficiently remote, however, to have permitted the specific differentiation of forms on the two coasts. Seventy-two species are common to the two coasts, but of these, forty-eight are cosmopolitan in their distribution. Two new genera and twenty-three new species are instituted in the first part of this report.

FUNGI FROM NORTH GREENLAND COAST.—As No. 12 of Part II. of the report of the 1916–18 Danish expedition to the North Coast of Greenland, J. Lind has recently described the fungi collected there by the late Dr. Th. Wulff. A point of some interest is the fact that only one parasite, *Melampsora arctica*, is present in the collection, whilst many saprophytes are included, mainly very small Pyrenomycetes and Discomycetes, nearly all of which are invisible to the naked eye, so that the 46 species described would seem a great tribute to the energy and discrimination of the collector. Lind points out that the prevalence of saprophytic forms in North Greenland is undoubtedly due to the fact that the dead parts of plants do not rot away as in more southerly latitudes, "but remain during one or several years forming a protective coating around the young buds and shoots." These old, withered leaves and stalks constitute an excellent substratum for small saprophytes.

CYTOLOGY OF COTTON.—Mr. Humphrey John Denham has published the results of extensive studies of the cytology of cotton in two papers in the *Annals of Botany* (vol. 38, pp. 407-438, 1924), paying special attention to microspore development. The haploid chromosome number proves to be 26, two chromosomes being distinctly larger than the remainder. The author has counted the chromosomes in some 32

varieties of cotton and arrives at the interesting result that the cottons of the New World and Egypt uniformly possess 26 chromosomes, whilst those of Asia have 13 chromosomes. This result probably throws some light upon the difficulty of successful crossing between Indian and American or Egyptian cottons and is therefore of considerable interest to those engaged in the scientific development of cotton-growing within the British Empire. This is probably the reason why Mr. Denham's two papers are also printed in the Journal of the Textile Institute (vol. 15, No. 10, October 1924), but they will prove difficult to readers unaccustomed to technical botanical terminology in spite of the fact that they are preceded by a brief introductory note to which a glossary of technical terms is appended.

TERTIARY AND CRETACEOUS FOSSILS FROM THE ARGENTINE.—Our knowledge of Argentine fossils is not so extensive but that additions, however small, are welcome. Two small papers by M. Doello-Jurado are before us. The one (*Anal. Soc. Cient. Argentina*, tom. xciv.) describes under the name of *Mytilus pseudochorus*, n. sp., the cast of a mytiloid shell from the Santa Cruz formation that has lain some time in the National Museum of Natural History at Buenos Aires, and of which the likeness to *M. chorus*, Mol., had already been recognised by Von Ihering. The other communication (*Physis*, tom. v.) deals with a new species of Viviparus, *V. wichmanni*, from freshwater beds in the Upper Cretaceous of Rio Negro. The author's figures are not very clearly printed, and the doubt may be permitted whether most palæontologists would refer the specimen to Viviparus *sensu stricto*.

WELL-WATERS OF SOUTH AUSTRALIA.—Mr. R. L. Jack publishes three maps and a series of analyses on the well-waters of the South Australian part of the great artesian basin of Australia in the Trans. and Proc. of the Royal Society of South Australia, xlvii., 1923. He strikes another blow at the old view that their waters were all derived by annual percolation from the Queensland hills, by showing that some of it has come from the now arid regions of the very centre of Australia north-west of Lake Eyre. He shows that these waters are of two chemical types, one rich in sulphate and the other in carbonate. The table of analyses records only the chlorine, CO_3 and SO_4. Mr. Jack accepts the view that there should be rigid control to prevent waste of water from the bores, as they are draining water of cisternage which ultimately will only be recoverable by expensive deep pumping. It is unfortunate for the Australian artesian basin that the wholesale waste of the water was so long permitted.

THE WATER-POWER OF SWEDEN.—The growing interest in water-power, especially in countries with little or no coal of their own, adds to the importance of a paper by Mr. S. Norlindh entitled "Översikt över Sveriges Vattenkraft" (*Meddelanden från Statens Meteorologisk-Hydrografiska Anstalt*, Bd. I. No. 5). The publication is mainly statistical and gives very full data of all the important falls on more than 100 Swedish rivers and their main tributaries. For each is given the drainage area, weight and the theoretical horse-power. Other tables give the largest falls and the large falls at present utilised. From comparative statistics of various countries, Sweden with nearly 18 million H.P. appears to be better supplied with water-power than any other country in Europe, next coming Norway and France, each with about 12 million H.P. It is doubtful, however, if world statistics of this nature are altogether comparable since most are merely estimates founded in many cases on inadequate data. A notable part of the publication is a well-produced map of Sweden (scale 1 : 1,000,000) showing the location and horse-power of the chief falls with distinctive colouring for those which are now in use. This map shows strikingly how much power has been harnessed in the south of Sweden and the vast unemployed resources in the north of the country, notable exceptions being the falls on the Luleälv at Porjus and Harspränget in Swedish Lapland.

THE EARTH'S CRUST.—"The Composition of the Earth's Crust," by F. W. Clarke and H. S. Washington (Professional Paper 127, United States Geol. Survey, Washington, 1924), sets out in detail the results obtained by these authors in their most recent examination of the best analyses of igneous rocks available up to the present time. A summary of these results was published in the Proceedings of the National Academy of Science (1922, vol. 8, p. 108), and referred to in NATURE of August 19, 1922, p. 253, where an analysis of the average igneous rock of the earth's crust, and the estimated percentages of the commoner elements in the lithosphere, hydrosphere, and atmosphere, according to Clarke and Washington, were given. The figure obtained is the average of 5159 analyses of specimens of igneous rocks, and should correctly be described as such, rather than as the average igneous rock of the earth's crust. This may be best realised from a consideration of the fact that, of the 5159 analyses, 1985 represent Europe, 1709 North America, and 1465 the rest of the earth. The Pacific is represented by 72 analyses of rocks from Polynesia. On p. 19 of their paper the authors quote the Italian proverb: "Chi va piano va sano." They themselves, however, fail to exemplify the teaching of this good old proverb, for they proceed at an unsafely quick pace when they infer that an average of the available analyses of specimens of igneous rocks shows the average composition of the earth's crust.

UPPER AIR OBSERVATIONS.—Successful results of observations in the upper air by means of *ballon sonde* and pilot balloon are given in the *Meteorological Magazine* for October and November. A Dines meteorograph, according to the number for October, was sent up from H.M.S. *Kellett* in the English Channel on June 16. Two balloons were employed in tandem. The apparatus fell into the sea near Eastbourne and was returned to the Meteorological Office. The lifter balloon was followed by means of glasses and is thought to have burst at a height of about 12 km. (7 miles). At sea-level the atmospheric pressure was 1014 mb. and the temperature 68° F.; at 3 km. (1·8 miles) pressure was 709 mb. and temperature 43° F.; at 5·4 km. (3·3 miles) pressure was 520 mb. and temperature 12° F. Two *ballon sonde* ascents were made from the meteorological station at Sealand Aerodrome, near Chester, on July 14 and 15, each of which reached a height of about 20½ km. (12·3 miles); this is the greatest height reached in Great Britain for 12 years. The November number gives a note on a high pilot balloon ascent at Shoeburyness on May 28. The balloon was followed with two theodolites up to a height of 50,000 ft. (9·5 miles), when the home station lost it. The ascent reached well into the stratosphere. To a height of 16,000 ft. the wind was south-easterly with a speed of 10 m. per hour; it veered to south at 25,000 ft., and beyond this height it continued to veer becoming south-west, 20 m.p.h. at 30,000 ft.; beyond 40,000 ft. it backed slowly and decreased. At 50,000 ft. the wind was west or west by south and very light. At the time of the ascent there was a depression far out in the Atlantic and an anticyclone extended eastward from the southern Baltic; the pilot balloon thus showed the southerly circulation between the two.

PERIODICITY OF TEMPERATURES IN EUROPE.—A. Wagner, in a paper read at the Academy of Sciences, Vienna, in July of this year, presented evidence for the existence of a 16-year periodicity of temperature in Europe, based on the examination of long series of data for Vienna and other stations. He finds that the phases of this cycle are opposite in summer and winter, so that it is best seen in the annual range. The amplitude is greatest in Central Europe, whence it decreases southwards and especially northwards, but the phase remains constant. Along a line from Stykkisholm through Stockholm to Petrograd the periodicity vanishes, to reappear farther north with the phases exactly reversed. The author is quite satisfied as to the reality of the periodicity, but until the full evidence is available it would be premature to express an opinion. It should, however, be pointed out that if the periodicity is as definite as the author claims, its length is not sufficiently defined. A cycle of 16 years may imply anything between 15·5 and 16·5 years. If it is real, the series of 147 years' observations available at Vienna should be quite sufficient to determine the length to one place of decimals. If every discoverer of a periodicity would set himself to calculate accurately its length and amplitude before giving it to the world, there would be less confusion in the subject.

THE ELECTRICAL CONDUCTIVITY OF ROCK-SALT CRYSTALS.—A very comprehensive investigation of the electrical behaviour of rock-salt, at temperatures ranging from 15° to 500° C., is described by Dr. D. v. Seelen in the *Zeitschrift für Physik*, October 23. It was found that all the specimens available required a preliminary treatment by heating to 400°; measurements made before this treatment did not agree with those made under similar conditions afterwards, but the effect of the heating was to give a material which had a fairly definite conductivity and temperature coefficient for each temperature. One of the experiments, in which three polished plates were carefully weighed, piled between silver plates, heated to 400° C. for several days while a current was passed through them and again weighed, showed that conduction took place according to Faraday's law, and was electrolytic in character. Sodium ions (Na^+) are the only carriers of electricity, and chlorine ions (Cl^-) do not travel through the crystal. The distribution of potential along the length of the crystal was investigated; it does not follow the straight line law, and space charges in the interior of the crystal have to be assumed. There is nothing which alters the potential distribution, such as double layers or space charges, at the electrodes. The author considers that his experiments indicate a loosening of the crystal lattice as a preliminary to conduction; under the conditions of his experiments the formation of metal bridges in the crystal lattice was not possible, and the fact that the crystals did not lose weight when heated all day to 400° excluded the possibility that conduction was due to salt solution included in the crystal.

RANGES OF POLONIUM α-RAYS IN OXYGEN AND NITROGEN.—Mlle. I. Curie, using air in the Wilson apparatus, formerly obtained a very different result for the above distribution than that given by the scintillation method, and found that the latter does not detect the majority of the rays towards the end of their range. In the *C.R. Acad. Sci. Paris*, Oct. 20, Mlle. Curie and Mr. N. Yamada describe measurements in oxygen and nitrogen. The number of particles with ranges between x and $x+dx$ is proportional to $\epsilon^{-\xi^2/a^2}$; $\xi = x-\rho$, ρ being the most probable range, and a an experimental constant. The value of a/ρ for nitrogen is 0·0208, for oxygen 0·0208, and that previously found for air is 0·015. The exact equality of the values of a/ρ for oxygen and nitrogen is partly fortuitous, the difference in the case of air being due to the greater thickness and possible irregularity of the preparation and impurities. It appears that the difference in the form of Bragg's ionisation curves for oxygen and nitrogen is due to the law of variation of ionisation along the α-ray, and not to any difference between the distribution of ranges in the two gases.

HALIDES OF SILVER.—The photochemical decomposition of silver bromide has recently been investigated by E. J. Hartung with the aid of the microbalance (Jour. Chem. Soc., November). It is interesting to note that experiments on the rate of bromination of thin films of metallic silver afforded no evidence of the formation of silver sub-bromides or perbromides. Thin films of silver bromide, when sealed up in a vacuum in the presence of copper gauze and placed in the light, lose more than 96 per cent. of their bromine. These results support the non-existence of silver sub-halides, and they bear out the conclusions reached by Reinders in 1911 and Bancroft in 1923.

ELECTRO-ENDOSMOSIS.—A contribution to the study of electro-endosmosis, by F. Fairbrother and H. Mastin, appears in the Jour. Chem. Soc. for November. The calculation of the potential gradient along the walls of the capillaries in the diaphragm of an electro-endosmose apparatus involves uncertain assumptions, and a method is described for overcoming these difficulties. In effect, the method consists in measuring the "cell-constant" of the diaphragm, the conductivity of the calibrating liquid being assumed. Measurements with carborundum powder in acid and alkali are recorded; the electrokinetic potential, calculated from the modified Helmholtz equation, reaches a maximum in dilute alkali; it decreases as the concentration of the latter decreases and as the concentration of the acid increases. At the intermediate point (water) the carborundum is negatively charged; the value −0·0698 volt is found for the potential between the two parts of the double layer in distilled water. No reversal of the direction of electro-endosmosis was found with carborundum in hydrochloric acid solutions up to N/50 strength.

THE ATOMIC WEIGHT OF ANTIMONY.—In the November number of the Journal of the American Chemical Society, P. F. Weatherill describes experiments on the atomic weight of antimony. Antimony trichloride, prepared from pure antimony and chlorine in a vacuum, was repeatedly distilled in a vacuum in an all-glass apparatus. It was dissolved in a solution of pure tartaric acid, and compared with pure silver. The mean of nine analyses gave Sb = 121·748 ± 0·00086, which may be compared with the value 121·77 obtained by Willard and McAlpine from the analysis of the tribromide, and the value 121·76 obtained by Hönigschmidt from the analysis of both the tribromide and the trichloride. By taking all three independent researches into account, a value of 121·76 would seem to be close to the truth. The value 120·2, which has appeared in the tables for a number of years, is much too low. It may be remarked incidentally that no atomic weight table appears to have been published by the International Commission since 1921, and that a new table would seem to be due. Differences of the order indicated affect ordinary analytical practice.

Crystal Structure.

DURING the Toronto meeting of the British Association, Sir William Bragg's presidential address was followed by a discussion on crystal structure.

Prof. W. L. Bragg described the manner in which the refractive indices of certain crystals, the structure of which has been determined by X-ray methods, can be quantitatively explained. In calcite, for example, the arrangement of atoms in the planes perpendicular to the trigonal axis consists alternately of calcium ions and CO_3 groups arranged at the corners of a triangular network. The three oxygen atoms are closely packed round a central carbon atom and lie parallel to the planes. Wasastjerna has given reasons, based on the similarity of the refractivities of the molecules or ions Al_2O_3; SO_3; NO_3 and CO_3, for assuming that the refractivity in such groups is to be ascribed to the *oxygen* atoms.

If, then, the carbon atom in the CO_3 group is left out of account, it appears that an electric field perpendicular to the trigonal axes, and so parallel to the plane of the CO_3 group, causes a polarisation of the oxygen atoms which is greater than it would be for an isolated atom. On the other hand, an electric vector perpendicular to the CO_3 plane produces a less polarisation than it would do for a single atom. This polarisation is equivalent to the creation of a set of electric doublets the moments of which will be greater in the first case than in the second. It is evident that the velocity of a wave in the crystal, depending on the ratio of the total polarisation per unit volume and the intensity of the electric field, will be less when the electric vector is perpendicular to the trigonal axes than when it is parallel to these axes. The crystal has a high refractive index for light with its electric vector parallel to the CO_3 planes or perpendicular to the trigonal axis, but a low refractivity for light having its electric vector perpendicular to these CO_3 planes.

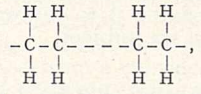
It is possible to calculate the polarisation of the atoms of calcite under a given field. Since the relative positions of the atoms are known, it is possible, by making the assumption that the polarised atom has an external field identical with an electric doublet placed at its centre, to calculate the two refractive indices.

Values of the refractive indices calculated for calcite and aragonite, both crystalline forms of calcium carbonate, show very good agreement with observed values.

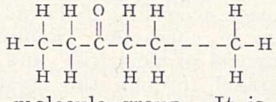
Prof. S. Chapman explained how he and Prof. W. L. Bragg had attempted theoretically to calculate the rhombohedral angles of crystals of the calcite type. A number of carbonates form rhombohedral crystals similar to calcite, having an angle between the crystallographic axes of about 102° for the whole series. The calcite type of crystal has the form of a cube shortened along a diagonal (its trigonal axis) and consists of ions of the form R^{++} and CO_3^{--}. The CO_3 planes, as described above, are perpendicular to this axis. It is, therefore, possible to picture a distortion of this crystal along a trigonal axis such that the type of the lattice is preserved, and the distance between neighbouring oxygen-metal or carbon-oxygen centres is constant. It is found that the electrostatic potential energy per gram molecule of calcite, when calculated for a series of such positions, has a minimum value for an axial angle of about 106°. The difference of 4° can be accounted for as being due to the simplicity of the assumptions underlying the calculation. The *variation* of the angle in a group of crystal carbonates containing different metallic ions can be accurately accounted for by the different sizes of the metallic ions.

When considering the arrangement inside a crystal, it is obvious that the atoms must be held in position by forces symmetrically disposed. This symmetry disappears at the surface, so the surface layers must possess properties different from those of the mass. Prof. C. H. Desch described experiments made with gold, showing that the cohesion and surface tension of a crystal do not necessarily decrease at the same rate with rise of temperature. The surface tension at high temperatures is sufficient to round the sharp angles of a crystal, so that beads of gold slowly cooled have a skin resembling a film of gelatin over them. This can be removed by etching to expose the normal structure.

In discussing the structure of the long chain carbon compounds, Dr. Shearer emphasised the fact that the measurements he and Dr. Müller had made pointed to the existence of a simple relation between the dimensions of a single molecule and the dimensions of the crystal cell. When X-ray spectrograms of compounds are measured which have a structure based on the chain

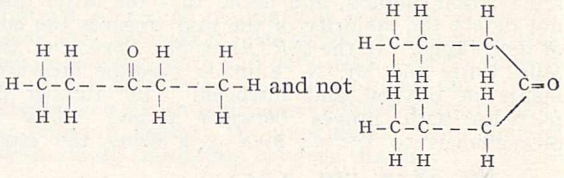


it is found that the most prominent lines are due to one spacing which is much larger than the others. For substances which differ only in the number of CH_2 molecules in the chain there is a regular progressive increase in the size of this spacing as the number of CH_2 groups increases. Frequently, if the number of carbon atoms in such a chain is plotted against the spacing, the points lie on a straight line, and approximately the spacing is either equal to or twice the length of the molecule. The double spacing is characteristic of molecules having an active group at one end; hydrocarbons, esters, and ketones, which have no active group at the end, show the single molecule spacing. For example, measurements of a ketone series such as



gave a single molecule group. It is interesting to note, however, that five methyl ketones, in which the oxygen is attached to the penultimate carbon atom, gave the double spacing. When the spacing of these methyl ketones is divided by two, these compounds take their place on the straight line representing the other ketones. Evidently in the methyl ketones the oxygen is sufficiently near the end of the chain to behave as an active group. This result indicates the effective range of attraction of the oxygen atom.

There are three rates of growth indicated for chain compounds, appearing to show that the CH_2 molecule can occupy three different lengths in the chain. Suggestions have been made to account for this variation in length by different arrangements of the carbon atoms in the chain. These measurements appear to give a real meaning to stereochemical formulæ. It appears, for example, that ketones have the structure



The spectra of double molecule chains give, as one would expect, strong odd orders and weak even, whilst the single chains give orders decreasing uniformly in intensity.

Mr. S. H. Piper gave some examples of the use of X-ray spectra in distinguishing between long chain compounds of similar types. It was possible to show that the fractions obtained by distilling paraffin wax *in vacuo* were not identical with normal hydrocarbons. For example, one fraction having the same number of carbon atoms in the chain as dotriacontane showed a very much smaller spacing. All fractions appeared to photograph as pure substances, and it was interesting to notice that the lines shown by a film of crude paraffin wax melted on glass gave the same spacing as one of the eight fractions. On mixing this fraction with one or more of the others, its lines only appeared on the plate.

Dr. Müller mentioned that the main spacing given by certain hydrocarbons appeared to have two possible values, indicating two possible crystalline structures for these substances.

Mr. W. T. Astbury indicated how it is possible to determine from X-ray measurements, by making use of the theory of space groups, the elements of symmetry possible to the molecules in the crystal cell. It is then possible to distinguish between two or more structural formulæ for a given compound. A most valuable series of tables was shown giving the possible molecular symmetry for all the 230 space groups.

Oyster Mortality in 1920.

PART I. of the report under notice [1] was reviewed in NATURE of July 19, p. 82. It contained Dr. Orton's Final Report, while Part II. commences with his Interim Report of December 30, 1920, which apparently is now published for the first time. It shows the preliminary biological investigations that were made by Dr. Orton, together with his examination of the dumping-ground for explosives in the Black Deep, and is altogether admirable. Why this was not printed in proper sequence, these being the preliminary conclusions of the same author, it is impossible to understand. Further, if it had been published as soon as received instead of in 1924, it would have relieved the minds of those concerned with the oyster industry, and probably elicited from them much further information, besides stimulating and directing their own observations; those responsible for the industry are not unheeding of the results of scientific research.

Dr. Orton's interim report is followed by a series of valuable research reports on special questions. Dr. Eyre's very thorough investigations, mainly shown in tables, lead to the conclusion that no evidence points to the excessive mortality being due to *disease* of bacterial origin. Dr. Brady tested very thoroughly from the chemical side and came to a similar negative conclusion in respect to the dumped munitions of war. The Government Chemist and his staff in four reports are largely concerned with arsenic, which is very widely contained in silts formed from rocks containing arsenic. As diseased and healthy oysters have the same amount, this clearly cannot account for the mortality, nor is there any suggestion of the mortality possibly being due to "dumping" of arsenic compounds either by factories or by the Munitions Department. However, the possibility of arsenic in oysters being of danger to man is unavoidably raised, especially as the silts of the Fal contain large quantities of copper, zinc and tin also, whereas these are practically absent from the oyster grounds of the Thames estuary and the East coast. The present reports, critically examined in connexion with former researches, give no cause for any suggestion of danger to human life from these substances as consumed by the most gluttonous lover of oysters. Yet, we do not think these researches should stop here without a more definite examination and pronouncement on this question by the Government Chemist, whose staff must now have considerable experience in the necessary analyses, and who can consult as may be advisable with the expert physiologists of the Ministry of Health.

If the analyses of any oysters give any suggestions of danger, the beds from which those oysters come must clearly be closed for direct sales, the fish being first laid elsewhere for a period sufficient to remove the noxious substance, as is required for bacterial infections. What is first required, however, is a definite pronouncement as to what constitutes danger. Without this the present report will inevitably give rise to alarm, if it ever becomes known to the "man in the street." This is unlikely, however, as it costs 7*s.* 6*d.* for 69 pages, without illustrations, and free copies are not distributed. This is scarcely the way in which to make scientific research popular. Our Government authorities have much to learn from a study of the effect of a liberal free distribution of similar reports in the United States. J. S. G.

[1] Ministry of Agriculture and Fisheries. Fisheries Investigations, Series 2, vol. 6, No. 4, 1924: An Account of Investigations into the Cause or Causes of the Unusual Mortality among Oysters in English Oyster Beds during 1920 and 1921. Part 2: Chemical Reports, (1) by George Stubbs, Andrew More and John Ralph Nicholls, and (2) by Dr. O. L. Brady; Bacteriological Reports, by Prof. J. Eyre; Report on Field Work, by F. S. Wright; Biological Investigations, by Dr. J. H. Orton; Recommendations as to Further Research, by Dr. J. H. Orton. Pp. 69. (London: H.M. Stationery Office, 1924.) 7*s.* 6*d.* net.

The Thermal Efficiency of Steam Engines.

A DISCUSSION on the standards of comparison in connexion with the thermal efficiency of steam engines was held at the Institution of Civil Engineers on Thursday, December 11. The Heat Engine and Boiler Trials Tabulation Committee has appreciated the fact that the present standard of comparison needed development, and asked Capt. H. Riall Sankey to prepare a memorandum on the subject with a view to discussion at a joint meeting of the Institutions represented on the Committee (*v.* NATURE, December 6, p. 835). The 1896 Committee of the Institution of Civil Engineers, under the chairmanship of Sir Alexander Kennedy, proposed the Rankine cycle as a standard. Since that time the practice of heating the feed-water by live steam abstracted from the engine during expansion, known as "bleeding," has been developed, resulting in considerable economy, but to this case the Rankine cycle does not apply. The practice is also adopted of reheating the steam after a partial expansion, a process which can be repeated once or more, after which the steam is expanded to the back pressure, but it would be stretching the definition of the Rankine cycle to apply it to this case. Further, these feed-heating and reheating cycles can be combined, and the question arises, can a standard of comparison be defined that will meet all cases?

It is submitted that the following extended definition can be applied to all cases :

It is assumed that all the component parts of the steam plant are perfect, and that there are no losses due to initial condensation, leakage, radiation, or conduction, and that there is no clearance in the cylinder. The feed-water required is taken into the boiler at the exhaust temperature, and its temperature is gradually raised until that corresponding to saturated steam is reached. Steam is then formed at constant pressure until dry saturated steam is produced, after which, if the steam is to be superheated, heat is added at constant pressure and at increasing temperature, until the required temperature of superheat is reached. The steam is introduced into the cylinder at constant pressure, displacing the piston, and performing external work equal to the absolute pressure multiplied by the volume swept through by the piston up to the point of cut-off. Beyond that point expansion takes place adiabatically, doing work until any desired pressure is reached, when the steam is reheated at constant pressure to any desired temperature whence adiabatic expansion takes place ; such reheating process can be repeated as often as desired. Finally, the steam is expanded adiabatically until the temperature of saturation corresponding to the boiler pressure is met. From this point, *either* adiabatic expansion continues doing work until the pressure in the cylinder is equal to the back pressure against which the engine is working, *or* the steam is expanded so that a portion of the heat is transferred to the feed-water in such a manner that at every temperature the amount of heat so transferred is equal to the increase in water-heat at that temperature, until the pressure in the cylinder is equal to the back pressure against which the engine is working. The steam is then completely exhausted from the cylinder at constant pressure corresponding with the lower limit of temperature, work being done on the steam by the engine during exhaust, equal to the absolute back pressure multiplied by the total volume swept through by the piston. The steam is thus removed from the cylinder and the cycle is complete.

In practice, the following main cases occur resulting from the omission of one or more of the factors of the comprehensive definition :

(1) Saturated steam with simple adiabatic expansion to the back pressure.

(2) Superheated steam with simple adiabatic expansion to the back pressure.

(3) Superheated steam with one or more reheats with final adiabatic expansion to the back pressure.

(4) Saturated or superheated steam with feed-heating expansion to the back pressure.

(5) Superheated steam with one or more reheats, and final feed-heating expansion to the back pressure.

The thermal efficiency of any heat engine is defined as the ratio of the heat utilised as work to the heat supplied. Capt. Sankey gives some worked-out examples to illustrate the method, and makes use of the Mollier chart and of Callendar's Fahrenheit Steam Tables. He also includes tables of results of a large number of other calculations for different cases, and includes among these one illustrating the Benson cycle, in which steam is generated at the critical temperature (706° F.) at a pressure of 3200 lb. per sq. inch absolute. For comparison, the thermal efficiencies of a gas engine and of an oil engine have also been worked out and are included in the tables.

Capt. Sankey's memorandum gives some idea of the arduous task which the Committee has had to face, and the final recommendations will be welcomed by the engineering profession.

Parker Plant for Low Temperature Carbonisation.

ATTENTION has already been directed in NATURE (September 20, p. 441) to the Government offer to test at public expense approved processes for the carbonisation of coal at low temperatures. The Low Temperature Carbonisation Company, Ltd., has been quick to submit for test the standard unit of " Parker " plant installed near Barnsley at Barugh (locally pronounced " bark," it may be added for the enlightenment of the uninitiated). The Department of Scientific and Industrial Research has now issued a report of the test made in July last. The Director of Fuel Research in a prefatory note emphasises that the report is on technical results only, and that " no attempt is made to pronounce on the commercial possibilities of the plant."

The coal is carbonised in vertical iron tubular retorts, 9 ft. long and of average diameter of 5 in., the retorts being cast in groups of 12 assembled in a setting of 32 groups. The setting is heated by the gas made, and is equipped with closed chambers below the retorts to receive the coke after carbonisation, and allow it to cool without quenching and consequent contamination with moisture. Such a setting was designed to have a throughput of 50 tons of coal per day, and in the test, lasting two days, it was found that this claim was substantiated.

The coal employed was " Dalton Main," with which the Fuel Research Station had already considerable experience. It was a washed slack, fairly dry, containing 5 per cent. only of ash—a low figure for commercial supplies of coal. The yields of products per ton of coal as charged were :

Coke	13·92 cwt.
Gas	5620 cub. ft. or 39·6 therms.
Tar	18·62 gallons.
Crude Spirit (motor)	1·78 gall. yielding 1·39 gall. of refined product.
Liquor	26 gall., equivalent to 13·55 lb. of ammonium sulphate.

The coke produced, the report states, was of suitable size, not friable, contained little breeze, and only 4 per cent. of volatile matter. It successfully withstood an eight-day railway journey to the Fuel Research Station, was readily ignited in a household grate, and gave a good hot fire. It would appear, therefore, that the claim that the process produced a smokeless domestic fuel was substantiated. The analysis showing a volatile content of some 4 per cent. raises a doubt as to whether this fuel will develop the " cheerful blaze " which is so attractive to lovers of a coal fire, and contributes so much to speed of ignition.

The yield of tar was high, and chemically it was of the " low temperature " character. The yield of crude motor spirit was moderate, but the refining loss and consequent cost was considerable. The quantity of ammonia recovered per ton was good for low temperature practice, though low judged by existing carbonising practice, while the liquor obtained was so dilute that it is considered doubtful whether recovery was commercially justifiable.

The whole of the rich gas made was employed in heating the setting, supplemented by some producer gas specially generated. Compared with modern carbonising practice, this is a high fuel consumption, and it is pointed out in the report that a reduction could be effected by better design of the plant. The loss of this rich gas is more serious commercially, as the gas is the most valuable and least speculative

by-product of low temperature carbonisation. It may be assumed that the gas will eventually be put to some better use than heating the setting, for otherwise the financial burden of the process would have to be carried entirely by the coke and the tar and light oil—conditions which do not hold promise of smokeless fuel at a low price. As regards the economics of the process in general, though the report expresses no opinion, the data given as to plant and labour do not suggest low costs when compared with those of current carbonising practice.

The general impression which the report conveys is that the process yields a carbonised fuel regarded as meeting domestic requirements which will probably prove costly per ton, and the scope of the process will depend on whether the general public will be prepared to pay the price for such smokeless fuel in order to avoid the atmospheric pollution following the use of raw coal. H. J. H.

Applied Science at the University of Brussels.

THE highly successful celebrations in connexion with the fiftieth anniversary of the founding of the Applied Science School of the University of Brussels were held in the latter half of November, and were attended by the King of the Belgians, who received the foreign delegates, and also by the Duke of Brabant, who laid the foundation stone of a new building which will continue the development of the University. The city of Brussels and private donors have contributed largely to this scheme, as also the American Committee for the relief of Belgium. Great progress has been made in the buildings for pure and applied science at Solbosch, on the outskirts of Brussels, where, with ample space at disposal, it has been possible to erect a very fine block of buildings in the form of a hollow square.

Physics and chemistry are very well housed and equipped, and especial care has been taken to provide a number of small rooms for research work. The electrical engineering laboratories are remarkably well planned, and especially so as regards the arrangement of their numerous power circuits, which are carried round the walls below the windows and are protected by wire grillages. These circuits are connected to a number of panel units also completely enclosed and provided with the usual resistances, switch gear and measuring instruments all connected up in such a manner that students can readily trace out the various circuits, to which access is gained by numerous doors.

The main laboratory for investigating the strength and other physical properties of materials is chiefly notable for a fine equipment of Amsler testing machines housed in a spacious room provided with an overhead crane, and there are also a considerable number of accessory instruments for measurement and calibration work. A special photo-elastic laboratory is also arranged for in connexion with this department.

The laboratories for technical thermodynamics and hydraulics are now in course of equipment and are on a large scale typical of continental views of such matters, and, like the other laboratories, have well-lighted basements with considerable head room, an arrangement which is especially convenient for steam plants and machinery dealing with the flow of liquids.

In connexion with the celebrations, a number of scientific and technical addresses were given, and numerous other functions were arranged by the Government, the University, and the civic authorities. E. G. C.

University and Educational Intelligence.

ABERDEEN.—The University Court has appointed Dr. A. Bowman to the lectureship on the scientific study of fisheries, in succession to Dr. T. Wemyss Fulton, resigned.

Prof. A. Findlay has proceeded on leave of absence to the United States, where he will act as substitute professor of chemistry at Leland Stanford University for the next nine months.

CAMBRIDGE.—The report of the Botanic Garden Syndicate refers to continued financial anxiety despite the generous support of Mr. Reginald Cory. A prospective legacy from an old friend of the Garden is referred to in the report at her special request in order that it may stimulate others to follow her excellent example. In the recent death of Mr. R. I. Lynch, Curator of the Garden from 1879 until 1919, a link with the past has been snapped. One item of interest in the report is the exchange of shrubs from the Garden for birds from the Zoological Society of London, two pairs of mandarin ducks having been recently received.

The John Bernard Seely Prize, formerly given for an essay in aeronautics, is in future to be awarded to the candidate who does best in aeronautics in the Mechanical Sciences Tripos.

EDINBURGH.—Sir Richard Lodge, who has been Dean of the Faculty of Arts for thirteen years, has resigned this office, and the Faculty has elected Prof. E. T. Whittaker to succeed him as Dean. Prof. Hudson Beare and Prof. Lorrain Smith have been re-elected Deans of the Faculties of Science and Medicine respectively.

At its last meeting the University Court, on the recommendation of the Senatus, appointed Dr. Claude B. Ker, lecturer in infective fevers, to be a senior lecturer, with a seat on the Faculty of Medicine and on the Senatus, and Dr. E. M. Horsburgh, reader in technical mathematics, to be a member of the Senatus.

Dr. Douglas A. Allan, at present an assistant in the Department of Geology, has been appointed lecturer in geology in Armstrong College, University of Durham.

LONDON.—The following doctorates have been awarded:—*Ph.D.* (*Science*), Mr. R. E. W. Maddison (King's College) for a thesis entitled "Part I.: The action of light on chlorine water and aqueous hypochlorous acid solutions; Part II.: Retardation and acceleration of certain chemical reactions by light of different wave-lengths"; Sachindranath Sen (Imperial College—Royal College of Science) for a thesis entitled "On the design of the Kew pattern barometer."

WE learn from the *Chemiker Zeitung* that Prof. A. von Parseval has been nominated to the newly instituted chair of aviation at the Munich Technical Hochschule; and that Dr. Wilhelm Eitel, professor of physico-chemical mineralogy and petrography at Königsberg, has been invited to the chair of mineralogy at Freiburg-im-Breisgau.

APPLICATIONS are invited from medical graduates for the Marks lectureship in applied physiology and the Sheridan fellowship in the University of Adelaide. The applications, with testimonials, statement of academic qualifications, published researches, and a recent photograph, should be sent before the end of January, marked outside "Application for Marks Lectureship," to the Vice-Chancellor of the University, c/o the Agent-General for South Australia, Australia House, Strand, W.C.2.

FOLLOWING closely on the announcement of a gift by Mr. G. Eastman of about 3,000,000*l.* for educational purposes, which was referred to in this column last week, came a message from the New York correspondent of the *Times* announcing a further munificent gift to American education. It is stated that Mr. James B. Duke, who is connected with the tobacco and water-power industries, has created a trust fund of about 8,000,000*l.* for establishing a university in North Carolina which will bear his name. Should Trinity College at Durham in that State agree to change its name to Duke University, the trustees of the fund are authorised to expend 1,200,000*l.* in expanding and extending it, otherwise this sum will be used to start immediately the building of the new university. The trust provides that 20 per cent. of the income from the capital shall be withheld until an additional 8,000,000*l.* has been contributed from other sources. Other educational institutions, churches, hospitals, etc., in North and South Carolina will also benefit under the trust.

A PAMPHLET has been issued by the London County Council containing the lectures for teachers which have been arranged for the coming year. Some of the courses are repetitions of those given during the past term and announced in the handbook of lectures issued last August (see NATURE, August 30, p. 334). New courses include a series on some of the public services of London, each lecture of which is to be delivered by an authority. Among the lecturers are Mr. T. Hardie, of the Gas Light and Coke Co., on the manufacture and distribution of gas; Sir Alexander Houston, of the Metropolitan Water Board, on pure water supply; Mr. J. H. Rider, on electricity supply. Special single lectures will also be given by Mr. W. H. Barker and Prof. P. M. Roxby on problems of tropical Africa and the political geography of the Far East respectively, while Dr. Cyril Burt is to deliver two courses of five lectures each on sub- and super-normal children. Particulars of the lectures can be obtained from the County Hall, Westminster Bridge, London, S.E.1.

AT the annual meeting on November 20 of the Carnegie Corporation of New York, the president and treasurer presented reports, and a brief statement has been printed in *Science*. From this account it appears that the assets of the Corporation on October 1, 1923, were about 26,700,000*l.*; this sum constitutes two trusts for the advancement and diffusion of knowledge and understanding among the people of the United States and in Canada and other British Dominions respectively. During the past year about 2,600,000*l.* was paid out from the former trust and about 18,000*l.* from the latter. Noteworthy grants (approximately in pounds sterling) made during the year were as follows: Carnegie Institute of Pittsburgh, 3,265,000*l.* (the largest single grant made in the history of the Corporation); National Research Council and National Academy of Sciences, 1,000,000*l.*; educational institutions in Eastern Canada, 600,000*l.*; Institute of Economics, 330,000*l.*; Food Research Institute (Stanford University, California), 141,000*l.*; Johns Hopkins Medical School, 400,000*l.*; New York Academy of Medicine, 200,000*l.*; American Library Association, 37,000*l.*; Harvard University (for training personnel for museum service), 20,000*l.*; Institute of International Education, 36,000*l.*; Society for the Promotion of Engineering Education, 22,000*l.*; University of California (for the study of pyorrhea), 17,000*l.*; Union University (Albany Medical College), 10,000*l.*; various agencies for insulin research, 9000*l.*

Early Science at the Royal Society.

December 20, 1677. Mr. Oliver Hill read a written discourse of his, about the method which the Society ought to take in their proceedings, much different from what they then followed.

December 21, 1663. It was ordered that Dr. Merret and Dr. Whistler inquire of some members of the College of Physicians concerning the form of the warrant for bodies to be demanded from the sheriff of London for dissection, and make report thereof.

1664. There were read three several accounts of the comet lately seen, one by Sir Robert Moray, as he observed it December 17 at Whitehall; another sent from Portsmouth, as it was seen by the earl of Sandwich on board of the London at Spithead; a third sent from Ireland, as it was seen at Dublin by Mr. Kearney and another gentleman severally.

1671. Mr. Isaac Newton, professor of mathematics in the university of Cambridge, was proposed candidate by the lord bishop of Salisbury.

December 22, 1686. A paper of Dr. Papin about shooting a spherical bullet by exhausting the air out of the barrel was read, and the experiment shown: but by reason of the night the fall of the bullet could not be seen, and therefore the experiment was ordered to be made some other time [Earl of Carbery, president].—Mr. Hooke read his discourse concerning shells, etc., wherein he gave several material instances to prove, that there have been very great changes in the earth's surface, as of rows of oister shells found in a cliff in the Alps, sea-sand and shells at a great depth in St. James's fields, and the like shells observed by himself at a great hight from the sea, in a cliff in the Isle of Wight.

December 23, 1663. Occasion being given to discourse of tormenting a person with the sympathy-powder, Dr. Wren related, that in the house of a kinsman of his, the experiment had been tried by him upon a servant, who had grievously cut her finger; and a rag rubbed upon the wound being dressed with calcined vitriol, and put into the maid's bosom, her finger within a short time was cured. Whereupon he had taken the rag from her and heated it upon the fire, whilst the maid was sweeping the next chamber; who, upon a sudden, flung away the broom, and cried out for the pain in her finger; which being looked to was found very fiery: upon which they cooled the rag again, and dressed as formerly, and within a day or two the finger was intirely cured. Mr. Boyle undertook to try this experiment upon a dog.

December 24, 1662. Mr. Charles Howard was proposed candidate by Col. Tuke, and was presently chosen; his desire being to be rather admitted by scrutiny, than by the privilege of his birth.—Sir Robert Moray and Mr. Bruce made several relations of accidents which had happened in coal-mines; and were desired to give them in writing.

December 27, 1666. It was ordered, that the operator Richard Shortgrave, do for the future bring no bill of work done for the society without some avoucher, who shall be a curator of the respective experiments, about which he shall have been employed: and that without such avoucher, no account of the said operator shall pass in council: with which order he, being called was made acquainted. [This "operator" would appear to have acted as such for ten years, since at the expiration of that period, we read that it was ordered that "the apothecary's bill for the last sickness of the late Mr. Shortgrave be paid by the treasurer, his widow having first delivered up all the instruments, utensils, etc., belonging to the Society."]

Societies and Academies.

LONDON.

Royal Statistical Society, November 18.—G. Udny **Yule**: The growth of population and the factors which control it. Prof. Verhulst's law implies that the percentage rate of increase falls continuously, and in the simplest case is a linear function of the population at any moment. Verhulst's work fell into oblivion, but recently and independently has been suggested by Profs. Pearl and Reed. If a population unaffected by migration follows such a law of increase, it can only be by the death-rate rising, or the birth-rate falling, or generally by the death-rate rising continuously *relatively* to the birth-rate. The death-rate tends to increase with density of population, but in recent times in civilised States this tendency has been completely outweighed by the progress of medicine, and the death-rate has fallen rapidly in spite of great increases in population. This suggests that, in recent times at least, the birth-rate has been the controlling factor. If a population, subjected to constant death-rates at every age, grows in accordance with a law of the kind suggested, the death-rate tends continuously to increase—at first slowly, then more rapidly, and then slowly again—owing to the increase in the proportion of the old. The facts in general, in particular the very early stage at which the fall in the rate of increase becomes apparent, suggest that the growth of population is a biologically self-regulating process and that the regulation is highly sensitive. Malthus's conclusion that the checks to population may be fairly resolved into misery and vice is an exaggerated statement of the case.

Royal Microscopical Society, November 19.—G. R. **de Beer**: The histology of the pituitary body. The anterior lobe of the pituitary body has been known for some time to contain cells of two markedly different kinds, and the problem has not been solved as to whether these kinds represent distinct cell-types, or different stages of functional activity of one kind of cell. Critical fixation and staining with particular Romanowsky stains reveals the difference in staining-reaction between the two types of cells, and the interesting point that no intermediates appear, at least in the cat and the ox. Examination of the nuclei, the nature of the granular contents of those cells which can be proved to be active in secretion, and of the Golgi apparatus, reveals variability. The argument from comparison, however, and especially with the rabbit, where intermediates appear, and forms lower on the vertebrate scale of evolution, suggest that the latter of the alternative hypotheses is true. Critical methods emphasise the distinctness of the recently recognised pars tuberalis.—Miss J. **Latter**: Pollen development in *Lathyrus odoratus*. The resting nuclei of the pollen mother cells of *Lathyrus odoratus* exhibit a large nucleolus in which a crystalloid, probably of protein nature, is constantly present. The reticulum is of a very granular appearance, becoming definitely thread-like during synapsis. The post-synaptic thread at first lies in large irregular loops throughout the nuclear cavity, one loop always being connected with a deeply staining body in the nucleolus, possibly a modified form of the protein crystalloid. Seven loops of the thread persist, each comprising a pair of homologous chromosomes united end to end, and they radiate from the centre of the cavity. The name *broxonema* is given to this stage. The arms of the loop become intimately twisted round one another, thus affording opportunity for exchange of segments between the homologous chromosomes of a pair. This provides a possible physical basis for the phenomena of crossing over.—W. N. F. **Woodland**: Some remarkable caryophyllæids from siluroid fishes of the Sudan. Caryophyllæus is of special interest as being an example of a monozoan cestode. Until last year, less than a dozen species were known, all very similar to each other. The new caryophyllæids differ greatly from all those previously discovered and form a new genus Wenyonia. Wenyonia differs from Caryophyllæus in having the sexual apertures situated in the anterior half of the body, in the longitudinal extent of the uterus being as great or greater than that of the testes, in the vitellaria being medullary instead of cortical, and in some other respects.

Linnean Society, November 20.—H. A. **Baylis**: Cestodes from whales of the genus Balænoptera. The first form referred to was the recently described *Priapocephalus grandis* Nybelin, a tetrabothriid in which the typical suckers and auricular appendages of the scolex have disappeared, and the scolex has been modified into a bulbous "holdfast," which is buried in the lining of the host's intestine. Great similarity exists between the scolex of Tetrabothrius and that of Dinobothrium, a genus usually referred to a different group of cestodes, the Tetraphyllidea. It was suggested that, through such forms as these two genera, the Cyclophyllidea and Tetraphyllidea grade into each other.—J. R. **Norman**: Blind cave-fishes. The known forms now number about seventeen, to which may be added an undescribed blind catfish recently received by the British Museum (Nat. Hist.) from the Guacharo Caves, Trinidad. The cyprinodont family Amblyopsidæ contains eight species variously distributed in the United States, seven of which live permanently in subterranean waters, while one inhabits open streams. All have more or less degenerate eyes, which are merely vestigial in five species. In most of them sensory papillæ have been developed on the head and body to compensate for the loss of vision. The two blind fishes occurring in caves in Cuba belong to a marine family, the Brotulidæ. In both the eyes are vestigial and covered with skin in the adult, but small and well developed in the young. The head is provided with small tactile appendages. The remainder of the blind cave-fishes are all members of the order Ostariophysi, and occur in America and Africa. Two of them, belonging to the cyprinoid suborder, are related to the widely distributed genus Barbus; the remainder are allied to various members of the sub-order Siluroidea (catfishes). The eyes present varying degrees of degeneration, sometimes even in the same species, and accessory sensory organs are sometimes developed. The association of degenerate eyes with cavernicolous habits thus appears in several very different families and in many widely separated regions of the world.—G. H. **Stilwell** and H. **White**: *Pyrus lagenarius*. The tree was raised from seed gathered by E. H. Wilson for the Arnold Arboretum, in 1910, at Tachien-lu, in the Province of Sze-chuan near the Tibet frontier, at a height of between 5000 and 6000 feet. The original bush is now 9 feet high. The flowers are red and white. The leaves large, persisting on the ends of the shoots during the winter, and after a few years it fruits freely. The fruits become a beautiful golden-yellow by Christmas, and make a delicious jelly. It appears quite hardy in the South of England, and grows rapidly.

Physical Society, November 28.—Discussion, arranged jointly with the Royal Meteorological Society; Ionisation in the atmosphere, and its influence on the propagation of wireless signals.—W. H. **Eccles**:

A brief history of wireless telegraphy in relation to atmospherics, and an outline of the parts that may be assigned to diffraction, the Heaviside layer and ionic refraction is given. Certain facts, such as the errors of direction finding at night, and the success of long-distance transmission using short wave-lengths, offer confirmation of the hypothesis of an ionised layer in the upper atmosphere.—C. **Chree**: Atmospheric ionisation and its variations. For instantaneous values it suffices to know the potential gradient and either the conductivity or the vertical air-earth current; but in the case of mean values a knowledge of all three elements is necessary. Information as to diurnal variation is very scanty, except in the case of potential gradient. The monthly values in the annual variation, and the hourly values in the daily variation, are expressed as percentages of their arithmetic means. This is done partly because less uncertainty attaches to relative than to absolute values in the case of all the electrical elements. Reference is made to some conclusions as to the diurnal variation of potential gradient and the existence of a sun-spot period recently arrived at by Dr. Bauer and Dr. Mauchly, of the Carnegie Institution of Washington.—E. V. **Appleton**: Geophysical influences on the transmission of wireless waves. The variability of signals may sometimes be attributed to the varying phase and amplitude of rays ionically refracted by the upper atmosphere. The diurnal variation of such signals is described, and the strong night signals attributed to a lower atmosphere devoid of excessive ionisation. The facts of wireless telegraphy show that the atmosphere exerts a variable but usually favourable influence on wave propagation. This influence may be interpreted in terms of ionic refraction (Eccles), which, to prevent excessive dissipation, must take place at levels sufficiently high to make the mean free paths of the effective carriers large (Larmor).—R. A. Watson **Watt**: Atmospherics. The results of an examination of the meteorological conditions prevailing at apparent sources of atmospherics, as located by direction finding, show that, even with the limited data available, relations with thunderstorm phenomena, precipitation, or barometric minima have been traced in 87 per cent. of 490 cases, distributed over Europe, the Mediterranean, and North Africa. The tracing of a "cold front" for forty hours over 2000 km. across Western Europe, by directional recording of atmospherics, is reported. —C. T. R. **Wilson**: The electric field of a thunderstorm and some of its effects. A thundercloud may be pictured as having its upper and lower regions oppositely charged, the positive charge being most commonly on the lower side. The cloud lies at a moderate distance above the earth, while the Heaviside layer lies at possibly 100 km. above the earth. A lightning flash constitutes a short-circuit, in the absence of which the charges may leak away to the earth and the Heaviside layer respectively. Three possible causes of ionisation are suggested: (1) The charges on the cloud may ionise by induction at heights where the density of the air is very small. An ordinary cloud may have a sufficient electric moment to produce a similar effect, since this moment may be great even where the charges themselves are small, provided that the charges are separated by a great depth. (2) Beneath a thundercloud there is an intense potential gradient, producing a heavy earth-air current; the intensity of this current is hidden near the earth by the fact that part of it passes upwards through trees and the like. (3) The radio-active matter in the atmosphere produces β-particles, the energy of which, under the influence of the immense potential differences available, may be so great as to impart to the particles a kinetic mass equal to the mass of hydrogen atoms.—S. **Chapman**: The evidence of terrestrial magnetism for the existence of highly ionised regions in the upper atmosphere. Balfour Stewart's "atmospheric dynamo" theory of the daily magnetic variations is described; the earth's permanent magnetic field is the magnetic field of the dynamo; the atmosphere (undergoing small, but extensive, motions owing to thermal or tidal causes) is the moving armature; and particular ionised regions in the upper strata correspond to the "windings" in which the induced currents flow. The variations of ionisation are the chief cause of the changes of intensity in the diurnal magnetic variations, as between day and night, winter and summer, and sunspot minimum and sunspot maximum. Hence these changes in the magnetic variations indicate the changes in the ionisation of the atmospheric regions concerned. There seem to be two modes of ionisation, both due to the sun, and affecting different regions; one region, ionised by ultra-violet radiation, is a practically world-wide layer, possibly at about 50 kilometres above the surface; this is most intensely ionised directly under the sun in the sun-lit hemisphere, and the ionisation diminishes during the night. The other region consists of the polar caps within the auroral zones, and especially these zones themselves; this region is ionised by the impact of corpuscles emitted from disturbed regions on the sun's surface.

CAMBRIDGE.

Philosophical Society, November 24.—C. T. R. **Wilson**: The acceleration of β-particles in strong electric fields such as those of thunderclouds. An electric force of two-thirds of the sparking value is sufficient to give to a β-particle, travelling in air in the direction of the field with a velocity corresponding to 20,000 volts, additional energy which exceeds by the equivalent of about 10,000 volts the average rate of loss per cm. of air traversed. As the energy of the particle increases under the action of the accelerating field, the chance of survival of the particle increases, and the critical magnitude of the field required to produce a resultant gain of energy diminishes, reaching a limiting value for fast β-particles of about 1000 volts per cm. In the strong electric fields extending over great distances associated with thunderclouds, the energy acquired by β-particles may reach extremely high values, and X- or γ-radiation of correspondingly high frequency may be associated with them. Thunderclouds may thus be sources of "penetrating radiation."—G. F. C. **Searle**: The determination of the frequency of an alternating current supply by the vibration of rods.—F. W. **Aston**: Photographic plates for the detection of mass rays. The sensitivity of photographic plates to mass rays bears practically no relation to their sensitivity to light. The process of improving the qualities of the plates by "schumannising" is discussed and details are given of the procedure so far found most advantageous.—E. B. **Moullin**: On the current induced in a wireless telegraph receiving antenna.—R. R. S. **Cox**: Note on the chemical constant of chlorine.—L. **Bastings**: The decay constant of radium emanation. By comparing the activity of two nearly equal sources of radium emanation, first separately, and later together, with a standard radium source, by the aid of a simple β-ray electroscope, the decay constant of the emanation has been deduced, $\lambda = 0{\cdot}1808$ day^{-1}, or half-period $3{\cdot}833$ days, with an accuracy of at least 1 in 500.—E. L. **Davies** and G. N. **Livens**: The kinetic theory of metallic condition.

EDINBURGH.

Royal Society, November 24.—J. A. **Eldridge**: Note on Prof. Whittaker's atomic model.—J. **Tait** and W. F. **Emmons**: The mechanism of massive movement of the operculum of *Balanus nubilis*. The interest of this movement lies in the fact that, in its defensive reaction against any irritation caused by the lodging of an object on the opercular membrane, *Balanus nubilis* makes forceful rotatory movements of the operculum, the effect of which is to grind or crush the intruding object between the shell and the tergal plates. The pressure so exerted is very great, and yet there is no articulation of the operculum with the shell involving the contact of solid bearing surfaces. The forceful movement of the operculum with the strong lateral pressure which it can exert is due to two factors: (1) the horizontal component in the pull of the obliquely directed fibres of the powerful depressor muscles, and (2) hydrostatic pressure within the fold of the opercular membrane on the opposite side, the internal pressure being found to reach so much as 430 mm. of mercury.—T. J. **Jehu** and R. M. **Craig**: Geology of South Uist and Eriskay. The outstanding feature in the geology of the region is the great belt of crushed and sheared rock extending from north to south for a length of 22 miles along the mountainous eastern side of the island. The base of the belt is marked by an extraordinary development of flinty crush rock. This is succeeded to the east by sheared and crushed gneisses, mylonites, and highly mashed gneisses. The gneisses within the belt and west of it were originally of much the same characters and are all of igneous origin, belonging to the Archæan Complex. Dykes of later age include olivine dolerites, quartz dolerites, and lamprophyres. The ice flowing in from the Minch was to some extent deflected by the mountains on the east. The coastal features afford evidence of recent subsidence.—W. **Saddler**: The irreducible system of concomitants of two double binary (2, 1) forms. The problem of finding this system, which is theoretically known to exist, is here solved by Gordan's method of transvectants. Hitherto the only system for two or more given (m, n) forms which has been enumerated is the bilinear case when $m = n = 1$.—A. C. **Aitken**: A series formula for the roots of algebraic and transcendental equations. A series for symmetric functions of any number of the roots of an equation, of which Whittaker's series is a case.

SYDNEY.

Linnean Society of New South Wales, September 24.—Mr. R. H. Cambage, president, in the chair.—A. J. **Turner**: Revision of Australian Lepidoptera. Lasiocampidæ. The name Lymantriadæ is adopted instead of Liparidæ, on the ground that Liparis was preoccupied by Scopoli in the Pisces and cannot be used in the Lepidoptera. The Eupterotidæ, previously recognised as a separate family, are merged in the Bombycidæ. One new species of Lymantriadæ, one of Anthelidæ, one of Saturniadæ, and one of Notodontidæ are described. The natural position and classification of the Lasiocampidæ are discussed, and all the known Australian species, 54 in number and referred to 12 genera, are completely revised.—R. J. **Tillyard**: Upper Permian Coleoptera and a new order from the Belmont Beds, N.S.W. Six specimens of remains of insects from the Upper Permian of Belmont are Coleopterous elytra—four small ones which appear to be ancestral to the Upper Triassic Ademosyne and allies, one large one which is considered to be an ancestor of the existing Hydrophilidæ, and one which belongs to the order from which the Coleoptera arose, for which a new order is proposed, intermediate between the Carboniferous Protoblattoidea and the true Coleoptera. Two new families are described in the order Coleoptera, with two new genera and six new species.—John **Mitchell**: (1) A preliminary reference to a new species of Elonichthys from the lower beds of the Newcastle Coal Measures. (2) Further reference to the occurrence of *Merista plebeia* Sowerby in New South Wales. (3) Eleven new species of Aviculopecten from Carboniferous rocks, Myall Lakes, N.S.W. These form an interesting addition to those already recorded from the Carboniferous and Permo-Carboniferous rocks of Australia. Their occurrence, unaccompanied by a single species known from rocks of similar age elsewhere, is of interest.

Royal Society of New South Wales, October 1.—Dr. C. Anderson, president, in the chair.—M. B. **Welch**: Note on the structure of some Eucalyptus woods. An anatomical investigation of the structure of Eucalyptus timbers may enable these woods, which often resemble each other closely, to be identified with greater accuracy. Thus there is a much greater development of parenchymatous tissue in what are regarded as the more primitive Eucalypts. The species specially dealt with are *E. maculata*, Hook., *E. pilularis*, Sm., and *E. microcorys*, F. v. M. In the latter, numerous oil globules occur, principally in the medullary rays. The presence or absence of tannin, the form of the rays, and the arrangement of the wood parenchyma are valuable diagnostic characters.—W. A. W. **de Beuzeville** and M. B. **Welch**: A description of a new species of Eucalyptus from southern New South Wales. The new Eucalypt was found at an elevation of 4000 feet on the Main Dividing Range, in the vicinity of the Big Badja Mountain. The bark is characterised by the presence of large groups of oil glands, which measure up to 0·25 mm. in diameter.—A. R. **Penfold**: The essential oils of *Melaleuca erubescens* (Otto) and *M. hypericifolia* (Smith). The former is a heath-like shrub with reddish purple flowers, whilst the latter is a handsome shrub with beautiful crimson bottle-brush flowers, and both occur in New South Wales. They both yielded pale lemon-yellow oils much resembling those of Eucalyptus, and were found to contain cineol, a-pinene, dipentene, limonene, a-terpineol, sesquiterpene, etc. *M. hypericifolia* yields the lowest quantity of oil and lowest percentage of cineol when growing near the coast in exposed positions, and the maximum yield of oil and cineol when obtained from moist rocky situations on the mountain ranges.—W. R. **Brown** and W. S. **Dun**: The stratigraphy of the basal portion of the Permo-Carboniferous system in the Hunter River Valley. The discovery of a fossil identified as *Eurydesma hobartense* in mudstones at the top of the Lochinvar shale indicates definitely that this must be regarded as the basal member of the Lower Marine division of the Permo-Carboniferous strata in the Hunter Valley, as originally suggested by Prof. David.—E. **Cheel**: Notes on Melaleuca, with descriptions of two new species and a new variety. Four of the species somewhat resemble the common Swamp Tea-tree (*Melaleuca ericifolia*) and have been previously confused with it, but certain structural characters, the geographical distribution, and chemical evidence distinguish them. A species somewhat resembling a Mountain Bottle-brush is described as a new species. It is fairly plentiful in the south coast districts of New South Wales. A new variety is also described from the Port Jackson district, having been found to have distinctive characters from the plants originally found in Tasmania. A species from the northern parts of the

State is also raised to specific rank, as it has very different characters from the Toad-flax-leaved Tea-tree with which is has previously been confused.

VIENNA.

Academy of Sciences, October 23.—K. **Stosius** and E. **Philippi**: On the action of ammonia on the esters of citraconic acid, mesaconic acid, and itaconic acid.—A. **Kailan**: On the chemical effects of penetrating radium radiation on potassium bichromate, potassium chromate, and potassium permanganate.—H. **Handel-Mazzetti**: Descriptions of new Chinese plants in the genera Carpinus, Podophyllum, Ehretia, Microcaryum, Trigonotis, Onosma, Ceropegia, Pentasacme.—L. **Abolin**: The influence of chemicals on colour change in fish. The action of infundin and adrenalin on the melano- and xantho-phores of the minnow Phoxinus. The assumption of male erythro-phore colouring by females treated with infundin.—V. F. **Brotherus**: New Chinese mosses from the Handel-Mazzetti expedition.

November 6.—Molecular compounds of phenols. IV.—G. **Weissenberger**, F. **Schuster**, and K. **Schuler**: The behaviour of binary systems with phenol and phenol-ethers. V.—G. **Weissenberger** and F. **Schuster**: Vapour pressure curves.

WASHINGTON.

National Academy of Sciences (Proc. Vol. 10, No. 10, October).—P. W. **Bridgman**: Some properties of single metal crystals. Crystals of zinc, cadmium, bismuth, antimony, tellurium, and tin were examined. Some interesting results are as follows: zinc, linear compressibility is nearly seven times as great parallel to the rotational axis as perpendicular to it, and electrical resistance decreases under pressure. Tellurium, linear compressibility parallel to, and thermal expansion along, the axis are negative. Electrical resistance, except for antimony, is greatest across the plane of easiest cleavage or slip. Cadmium forms two polymorphic forms at 20° C. under pressures of 3000 and 6000 kg./cm.^{2}—A. A. **Noyes** and H. W. **Estill**: Effect of insulin on the lactic fermentation. Insulin increases by 20-25 per cent. the amount of acid produced from glucose by *Lactobacillus bulgaricus*. It is hoped that work on these lines will aid in standardising insulin preparations.—M. T. **Bogert** and M. **Chertcoff**: A new group of dyes from poison gases through the 2-aminothiazoles as intermediates. The preparation of thiazole dyes of Doebner violet type. These substances dye silk, wool, and mordanted cotton a green tint similar to malachite green, but bluer and more dull. They are fugitive in direct sunlight. The poison gases used were dichloro ether, chloroacetone, and chloroacetophenone.—M. T. **Bogert** and P. S. **Nisson**: (1) The synthesis of terephthal green and terephthal brilliant green from cymene. These new dyes, compared with malachite and brilliant green (triphenylmethane derivatives), dye wool and silk a yellower green. They compare favourably in tinctorial power and fastness. (2) Further experiments in the field of the terephthalic acid derivatives.—E. B. **Wilson** and W. J. **Luyten**: A statistical discussion of sets of precise astronomical measurements (IV.); the mass-ratio in binaries. The apparent clustering of mass-ratios about unity is probably due to observational selection; the actual association may not be materially different from random mating.—H. **Shapley**: Note on the thermokinetics of dolichoderine ants. The speed of ants varies with changes of temperature. When the temperature was under control, maximum speed was attained by one species of ant, Tapinoma, at 36° C. Through a limited range of temperature, the speed-temperature ratio is constant.

Official Publications Received.

The North Staffordshire Field Club. Transactions and Annual Report, 1923-24. Edited by S. A. H. Burne. Vol. 58. Pp. 157+41-66+70. (Stafford.) 7*s*. 6*d*.

Society for the Provision of Birth Control Clinics. First Annual Report of the Walworth Women's Welfare Centre, 1924. Pp. 16. (London: 153A East Street, S.E.17.)

Memoirs of the Asiatic Society of Bengal. Vol. 8, No. 3: The Boats of the Ganges, by James Hornell; The Fishing Methods of the Ganges, by James Hornell. Pp. 171-238. (Calcutta.) 2.13 rupees.

The South-Eastern Naturalist: being the Twenty-ninth Volume of Transactions of the South-Eastern Union of Scientific Societies, including the Proceedings at the Twenty-ninth Annual Congress, held at Guildford, 1924. Edited by Edward A. Martin. Pp. lxxxvii+99. (London.) 5*s*. net.

British Honduras. Annual Report of the Forest Department for the Year ending 31st March 1924. Compiled by C. L. Stocker. Pp. 18+1 map. (London: Crown Agents for the Colonies.)

Department of the Interior: Bureau of Education. Bulletin, 1924, No. 5: The Chief State School Official. By Prof. Ward G. Reeder. Pp. iv+67. Bulletin 1924, No. 9: Intelligence of Seniors in the High Schools of Massachusetts. By Stephen S. Colvin and Andrew H. MacPhail. Pp. vi+39. Bulletin, 1924, No. 16: Objectives in Commercial Engineering; Report of the Second Conference on Business Training for Engineers and Engineering Training for Students of Business, Pittsburgh, Pennsylvania, May 1 and 2, 1922. Prepared by Glen Levin Swiggett. Pp. iii+66. (Washington: Government Printing Office.) 10 cents each.

The National Physical Laboratory, Teddington, Middlesex: Metrology Department. Gauge Testing. Pp. 39. (Teddington.)

The University of Manchester: the Manchester Museum. Museum Publication 88: Report of the Museum Committee for the Year 1923-24. Pp. 20. (Manchester: Manchester University Press; London: Longmans, Green and Co.) 6*d*. net.

The Manchester Museum: Museum Handbooks. Publication 87: Outline Classification of the Animal Kingdom. By Prof. Sydney J. Hickson. Fifth edition. Pp. 28 (interleaved). (Manchester: Manchester University Press; London: Longmans, Green and Co.) 6*d*.

Transactions of the Royal Society of Edinburgh. Vol. 53, Part 3, No. 29: Notes on Fossil Plants from the Old Red Sandstone of Scotland. II.: Nematophyton Forfarense, Kidston sp.; III.: On two Species of Pachytheca (P. media and P. fasciculata) based on the Characters of the Algal Filaments. By Dr. R. Kidston and Dr. W. H. Lang. Pp. 603-614+2 plates. (Edinburgh: R. Grant and Son; London: Williams and Norgate, Ltd.) 2*s*. 6*d*.

Journal of the Marine Biological Association of the United Kingdom. New Series, Vol. 13, No. 2, November. Pp. 319-530. (Plymouth.) 7*s*. net.

Publication de la Commission Géodésique Néerlandaise (Uitgegeven door de Rijkscommissie voor Graadmeting en Waterpassing). Observations de Pendule sur la mer pendant un voyage en sous-marin de Hollande à Java, 1923. Par Dr. F. A. Vening Meinesz. Pp. iii+16. (Delft: Boekhandel J. Waltman, Jr.)

Smithsonian Miscellaneous Collections. Vol. 76, No. 12: "Adaptations" to Social Life; the Termites (Isoptera). By Dr. Thomas E. Snyder. (Publication 2786.) Pp. 14+3 plates. Vol. 76, No. 13: Preliminary Archeological Explorations at Weeden Island, Florida. By J. Walter Fewkes. (Publication 2787.) Pp. 26+21 plates. (Washington: Smithsonian Institution.)

Department of the Interior: Bureau of Education. Suggestions for the Observance of American Education Week, November 17-23, 1924. Pp. 36. (Washington: Government Printing Office.) 5 cents.

Department of the Interior: United States Geological Survey. Professional Paper 127: The Composition of the Earth's Crust. By Frank Wigglesworth Clarke and Henry Stephens Washington. Pp. v+117. (Washington: Government Printing Office.) 20 cents.

Sixty-second Annual Report of the Secretary of the State Board of Agriculture of the State of Michigan, and Thirty-sixth Annual Report of the Experiment Station from July 1, 1922, to June 30, 1923. Pp. 504. (East Lansing.)

Annual Report of the Board of Regents of the Smithsonian Institution, showing the Operations, Expenditures, and Condition of the Institution for the Year ending June 30, 1922. (Publication 2724.) Pp. xii+554+142 plates. (Washington: Government Printing Office.) 1.50 dollars.

Department of the Interior: United States Geological Survey. Mineral Resources of the United States, 1915. Part 1: Metals. Pp. iv+99A+1000+3 plates. Mineral Resources of the United States, 1916. Part 1: Metals. Pp. v+73A+871+3 plates. Part 2: Nonmetals. Pp. v+1115+4 plates. Mineral Resources of the United States, 1917. Part 1: Metals. Pp. v+79A+980+8 plates. Part 2: Nonmetals. Pp. vi+1293+1 plate. Mineral Resources of the United States, 1918. Part 1: Metals. Pp. iv+149A+1096+9 plates. Part 2: Nonmetals. Pp. viii+1557+16 plates. (Washington: Government Printing Office.)

Proceedings of the Liverpool Geological Society. Session the Sixty-fifth, 1923-1924. Part 1, Vol. 14. Edited by C. B. Travis. Pp. xx+98+4 plates. (Liverpool.) 5*s*.

Diary of Societies.

TUESDAY, DECEMBER 23.

INSTITUTION OF AUTOMOBILE ENGINEERS (Informal Meeting) (at 83 Pall Mall), at 6.30.—Demonstration and Discussion on Anti-dazzle Devices.

HULL CHEMICAL AND ENGINEERING SOCIETY (at Grey Street, Hull), at 7.45.—A. E. Butterfield: The Development of Unattended Navigation Lights.

SATURDAY, DECEMBER 27.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—F. Balfour Browne: Concerning the Habits of Insects (I.). Insect Collecting and what it leads to.