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The Empire of Man.

THE note of international welfare sounded by the King and the Prince of Wales at the opening of the British Empire Exhibition at Wembley on April 23 was an appropriate mark of a notable event. The Empire itself is a brotherhood of free peoples of many races and social codes, widely distributed over the earth and subject to diverse geographical influences, but with powers of expansion under their own control. Each group of cells in this organism performs its particular functions independently, yet all are correlated in the scheme of growth, and their activities affect not alone the vitality of the corporate whole but all other human communities. Though the Exhibition is primarily devoted to the display of the natural resources and products of our Commonwealth of nations, it represents also many impressive achievements available for the service of mankind in general. It should conduce, therefore, in the words of the King, to " the peace and well-being of the world," as well as to the unity and prosperity of the Empire.

In so far as science is concerned with the advancement of knowledge, its aims and results are international; and when its discoveries are converted into industrial processes or mechanical inventions, all progressive communities are influenced by them. We may on this occasion be pardoned pride in British contributions of this kind to modern civilisation. Every steam engine, locomotive, and dynamo in the world owes its origin to Watt, Stephenson, and Faraday; and it is through the genius and ingenuity of these pioneers that the time factor in geographical space is continually being reduced, and peoples widely separated are being brought into contact in increasing numbers. Pioneers, it has been said, cannot stop to work out details; and that perhaps is one reason why, though many of the greatest electrical inventions originated in Great Britain, their earliest successful development was left to other countries. This, however, as the Exhibition shows, is not the condition to-day. Science and industry have entered into an alliance which should go on increasing in strength for the benefit of each and the promotion of human progress.

It is to be hoped that the invocation addressed to his people by the King—" to think of the scientific work accomplished in recent years for the prevention and treatment of tropical diseases "—together with the fine illustration of that work and its methods displayed in an appropriate section of the Exhibition itself, may bring home to those who live in the old, long-settled parts of the Empire some lasting understanding of what scientific medicine can do for the good settlement of its vast outlying undeveloped parts.

It would be impossible in a few paragraphs to set down even a summary account of the work for which the King bespoke this particular consideration. It must be enough to say that, starting pertinently from 1880—a year after the publication of the pregnant discovery that filariasis is maintained and disseminated by the sole agency of certain common mosquitoes, and a year before the illuminating discovery of the malaria parasite—such a summary would include the discoveries of the modes of causation, and in most cases also of the morbific agents, of most of the diseases that had invested the tropics with their traditional terror; it would include, among many less impressive achievements in the prevention of tropical disease, the long-sustained labours that made the construction of the Panama Canal possible; and it would also include all the clinical and pharmacological research that has brought success in the treatment of "incurable" diseases such as kala-azar and schistosome disease, hope in the dumb desponding despair of leprosy and sleeping-sickness, and precision and promptitude in the cure of loitering diseases like dysentery and malaria. More feasible is it, and perhaps also more in keeping with the spirit of the King's words, to follow the work in its general purport and in its lessons, as exemplified in some particular examples.

If an educated layman were asked to name offhand some of the most ominous tropical diseases, he probably would begin with malaria and dysentery. Malarial fevers have been talked about since the days of Hippocrates; their precise cause as an effect of the invasion of the red blood corpuscles by parasitic animalcules was discovered in 1881, and all the wonderful details of the process by which the parasites are extracted from the blood of the sick man and carefully injected into the blood of healthy men by Anopheles mosquitoes was discovered in 1899. The parasites and the Anopheles are not restricted to the torrid zone: they may be found producing malarial fevers in any inhabited part of the globe under certain suitable conditions, and malarial fevers were common in Britain not many generations ago. But in Britain malarial fevers have gradually become practically extinct: it is in the tropics that they still cause thousands of deaths annually. What is the reason of this difference? It is that in Britain people do not now live in insanitary villages, in clustered hovels attractive to Anopheles mosquitoes, whereas the rural populations of the tropics do live so: in Britain human beings and Anopheles live apart, in the tropics (except in big Europeanised cities) they live together. It has been one of the main preoccupations of tropical medicine during the last twenty years everywhere to impress this lesson upon civil administrations, that the surest way to keep malaria in permanent check is to keep Anopheles permanently distant from human habitations.

A lesson of much the same character is implied in work done on amœbic dysentery—another very common tropical disease, caused by specific parasites that feed upon the intestinal and other visceral tissues. The sick man passes encysted amœbæ from his bowel, and the cysts are spread abroad in water and in other ways, possibly to be swallowed eventually and give rise to other cases of the disease. Recent research has demonstrated that the dysentery amœbæ may be found in home-staying inhabitants of temperate lands, including Britain, where, however, they seldom make their presence felt. How is it that the infection is so dormant in Britain, for example, and so easily acquired and so vivid in its effects in the tropics? A considerable part of the answer must lie in the fact that in Britain any conditions that permitted everyday contamination of drinking-water by human excreta would be regarded as a national reproach, whereas among most tropical populations such conditions cause no solicitude at all.

Malaria and dysentery are but familiar examples of one of the most significant lessons demonstrated by workers in tropical medicine during the last twenty-five years—the lesson that the greater part of the diseases traditionally known as "tropical" are not in any exclusive or explanatory sense attributable to the effects of a hot and humid climate, but are diseases caused very largely by animal parasites and vital inter-associations of parasites, and are particularly prevalent in tropical countries mainly because the native inhabitants there have no conception of protective sanitation.

Only when that lesson is learnt by civil administrations in the tropics, and experienced medical officers really initiate and direct the sanitary policy of the administration, can the knowledge acquired in recent years for the prevention of tropical disease be applied to full advantage. But taking the practical achievements of tropical medicine in recent years, it can be said that they have made the tropics infinitely healthier for the European settler and sojourner as well as for the native inhabitants of large towns and the native workers in European enterprises, and also have brought about great precision in the treatment of tropical disease. Another great practical achievement has been to stimulate medical education, and remarkably to influence the attitude of the entire medical profession with regard to research upon the ætiology of disease. So beneficial has been its influence in this direction that one is almost inclined to think that a course of study in the methods of tropical medicine might be introduced with advantage into the ordinary medical curriculum.

Increased recognition of the scientific and administrative significance of knowledge relating to tropical diseases, on account of the words spoken by the King at the opening of the Exhibition, may well lead to developments which in due time will stamp the Exhibition as a landmark in the economic history of the Empire. This great display is of manifold significance. It demonstrates, with a degree of completeness never before attained, the remarkable variety of the human and material resources of the Empire; it is a "symbol of unity" with local freedom; and affords to the world clear evidence of the spirit of confidence which animates the British people, still slowly recovering from a devastating war.

In his speech the King said: "This Exhibition will enable us to take stock of the resources, actual and potential, of the Empire as a whole; to consider where they exist and how they can best be developed and utilised; to take counsel together how the peoples can co-operate to supply one another's needs, and to promote national well-being." This statement goes to the root of the matter and defines the material objects of the Exhibition. But it implies and invites consequent action, without which this fine imperial effort cannot, in any case, justify the expenditure of wealth and thought which has been lavished upon it. Such action to be effective must be organised. Much may be accomplished by devoting to the overseas countries a larger share of that business genius and commercial acumen in which the British race is not lacking, but the fundamental condition for success is a systematic investigation, on scientific lines, of the natural resources of the countries concerned.

In the case of the Dominions it may be said that, with adequate development of the agricultural and scientific departments which they already possess, machinery should be available to enable the necessary research to be carried out with comparatively little direct assistance from the mother country; but for many years to come a very different situation must remain in the case of the colonies, which will need all the assistance they can obtain from home in investigating and developing their natural resources. Fortunately, there are in Britain organisations expressly designed, and admirably adapted, to carry out such work. Little is needed but skilful and statesman-like coordination of their varying activities, combined with proper financial endowment to allow of the necessary reorganisation and expansion—including as an essential feature the development of a central clearing-house of imperial economic information—to put into commission the action implied by the words of the King. The British Empire Exhibition will not have failed if it achieves this result.

The Protection of Scientific Discovery.[1]

In our last issue, we alluded to the extent to which judge-made law had advanced towards conferring protection upon discoveries. We shall now consider at closer quarters the draft convention which was communicated to the League of Nations by its Committee on Intellectual Co-operation.

So far as public opinion in Great Britain can be judged, we think that—to borrow the Committee's statement when referring to the "complex problem of factory inventions"—an attempt at unification by means of international agreements would be altogether premature. Local law must precede international agreement if success is to be obtained. To adopt a phrase in the Report: "Reform has been preceded in every country by experiment and trial."

The draft convention is seemingly based upon data furnished by experience in protecting industrial, artistic, and literary property. It attempts to bridge the gap which extends from inventions on one hand to artistic and literary productions on the other. Article 3 runs as follows:

> The purpose of the present Convention is to protect discoveries, that is to say, expositions and demonstrations of the existence, previously unknown, of laws, principles, bodies, agents, or properties of living beings or of matter and inventions, that is to say, creations of the mind (consisting of methods, appliances, products, the composition of products previously unknown, and, in general, all new applications of discoveries and inventions), the specifically scientific character of which deprives them of the protection granted to works of industry, art, and literature.

This Article is subject to the qualification that the right of protection is not to be conferred if the discoveries "only give a scientific demonstration of a result or of a process already known, that is to say, already applied beforehand in industry or commerce." By Article 4 the duration of protection is to continue during the lifetime of the author and fifty years after his death, in this respect following the precedent set by copyright in literary productions.

In the other of the 23 articles of the Convention, what most concern men of science are the proposals for securing the recompense arising out of the exploitation of a discovery by another. From Article 5 we learn that the discoverer "shall have the right to exact a royalty on a scale to be determined by agreement between the parties or, in default thereof, by the tribunal," tribunal meaning apparently the Courts of Law before which inventions are brought for adjudication.

On turning to the Report to discover the real significance of this Article 5, and to obtain some indication of the nature of the reward which shall be

[1] Continued from p. 595.

bestowed, we find two proposals selected for consideration. According to one of these proposals, a fund is to be built up for division between laboratories and the inventor-investigators by levying, say, 30 per cent. of any profits which would accrue from the utilisation of discoveries. In exchange for this 30 per cent., the inventor will receive advantages such as a reduction in the fees for obtaining a patent and the abolition of compulsory working.

According to the second proposal, the reward is to be paid out of a fund formed from subscriptions paid by, or contributions levied on, the industries profiting by the discoveries, the share of the reward to be allocated by a commission on which the industrial representatives most directly concerned will be in a majority. The Committee lays down the rule that, so far as possible, payment should proceed in proportion to the profits earned from the application of the discovery to industry. It does not, however, entirely disdain a system of prize-giving in cases in which it is not possible to establish some direct and sure relationship between the discovery and its economic productivity. But, continues the Report, present-day opinion having veered from a system of giving prizes in settlement of all claims, towards conferring premiums proportional to services rendered, decisions upon this question may fitly be left open for each nation to decide in accordance with its own laws. This conclusion, as previously pointed out, is embodied in an Article of the Draft Convention. Of the idea of paying off an inventor by a lump sum, the Committee says that:

"It seeks to dispose of their pretensions in as speedy and summary a manner as possible by granting them a dole, just as merry-makers hasten to give alms to an importunate beggar in order that they may be well rid of him!"

In Great Britain there is even now in use a system which, not in the nature of prize-giving, is based upon economic exploitation, a system which points out the way for recompensing the man of science on his discovery being put into operation. The Postmaster-General, in virtue of a monopoly claimed by him under certain Telegraph Acts, requires the issue of a licence to every one who possesses listening-in sets in order to receive messages and information transmitted by the British Broadcasting Company. The licences are issued directly to the applicant. A proportion of the money paid for the licences is allocated to the British Broadcasting Company in payment for the Company's services in the wireless transmission of information, etc. According to a reply in Parliament, the Company, down to January 31 last, had been the recipient of 71,450*l.* of the sum of about 348,000*l.* which was due to it.

In this way, then, a central authority levies a charge upon all who make use of listening-in apparatus, and disburses a portion of the proceeds. Similarly, on a desire to employ a scientific discovery being expressed, a Government Department could grant permits, and hand over a proportion of its fees to the discoverer, or to a fund from which rewards could be drawn. Machinery, therefore, somewhat of the character adumbrated in the Report, is already in existence for rewarding the man of science so soon as the law confers upon his discovery the dignity of "property" and recognises the exclusive right of possession to be in him. Moreover, a system such as this satisfies the requirement of the Committee of the League when it says, "Above all, a special fund must be created." Further, the community will gain through the hope of reward stimulating the scientific worker to successful enterprise.

That an extension of the law in this direction will be obtained with difficulty is certain, for, as the Committee says, "we have to secure the acceptance by every legislature of a principle which they have hitherto excluded either explicitly or implicitly, or tacitly, but in every case in a very definite manner." In addition, there may be parties who, interested in the commercial exploitation of novel ideas in whatever form they are presented, would strenuously oppose any such amendment as is contemplated. Difficulties in practice would, of course, also be encountered, as well as the initial difficulty of determining whether a discovery is of such a nature as to be worthy of protection. But this difficulty would be but little removed from that which confronts a Court in every patent action when the Court is called upon to decide whether the invention which is brought before it is proper "subject-matter" for a patent.

We have been able to touch upon a few only of the many topics with which this interesting Report abounds. The Report is worthy of all the study that can be devoted to it, admirably reflecting as it does Continental feeling. It is unfortunate, however, that British opinion is not more fully represented and that practical proposals emanating from Great Britain should not have been fully discussed. That the League of Nations has taken the matter in hand gives hope for the future; but that the extension of the law which is advocated will proceed internationally before each country has prepared the way for the amendment of its own law is quite unlikely. Moreover, such a proposal to act in the first place through an international convention may prejudice acceptance of the general idea of the protection of scientific discoveries which are not statutorily "inventions." In Great Britain it remains for a united body of opinion to make its influence felt and to urge the legislature to bring about a reform which is so long overdue.

The Deeper Criticism of the Bible.

Folk-lore in the Old Testament: Studies in Comparative Religion, Legend, and Law. By Sir James George Frazer. Abridged edition. Pp. xxx+476. (London: Macmillan and Co., Ltd., 1923.) 18*s*. net.

THOUGH the "Golden Bough" will always rank as the greatest and most original achievement of Sir James Frazer, while again in "Totemism and Exogamy" he has given his most important contribution to scientific anthropology and sociology, the present book on folklore in the Old Testament, now abridged into one volume, makes an even greater appeal to the reader's general or philosophical interest than the other works, for it deals with the most important fact in human tradition and literature, and one associated with intimate personal experiences of all of us. In a field apparently made almost completely sterile by criticism, higher criticism, and uncritical speculations, Sir James contrives to revive dead questions and to reshape facts and situations familiar, yet always incomprehensible, until now they receive a new meaning in the light of comparative anthropology. In this work the learned author once more vindicates for anthropology its claim to be the ablest interpreter of all the documents of human tradition and culture.

In the opening chapters Sir James discusses the Myth of Myths—the biblical story of creation. This story has been lived through by every one of us. Every picture, every detail, has its deep, emotional associations, from earliest infancy, when they were taken as the paramount fairy tale, until the time when their literal sense had to be interpreted, perhaps even finally rejected. But at no time in a man's life of belief or doubt are the details of this myth mere incidents of a story or a fiction. The childish and naïve visions of paradise, the fears of punishment, the hopes of redemption, are all bound up with the great drama of Paradise Lost.

Yet, looking back to the youthful times when the fire of faith burned high, and when the deep, uncritical belief made the figures of paradise live and act in a world real and near to us, we can still perceive certain flickering shadows, certain blots on the picture. Besides the comprehensible and at times lovable figure of God, within the sunny garden where we felt quite at home with our first parents, there grows the strange tree with its dangerous fruits, there creeps the serpent around it, there happen such crude incidents as the moulding of Adam in clay, the transformation of a small bone into our first mother, and other events, showing a strange inconsistency of God and his unyielding vindictiveness, and creating hesitancy and lurking doubts.

Here Sir James takes us back once more to the vague apprehensions of our youth, revives our doubts, and formulates our questions anew. As we follow him, then, into the various parts of the world, where the Tree of Life grows on its native soil, where the first human beings spring naturally out of red clay, where the serpent beguiles the ancestors of man with good reason and to a sensible purpose, we begin to understand those incidents as they appear in a fragmentary and garbled form in our Bible. Above all, Divinity himself appears in a clearer light, in which he moves with more dignity, acts with greater consistency, and is led by a kinder purpose.

The mark of Cain, the covenant of Abraham, the tricks of Jacob and of Joseph; the vicissitudes of Moses, of the Judges and the Kings, the Witch of Endor, all their mysterious actions, their little lapses from morals and straightforward honesty, are analysed in the remaining chapters of the book. Sometimes Sir James shows us that the narrator of the biblical stories was aware of a certain sociological and customary context, which he took for granted with his readers, but which for us has to be reconstructed in each case by the hand of the skilful anthropologist. Sometimes a detail, obscure in itself, can be reinterpreted in anthropological terms, as when we realise that the mark of Cain might have been a disguise of immunity, or the kid-skins of Jacob may correspond to a rite of new birth.

The deeper biblical criticism of Sir James is not directed thus to the whitewashing of the biblical story. The blots on the Bible are not rubbed away, but painted into their full original forms, with the strong, variegated colours borrowed by Sir James Frazer from the peoples of all races, climates, and levels of civilisation.

There is no other work in which Sir James's admirable style, his quiet sense of humour, his true humanism are used to a more important purpose than in the present one. From his impartial and restrained attitude it is impossible to gauge whether he approaches the subject as a rationalist or as a mystic, or as a modern agnostic, who is neither entirely committed to reason nor absolutely absorbed by mysticism. The bigoted and dogmatic believer and the extreme rationalist may remain dissatisfied with the tone of the book. But both those who study the Bible for religious inspiration and those who regard it as a mere anthropological document will derive not only profit but also artistic pleasure from the present book. Both will be interested and grateful for the removal of absurdities, the imparting of a fuller and deeper meaning to the biblical account, for bringing God nearer to man, the creature to its Maker, whoever might be believed to be the one and who the other. Nowadays, when the modern believer seeks revelation in reality rather than reality in revelation, and when the modern agnostic has ceased to deny all reality to revelation, the two can meet on friendly terms in Sir James Frazer's anthropological workshop and discuss their differences amicably.

This makes one reflect on the distance between modern agnosticism and that of a generation ago. The longest chapter of this volume embodies the Huxley memorial lecture, delivered by Frazer in 1916 before the Royal Anthropological Institute. It treats of the subject of the Great Flood, on which Huxley himself had written the famous essay. The great agnostic naturalist had still to combat the literal acceptance of the biblical story and show its absurdity in the light of geology and natural science. To-day, it is true, some people still believe in a flat earth and a universal deluge—but Huxley's writings have done their work, and he would scarcely write on the same lines now as he did in his time.

The modern agnostic does not take much trouble any more to establish the absurdity of biblical stories literally taken. He is not now disturbed by the absurdity of belief. Sometimes he even doubts whether his own disbelief is less absurd or more rational than the credulity of his opponent. He merely knows that he is entirely incapable of those acts of faith which give his luckier neighbour so much happiness, which seem to reconcile him to all the trials of life by apparently priceless promises of some future existence and spiritual compensation. The difference, he knows, cannot be mastered by reason or combated by rational argument. It lies deep in man's emotional constitution, and it sunders the black sheep from the white by an unbridgable chasm.

It is the nature of the difference between the two which interests the modern disbeliever. He is fascinated by religious phenomena rather than shocked by them, and he contemplates and studies them with the same intensity of interest, almost with the same love and veneration, as the religious man. It is not the absurdity of the Great Flood which he wants to have proved; that he takes for granted. He wishes to find the foundations of this belief in the depths of human nature or in the vicissitudes of human history; and in this, Frazer's treatment of the Great Flood is more actual and modern than Huxley's, though not greater or more brilliant, for that is impossible! Each marks a milestone on the road of scientific and philosophic progress, each sums up an epoch in the relations between science and religion.

B. MALINOWSKI.

Scientific Photography.

(1) *The Theory of Development.* By A. H. Nietz. Pp. 190. (2) *Gelatin in Photography.* By Dr. S. E. Sheppard. Vol. 1. Pp. 263. (3) *Aerial Haze and its Effect on Photography from the Air.* Pp. 84. (Monographs on the Theory of Photography, from the Research Laboratory of the Eastman Kodak Co.) (New York: D. Van Nostrand Co.; Rochester, N.Y.: Eastman Kodak Co.; London: Kodak, Ltd., 1922 and 1923.) 15s. each.

ALL who take a scientific interest in photography and in the investigations of its problems owe a considerable debt of gratitude to the workers in the Research Laboratory of the Eastman Kodak Company for the preparation and issue of these monographs. The first, on "The Silver Bromide Grain of Photographic Emulsions," was issued about two years ago and was duly noticed in these pages. We have before us the next three, and we learn that two more will soon appear, namely, "The Physics of the Developed Photographic Image," by Dr. Ross, and "Gelatin in Photography, Volume II," by Dr. Sheppard. Further, it is hoped eventually to cover the entire field of scientific photography. The editors thus hope "to make available to the general public" material by numerous authors which is distributed throughout a wide range of journals, as well as the results of a considerable amount of unpublished work carried out in the Company's Laboratories. The expression "general public" here needs qualification, for the treatises are in no sense popular, nor does there appear to be any attempt to bring the scientific and mathematical expressions within the popular grasp. Experts will probably value them the more on this account. Each volume is well illustrated, has a good contents table and full indexes, besides an extensive bibliography and all desirable references to the original sources of information.

(1) Mr. A. H. Nietz at first intended to include the results of both electrometric and photographic methods; but as only the latter are ready, the consideration of the electrometric method of attacking the subject is postponed. He treats of the chemical structure of developing agents and its relationship to photographic properties, especially to their relative reduction potentials, velocity of development, effect on sensitiveness and gradation, fogging, etc., and he passes to the effects of the addition of soluble bromides and other neutral salts to the developing solution, and of other changes in it.

(2) Dr. Sheppard has found it necessary to divide his subject into two parts, the present volume dealing with the historical, manufacturing, and analytical aspects.

It is proposed to deal with the physical and general chemistry in the second volume. The technology is discussed with the view of the improvement of gelatin as a photographic raw material. The author says that the "manufacture of gelatin and glue is only now emerging from the infantile state of a 'secret art,'" and that the principles to be discussed in the second volume will undoubtedly have an increasing bearing on the processes of manufacture. Naturally the work is to a considerable extent a compilation from the authorities cited, but practically all the essential processes in the preparation of the material and in its analysis have been tested in the Eastman Kodak Laboratory and any divergences noted, and much hitherto unpublished work is included.

The historical part is divided into sections dealing respectively with the use of gelatin in emulsions, supports (films, etc.), positive printing, carbon printing, photo-lithography, and other photo-mechanical processes. The section on its manufacture includes a consideration of the original material from which it is prepared as well as the various processes that it passes through, and a series of photomicrographs of sections of calfskin as it is to start with, and after being subjected to various treatments. The largest section of the volume deals with the analytical and constitutional chemistry of gelatin. This includes its qualitative recognition, its quantitative constitutional analysis and the estimation of its various physical properties, and the properties of its solutions. The apparatus and methods are well illustrated.

(3) The volume on aerial haze has no specific author's name attached to it. In 1918 the Research Laboratory of the Eastman Kodak Company undertook, in collaboration with the Department of Military Aeronautics of the United States Army, a study of photography from the air, especially with regard to the problems presented by aerial haze. The work was not completed by November 1918 when the armistice was signed, but it was brought sufficiently to a conclusion to enable results of practical value to be deduced from the measurements. Although incomplete, the results will certainly be helpful to any one who has to attack the problem in the future either practically or as a theoretical piece of research. After describing the ordinary methods of photographic photometry, including the variation of the characteristic curve with the wavelength of light, the measurement of haze is considered, the reproduction of aerial haze effects in the laboratory, and finally the materials and conditions best adapted for eliminating the effect of haze in photography. In an appendix, the haze effect produced by pure dry air is dealt with mathematically.

C. J.

A French Treatise on Physics.

Cours de physique générale à l'usage des candidats au certificat de physique générale, au diplôme d'ingénieur-électricien et à l'agrégation des sciences physiques. Par Prof. H. Ollivier. Tome troisième: *Mouvements vibratoires, acoustique, optique, physique, ondes électromagnétiques, électro-optique, effets optiques du mouvement.* Deuxième édition, entièrement refondue. Pp. 712. (Paris: J. Hermann, 1923.) 45 francs net.

THIS is the third and last volume of the treatise the second volume of which we have noticed already (NATURE, Vol. 110, p. 405). Its subject is vibrations, and it covers sound, physical optics, and electromagnetic vibrations.

Concerning the method of treatment there is nothing to add to what was said before. M. Ollivier's method is unusual in a treatise of this kind, and some may doubt its value; experimental physics cannot be a purely deductive science, and to present it as such necessarily involves some distortion. But, if M. Ollivier's point of view is once accepted, there can be nothing but admiration for his exposition of it. Though we should be sorry to see it universally adopted, and fear that it is especially dangerous for the students whom the author addresses primarily, its success in his hands provides its own justification.

The completion of the work suggests some further consideration of the choice of material. Here again M. Ollivier departs from the practice familiar to most English readers. He has done great service by including subjects hitherto omitted from books of this kind (and not only an account of their novelty); most physicists will have much to learn from his account of astrophysics, the theory of symmetry, photometry, the operating characteristics of a triode, or "liquid crystals." But his exclusions are equally remarkable; there is nothing about mechanics or geometrical optics, and only asides about relativity, although much attention is paid to the electro-optics of moving systems. Perhaps the first two matters are regarded in France as belonging to "physique mathématique" rather than to "physique générale"—a distinction which we cannot quite grasp. In respect of the third, M. Ollivier is clearly a disbeliever; but has a writer for examination students a right to express his opinion by mere omission?

Again, the method of deducing everything from the most general principles leads to some anomalies of order; thus the electromagnetic theory of radiation is almost the last thing in the treatise, long after the electronic theory of matter and spectra, and separated by one whole and two half volumes from electromagnetism. Lastly, M. Ollivier may be accused, probably with as much and as little justice as any other writer, of giving undue prominence to the work of his co-linguists. On the other hand, there is one national fault of which he must be acclaimed guiltless; here is a French book with quite an adequate index!

To sum up, M. Ollivier has the defects of his qualities. He has a very clear and definite point of view; and, if it is that of a French-speaking mathematician and not one with which most of us are more familiar, that is all the more reason why we should study it. In spite of—or because of—the peculiarities to which we have directed attention, we assert once more that no physicist who is deeply interested in his subject can afford to neglect this profound and fascinating treatise.

N. R. C.

A Philosophical Local Flora.

James William Helenus Trail: a Memorial Volume. Pp. xi+331. (Aberdeen: Printed for the subscribers at the Aberdeen University Press, 1923.) n.p.

THE untimely death of Prof. J. W. H. Trail in 1919 led some of his friends and former pupils to resolve that tangible expression be given to the regard in which they held his memory. The executive body entrusted by them with the duty of carrying out that design has placed in the botanical department of the University of Aberdeen a medallion portrait of this distinguished teacher, and has at the same time issued the memorial volume now under notice.

The editorial committee charged with this latter task has planned the volume well. It is especially to be congratulated on having been able to make the volume mainly the work of Prof. Trail himself. The volume opens with a sketch of his life which has the advantage of being, in considerable part, autobiographical. That sketch is followed by a full chronological bibliography of the additions to natural knowledge made by Prof. Trail. Workers in the fields in which the late professor laboured will find this careful record as useful as those whom he taught will deem it welcome. These sections, however, serve only as preludes to the bulk of the volume, which consists of a "Flora of the City Parish of Aberdeen," a work on which it had long been known that Prof. Trail was engaged: those who knew him best were aware that the material for the purpose had begun to be accumulated so long ago as 1869, while he attended, for the first time, the class of botany in the University.

The actual systematic record of the plants occurring in the area had been completed by 1919; the manuscript had been made over by Prof. Trail, before his last illness, to a local scientific society, to the courtesy of the members of which the editorial committee has been indebted for its use now. The essay introductory to that record, the preparation of which cost him much thought, was still incomplete when Prof. Trail died; his attempts at its elaboration are contained in several separate manuscripts, written at different times and from various points of view. The editorial committee may be congratulated on the success with which it has, by some rearrangement of the matter and the omission of a single sentence, presented what the author had left behind him, in a connected account. The committee has apologised for the repetitions thus entailed; these, however, instead of marring the narrative, lend emphasis to the statements made.

The author's title indicates that the systematic record had been prepared primarily for use by local botanists, and its value must always be greatest for local students. But those who study that record will find that it is something more than a critical census of local plants and is by no means a mere list of names. It is replete with philosophical discussions of the biology of particular species, and supplies geographical, historical, ecological, and economic information of wide general interest. It deals fully with the cases, within his own experience, of the disappearance of plants once plentiful in the area, and of the establishment there of species formerly unknown.

The introductory essay, on the other hand, affords evidence that the author intended it to appeal to a wider circle. Its local interest is as great for the historian and the archæologist as for the phytologist. Its botanical interest is as great for workers other than local, engaged in studying the changes to be observed in the vegetation of a well-defined area during a well-defined period. The half-century over which Prof. Trail's personal observations and records extend saw, within the area to which they relate, an unusual amount of interference by man. The channel of one considerable river was diverted in such a fashion as to eliminate antecedent estuarine conditions; the foreshore between two river-mouths was the scene of operations that have completely changed the character of a line of sand-dunes and their associated "links"; development of building-estates has converted an extensive area of agricultural ground into suburban lawns and gardens; municipal policy has turned still wider stretches of woodland and heath into cultivated ground, has filled up old quarries, reclaimed mud-banks, altered natural drainage. The changes in the local vegetation that have accompanied these various modifications of environment have been marked. Fortunately for science, these changes have been under close and continued observation by one of the most competent naturalists of his generation. The results of that observation, recorded during fifty years, are embodied in the volume now before us. In the systematic record, those who may have to consider similar changes elsewhere will find a singularly trustworthy aid to comparative study; phytologists, archæologists, and historians alike will join in thanking the editorial committee for having placed at their disposal a document of such interest and importance to all of them as Prof. Trail's introductory essay.

Our Bookshelf.

(1) *Four-figure Mathematical Tables.* By Frank Castle. Pp. 48. (London: Macmillan and Co., Ltd., 1923.) 1*s.*

(2) *Mathematical Tables.* By Prof. G. H. Bryan. Pp. 27. (London: Macmillan and Co., Ltd., 1923.) 3*s.* 6*d.*

(3) *Tables logarithmiques à treize décimales.* Par Prof. H. Andoyer. Pp. x+27. (Paris: J. Hermann, 1923.) 8 francs.

IT is refreshing to come across a set of mathematical tables that are original in construction and use. Thus all that need be said of Mr. Castle's tables (1) is that they seem to contain what the usual student requires, including hyperbolic logarithms, and exponential and hyperbolic functions. But Prof. Bryan's tables (2) afford us the pleasure of novelty. They are original in practically every possible way, and do not look like any other four-figure tables. In Prof. Bryan's tables the squares of numbers up to 1000 are given *accurately*, a really useful innovation. But it is as regards logarithms that Prof. Bryan achieves his most notable lapse from orthodoxy. Ordinary tables give logarithms and antilogarithms, with the tacit assumption that in reality logarithms are the quantities required, while the antilogarithms are a sop to the lazy student. Many of us who were brought up on seven-figure tables scarcely realised that antilogarithms were ever printed. Prof. Bryan now reverses the scales. He gives primarily only antilogarithms (five figures up to 0·6 and then four figures up to 1). By bordering the tables with the terms *antilogarithms* and *antilogarithms of reciprocals* in opposite senses, he produces a compact set of figures which give logarithms and cologarithms, *i.e.* logarithms of reciprocals.

The process is unfamiliar, and only continued practice can decide whether this innovation is one worthy of general acceptance. One advantage is that in carrying out a calculation involving multiplications and divisions, we need only *add* all the logarithms taken out of the tables. Ordinary logarithms are given, however, for numbers of two digits. The logarithms of the circular functions are given with considerable elaboration. The high price of the tables is no doubt due to the novel features, which necessitated entirely new setting. The tables are in the nature of an experiment, and it will be interesting to see whether they justify themselves.

(3) The use of logarithms with a large number of figures is, of course, quite a different problem from the use of four- or five-figure tables. The large differences that arise in the former necessitate subsidiary calculations, and the question arises as to the best means of carrying out these calculations. Prof. Andoyer claims that his thirteen-figure logarithmic tables can be used quite easily with the aid of Crelle's multiplication tables or a calculating machine. There are three tables. The first gives the logarithms to thirteen figures of numbers from 100 to 1000. The second table gives the logarithms of numbers from 100,000 to 101,000, with differences and second differences. The third table gives the antilogarithms for 00000 to 00432 with differences and second differences. The process is then as follows. To find log 314159265358979 we divide by 314, getting the quotient 1000507214519O4. The logarithms of 314 and of 100050 are taken from the tables, and we use the differences and second differences of Table II. for the 721451904. Again, to find the number the logarithm (mantissa) of which is 4971498726941, we look up in Table I. the number the logarithm of which is nearest this: thus log 314 is 4969296480732, leaving 0002202246209. Table III. with the differences and second differences then gives the antilogarithm of this remainder, which when multiplied by 314 gives the number required. The process is simple in theory and quite easy in practice.

S. B.

The Nature and Properties of Soils: a College Text of Edaphology. By Prof. T. Lyttleton Lyon and Prof. Harry O. Buckman. (Agricultural Science Series.) Pp. v+588. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1922.) 15*s.* net.

THE various text-books on soil science that have been produced by Prof. Lyon and his associates at Cornell University overlap one another to a certain extent. Much of the present volume will also be found within the pages of "Soils: their Properties and Management," by Profs. Lyon, Fippen, and Buckman, but the book as a whole marks a definite advance on the earlier ones, and further establishes the prominent position occupied by the Cornell school in soil investigations.

The arrangement of the book follows the usual conventions: the geological factors are first considered, as a preliminary to a discussion of the physical and the closely related physico-chemical properties of soils and soil moisture; the chemical and biochemical properties are taken next, and the concluding chapters deal with manures and manurial practice. The discussion of these sections has, with few exceptions, been set out with due regard to modern research. The chapters on soil colloids and the tilth of the soil compare very favourably with the treatment given in the average American text-book, and one's dislike of the relegation of much important matter in these and other chapters to small-print footnotes must be tempered by approval that it has at any rate been included in the book. The section on mechanical analysis of soils would be improved if modern methods, such as those due to Odén and Wiegner, were included; and the discussion of humus and organic matter is incomplete without some reference to Odén's work.

Now that so many branches of science have converged to form the composite that, for want of a better name, is called soil science, the task of writing a college text-book on the subject is no easy one, especially if the volume is to be kept within a reasonable compass. Profs. Lyon and Buckman have provided in this book a very satisfactory working solution of the problem and the well-chosen references will enable the student to follow up any lines of work on which he desires further information. B. A. K.

A Course in Elementary Mathematics for Schools. By Dr. H. E. J. Curzon. (Organised Mathematics Series.) Book 3. Pp. 88. 2*s.* 6*d.* net; with answers, 3*s.* net. Book 4. Pp. 111. 2*s.* 9*d.* net; with answers, 3*s.* 3*d.* net. (London, Bombay and Sydney: Constable and Co., Ltd., 1922.)

Book 3 of Dr. Curzon's attempt to deal with school mathematics contains many problems, including compound interest, discount, stocks and shares, some arithmetic like square roots, the solid geometry of pyramids, cones and spheres, the algebra of quadratic equations, simultaneous equations, graphs, factors and fractions, some deductive geometry of triangles and parallelograms, and logarithms. Book 4 deals with Pythagoras's theorem, the circle, similar triangles and loci, algebra including simultaneous quadratic equations, cubic equations, surds and indices, logarithms, ratios and the progressions, numerical trigonometry, the elements of the calculus and some advanced practical geometry. It seems very doubtful whether it is better for the student to have different books for different years of study rather than for different branches of the subject. Perhaps the harassed parent may prefer the possible economy involved in Mr. Curzon's plan, in view of sudden transference from schooling to earning a living. From the educational point of view, the mixture might be really useful if the different components were organically combined, instead of being quite independent chapters placed side by side with no connecting links.

The treatment is competent if somewhat dull. We might remark that the exchanges on p. 12 of Book 3 are quite useless except as a reminder of the good old days. We certainly approve of the early introduction of the calculus, and wish it were possible to assume that all students who have done mathematics at a secondary school reach the university with at least a rudimentary knowledge of the calculus. S. B.

The Inspection and Testing of Materials, Apparatus and Lines. By F. L. Henley. (Manuals of Telegraph and Telephone Engineering.) Pp. xi+355+12 plates. (London: Longmans, Green and Co., 1923.) 21*s.* net.

The testing and inspection of the material and apparatus used in the British Post Office is an operation of great importance and requires the services of a large staff. The Post Office issues invitations to tender for telephone and telegraph apparatus and material, and as a rule the manufacturer quoting the lowest price obtains the contract. The manufacturers, therefore, have to be furnished with a satisfactory specification, and must have an assurance that nothing inferior to the standard specified will be accepted. Fully equipped mechanical, chemical, and electrical testing laboratories are necessary, and the inspection and testing of the tenders requires thorough knowledge, high skill, and lengthy experience. Mr. Henley's book gives many theorems in chemistry, mechanics, physics, and mathematics which have direct applications in practice. The subject is one of ever-increasing importance, and only those engaged in everyday testing are fully aware of the many assumptions that have to be made in theory and how these assumptions limit the application of ordinary academic methods. Mr. Henley gives a great deal of interesting information which will be of value to the scientific worker and will show him the type of problem in which the practical man will be grateful for his help.

The Maori Mantle: and some Comparative Notes on N.W. American Twined Work. By H. Ling Roth. Pp. 124+22 plates. (Halifax: Bankfield Museum, 1923.) 42*s.*

Early accounts of the inhabitants of New Zealand describe their body-garment as a mat or cloth, almost square in shape; and in this later writers concur. These garments have also been made a subject of study by modern writers on Maori culture, such as Mr. Elsdon Best. There are, however, several points which have remained obscure, and these Mr. Ling Roth has endeavoured to elucidate in this valuable monograph. The author gives the results of an exhaustive study of specimens in museums and private collections upon which his profound knowledge of the technique of primitive textile work has been brought to bear. The method of manufacture, he points out, is that known to technologists as "twining," and not that of weaving. Mr. Ling Roth's letterpress, taken in conjunction with the very full series of illustrations, which are responsible for the high price of the book, may be regarded as the last word on the technological side of the subject. This, however, does not exhaust its interest. The conclusions at which the author has arrived as to the light these technical processes throw upon the question of cultural affinities may be commended to the careful attention of ethnologists.

The Genesis of Petroleum. By Dr. P. E. Spielmann. Pp. iv+72. (London: Ernest Benn, Ltd., 1923.) 5*s.* net.

The origin of petroleum remains an obscure problem after much experimental work and more theoretical discussion. Of the two principal explanatory hypotheses, one is that petroleum results from the action of water on metallic carbides in the interior of the earth; according to the other (which is more favoured), it is derived from the decomposition, by destructive distillation or slow change, possibly bacterial, of vegetable or animal matter, probably fish. A suggestive fact, recently brought to light by Chaston Chapman and others, is that the shark-liver oils contain as much as 90 per cent. of long-chain unsaturated hydrocarbons. Dr. Spielmann gives an impartial and detailed account of the whole situation, with special attention to recent work, and an excellent bibliography. His book is a most useful contribution to the literature on petroleum.

The Theory of Relativity: Three Lectures for Chemists. By Erwin Freundlich. Translated by Henry L. Brose. Pp. xii+98. (London: Methuen and Co. Ltd., 1924.) 5*s.* net.

A popular exposition of Einstein's theory by a competent mathematician in three short lectures. They are described as "for chemists," but have no special application to chemistry.

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.*]

X-ray Examination of Metal Films.

IN the Bakerian Lecture of 1857, Faraday discussed "The Experimental Relations of Gold and other Metals to Light." He had been making experiments in the hope that he might discover the mode in which finely divided gold affected the colour of incident light. In particular, he was interested in the question of the transparency acquired by gold leaf when heated to a temperature somewhat below the softening point of glass. The subject has been further investigated by Sir George Beilby ("Aggregation and Flow of Solids," Section X.), who ascribes the transparency to an opening up of the molecular structure: thus modifying a suggestion of Faraday's that it was due to an opening up of grosser portions of the metal. The transparent leaf when pressed by the smooth round end of an agate pencil becomes once more green by transmitted and yellow by reflected light.

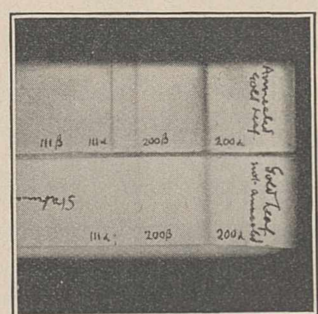

FIG. 1.—X-ray spectrographs of annealed and unannealed gold leaf.

The effect would seem to be of considerable interest not only on its optical side but also because it is a simple case of change due to cold working and subsequent annealing. The changes produced in metals by rolling and drawing have been examined, by X-ray methods, by Mark, Schmid, Weissenberg, Polanyi, and others in Germany; and a summary is given by Polanyi (*Zeit. f. Phys.* vol. xvii. p. 42) in the light of the experiments on the stretching of an aluminium crystal described by Taylor and Elam in their Bakerian Lecture of 1923. The thinness of gold leaves would seem to make for simplicity in the interpretation of the results; and it might be possible to connect the mechanical and the optical changes together.

Sir George Beilby has been kind enough to lend me some of his pure gold films; and Dr. Shearer has examined them by the X-ray method, using a Müller spectrometer, which is well adapted for the purpose. The film is mounted on glass, and in most of the experiments the sheet was used as a reflecting face, being equally inclined to the incident and reflected rays. It was rotated backwards and forwards during the exposure of the photograph, through such angles as were required to cover the portion of the spectrum under investigation.

Fig. 1 shows the photographs obtained with a gold leaf before and after annealing. There is an obvious difference. The two strong lines in the lower photograph are due to the reflection of the $K\alpha$ and $K\beta$ lines of iron in the (200) plane of gold. If the minute gold crystals had been in complete disorder, the (111) lines would have been present also, and, we should expect, would have been stronger than the (200). Their relative weakness implies that the cubic crystals of gold are arranged with cube faces parallel to the sheet. The upper photograph was taken after the gold leaf had been heated and become transparent. The (111) lines are clearly seen: evidently the crystals are now in disorder.

Unannealed leaves of silver, aluminium, and copper all show the same special orientation. In Figs. 2 and 3 are shown photographs obtained from leaves of silver and aluminium and also from thick plates of these metals. In the case of the leaves, the (200) reflections are strong and the (111) reflections practically absent. For the corresponding metal plate the (111) lines are the strongest. The same was found for copper.

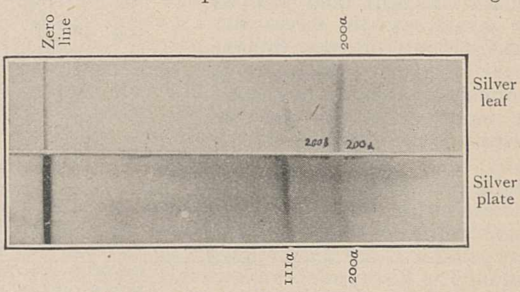

FIG. 2.—X-ray spectrographs of silver leaf and plate.

When these leaves are heated the (111) reflection becomes stronger, although it is still weaker than the (200). In the case of copper the spectrum of CuO replaces the copper spectrum when the heating has been carried sufficiently far.

In order to test from another point of view the suggestion as to the arrangement of the crystals in the beaten copper foil, a photograph of the foil was taken with X-rays passing normally *through* it.

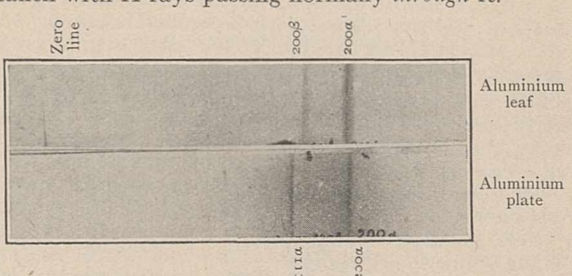

FIG. 3.—X-ray spectrographs of aluminium leaf and plate.

It was expected that the crystals would be quite irregular as regards their orientation in the foil: the regularity concerns only the arrangement of the (100) faces parallel to the foil. The (111) reflection now appeared as a uniform ring, thus fulfilling the expectation that reflection occurred in all directions round the incident ray, the reflected rays forming a cone of which the incident ray was the axis.

It would seem that the beating puts some strain into the crystal, though it increases the amount of arrangement. Heating relieves the strain: or, as it may also be put, allows surface tension to come into play. The greater strain is also, no doubt, the cause of the greater response to chemical action which is found in the beaten state.

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Short Electromagnetic Waves of Wave-length up to 82 Microns.

UP to the present date, short electromagnetic waves have been generated only by the method of the Hertz vibrator. This method offers very serious difficulties when we try to produce electromagnetic waves of the smallest possible length, as the vibrator burns out very soon, so that the amount of the energy and the length of the waves produced do not remain constant, and also as the length of the waves decreases slowly, if the dimensions of the vibrator are diminished, when we approach the region of the very shortest waves. The experiments of many investigators who have tried to fill the interval between the short electromagnetic waves of Lebedew and the long heat-waves of Rubens, have proved how difficult it is to obtain the shortest electromagnetic waves by the Hertz method, and have shown the necessity of finding a new method.

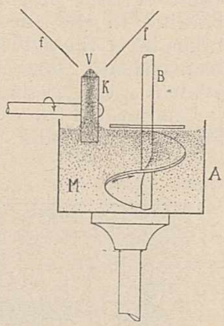

FIG. 1.—Paste radiator.

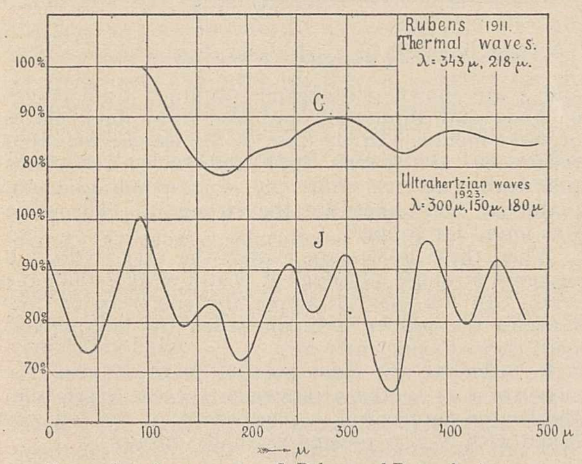

FIG. 2.—Interference curves: C, Rubens and Baeyer heat-waves; T, electromagnetic waves, obtained by the author.

Ten years ago Prof. W. Arkadiew had hinted at a new method of producing short electromagnetic waves. In order to increase the energy of short electromagnetic waves, it is necessary to substitute for the single Hertz vibrator a number of small vibrators. To avoid the burning out of the vibrators it is necessary to change them frequently.

I have now completed the construction of such a type of wave generator. The receptacle A (Fig. 1) is filled with a mixture of brass or aluminium filings and viscous mineral oil. This mixture is agitated by a constantly working mixer B and gets into the state of a uniform pap-like paste—the "vibratory substance." By a small rotating wheel K, made of carbolite, this vibratory substance is taken out of the receptacle and covers the wheel in the form of a sticky tyre. The wires, ff, convey the high-tension current from the induction coil in such a way that the discharge takes place through the vibratory substance in the tyre on the wheel at V. As the investigation has shown, such a source of radiation—a "paste radiator"—sends out short electromagnetic waves of various lengths, depending mostly upon the size of the metallic grains. The different wave-lengths in the present case are also due to the not very precise sifting of the filings taken for the vibratory substance.

To detect the waves, thermo-elements of seven different types were used. The measurement of the wave-lengths was carried out by the method of Boltzmann mirrors. In Fig. 2 are shown the interference curves of the Rubens and Baeyer heat-waves (curve C) radiating from the quartz lamp, and the electromagnetic ultra-Hertz waves (curve J) which were obtained by the writer from a paste radiator in the same region of the spectrum of the electromagnetic waves. An harmonic analysis of the interference curves obtained at various conditions of the experiment has shown that the length of the waves from the new source is as follows: λ = 50, 48, 40, 24, 20, 13, 12, 8, 6·7, 6, 4·8, 4·4, 2·8, 2·6, 1·8, 1·2, 0·9, 0·8, 0·55, 0·45, 0·35, 0·30, 0·28, 0·225, 0·20, 0·18, 0·15, 0·129, 0·082 mm.

In this way, the waves radiated by the paste radiator lie between the short electromagnetic waves of Nichols and Tear on one side, and the Rubens heat-waves on the other, and so fill the interval that has hitherto existed in the scale of the electromagnetic waves (Fig. 3).

Of special interest is the circumstance that the waves sent out by the paste radiator possess considerable energy, which is proved by the possibility of using measuring instruments of ordinary sensibility. These waves are the results of independent electric oscillations in very small vibrators, and are not overtones of a vibrator or resonator, as has usually been the case in experiments of investigators studying this question. The source of radiation due to the essence of the paste vibrator approaches the sources of radiation of heat and light waves: it forms the transition from the radiation of an individual Hertz vibrator to the total radiation of an aggregation of molecules in a heated body.

A. GLAGOLEWA-ARKADIEWA.

Magnetic Laboratory,
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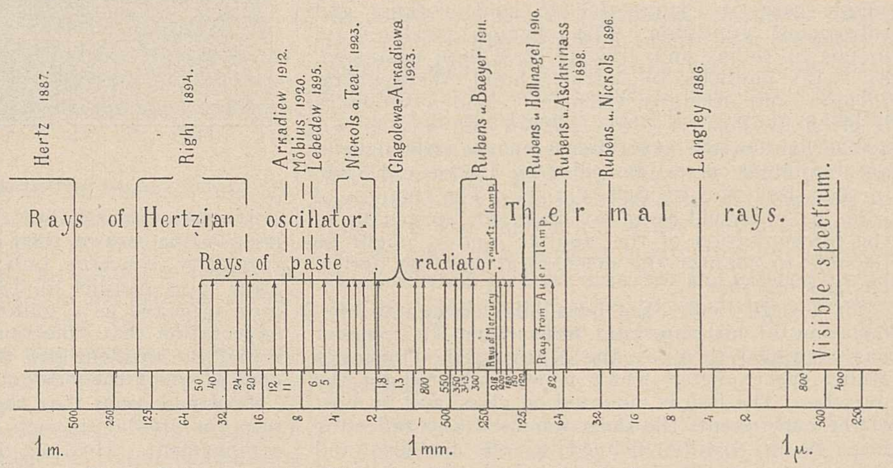

FIG. 3.—Position of radiation of the paste radiator on the scale of the electromagnetic waves.

Dutch Pendulum Observations in Submarines.

As Dr. Vening Meinesz is now back again in Holland I am able to make some additions and rectifications to my former letters, published in NATURE of September 15 and December 1, 1923, and of March 1, 1924.

It appears from the results that so long as the inclination of the apparatus caused by the rolling and pitching does not exceed a rather wide limit, there is no question of any sliding of the pendulums on the support. The elimination of the disturbances caused by the movements of the vessel is, however, more efficient when these movements are small. Therefore it is advisable, when the sea is not perfectly calm, to go down as deep as possible. During the passage across the Indian Ocean it was not possible to go deeper than 20 metres, because a small leak, otherwise of no importance, caused some trouble at a greater depth on account of the high pressure of the water. Nevertheless, the mean error of the results did not exceed 0·005 cm. sec.$^{-2}$, the influence of the Eötvös effect so far as it is connected with the current, and partly that of the temperature, being left out of consideration. It must, however, be borne in mind that the pendulum observations were not the chief object during this voyage, which had to be performed together with the other vessels in a fixed time. Consequently, the observer could not always make use of the most favourable circumstances, although he enjoyed the most comprehensive assistance so far as the service allowed.

The movements of the pendulums recorded on the films show very different types according to the circumstances in which they were made. In the harbours, where the ships lay side by side, the amplitudes were very variable because of the accelerations caused by bumping up against each other; at some moments they were actually reduced to nothing. The best results were obtained in Tunis, where the ships lay anchored apart. In the submerged vessel the amplitudes were nearly constant, even when the movements of the vessel itself were rather considerable.

The periods and amplitudes of the vertical accelerations change very slowly. Consequently, the effect on the movement of the pendulum, so far as it is associated with the phase, may be neglected, and each pair of pendulums may be considered to give an independent result. The small divergencies for each of both pairs run, however, distinctly parallel; it is, therefore, obvious that these divergencies cannot be ascribed merely to inaccuracies in the measurement of the records, but are really also caused by the vertical accelerations. The influence of these is wholly eliminated, if the vertical velocity of the ship is nil at the beginning and at the end of the observations. This, however, cannot be ascertained with accuracy, and it must be considered as sufficient to take the mean of the fluctuations at the beginning and at the end of the observations.

Of the angular variations in the position of the ship, only the inclination of the plane of oscillation is of interest. If the angle of inclination is α, the force is $g \cos \alpha$ instead of g. The centrifugal forces caused by the movements of the plane of oscillation, and the vertical accelerations of the pendulums, in respect to each other, are of no importance. The calculations are, therefore, much easier than was first expected.

The Eötvös effect must always be taken into account; the course and the velocity of the ship during the observations must therefore be known. The influence of the sea current must also be taken into consideration, but it is utterly impossible to determine the actual direction and velocity at an observation, and an average value must be taken instead. This is really an important source of error, the influence of a current of one mile per hour in an E.-W. direction near the equator being $7·5 \times 10^{-3}$ cm. sec.$^{-2}$.

Another source of error is the uncertainty of the rate of the chronometer. As it is impossible to extend the duration of an observation to the whole time between two time signals, the fluctuation of the rate causes an error in the result.

Great trouble is connected with the exact determination of the temperature of the pendulums, as this usually shows a considerable increase during the observations. Perhaps it will be possible in the future to place the whole apparatus in a box, where the temperature may be kept within certain limits.

The accuracy of the observations may also be increased by improving the arrangement for the making of photographic records.

Before the final computations can be carried out, it will be necessary to make a new determination of the temperature constants of the bronze pendulums. For the provisional computations the constants were used which Prof. Haasemann determined at Potsdam in 1905. It appears from the observations made at de Bilt, before and after the voyage, and at Batavia, at widely different temperatures, that these quantities must have changed in the course of years; since 1915 the bronze pendulums had not been used. A new determination will be made by Dr. Vening Meinesz in the Geodetical Institute at Potsdam in the month of May, for which the Director, Dr. Kohlschütter, has already kindly given his consent.

The sea-depth was determined on board by an acoustic method using the echo of the underwater clock-signals; the time elapsing between the moment of the signal and that of the perception of the echo was determined with a stop-watch.

In my last letter (NATURE, March 1, 1924, p. 308) I mentioned that in the Indian Ocean the anomalies increased from west to east. This was computed by using Helmert's formula for a spheroidical figure of the earth. Helmert deduced still another formula containing a term which depends on longitude. By applying the latter the negative anomalies, increasing from west to east, continue, but their value is much smaller, which should confirm the supposed flattening of the equator.

In compliance with an invitation of Col. H. G. Lyons, Director of the Science Museum, South Kensington, the Dutch Geodetical Committee intends to exhibit this summer in the Museum a set of photographs, diagrams, etc., relating to the voyage of Dr. Vening Meinesz, together with some of the original films showing different types of records.

J. J. A. MULLER.

Zeist, April 7.

Long-range Particles from Radium-active Deposit.

IN a letter to NATURE under this heading (Sept. 22, 1923, p. 435), Messrs. L. F. Bates and J. S. Rogers announce that they have found a certain number of long-range α-particles and also of H-particles to be discharged from radium C. For every ten millions of the ordinary α-particles of 7 cm. range they claim to have found the following numbers of long-range α-particles: 380 of 9·3 cm., 126 of 11·1 cm., and 65 of 13·2 cm., besides 160 particles of still greater range, assumed to be H-particles. In a more detailed report of their experiments (Proc. Roy. Soc. A, vol. 105, p. 97, 1924) the latter number is stated to include also H-particles expelled from the air and the mica traversed by the ordinary α-particles. Similar particles of different ranges exceeding those of the ordinary particles are stated to come also from thorium C, from actinium C, and, according to a second letter to NATURE (Dec. 29, 1923, p. 938), also from polonium.

The existence of such long-range particles, if proved to be real, would have far-reaching consequences for well-established rules governing radioactive phenomena, as they seem to upset the general validity of Geiger-Nutall's equation. This fact is further emphasised by a scrutiny of the absorption curves given for these particles, which prove that their initial velocity is not constant within each group, but varies from the maximum value given as the "range" to the minimum value representing the range of the next lower group. Such a heterogeneity of velocity is unprecedented with α-particles from a radioactive disintegration, but is, on the other hand, a familiar feature with particles of secondary origin, *i.e.* with the natural H-particles set in motion from hydrogen by the impacts of swift α-particles, as well as with the fragments (H-particles, possibly also α-particles) expelled from disintegrated atoms by the same means.

The importance of these long-range particles from a theoretical point of view, as well as for the interpretation of observations on atomic disintegration made by methods previously used in this Institute, made it desirable to investigate whether their number is to some extent dependent on the experimental conditions. I have therefore made a considerable number of experiments with the α-particles from radium C, a disc of brass or, in some experiments, of gold, activated by the condensation method, serving as source. In order to minimise the risks of getting secondary particles from the matter traversed by the ordinary α-particles from the source, I have used thin foils of gold or of copper, deprived of occluded gases by prolonged heating in a vacuum, as primary absorbers for the ordinary α-particles, instead of allowing them to pass through air or mica, as in the experimental arrangement of Bates and Rogers.

The results from experiments with gold foils, equivalent in absorption to from 5 to 6 cm. of air, placed immediately in front of the source, proved that the number of H-particles of a range exceeding 9·2 cm. is extremely small, considerably less than one in a million ordinary α-particles of the range 7 cm. discharged from the source. The number of α-particles observed of a range exceeding 9·2 cm. was nil. For less values of absorption, gold could not be used, owing to the well-known difficulty of making foils perfectly uniform in thickness from that metal. With copper foil, which is much more homogeneous, there are again greater difficulties than with gold in driving off the last traces of occluded hydrogen, so that a limited number of H-particles, presumably "natural" H-particles, possibly the product of an atomic disintegration of copper, not yet investigated, are always found with copper foil.

The results from one of numerous experiments with copper foil, of the air-equivalent 5·1 cm. (which had been very effectively heated), are set out in the following short table,

Absorption cm. of Air.	Observed Particles.		Bates and Rogers.	
	H-particles.*	α-particles.	H-particles.	α-particles.
8·5	1·7 per 10^7	0	160 per 10^7	340 per 10^7
8·1	7·2 ,, ,,	0	160 ,, ,,	390 ,, ,,
7·5	6·3 ,, ,,	0	160 ,, ,,	570 ,, ,,

in which the first column gives the total absorption (copper, air, and mica) in cm. of air, the second and third column the number of H- and of α-particles per ten millions of ordinary α-particles from the source, which was found at each value of absorption investigated, while the last two columns of the table give the corresponding numbers to be expected according to Bates and Rogers. It is seen that their number of H-particles of the absorption 8·5 cm. is nearly 100 times larger than that found under my own conditions of experiment, in which the α-particles of a range exceeding 7·5 cm. are seen to be totally absent.

It may be added that the use of a greatly improved microscope (with an objective of 0·70 numerical aperture) made it relatively easy to distinguish between scintillations from H- and from α-particles, so that they could be counted separately. Owing to the experimental conditions, it was not possible to take direct counts of the ordinary α-particles from the source, which have instead been calculated from its γ-activity, measured before the countings and checked by control measurements taken afterwards. The possible errors due to this method of calculation cannot materially influence the results.

Judging from these experiments, which are being published in detail in the Sitzungsberichte of the Vienna Academy of Sciences, it appears extremely doubtful whether any H- or α-particles of a range exceeding 7·5 cm. of air are discharged from radium C. In any case, their number under the conditions of experiment here described cannot be more than a few per cent. of the values given by Bates and Rogers. Whether the same applies also to the long-range particles from the other substances they have investigated must remain a subject for further inquiry.

DAGMAR PETTERSSON.

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April 7.

The "Missing Element" between Cadmium and Mercury.

IN NATURE (April 12) the writer of the notice of Dr. Mellor's treatise on chemistry refers to the suggestion of a missing element between cadmium and mercury. That there is no unknown element to go there is of course evident, but it is highly probable that a known one should be placed there. In 1914 Rydberg (Kong. fysiog. Sällskapets Hand. 24) proposed an arrangement of the periodic table to which little attention appears to have been paid. In directing attention to it in the *Philosophical Magazine* (28, p. 139, 1914) I suggested a small change which brought europium between cadmium and mercury. Indeed, the rare earths in this arrangement divide the periodic table horizontally and vertically into two parts. In this arrangement the atomic weight and number are in step with those of the other elements of group II. Whatever may be the difficulties from a chemical point of view in thus placing it, the spectral evidence in its favour appears to me to be conclusive.

I discussed the series relationships of this element in the Transactions of the Royal Society (212, p. 58, 1912; 213, p. 323, 1913), and have given a more complete statement of the data in the "Analysis of Spectra" (pp. 88, 285). Not only does the spectrum of the neutral atom comprise the usual triplet and singlet series and that of the ionised atom those of doublets, but the series and the separations are remarkably in step with those of cadmium and mercury.

Some indication of this close connexion may be seen by the accompanying data, which give the wave-lengths of the first sets of the S.D. series for each element, with their corresponding ν and σ separations. For fuller conviction the more complete data (*l.c.*) should be consulted. It is much to be desired that the spectra for Gd (between In and Tl) and for Sa (between Ag and Au) should be discussed for series data in order to make the general evidence more complete.

NEUTRAL ATOM.

CdS‴2.		EuS‴2.		HgS‴2.	
5085·8		5377·0		5460·7	
	1170·88		2633·71		4630·62
4799·9		4709·8		4358·3	
	541·89		1013·96		1767·35
4678·2		4495·1		4046·5	
D‴2.		D‴2.		D‴2.	
{ 3614·4		{ 3638·1		{ 3662·8	
	11·10		62·63		60·10
3612·9		3629·8		3654·8	
	18·23		103·85		35·14
3610·5 }		3616·2 }		3650·1 }	
	1171·10		2633·39		4630·56
{ 3467·6		{ 3320·0		{ 3131·5	
	11·87		59·77		60·73
3466·2 }		3313·4 }		3125·5 }	
	542·19		1004·16		1767·41
3403·6		3312·8		2967·2	

IONISED ATOM.

S″1.		S″1.		S″1.	
−2144·4		−2375·5			
	2482·01		5338·68	?	ν=9831
−2265·0		−2720·6			
D″2.		D″2.		D″2.	
{ 2321·2		{ 2688·5			
	155·74		301·52		
2312·8 }		2666·9 }			
	2482·79		5345·25	?	
2194·6		2350·6			

W. M. HICKS.

The Critical Velocity in Pipes.

IN the course of a recent conversation, Major A. R. Low pointed out to me that one state of steady fluid flow will not change to another unless there is a difference in the energies corresponding to the two types, or, as I prefer to put it, no change from one state to the other will occur spontaneously unless the change involves a dissipation of energy. If we call p/ρ the head in C.G.S. units, then in viscous flow the head lost in a length Δx of a pipe can be written in the form

$$\frac{1}{\rho}\cdot\frac{\partial p}{\partial x}\Delta x=\frac{32\rho v^3}{\mu}\cdot\left(\frac{\mu}{\rho v d}\right)^2\Delta x.$$

In turbulent flow the head similarly lost can be expressed as

$$\frac{4\rho v^3}{\mu}\cdot\left(\frac{\mu}{\rho v d}\right)L\,.\,\Delta x,$$

where L is defined by the relation

$$F=\rho v^2\,.\,L,$$

and F is the wall friction in dynes per sq. cm.

Hence it follows that viscous flow cannot change to turbulent flow unless $L \gtrless \frac{8\mu}{\rho v d}$.

In the foregoing, μ is the viscosity, ρ the density, and v the velocity of the fluid, all in C.G.S. units, whilst d is the pipe diameter in cm.

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Densities of Photographic Plates.

IN NATURE of April 5, p. 494, Mr. G. M. B. Dobson suggests that it should be possible for photographic plate manufacturers to produce plates which would yield uniform density after uniform exposure and development.

It has been pointed out (*Photographic Journal*, vol. 61, p. 425) that, even if the emulsion is uniformly coated upon optically worked glass, and dried under such conditions that no irregularities from this cause can arise in the portion of the plate to be used, normal methods of development lead to the production of non-uniform density. One of the causes is the local concentration of the products of reaction due to development.

In the paper referred to, a means of minimising this is described. The evidence shows that variations due to development are greater than those due to irregularities in the processes of coating and drying the emulsion when these operations are carried out for experimental work of this character.

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April 5.

Refractive Index of Gums.

IN the letter on the Refractive Indices of Gums published in NATURE, February 2, p. 159, the formula used in computing the indices was wrong, and should have been $\mu=1+pc$, where c is the difference between the refractive index of the standard material and unity. The order in which the gums are placed in the table is correct, but the values given to μ are too large.

A corrected table, with some additions, is given below.

CORRECTED TABLE OF REFRACTIVE INDICES.

	μ.		μ.
Water	1·333	†Kauri	1·48
Ether	1·358	†Copal	1·49
Acetone	1·360	†Storax	1·50
Alcohol	1·355	†Benzoin	1·51
Amyl acetate	1·395	†Shellac	1·51
Chloroform	1·460	†Mastic	1·52
Benzole	1·49	†Damar	1·52
Xylol	1·49	†Gutta-percha	1·52
Cedar oil	1·51	†Resin	1·53
Oil of Cassia	1·64	†Sandarac	1·53
Albumen	1·35	†Guiacum	1·53
Treacle	1·495	§Styrax (*a*)	1·54
†Cane Sugar	1·54	§ ,, (*b*)	1·57
‡Artist's copal varnish	1·48	§ ,, (*c*)	1·59
*Gum of Cherry, Thick Sol.	1·34	‡ ,, (*d*)	1·64
Gum of Cherry, Solid	1·45	Mixed Iodides of Mercury and Potassium	1·73
*Gum Acacia, Thick Sol.	1·37	†Sulphur	2·03
Gum Acacia, Solid	1·47	†Phosphorus	2·12
*Gum Arabic, Thick Sol.	1·37	†Realgar (Red Light)	2·55
Gum Arabic, Solid	1·45	,, (Green Light)	2·61

The simplest way of dealing with the observations is by a diagram. If n_x and n_a are the micrometer readings for the displacements caused by substances the refractive indices of which are respectively μ_x and μ_a; $p_x=n_x/n_a=\mu_x-1/\mu_a-1$.

Taking p as the abscissa and μ for the ordinates, draw a straight line through the origin and the point $p=1$, $\mu=\mu_a$, then for any value p_x of p the ordinate is μ_x.

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* Thick solution in water. † Melted in prism.
‡ As sold. § Evaporated alcoholic extract.
(*a*) Gum imported in small dry black pellets.
(*b*) and (*c*) Imported in a semi-fluid state.
(*d*) Prepared by Grübler of Leipzig.

Progress in Biology.[1]

By W. Bateson, F.R.S.

An address on progress in biology during the last hundred years has one element of simplicity; since, with scarcely a tinge of exaggeration, the whole subject from its inception may be held included. Though the materials studied by biologists are those which have been the objects of man's curiosity from the earliest times, yet the biological way of looking at them was new, and biology was a term deliberately selected to proclaim the consciousness of a new hope. Treviranus—Gottfried Reinhold, 1776–1837, of Bremen, elder brother of the well-known botanist Ludolf Christian (1779–1864)—was the first to use the word *Biology* (1802). He complained that the current treatments both of zoology and botany were lacking in penetration and in comprehensiveness, and that their practitioners were too often giving a divided attention, with an eye ever wandering towards medicine and other applications. The catalogues of plants and animals, and barren descriptions compiled in the name of those sciences, are a beginning, not an end. They are the materials which the science of living things is to absorb and co-ordinate. The problem before the biologist is, What is Life? and the collections have value in so far as they contribute to a solution of that problem.

Treviranus says all this, and says it very well, with a lofty but well-controlled imagination. If some one objects that he is offering old things in a new form he will not deny that, but he claims that to see them in the new form is no trifling help. Surely he has proved right. The new word connoted a new thought. Though it was not given to him to see further into the mystery than his contemporaries, nor indeed so far as many, notably Bichat and Lamarck, he was looking in the right direction, and he polarised the attention of many more.

Sir William Lawrence introduced the word into English in those lively "Lectures on Physiology" (ed. 1818) which, in spite—or perhaps in consequence—of much detraction, went through many editions and were very widely read. He too was aware that the term biology implied a certain ambition.[2]

We see other signs that about a century ago the study of life underwent a renaissance. Before biology was dreamed of there were plenty of good naturalists, men devoted and exact, full of curiosity, gathering truth where they could, in the right spirit of science, but it is at this critical period that we first hear those graver notes of more resolute endeavour which thenceforth constantly recur. The gain in depth and precision was of course promoted by the development of microscopy, but the aspirations of the first biologists to obtain a fuller understanding of the nature of life had been excited, and their minds were prepared before that visible revelation came in unquestionable form. I like at least to think that the questions were asked before the instrument-makers came on the field. Sage Sidrophel, who

"made an Instrument to Know
If the Moon shine at Full or no,"

has been a great begetter of modern researches, but less fortuitous discoveries are the more honourable and command a warmer admiration.

However that may have been, as a matter of history the first great advance was the recognition of the cell; and nowadays, when we talk of biology, we mean the study of life in terms of cells—their structure, properties, and behaviour. The microscope led soon, though not immediately, to the cell theory, and cellular biology began. It is not my purpose to repeat that familiar story. I ask you to observe, however, that, little as we yet know of life, it is not a century since we began to be certain about even the proximate and easily accessible phenomena which characterise life. The rudiments of chemistry, to be sure, were still only dimly apprehended, and it may be thought that, in the absence of chemical knowledge, sound ideas about life could scarcely be expected. Perhaps; but surely the essential feature which—apart from psychical attributes—differentiates living creatures from all other systems whatever, might have been distinguished by ordinary observation, at any time. Living organisms are systems which have the power of continual and spontaneous division. In that they are unique. *How* they divide could not even be imagined, much less investigated, without the microscope; but nothing in the history of discovery is more curious than this fact, that until well into the nineteenth century, men should not have known familiarly that living things come into existence solely by a process of orderly division. The conception of the cell as a unit was necessary to give anything like accuracy to this knowledge, but it was not essential, and may not improbably be replaced hereafter.

Scarcely less remarkable is the fact that upon this process of division attention has only quite recently been concentrated. The other attributes of life, chemical and physical, have proved both more amenable to experimental study and more prolific in fine discoveries immediately applicable to medical practice; with the result that to them—at least in our English use—the once comprehensive term physiology has become exclusively attached. An overburdened study must discard something, but it is scarcely fortunate that the process of genetical division, the central phenomenon of physiology, should in its several manifestations—heredity, variation, segregation, differentiation, and the regulation of form—be unfamiliar ground to academic physiologists.

I have referred to the moment from which our survey begins as a time of renascence. The student of to-day sometimes scarcely realises what happened then. A hundred years ago you might find an undescribed—even an unnamed—animal any day on the British coasts. Next to nothing was known of the development of any creature whatsoever, animal or plant. The student's microscope, of course, did not exist, and indeed was only coming into general use in my own student days. Neither my revered master, the professor of zoology of that time in Cambridge—a man of great learning and distinguished gifts—nor his colleague,

[1] Address delivered on March 12 in connexion with the centenary of the Birkbeck College.
[2] See especially pp. 52 and 58-60, ed. 1823.

the professor of botany, could use a microscope to any purpose; and I doubt if either of them would have seen much in a section of anything. No doubt we were a bit behind the rest of the world just then. They were ahead of us in France, and very greatly ahead in Germany. Reputation, if not fortune, might occasionally be made by a little judicious dumping of foreign products. That state of things happily soon passed away, and an international standard of scientific public opinion in biology became universal.

Though in 1824 little was known of what we now call morphology, the unicellular organisms had not attracted serious attention at all. Such creatures, even some bacteria, had been seen, but no one had felt much concern about them. If you care to attach history to dates, let me give you two easy ones, worth remembering. 1838 is the year in which Schleiden gave formal expression to the cell theory, and being also the date of Ehrenberg's "Infusionsthierchen" with the first good pictures of bacteria and many infusoria, is doubly memorable. Ten years later we come to 1848, a date which in significance to mankind may rank with 753 B.C., or, indeed, any of the greatest anniversaries.

In written history there are only a few cardinal points—the invention of printing, the First Folio Shakespeare, Newton's "Principia," the discovery of oxygen, with some dozen more. Of these most certainly one came in 1848, when Pasteur first demonstrated to Biot his observations on the asymmetry of tartrates. From that one small bit of clean experimenting, interpreted by penetrative genius of the highest order, has grown modern surgery, a rational investigation of disease, bacteriology, much of biochemistry, hygiene, with all the consequences that those developments have had on vital statistics, the structure of populations, and contributions to almost all the arts and the multifarious activities of civilised man. 1848 was the year of the revolutions. The public was not thinking much about bacteria or biology. Mobs were in the streets and the fermentations then most regarded were metaphorical. But the world as we see it to-day is rather the product of biological discovery than of democratic institutions, and there are moments when your modern Esau would wisely barter a lot of his political rights for some honest antiseptic.

The great corpus of knowledge grows by solid increments, definite, predicable discoveries of fact. Rarely is any piece of interpretation an event of equal consequence. In that small group of fertile theories, by common consent we class the "Origin of Species." For the public of 1859 Charles Darwin's book seemed, and for most of the laity to-day it still seems, like some meteor of the heavens, to have been a revelation unheralded. That of course we know it was not. Apart from earlier adumbrations, some vague, some clear, the doctrine of evolution first took categorical form in the hands of Lamarck (1809). For fifty years the new ideas were strenuously debated, especially in France. The discussion, nevertheless, had reached England, though our contributions were largely on the non-placet side. Chambers (1844) was a timid evolutionist; Herbert Spencer, though no naturalist, a bold one (from 1852). Lyell in 1832 had argued against "evolution," adopting the word. Sir W. Lawrence had (1818) collected many illustrations of variability, but maintains that none transgress the limits of specific difference, and he took a firm stand against the Lamarckian teaching of the transmission of acquired characters, which he declared was contrary to experience—the first, I believe, actively to denounce that illusion.

The very considerable work of Godron, "De l'Espèce" appeared in book-form in 1859,[3] the year of the "Origin." Godron was a most competent botanist. His collection of evidence as to variation was the fullest then compiled. Most of it was afterwards incorporated in Darwin's "Animals and Plants under Domestication," but the book is still of value. Godron examines "la théorie de l'évolution successive de l'espèce," and rejects it. Darwin, using very similar evidence—though greater in quantity and more varied in character—with the introduction of the one wholly new consideration, natural selection, succeeded in making the doctrine of transformation acceptable. Natural selection was an undeniable *vera causa*, whereas few had felt quite comfortable about Lamarck's appeal to the effects of conditions. The presentation, moreover, was set forth in language so suave and cogent that the reader gladly resigns himself into the hands of a master. With the advances in knowledge, the additions from embryology, from palæontology, geographical distribution, and many other convergent lines, the truth of the doctrine of evolution became in broad outline finally established.

This much being admitted by all, we may inquire why had so many good naturalists, whose information was sound, resisted so firmly? With the exception of natural selection, every essential element in Darwin's case had been present to their minds before. To suppose that all these writers had suffered from theological obsessions is absurd. Lawrence, for example, flouted authority with great enjoyment. They were genuinely convinced, some of them probably against their will, that the mutability of species was contrary to observation. Remember that up to Linnæus few, if any, troubled to consider whether species were or were not mutable; but after species had been declared to be immutable, those who proposed to maintain the doctrine of mutability might be expected to prove their case.

What weighed, then, with Godron and careful men of his type was that the variability they observed did not result in the production of new species, and that in particular, as they insisted, the new forms derived from a single common origin, when interbred, do not produce offspring of impaired fertility as so many genuine species do. This critical link in the evidence is equally absent from Darwin's case. He satisfies the mind about so many other difficulties that this one is allowed to pass, and the reader, learning that many putative species give hybrids fully fertile and that between these and the totally sterile hybrids all gradations can be seen, feels that this objection must have been removed, though as a matter of fact it remains.

The progress of the last twenty years has brought us to a position from which we can at last begin to discuss these problems fruitfully. No general principles governing the incidence of interspecific sterility have been ascertained. We there find ourselves in a tangle

[3] Following previous publication in *Mém. Acad. Stanislas*, Nancy 1848–9.

of empirical and as yet unrelated phenomena, specific like those of chemistry. Expectation founded on our estimates of divergence are constantly at fault. The Oxen, the Canidæ, the Finches, the Ducks, the Pheasants: who can say right off which crosses in these orders give hybrids fertile in both sexes, or in one sex only, or in neither? Which species cannot be crossed at all? Like chess openings, these things, no doubt, are governed by principle, but the principle is not obvious. For the right answers we depend largely on memory. They have been ascertained by accumulated experience and are not easily found "over the board."

We are clear that the forms of life are the products of evolution, but we are equally sure that specific distinctions are not culminating terms reached by the accumulation of small differences. The variations by which they have arisen are not yet known to us, but we are satisfied that the particular account of their origin which is the one Darwin chiefly favoured is incorrect.

Of the origin of specific distinctions we have, as I have said, no acceptable account. Appeals to adaptative value are here beset by the gravest improbability. The Darwinian principle that the fixity of a character is a measure of its value to the possessor is not tenable. The sharpest and most permanent specific differences are constantly to be found as characteristics which no one by the utmost exercise of ingenuity has been able to represent as other than trivial in adaptative significance. Whatever stress we are disposed to lay on natural selection, it does not assist us here.

We must frankly admit that modern discoveries have given little aid with the problem of the origin of adaptation. Darwin in 1844 regarded all adaptation as the consequence of natural selection. His letters of that date speak of Lamarck with contempt. With the lapse of time, nevertheless, we find him frequently and increasingly appealing to the transmitted effects of the conditions of life, and between the two he sometimes does not distinguish so clearly as we would wish. His most urgent task was to make evolution an acceptable principle, and one argument failing he would invoke the other, until in the edition of 1876 certain passages read uncommonly like Lamarck obscured. Seizing upon one which is, to say the least of it, ambiguous, the irreverent Samuel Butler makes the flippant comment: "This comes of tinkering. We do not know whether we are on our head or our heels. We catch ourselves repeating 'important,' 'unimportant,' 'unimportant,' 'important,' like the King when addressing the jury in 'Alice in Wonderland.'"[4]

All this matters little now. In response to Weismann's challenge that critical proof of the transmission of adaptative responses to environmental influences should be produced, none satisfactory has been forthcoming. In one respect only, I think, we have to recognise positive evidence which Weismann did not perhaps sufficiently anticipate. The germ-cells have in certain experiments been injured by special and violent treatment to which the parents have been exposed, with permanent consequences to the posterity. But there is no question here of adaptation, and such evidence does not make the origin of the adaptative mechanisms more easy to understand.

[4] "Luck or Cunning," 1887, pp. 185-6.

(To be continued.)

Science and Philosophy.[1]

By Prof. H. WILDON CARR.

II.

WHEN Auguste Comte proclaimed the passing of metaphysics and the coming of positive science, the positivity which he claimed for science depended on two presuppositions—first, that the independent existence of the physical universe is unquestionable, and second, that the authority of reason is unchallengeable. The principle of relativity has questioned the first, the theory of creative evolution has challenged the second. The two theories may seem to be quite disconnected, but when we consider the complete revolution which the fundamental concepts of science have undergone since they were formulated, they are seen to be very closely related. The first concerns the relation of philosophy to physics; the second, with which this article deals, concerns the relation of philosophy to biology and psychology.

The experience of consciousness or awareness seems to be in all simplicity a mind's contemplation of a self-revealing world. Every attempt to go behind consciousness, to treat it scientifically as an object, to analyse its nature and discover its genesis, seems to involve a vicious circle and end in a meaningless tautology. Science seems to depend on accepting consciousness at its face value, on regarding it as absolute and unquestionable in its first intention. The reason is obvious. Consciousness is the basis of reasoning, the ultimate and final arbiter, the only authoritative court of appeal. It alone justifies the affirmation that anything is and what anything is. If consciousness be itself arraigned at its own judgment bar, it must be at once both judge and judged, and to present this double relation to thought surpasses the power of imagination or even of intellectual conception. Therefore, though we may conceive a mind inefficient to any degree, and the data presented to a mind obscure and limited to any degree, to submit consciousness itself to analysis seems to undermine the authority of the only criterion to which science can appeal. Science cannot raise the question what consciousness is, notwithstanding that it can and must inquire how and under what conditions it makes its appearance. Yet on the other hand it is impossible for science to be satisfied with such an exclusion. For biology, consciousness is a particular phenomenon. It characterises living forms, which to be understood must be studied in their integral nature, and therefore to assume its unquestionability is to spoil the symmetry of science and destroy its ideal. Moreover, it renders science vulnerable in its most vital principle.

This peculiar dilemma that science must postulate the absolute nature of consciousness for its knowing, and at the same time treat this knowing as a pheno-

[1] Continued from p. 613.

menon which depends on pre-existing conditions, has been a difficulty from the beginning of the modern period. Thus Bacon, who was the first to propound the inductive method, conceived the mind as a mirror in which natural objects are faithfully reflected, and yet he had to warn the observer against a distortion of knowledge, not due to the object known but to the mind itself, to the bias it receives from its human form and trappings. A first condition of pure scientific discovery, he teaches, is that the observer shall learn to recognise and allow for the *idola tribus*, the *idola specus*, the *idola fori*, and the *idola theatri*. The idols of the tribe are those which pertain to our common human nature; the idols of the cave, a suggestion from Plato's allegory, are those which pertain to our individual nature by reason of our mind's habitation of a body; the idols of the market-place are the clothing of thought in speech; and the idols of the theatre (the least important, because the most easily avoided) are the influences of authoritative or rational systems of thought. All these distort the image in the mirror, making the mirror resemble a magic mirror, but apart from these and attainable in its purity is the absolute fact of consciousness, the clear reflection of the world in the mind.

Yet, although the possibility of distortion of knowledge has always been recognised as a danger, the crucial problem in regard to reason or intellect did not, in fact, arise until the coming of the biological theories of evolution in the nineteenth century. Before the Darwinian theory of the origin of species by natural selection, it was possible to separate the problem of the nature of reason from the problem of its origin. As a matter of fact, no challenge to its absolute nature had ever come from science itself. The biological theories, in compelling attention to the relation of function to structure, at last raised the problem of the nature of reason in the most direct manner. The Darwinian hypothesis had of necessity laid the whole emphasis on structure and treated function as a simple concomitant. It aimed at interpreting the transformism of structure which had eventuated in new species, and it assumed that with the modification of structure there arose the corresponding function, but it allowed no efficiency or determining influence of function on structure. The determining factor of man's ascendancy was the human brain. With the evolution of the brain the rational function had appeared. The psychological difficulties in this mechanistic theory of evolution soon became urgent. If the human intellect were no more than a highly specialised form of the function which accompanies neural structure, if this function were always the same in kind and only different in degree, it would then be sufficient, so far as evolution is concerned, to correlate structure and function, and the complexity of the brain would simply be registering the amount of consciousness and the degree of reasoning power.

The theory broke down, however, when it was attempted to apply it to instincts. It soon became evident that, in these specialised forms of behaviour, function, not structure, was the determining influence which had directed the evolution. The theory of creative evolution, in its scientific form and apart from its general philosophical principle, affirms that for the human intellect as for the animal instincts, the determining factor is function, not structure. Structure is subservient to function, and not vice versa. This theory has made it possible to bring science itself, science as knowing, the intellectual reasoning function of the human brain, within the scheme of a comprehensive scientific theory. According to creative evolution, the human intellect is not the acquirement by man of a disinterested knowledge obtainable by contemplation of a self-revealing, independent world, consequent on the arrival of a particular stage of complexity in the evolution of the brain; on the contrary, the human intellect is a mode of mentality which defines a particular range and a particular mode of activity for which the evolution of structure is necessary but wholly subservient.

This is, in fact, the principle of relativity (not its mathematical form but its philosophical meaning) applied to the intellect itself. Does it then, let us ask, destroy physical science by undermining the absoluteness of the criterion of science and introducing a scepticism of the instrument? It is clear that its effect is the very contrary, for it enlarges the scope and domain of science by including within it what had been wrongly assumed to be non-amenable to scientific treatment. In fact, it assures the basis of science and, what is of supreme importance, the universality of its method. At the same time, it completely reverses the old position. Physical science no longer depends on presuppositions, and is absolved from making any assumptions. If the human intellect is a product of evolution, then its nature is only to be understood by interpreting the human mode of activity and defining its range. The effect of this doctrine is undoubtedly to make science relative, but not in any meaning which destroys its positive character. Notwithstanding that it is by our intellect that we study our intellect, notwithstanding that we have no viewpoint of disinterested contemplation, our science has gained in stability from the very fact that it is organically interrelated throughout and that its criterion of truth is internal, not external.

In adopting a relative in place of an absolute basis, is not science yielding its claim to possess an independent objective reference and surrendering to subjective idealism? Those who ask this question forget that knowledge, science, is in its very meaning ideal. In accepting an idealist criterion in place of a purely supposititious real criterion, science is strengthening, not weakening, its hold on reality. Undoubtedly science has lost the simplicity which seemed to characterise its method when it was assumed that the law and order of Nature were inherent in the external universe and had only to be discovered. Careful observation was then all that science appeared to demand of its votaries. With the new principles the case is altered. The scientific student now finds that, like M. Jourdain, he has been a philosopher without knowing it. Science has proved to be not a simple work of organised observation, but a difficult work of intellectual construction. The purpose of this construction is indeed to provide a framework of pure objective reference independent of particular subjective experience. It is now seen that an essential condition of success is not only that the subjective viewpoint shall be recognised, but that it shall be included. Science in attaining its ideal becomes philosophy.

The British Empire Exhibition.

ON Wednesday, April 23, the greatest exhibition contrived by human hands in historic time was formally declared open. The King, who was accompanied by the Queen, drove in state to the Stadium at Wembley, where he was received by the Prince of Wales, the president of the Exhibition, and from the throne erected on the Royal dais, spoke the words which inaugurated the British Empire Exhibition.

The nature and purpose of the Exhibition were admirably summed up by the Prince of Wales in his introductory speech, in the course of which he said, addressing the King:

"The Dominions, India, the Colonies, the Protectorates and Mandated Territories under your care have joined together in the great task of presenting this picture of our Commonwealth of Nations. The Exhibition is thus the work of the whole Empire, and it shows the craftsmanship, the agricultural skill, the trading and transport organisations of all our peoples and all our territories. It gives also a living picture of the history of the Empire and of its present structure. It will suggest to the world, I truly believe, that the most powerful agency of civilisation has its heart set upon peaceful aims and the good of mankind."

The deeper note referring to the international importance of the undertaking was taken up again and emphasised in the Prince's concluding words, when he expressed the hope that the result of the Exhibition would be to impress vividly upon all the peoples of the Empire

"that they should be fully awake to their responsibilities as the heirs of so glorious a heritage; that they should be in no wise slothful stewards, but that they should work unitedly and energetically to develop the resources of the Empire for the benefit of the British race, for the benefit of those other races which have accepted our guardianship over their destinies, and for the benefit of mankind generally."

The King's speech was a stirring appeal for the success of the Exhibition, in the interests of the British commonwealth of nations and of the whole world. In notable words, he stressed the importance of discovery, exploration, and research:

"The Exhibition may be said to reveal to us the whole Empire in little, containing within its 220 acres of ground a vivid model of the architecture, art, and industry of all the races which come under the British flag. It represents to the world a graphic illustration of that spirit of free and tolerant co-operation which has inspired peoples of different races, creeds, institutions, and ways of thought, to unite in a single commonwealth and to contribute their varying national gifts to one great end.

"This Exhibition will enable us to take stock of the resources, actual and potential, of the Empire as a whole; to consider where these exist and how they can best be developed and utilised; to take counsel together how the peoples can co-operate to supply one another's needs, and to promote national well-being. It stands for a co-ordination of our scientific knowledge and a common effort to overcome disease, and to better the difficult conditions which still surround life in many parts of the Empire. Think, for example, of the scientific work accomplished in recent years for the prevention and treatment of tropical diseases. And it is easy to imagine how greatly the Exhibition can contribute towards the progress of our tropical territories and the development of the yet unexplored capacities of the Empire.

"And we hope, further, that the success of the Exhibition may bring lasting benefits, not to the Empire only, but to mankind in general. No nation, or group of nations, can isolate itself from the main stream of modern commerce; and if this Exhibition leads to a greater development of the material resources of the Empire and to an expansion of its trade, it will, at the same time, be raising the economic life of the world from the disorganisation caused by the War."

The proceedings were the occasion of a remarkable telegraphic feat. The King's message declaring the Exhibition open was telegraphed round the world in 80 seconds, which is only one-thirtieth of the time in which Puck declared that he could put "a girdle round about the earth." A day or two previously, anxiety was felt, as a fault appeared to be developing on one of the submarine cables forming the chain, but luckily this was cleared in time. When the telegram was despatched, all the lines were being kept in readiness and the telegraphists were at their posts. From the Stadium, it was sent over the Imperial Cable to Halifax, being relayed at Fayal on the way. It then crossed Canada by the land lines to Bamfield, where it entered the Pacific, passing through Fanning Island, Suva, Auckland, and Sydney. At Sydney, it was given to the Eastern Telegraph Co. It went through Adelaide, Perth, Cocos Isle, Rodriguez, Durban, Cape Town, St. Helena, Ascension, St. Vincent and Madeira, and thence back to London. In order that it should go through as many towns as possible, it was also sent from Adelaide to Port Darwin and thence to Singapore via Java. From Singapore it was sent to Penang, Madras, Bombay, Aden, Port Sudan, Suez, Alexandria, Malta, Gibraltar, and from thence to London. From Cocos it was also sent to Batavia, Singapore, Penang, Colombo, Aden, and then by the route described above to London. From Durban it was despatched to Mozambique, Zanzibar, Aden, and again by the route described above to London. Aden received the message simultaneously by all three routes.

The Eastern Telegraph Co. employed automatic working over its portion of the route, and as the message was received on one side of a station it was automatically transmitted on the other. At Electra House, Moorgate, the message arrived simultaneously on four cables and was immediately telegraphed to the Exhibition. We congratulate the engineers of the General Post Office, of the Eastern Associated Telegraph Companies, and of the other Companies owning part of the route, on the great success of their experiment.

The Western Electric Co. is also to be congratulated on their arrangements for distributing the speeches delivered at the opening of the Exhibition over the large area covered by the Stadium and the Amusements Park. The voices of the King, the Prince of Wales, and the Bishop of London were picked up by the microphone, amplified, and then distributed to seven projectors on the pavilion roof and to groups of projectors erected in the Amusements Park. Each amplifier is provided with facilities for microphone switching, volume indication and control. Special arrangements are also made for adjusting the volume distributed to each projector, and if necessary the operator can bring reserve apparatus into operation. At the opening ceremony, the control engineer watched the royal platform, the operating engineer stood by the amplifier panels, and all the observers were at their posts. When the control engineer gave the signal, the loud spoken signals were heard with the greatest ease by an audience of 120,000. The observers were all kept busy telephoning to the control station messages to increase or diminish the sound volume so as to give the most satisfactory results in each area. All the equipment was duplicated so as to obviate the risk of a breakdown.

The speeches were also carried by cable to the London Broadcasting Station, where they were broadcasted over the British stations by the British Broadcasting Company and the Marconi Company. The ceremony was heard excellently in receiving sets all over the British Isles, and in several distant towns it was made plainly audible to large crowds by means of loud speakers many of which were provided by some of the daily newspapers. They were also heard at many stations abroad. The apparatus employed and the great care and forethought exercised by the engineers made both the "public address system" and the broadcasting methods a great success. There is plenty of scope, however, for inventors to increase the efficiency and diminish the cost of the former, and there are many acoustical problems in connexion with the latter that have still to be solved.

The Exhibition was inaugurated in the presence of a great gathering in the Stadium at Wembley; the proceedings were followed with enthusiasm and interest by a vastly greater body of the general public through the medium of the broadcasting services; the news of the opening was telegraphed round the world. It now remains for the Exhibition to justify its magnificent send-off and to make a name for itself as a landmark in the history of the world. It will be impossible for us to attempt to mention more than a few of the exhibits relating to science and technology, but we hope that the articles to be published in our columns will present some of the chief aspects of the Exhibition of interest to scientific readers.

Obituary.

PROF. GRENVILLE A. J. COLE, F.R.S.

ON April 20, after several years of acute suffering, most patiently and cheerfully borne, died Grenville Arthur James Cole, professor of geology since 1890 in the Royal College of Science, Dublin, and since 1905 Director of the Geological Survey of Ireland. He was the son of J. J. Cole, architect to the London Stock Exchange and a pioneer in geological photography, was born in 1859, and educated at the City of London School under Abbott, and at the Royal School of Mines. He was trained in geology by Prof. Judd, and in 1880 was appointed to a demonstratorship created for him in the Geological Division of the Royal School of Mines, where he served until his appointment as professor in Dublin in 1890. In him, Prof. Judd found an active and able lieutenant in shaping and developing the practical laboratory course, the first established in Great Britain, which was made, and has since been maintained, as the characteristic feature of geological training at the conjoined School of Mines and College of Science. To such a course his most valuable contribution was perhaps his "Aids in Practical Geology," first published in 1890, and afterwards improved and kept up-to-date.

Cole's earliest published work was in conjunction with Prof. Judd, and related to the glassy basic rocks, tachylytes and the like, collected by one or other of the authors in the Western Isles. The interest of this study was maintained by subsequent work on the devitrification of glassy rocks, and the spherulitic, lithophysal, and other structures which they possess or acquire. This work was of value to him later when he came to study the rhyolites of Antrim. For this and other purposes he visited Hungary, Switzerland, and other European localities, and the result was the publication of such papers as that on the Rhyolites of the Vosges, that with Prof. J. W. Gregory on the variolitic rocks of Mont Genèvre, and that with G. W. Butler on the lithophyses of the Rocche Rosse. In connexion with this work he was also attracted by the alteration of the basic glasses, and described examples of variolites from Anglesey and County Down. At this period he took an interest in the igneous rocks associated with the Lower Palæozoic sediments, visiting Cader Idris with V. Jennings, and Rhobell Fawr with Sir T. H. Holland, the rocks of these areas being determined as earlier than the Ordovician volcanic rocks of Arenig and elsewhere. He also wrote on the remarkable suite of acid and basic rocks between Kington and New Radnor, but without being able to determine their age, a problem yet unsolved.

Both at this time and later, Cole devoted much time to mineralogy, devising or elaborating new methods of recognition, correcting erroneous determinations, and describing new-found varieties. His paper on the Riebeckite of Mynydd Mawr is notable in that he clearly discriminated between the rock forming this mountain and the boulders of a rock of similar composition and also containing riebeckite, now known to have come from Ailsa Craig but at that date of unknown source, found on the neighbouring mountain of Moel Tryfaen.

On taking up his residence in Dublin, Cole at once threw himself into the scientific life of the country, took an interest in its politics, made studies of many of its districts, took an active part in the meetings of scientific societies and the Academy, and trained many students who have since done excellent work at home and abroad. In connexion with visits of the British Association and the Geologists' Association, he led excursions to places of geological interest, and published accounts of the geology of the districts of Dublin and Belfast, in which he included his own discoveries and conclusions. He paid much attention to Irish minerals and building stones, and contributed a descriptive account of the country and its mineral resources to "Ireland, Industrial and Agricultural." His interest in fossil organisms was perhaps greater than might have been expected. He dealt with the peculiarly Irish ancient fossils, Oldhamia and its allies, with the Carboniferous Fenestellidæ, describing a new genus, and with the earliest known Belinurus from the Upper Old Red Sandstone of the country. He also published in *Natural Science* "The Story of Olenellus," a charming account of this curious trilobite and the advances in science due to the discovery of it and its age.

Other, and for the most part later, work involved the application of Cole's experiences among the glaciers of Spitsbergen to the drift phenomena of Ireland, his interpretation of some of these deposits as requiring an interglacial episode, his study of the development of the Liffey drainage, involving a post-glacial reversal of part of the course of that river, and the application of the geology of Ireland to the elucidation of its geography. Before he became Director of the Geological Survey, he had paid attention to the collections of rocks dredged from off the coasts of Ireland, and the light thrown by them on the possible existence of submerged Cretaceous and Tertiary outliers, a subject to which he afterwards devoted a Memoir of the Geological Survey. A similar history attaches to his work on the bauxites and iron ores of Antrim.

Perhaps the most important geological work done by Cole was his study of the absorption of rocks and minerals by igneous magmas, which led on to research in various northern and western areas of gneiss and schist, from which he concluded that these were masses of intrusive magma which had invaded and incorporated vast quantities of pre-existing rocks and sediments. Thus he brought into harmony results obtained on one hand by the Canadian and American observers in "Laurentian" rocks, and on the other by the French geologists on *lit-par-lit* injection and metamorphism. These studies produced many by-products, among others being important new discoveries on the orbitoidal structures of certain plutonic rocks.

This vast amount of purely scientific work, even combined as it was with Cole's teaching and administrative work, by no means exhausted his energy. He was a regular contributor to the columns of NATURE, *The Irish Naturalist*, and other scientific journals, and in addition contrived to find time to write a round dozen books, generally dealing with his science in some form, but including the observations of frequent travel and the gist of his own thought and imagination. These were written in a style as charming and attractive as were the speech and demeanour of the man himself. His literary instincts and attainments and his wide reading added no little to the influence of his scientific papers, but it must be confessed that this, combined with his unselfish insistence on giving due credit to the value of the work of his predecessors and contemporaries, though not detracting from the preciseness of his statements, makes them by no means easy to grasp.

It will remain a matter for lasting regret that one so perfectly equipped for the task in knowledge, critical acumen, judgment, and power of expression, was not spared to write a comprehensive work on the geology, free from fads and fallacies as it would have been, of the country to which, though an alien, he was so devoted a friend and in the service of which he freely gave health, comfort, and life itself.

DR. A. L. SMITH.

BY the death of Dr. A. L. Smith, the Master of Balliol, on April 12 at the age of seventy-three years, the cause of science has lost one of its most sympathetic and effective supporters. Amid the many calls of his busy life he contrived to keep in touch with the progress of discovery, and for a layman he had a remarkably wide knowledge of science and clear grasp of its problems. Nothing did he enjoy more than hearing at first-hand an account of a research, and discussing the ideas underlying it and the nature of the investigation. It seemed likely that if in his school days there had been the wider opportunities of to-day, science would have had an irresistible attraction for him. But, as it was, he was elected to a Classical Exhibition at Balliol College, Oxford, in 1869, and after getting a "first" in classical Moderations and in Greats, he turned to modern history, in which he was to be the leading tutor in Oxford for nearly half a century.

Dr. Smith had all the qualities that go to make a great teacher—intense vitality, great humanity and sympathy, and keen critical insight. His memory was a vast storehouse of knowledge—classical, medieval, and modern—but rarely can learning have sat more lightly or been used to better effect. For thirty years he worked as a College tutor, and no man spared himself less, and then in 1906, at an age when most men are beginning to relax their efforts in anticipation of the evening of their lives, his appointment to a Jowett fellowship gave him the leisure to accept the opportunities that were offered him, and he quickly became a public figure. His activities grew continuously almost until his death, and his personal influence was felt in ever-widening circles. In Oxford he became a trustee of the University Endowment Fund, and served on many Boards, including the Hebdomadal Council, while in 1916 he was elected Master of Balliol. He was intensely anxious that the University should keep abreast of the changing needs of the life of the nation, and he took a special interest in new scientific developments at Oxford, many of which at one stage or another owed much to his help. He would take endless pains to find out all the details of any scheme in which he was interested, and to see every one concerned, and this was but one reason why his support was so valuable.

Dr. Smith took a leading part in founding the Workers' Educational Association; he was chairman of the Prime Minister's Committee on Adult Education, and he took an active interest in the social-economic aspect of industrial problems. He was a most effective speaker, and he had an amazing gift for getting into close touch with any audience. His humour, his simplicity, his lack of convention, his candour, and his humanity gave to every one the impression of his real personal interest in their individual problems. No man was more accessible to those who needed his help than the Master; no man gave more willingly of his best.

In 1922 Dr. Smith was president of the Science Masters' Association, and many will recall his address on science and history, its wisdom and insight, its raciness, its wealth of apt allusions, and the intensely human touch that ran through it. The Master was a great personality, and his death is a real loss to this generation.

Current Topics and Events.

THE bicentenary of the birth of Immanuel Kant, born at Königsberg on April 22, 1724, has just been celebrated in that city. Königsberg was not only Kant's birthplace, but the scene of his intellectual activity throughout the whole of his long life. He died on February 12, 1804. Many well-known German philosophers and representatives of all the principal universities were present at the celebrations. Mr. J. L. Stocks of St. John's College, Oxford, attended as the British Delegate. There is also to be a celebration of the bicentenary at Naples in connexion with the International Congress of Philosophy to be held there in May when the University of Naples commemorates the seventh centenary of its foundation. In Paris a special number of the *Revue de Métaphysique et du Morale* entirely devoted to studies of the philosophy of Kant is announced in honour of the occasion. No philosopher in the modern period has retained his living freshness for the student of philosophy to the same extent as Kant. Quite recently in Great Britain two works of the first importance—Prof. James Ward's "A Study of Kant," and Prof. Norman Kemp Smith's "A Commentary on Kant's Critique of Pure Reason"—are evidence of the vitality of his philosophy. At least one reason is its intimate relation to the problems of modern mathematical and physical science. It was Newton who inspired his research if it was Hume who awakened him from his dogmatic slumber. It was no mere flower of speech but profound interest in astronomy which found expression in the oft-quoted remark in the "Critique of Practical Reason," concerning the two things which filled him with never-ceasing wonder and awe, the starry sky above and the moral law within him. His early writings are exclusively on questions of physical science. He anticipated Laplace with the nebular hypothesis, and he was the first to point out that the tidal action of the moon must have a retarding effect on the earth's velocity of rotation. Even in the purely philosophical work, the transcendental doctrine of space and time was probably inspired by the desire to find a rational basis for the Newtonian concepts.

THE Institution of Civil Engineers, having extended the terms of reference to its Committee on Steam Engine and Boiler Trials to include a reconsideration of the work of its 1905 Committee on the Efficiency of Internal Combustion Engines, arranged on April 8 a discussion, introduced by Mr. G. J. Wells, on "Standards of Comparison in connection with the Thermal Efficiency of Internal Combustion Engines." Mr. Wells considers that, in view of the greater knowledge now possessed of the properties of the working medium in such engines, the time is ripe for the introduction of a standard of reference which shall approximate to the conditions more closely than the "Air Standard" of 1905, and he has suggested a method of computing the data to enable experimenters to calculate the true "gas standard" efficiency suited to any particular circumstances. It is a question how far along this path it is worth while proceeding. Tizard and Pye have already shown that for petrol engines a reasonably satisfactory figure is obtained by inserting in the Air Standard equation the value 1·3, instead of 1·4, for the specific heat ratio. If it be desired to pursue the matter further still, it is necessary to distinguish between true and apparent specific heats, and to consider the amount of dissociation; the latter will depend on a number of factors and render short-cut calculations abortive if the desire for extreme accuracy be pushed too far. It may be agreed that the time has come for a reconsideration of efficiency standards in general, and Mr. Wells's proposals, so far as they go, are a convenient contribution towards a beginning of such work.

AGRICULTURAL conditions in the Sudan were described by Sir John Russell in a lecture to the Society of Economic Biologists delivered on April 4. Sir John stated that the agriculture of the Sudan is largely dominated by problems of water supply. The difficulty is met in three ways: by various native devices for utilising the limited and seasonal rainfall to maximum advantage; by the utilisation of flood-water brought down in July, August, and September; and by definite irrigation works which aim at a continuous supply of water to the plant during the whole of its growing period. The problems presented to the agricultural investigator differ according to the method used. In the case of rains cultivation, it is necessary to secure varieties suited to the somewhat trying conditions, and, in the case of the cotton crop, to deal in addition with certain insect pests which may do considerable damage. Where flood cultivation is employed, certain unusual physiological conditions may arise from the fact that the plant receives most of its water supply before it has reached full growth, and the water level in the soil is tending to fall during the greater part of the time. Insect pests may cause difficulty here also, but, up to the present, fungus pests have not been in evidence, presumably because the dry conditions generally obtaining are not suited to their development. The irrigation method has only recently been adopted, and is presenting a new and highly important set of problems. Irrigation has, in the past, almost always led sooner or later to soil troubles, and there is no reason to suppose that the Sudan will be any exception to this rule. The insect pests are at least as troublesome as under any other form of cultivation, and a bacterial disease has already made its appearance, suggesting that troubles from fungi may still be in store. Equally urgent problems are the supply of pure seed, and the search for new varieties better suited than those at present in use to the requirements of the market and to the local conditions. Given adequate scientific investigation, none of these problems is insuperable, though, undoubtedly, most of them present difficult features.

THE growing importance of the utilisation of water power, particularly in parts of the British Empire outside the home countries, has made it desirable that a responsible but disinterested body should draw up a code of tests for hydraulic turbines somewhat similar to those that have already been published in connexion with steam engines and internal combustion engines. Some months ago the Institutions of Mechanical and Civil Engineers set up a joint committee to report on the subject of standard tests for hydraulic turbines, and the preliminary draft of the committee's report has now been published. It is a valuable document from three points of view. The various terms and quantities that must be used in a careful analysis of an hydraulic plant are defined, and the recommendations of the committee, if closely followed, will make it possible to analyse the efficiencies of the various parts of the plant as well as the efficiency of the plant as a whole. The measurements that are necessary are carefully set forth, and valuable suggestions are made as to the best methods of making the measurements. A standard test sheet is suggested in which all measurements and quantities are to be entered under 98 separate items. For the acceptation test, it possibly would be necessary to enter only comparatively few of the quantities suggested in the sheet, but the very complete analysis of turbines that will be obtained if all items are entered, should be of considerable scientific value and should assist in the perfection of hydraulic plant. From some points of view, it may be suggested that for commercial purposes the test sheet is far too complete and cumbersome, but the committee has rightly recognised that its work would be very incomplete if its report stopped at suggesting records which would simply give acceptance tests that would be valuable only for sellers and purchasers. The appendix dealing with apparatus for the measurements of the volume of water is important, and with one or two additions describing methods of measuring volumes that have recently been developed in America, the report with its appendix will be very complete. It is interesting to compare it with a report recently issued by the American Engineering Societies. In one or two cases its definitions differ slightly from those of the American report.

MR. W. H. JOHNSON has an interesting note in the Bulletin of the Imperial Institute, Volume 21, No. 4, on cotton-growing in Australia, which has been attempted spasmodically since 1788, but is still even in Queensland dependent on the guarantee of artificial high prices, so that the industry seems to exist upon an unsound basis. It is, however, significant that the Mexican cotton boll-weevil and the pink boll-worm are still not recorded for Australia, and Mr. Johnson concludes that the soil and climatic conditions in large portions of Queensland, North New South Wales, North-West Australia, the Irrigation Settlements, and probably also in the new territory are well adapted for cotton cultivation; but that properly conducted experiments will have to be carried out to decide whether the crop can be profitably grown on a commercial scale, to determine the best planting season, and the variety or varieties that are best adapted for cultivation in particular districts. In the same number of the Bulletin there is a brief report upon the progress of cotton-growing in South Africa, particulars being taken largely from the report made by Mr. G. F. Keatinge, who made a tour in South Africa during 1922–23 on behalf of the Empire Cotton Growing Corporation. This report recommends that an experiment station should be established in the Transvaal Low Country, and that another station for selection and breeding and a seed farm should be established in the Ntambanana-Nkwaleli area. It is pointed out that a strong commercial corporation would be needed for the purposes of handling, marketing, and financing the crop with the support of the Union Government and the Empire Cotton Growing Corporation, and that such a corporation would advisedly commence operations in the Transvaal Low Country.

WITH the view of exploiting further the possibilities of free-ballooning for meteorological inquiries, the U.S. Weather Bureau, in co-operation with the Army Air Service, has arranged a series of flights. The *Meteorological Magazine* for April contains some notes by Dr. C. Le Roy Meisinger, who is to represent the Weather Bureau on these flights. The balloons are of 35,000 cubic feet capacity, filled with hydrogen, and will carry two men. The ascents are arranged for April and May, and the starting-point in each case will be Scott Field, Illinois. Particular attention is to be given to the determination of free-air trajectories by the balloon riding at relatively constant elevations. For fixing the horizontal trajectory when the earth is obscured by clouds, coloured post-cards, weighted, will be dropped to be mailed to headquarters. An Owens' dust counter will be carried, and observations of sky-brightness will be taken. An attempt will be made to measure the size of water droplets in clouds. The balloonists will be in communication with the forecast officials in Washington. The balloon will be equipped for radio reception, but not for transmission.

THE widespread demand for information as to the present state of our knowledge in the various branches of science is being met by the appearance of scientific articles in the daily press and in publications which a quarter of a century ago would have looked on such a step as revolutionary or even incendiary. Unfortunately, it is not yet possible to say that these articles in all cases do justice to their subjects or reflect credit on their authors. Too many are written in the style of overpraise which one associates with the advertisement of a new quack remedy; others explain the obvious at great length and have no room for the barest mention of difficulties, while the principle of economy in words finds few adherents. An article on the atom, by Dr. A. S. Russell, which appears in the April issue of the *Quarterly Review* and gives a clear account of the nuclear atom and its capabilities, is freer from these defects than many on the subject which have been written, but would in our opinion have been improved by the omission of the speculation on the vast store of energy in a helium atom if formed from four hydrogen nuclei and two electrons.

THE Geographical Society of Geneva, acting under the auspices of the International Red Cross Committee and of the League of Red Cross Societies, proposes to issue a quarterly review in French and English to be called *Matériaux pour l'étude des calamités.* The journal is to have two main objects: (*a*) to suggest preparations on definite plans for providing international emergency relief in disasters due to earthquakes, floods, epidemics, famines, etc.; (*b*) to study the causes of such catastrophes, their geographical distribution, and the methods of forestalling them. Inquiries under the latter heading are of course being actively pursued in all civilised countries liable to these catastrophes, as in Japan by the Imperial Earthquake Investigation Committee. For example, on the advice of this Committee the whole population of the Sakura-jima (23,000 in number) was removed from the island during the day preceding the great eruption of 1914, and no lives were lost but those of three over-zealous officials. But a journal that would arouse interest in such subjects and that would help to prevent the waste of effort and loss of time inevitable to all emergency work would serve a very useful purpose. The editor is M. Raoul Montandon (1 Promenade du Pin, Geneva), to whom we are indebted for a paper (reprinted from the *Revue Internationale de la Croix-Rouge* for April 1923), in which are given nine maps of the world showing the distribution of earthquakes, volcanic eruptions, seismic sea-waves, typhoons, etc., droughts, floods, etc., swarms of locusts, famines, and cholera and yellow fever.

WE welcome the appearance of a new monthly journal, *The Colliery Engineer*, which promises to form a useful addition to the existing technical papers, and should fill a want which has hitherto remained unsupplied. As is well known, there are several journals which cater essentially for the commercial and industrial aspects of coal-mining, but have largely left the scientific technology of the industry to the Institution of Mining Engineers. The Transactions of this Institution will continue as heretofore to be the medium through which mining engineers will learn of the newest developments in coal-mining; but alongside of this there is room for a high-class journal which is able to describe plants, methods, and processes, which, whilst presenting no feature of novelty sufficient to warrant their being communicated to the Institution, yet afford valuable information to the colliery engineer. This appears to be the work to which the new journal is devoting itself, and the first two numbers, for March and April, indicate that it is doing the work very successfully. We find, for example, descriptions of collieries, such as the Llantrisant and Llanharan sinking of the Powell-Duffryn Steam Coal Co., Ltd., and the Horden Colliery of the Horden Colliery Co., Ltd.; there are articles on coal-washing and the recovery of solids from washery water, on wire ropes and colliery headgears; while the scientific side of the subject is discussed in such articles as that of Dr. Thornton's on electricity in mines, Mr. Shatwell's paper on the Bergius process for the production of oil from coal, and Mr. J. Ivon Graham's paper on spontaneous combustion in coal mines. There are in addition other articles dealing with the more important present-day questions with which colliery engineers are concerned, and a series of special abstracts from Continental and foreign technical and scientific papers; this feature should be of the greatest value to British coal-mining engineers, who as a rule are not able to keep in as close touch as they should do with the developments of coal-mining abroad.

PROF. R. A. MILLIKAN will deliver the Faraday Lecture of the Chemical Society at the Royal Institution, Albemarle Street, W.1, on Thursday, June 12, at 8.30 P.M.

THE Annual Oration of the Medical Society of London will be delivered in the rooms of the society, 11 Chandos Street, Cavendish Square, W.1, on Monday, May 5, by Mr. Wilfred Trotter, who will take as his subject, "On Certain Minor Injuries of the Brain."

APPLICATIONS are invited for the directorship of the National Museum of Wales, Cardiff. Particulars of the duties of the office and other information can be obtained from the Secretary of the Museum. The latest date for the receipt of applications for the post is June 14.

ACCORDING to the *Chemical Age*, Prof. Hugh Ryan, of the National University, Ireland, has been appointed Chief State Chemist for the Irish Free State Government. It is a temporary part-time appointment, and Prof. Ryan, who has been carrying out the duties for a considerable time, will still continue his work at the University.

NOTICE is given by the Ministry of Agriculture and Fisheries that applications for grants in aid of scientific investigations bearing on agriculture to be carried out in England and Wales during the academic year beginning on October 1 next can be received until May 15. The applications must be made upon form A.230/I., copies of which may be obtained from the Secretary of the Ministry, 10 Whitehall Place, S.W.1.

Two university graduates with research experience are required by the British Non-Ferrous Metals Research Association for specific investigations of a metallurgical and chemical nature. Written applications giving particulars of training and experience should be received—by, at latest, May 12—by the Secretary of the Association, 71 Temple Row, Birmingham.

A LIMITED number of grants-in-aid to young men and women employed in chemical works in or near London, desirous of a career in chemical industry, will be made by the Salters' Institute of Industrial Chemistry in July. Applicants must not be under seventeen years of age, and should apply for the grants by, at latest, June 14 to the Director of the Institute, Salters' Hall, St. Swithin's Lane, E.C.4.

SEVERE earthquakes were felt on the east coast of Mindanao Island (Philippine Islands) on April 18 and 19, the town of Mati being badly damaged. The ground there sank two feet. The epicentre was probably in the Philippines Deep, beneath which a large number of the strongest earthquakes felt in the islands have originated. On April 19, another earth-shake, less severe than that of April 4 (Nature, April 19, p. 578), was felt in the Alfreton coalfields on the borders of Derbyshire and Nottinghamshire, most strongly at South Normanton and Pinxton. This is at least the fifth earth-shake felt in this district during the present year.

The annual dinner of the British Science Guild will be held at the Hotel Cecil, Strand, W.C.2, on Thursday, May 22, with the president, Lord Askwith, in the chair. Among the guests of the Guild will be the French Ambassador and the Comtesse de Saint-Aulaire, Lord Sumner, Lord Terrington, Sir Frederick Maurice, Sir Henry and Lady Galway, Canon Carnegie, Hon. G. N. Barnes, Mr. Alfred Noyes, Dame Helen Gwynne-Vaughan, and Mrs. Barbara Wootton.

Among the Chadwick Public Lectures announced for May and June is one by Prof. E. W. MacBride, professor of zoology in the Imperial College of Science and Technology, South Kensington, to be given on May 9 at 5.15 p.m., on "Some Causes of a C3 Population." The lecture will be delivered at the Royal Society of Arts. Another is by Sir David Prain, who will deal with the "Economic and Hygienic Relationships of Cinchona Bark and Quinine." The lecture will be delivered on June 4 at 5 p.m. in the Chelsea Physic Garden. Further information about Chadwick Lectures can be obtained from the secretary of the Chadwick Trust, Mrs. A. Richardson, 13 Great George Street, Westminster.

At the annual general meeting of the Society of Glass Technology, held in Sheffield on Wednesday, April 16, Col. S. C. Halse, of Messrs. John Lumb and Co., Ltd., Castleford, was elected president in succession to Prof. W. E. S. Turner. The other vacancies arising were filled as follows: *Vice-Presidents*, Mr. F. G. Clark and Mr. R. L. Frink; *Members of Council*, Mr. H. A. Bateson, Mr. W. R. Dale, Mr. J. Moncrieff, Mr. W. J. Rees, Mr. J. H. Steele, and Mr. H. Webb; *Honorary Treasurer*, Mr. J. Connolly; *American Treasurer*, Mr. W. M. Clark; *Honorary Secretary*, Mr. S. English.

Grants for the promotion of scientific investigation are offered by the Ella Sachs Plotz Foundation, which has been established in memory of Ella Sachs Plotz, of New York. For the present, researches will be favoured that are directed towards the solution of problems in medicine and surgery or in branches of science bearing on medicine and surgery. Plans for concerted attack by a group of investigators, either at one centre or working in different places, will be especially welcomed. The present available annual income is 10,000 dollars. Applications for support from this Foundation should be accompanied by a full statement of the need for the investigation, the conditions under which it is to be prosecuted, and the way in which the grant would be expended. They should be forwarded to the secretary of the executive committee of the Foundation, Dr. Francis W. Peabody, Boston City Hospital, Boston, Massachusetts.

We understand that Mr. Reid Moir is to conduct a Percy Sladen Fund research at Cromer during May and June next. The object of this investigation is to discover and collect remains of man from the ancient Cromer Forest Bed and associated deposits. In July, Mr. Moir, in collaboration with Mr. H. J. E. Peake, Prof. Boswell, and other geologists, is to carry out excavations in the well-known implementiferous brick-earth at Hoxne, Suffolk, when it is hoped that the exact relationship of this bed to the glacial accumulations of East Anglia may be made clear. The Hoxne diggings will be conducted by means of a British Association grant. In September, Mr. Moir is to begin an extensive excavation in the sub-Crag detritus-bed at Bramford, near Ipswich. The detritus-bed at this place is of unusual thickness, and should amply repay examination. The money for this research is being provided by the Royal Society, the committee of the Ipswich Museum, and by a number of private subscribers.

The American Geographical Society, New York, announces the election of the three following honorary corresponding members: Dr. Edwin R. Heath of Kansas City, Mo.; Dr. H. L. Shantz of Washington, D.C.; and M. Paul Le Cointe of Belem (Pará), Brazil. Dr. Heath is well known for his early explorations in South America, having explored the Rio Beni region in 1880. In honour of his distinguished work a branch of the Rio Beni north of Lake Titicaca has been called the River Heath. Dr. H. L. Shantz, of the Department of Agriculture, Washington, D.C., has made notable explorations in Africa, and he is now engaged upon further study in plant ecology in that field. He is joint author with Dr. C. F. Marbut of Research Series No. 13, "Vegetation and Soils of Africa," published by the American Geographical Society in co-operation with the National Research Council. M. Paul Le Cointe of Belem (Pará), Brazil, is the author of "L'Amazonie brésilienne: Le pays—ses habitants, ses ressources, notes et statistiques jusqu'en 1920," a work of high distinction, especially when the difficulties to be overcome in gathering and publishing the material are considered. Of particular importance are his discussions of the climate, economic development, and forest life of Amazonia.

A new periodical called *Radio für Alle*, edited by Hanns Günther and Franz Fuchs, and published in Stuttgart, combines in a happy way both technical and popular news about radio communication. It contains a very good description of the antennæ at the super-radio station at Nauen. A description is given of the concert recently broadcasted from Pittsburg to the British Isles, and an excellent map is reproduced showing how the waves suffer reflection in their passage over the Atlantic Ocean. On the assumption that there is a conducting stratum—the Heaviside layer—in the upper atmosphere, Dr. Göttinger gives a fairly convincing explanation of the "fading" effect. An article describes how the position of an aeroplane can be readily located by taking simultaneous observations at two land stations. Several articles are written specially for amateurs and show good ways of erecting aerials out of doors, fixing antennæ inside the roof, and constructing aerials that can be used inside a room. In conclusion there is the usual local news for German radio-clubs.

WE welcome the appearance of the first number of *Watson's Microscope Record* as evidence of renewed activity in one branch of the instrument-making trade. This small bi-monthly periodical, which is published by Messrs. W. Watson and Sons, Ltd., deals with the microscope and its various applications. The *Record* will contain not only notes relating to new instruments and accessories, but also details of new processes and papers dealing with the technique of various branches of microscopy. The present number contains a paper by A. A. C. Eliot Merlin on "Critical Observational Methods in Efficient Bacteriological Microscopy," in which observational procedure is discussed, while an article by E. Cuzner describing a method of collecting hydrozoa from the sea-shore and examining them should appeal to both the student and the amateur microscopist. In addition, there are brief descriptions of a new binocular microscope, and of a dark ground illuminator designed by E. M. Nelson. Copies of the *Record* will be regularly sent free of charge to those interested in microscopical matters on their making application to the publishers at 313 High Holborn, London, W.C.1.

BOTANISTS in Great Britain have recently received from Prague, copies of the first volume of "Studies" from the Plant Physiological Laboratory of Charles University, edited by Prof. B. Němec, who requests publications in exchange. This first volume of some 120 pages, with three plates, contains five papers, in various languages, but those not in English, French, or German are accompanied by an abstract. W. Lepeschkin writes upon "The Constancy of the Living Substance" in English, a language which seems to have given both author and compositor some trouble. In this work the author develops still further his studies of the effect of heat upon protoplasm, recognising four phases of heat-coagulation in the case of living cells of Spirogyra. The effects of light, hydrogen ion concentration, and narcotics upon living Spirogyra cell are also studied and to a great extent interpreted in terms of their effect upon the denaturation of protein. Dr. Artur Brožek has a long paper upon selection and crossing experiments with white variegated races of Mimulus, a case of non-Mendelian inheritance. There are also shorter papers as follows: (1) Dr. J. Kořinek upon the digestion of *Mycobacterium tuberculosis poikilothermorum*, L. N. de Freedmann, by *Bacterium fluorescens* and *B. pyocaneum* in cultures on potato agar; (2) Dr. S. Prát upon the effect of centrifugal force on Hydrodictyon; (3) W. S. Iljin upon the penetration of the protoplasts of the guard-cells of stomata by salts.

THE Marshall Jones Company of Boston, Mass., U.S.A., are to publish under the title "Birds and their Attributes" the ten lectures on "An Introduction to the Study of Birds" which were delivered by Dr. G. M. Allen, secretary of the Boston Society of Natural History, under the auspices of the New England Bird Banding Association.

Our Astronomical Column.

JUPITER.—This planet, now rising before midnight, will soon be visible in the evening hours. The chief features, including the great Red Spot and the South Tropical Disturbance situated in nearly the same latitude, continue to be perceptible and invite renewed observation. The Red Spot is at present situated in longitude about 180° (System II.), and will therefore come to the meridian about $4^h\ 58^m$ before and after the passages of the zero meridian (based on the rotation period $9^h\ 55^m\ 40{\cdot}63^s$) as given in the *Nautical Almanac*. In fact, the Red Spot is now on the opposite side of the planet to the place of the zero meridian. The South Temperate Disturbance is situated in the region following the Red Spot, and the preceding end of the former is, according to Mr. P. M. Ryves's recent observations at Saragossa in Spain, in longitude 197°, and corresponds in place with the following end of the Hollow in the great South Equatorial Belt. The conjunction of the centres of the two objects will probably occur in about three years, for the difference in their velocities is now only $3{\cdot}8^s$ per rotation. In 1901 the difference was about 20^s.

STELLAR MASS AS A FUNCTION OF ABSOLUTE MAGNITUDE.—The *Observatory* for April reproduces Prof. Eddington's curve that gives mass as a function of absolute magnitude. A mass $\frac{1}{6}$ of the sun has absolute magnitude 12, unit mass has absolute magnitude 5, and mass twenty-five times the sun absolute magnitude -4. The curve would fit well with Plaskett's very massive star, giving absolute magnitude $-6{\cdot}5$. This was not used in forming the curve, since it is not an eclipsing binary, so only the minimum mass is known. The curve is quite a smooth one, the average residual between theory and observation being $\pm 0{\cdot}56$ magnitude.

Prof. Lindemann, in the discussion, spoke of the "comparatively puny temperatures and pressures obtaining in the interior of a star." If these temperatures are puny, one wonders where one must go to obtain a really high temperature.

CAPE ASTROGRAPHIC CATALOGUE ZONES $-46°$, $-47°$.—These two volumes have lately been issued; they consist respectively of 506 and 509 pages of catalogue, the average number of stars per page being about 140, so that there are some 70,000 stars in each volume. x and y are given to the third decimal of 1′, also the diameters of images, and the C.P.D. No. and mag. for stars in that work. The following figures give some idea of the distribution of stars:

Zone.	R.A. 0^h to 6^h.	R.A. 6^h to 12^h.	R.A. 12^h to 18^h.	R.A. 18^h to 24^h.
$-46°$	53 pp.	191 pp.	167 pp.	95 pp.
$-47°$	52 ,,	161 ,,	201 ,,	94 ,,

The plate constants are given in the introduction, together with formulæ for reducing x, y to R.A. and Decl.

The introduction gives a full description of the methods of exposing and measuring the plates: as a rough guide to sufficiency of exposure, it was examined whether stars down to mag. 9 were shown with the 20 sec. exposure. The long-exposure (6 min.) images were measured unless some defect was present in them, in which case the second exposure was substituted and a correction applied to the place.

Research Items.

NEOLITHIC PAINTED POTTERY FROM THE BUKOVINA.—Mr. V. Gordon Childe describes in vol. liii. pt. 2 of the Journal of the Royal Anthropological Institute a representative series of painted pottery from Schipenitz, a late neolithic station in Bukovina belonging to the important neolithic culture of the famous black earth belt of South-Eastern Europe, for which affinities with the Ægean have been suggested. The sites of the black earth belt fall into three groups of which the eastern forms the true Tripolye culture. Of the central group, to which Schipenitz belongs, Cucuteni alone shows any stratification. Here the pottery of the later of two culture levels corresponds to that of Schipenitz, as also does that of the later of two chronological groups on the Dniepr. The painted pottery is generally found in rectangular structures of wattle and daub. At Schipenitz it shows no sign of development and belongs to a single cultural epoch. It exhibits a considerable range of form with a characteristic but limited range of design based upon the S-shaped spiral for each. Black monochrome or black with thin red line hatching is applied to a polished surface ranging from deep red to yellow, or to a thin slip varying from brown to creamy white. The people of Schipenitz were pastorals, but there is evidence that they also practised agriculture. Their culture came to an end owing to the inroads of nomads from the east and north, and apparently did not outlive the second Middle Minoan period.

SOCIAL ORGANISATION OF THE MANCHUS.—In extra volume iii. of the North China Branch of the Royal Asiatic Society, Dr. Shirokogoroff deals in great detail with the Manchu clan organisation—a subject in which any addition to our scanty information is welcome. While reserving broad generalisations for later consideration, he concludes that the Manchu clan is a group united by agnatic relationship, owning a common ancestor and a group of spirits peculiar to the group, and including women adopted as wives of the male clan members. The ancient social organisation has been preserved but adapted to the new conditions involved by residence among the Chinese. The military and economic domination of the Manchus over the Chinese preserved them from complete assimilation by the latter. The clan organisation is closely bound up with their system of spirits, Shamanism being one of the elements forming the basis of the clan organisation which could not exist apart from it. Their classificatory system of relationship is based on a division into classes, each of which is divided into junior and senior groups. This represents the unification of two systems, one matrilineal and the other patrilineal, the latter showing traces of Chinese influence. The clan organisation indeed, in certain particulars, affords evidence pointing to an earlier system which allowed greater rights to women than at present.

PSYCHO-ANALYSIS AND ANTHROPOLOGY.—In *Psyche* for April, Dr. Malinowski has subjected the nuclear family complex of the psycho-analysts to a critical examination on the comparative lines suggested in his communication to NATURE (see NATURE, November 3, 1923, p. 650). The nuclear family complex, the most important fact in human mentality according to Freud, is due to the action of a certain type of social grouping. The psycho-analysts, basing their views upon the typical patriarchal family, assume that the Œdipus complex is universal, but they fail to take into account the possibility of variation according to the constitution of the family. A comparative study of conditions in three types of family life, the peasant and the well-to-do in a civilised community, and a family under the matriarchal system, in this case in the Trobriand Islands, shows that while there are differences in degree rather than in kind in the case of the two civilised units, both differ entirely from the matriarchal type. The characteristic relations between child and parents, and the attitude towards sex and kindred matters which give rise in the patriarchal family to the Œdipus complex, are absent in the matriarchal family, and their place is taken by analogous relations to the mother's brother and in sexual matters to the sister, resulting in a matrilinear complex essentially different from the Œdipus complex. It would appear, therefore, that in studying each type of civilisation, it is necessary to establish the special complex which pertains to it.

LIFE WITHOUT OXYGEN.—Modern views on the subject of respiration are much occupied with the subject of anaerobic life. In spite of the incredulity with which the theory of life without oxygen was received in the past, it is now generally admitted to be thoroughly well established. In his presidential address to the Chemical Society of Washington in January on "Life without Oxygen" (Journ. Wash. Acad. of Sci., March 19), Dr. W. Mansfield Clark says: "In the arguments of those who insist upon the necessity of molecular oxygen are many fallacies. Undoubtedly the outstanding fault is psychological." Pasteur wondered how it was that anaerobes were able to exist in an environment permeated so universally with free oxygen. He himself supplied the answer: anaerobes are found in company with aerobes, and the latter, by using up the oxygen of the environment, provide anaerobic conditions without which the anaerobes could not thrive. We know that the organism of tetanus, for example, will not develop in a wound unless there is also an infection with aerobes. It is also a fact that certain anaerobes have the power of themselves using up oxygen from their surroundings, and so creating their own anaerobiosis. In the investigation of the reducing power of living cells, the reduction of such coloured substances as methylene blue or indigo carmine have been the tools most frequently employed. The researches of Dr. W. Mansfield Clark have thrown a new light on these reduction phenomena, and have given information of the intensity conditions governing these reductions in terms of electrical potentials. A mixture of indigo carmine and leuco indigo carmine at constant H-ion concentration gives a definite electrode potential difference, which can be interpreted in terms of the oxyhydrogen gas cell. Knowing the potential difference in terms of a hydrogen electrode and the P_H, we can then calculate for a partially reduced indigo solution the hypothetical hydrogen or oxygen pressures in equilibrium with the system. In a case where 80 per cent. reduction had occurred, the oxygen pressure came out at 10^{-36} atmospheres. This is, as Dr. Clark says, "*some* anaerobiosis."

HABITATS OF LIMNÆA.—Dr. W. R. G. Atkins and Dr. Marie Lebour contribute a note (Sci. Proc. R. Dublin Soc., March 1924, pp. 327-331) on *Limnæa truncatula* and *L. pereger* in relation to hydrogen-ion concentration and other conditions. The latter is truly a water snail and can endure even somewhat stagnant water; the former is amphibious, and can live either in shallow, well-aerated water or on moist land, or even on cliffs in a region of high humidity. The observed ranges for the two species as regards acidity and salt-content of the water are almost identical.

REVERSAL OF GEOTROPISM.—In three recent papers the results which Prof. J. Small believed he had obtained in causing stems to grow downwards and roots to grow upwards, by placing the former in an acid and the latter in an alkaline medium, have been controverted. Prof. F. C. Newcombe (*New Phytol.*, vol. 22, No. 5) has repeated many of the experiments both with roots and stems. He obtained only negative results and points out various sources of error in the experiments. Cholodny (*Ber. deut. Bot. Gesells.*, vol. 41) has reached similar conclusions, finding the downward bending of young stems in an atmosphere of carbon dioxide to be due to a softening of the tissues. Messrs. R. E. Chapman, W. R. I. Cook, and Miss N. L. Thompson (*New Phytol.*, vol. 23, No. 1), in another series of experiments with seedlings in 10-60 per cent. carbon dioxide, also find only normal geotropic response of stems, unless the growth is inhibited altogether. In the higher concentrations of carbon dioxide, geotropic curvature usually occurs before the heliotropic, and as the carbon dioxide concentration increases the stomata tend to close.

ICE IN THE ARCTIC SEAS.—The Danish Meteorological Institute has published its well-known report on the state of the ice in the Arctic Seas for 1923. In many respects the year was an exceptional one. In the Kara Sea conditions were unusually favourable, for not only was the southern part ice-free in July, but also practically the whole sea was clear of ice in August and September, and probably much of October. The Barents Sea was unusually clear from April to the end of the summer. In August there was open water to Franz Josef Land and the Wiche Islands and well to the north of Spitsbergen. Around Spitsbergen the ice conditions were also somewhat exceptional. Bear Island was clear of pack by the end of April, and the west coast of Spitsbergen had no ice of significance from May until November. The north coast was so free from ice that Spitsbergen was circumnavigated with comparative ease. While reports from the east coast of Greenland were few, there is evidence that ice conditions in that region were bad and that the ice was packed closely against the coast. In spring and early summer there was an unusual quantity of ice on the Newfoundland Banks, but in Davis Strait the ice was scarce. Scantiness of information from many Arctic seas necessarily detracts from the value of this annual record, but it represents the only systematic collection of data relating to ice-movements in which it may be possible in time to recognise some periodicity in occurrence.

SHELLS OF FOSSIL BRACHIOPODS.—Mr. W. E. Alkins has measured some four hundred specimens of a Rhynchonellid, doubtfully referable to *Rh. boueti*, from the base of the Forest Marble at Harbyleigh, Dorset, now in the collection of the Manchester Museum. The length, width and depth of the shells were measured and the correlations determined. The species as represented by these specimens is shown to be homogeneous; the correlation between length and width is fairly high (0·86), but between length and depth is surprisingly low (0·31). A similar series of measurements is recorded for 300-400 specimens f *Terebratula punctata* (Manchester Memoirs, vol. 67, No. 9, 1923).

NATURAL OIL-RESERVOIRS AS "STOCK-TANKS."—The somewhat novel idea of utilising exhausted oil-reservoirs for storage, not only of heavy fuel-oil but also for lighter distillates, has been mooted on more than one occasion in the past. It is therefore interesting to be able to record details of an actual case of recourse to this extremity, showing that in practice the idea is not such a wild one as appears from first consideration. During the War, crude oil obtained in Sarawak was the source of several thousand tons of valuable fuel for the British and allied navies operating in eastern waters, but owing to a shortage of tankers, there arose great difficulty in disposing of the lighter oils necessarily produced when refining the crude material. Rather than waste such valuable products, certain wells in the Miri field, known to be practically exhausted, were used for pumping into the sands they had previously drained, more than 30,000 tons of petrol, often at quite high pump pressure (over 100 pounds to the square inch). This policy was resorted to particularly in 1916–17. With the cessation of hostilities, there were more tankers available and the oil was re-pumped from the wells, so that in 1919 no less than 14,000 tons of oil were recovered in the form of a light crude. According to the Hon. T. G. Cochrane, who dealt with this subject at a meeting of the Royal Society of Arts on March 4, the total amount of oil recovered was actually in excess of that quoted, as owing to migration, some of the oil appeared in producing wells located at a distance from the storage wells. A fifty per cent. recovery is obviously better than a hundred per cent. wastage, which would have occurred had some expedient not been adopted to deal with the situation. Loss of oil due to migration, however, is in most cases bound to be substantial, and while this practice may be defended in extenuating circumstances, the conversion of derelict reservoirs into temporary stock-tanks is a policy scarcely likely to meet with general approval.

THE CRUDE OILS OF BURMA AND ASSAM.—Most of the crude oil produced in Burma emanates from the Yenangyoung, Singu, and Yenangyat fields, situated in the basin of the Irawadi River, some 300 miles north of Rangoon. There is much similarity between the oils produced in these three fields, though the Singu and Yenangyat crudes tend to be richer in light fractions. In general the oil is green in colour (brown by transmitted light), has a pleasant odour, and is practically free from water; the sulphur content is low. The chief characteristic of Burma crude is the exceptionally high content of solid paraffins, causing the oil to have a setting point below about 70° F. As it contains an appreciable amount of asphalt, it cannot be classed as a pure paraffin base crude, though the specific gravity (0·835) is by no means high. An average distillation, in the absence of cracking, gives 28 per cent. petrol, 35 per cent. kerosene, 6 per cent. intermediate oil, 10 per cent. paraffin, 13 per cent. lubricating oil base, and 8 per cent. residuum; these and the foregoing data were given *inter alia* during the course of a paper read by Mr. W. J. Wilson at the Institution of Petroleum Technologists on April 8. The author also discussed the crude oil of Assam, derived principally from the Digboi and Badarpur oilfields, the product of both areas being essentially different. The Digboi crude has an average specific gravity of 0·856, a larger percentage of solid paraffins than that of Burma, and a greater amount of asphalt. The Badarpur crude, described by the author as a "freak oil," has a high gravity (0·9775) and is a natural fuel-oil, usually void of gasoline, solid paraffins, and having a residuum resembling rosin rather than asphalt, of which only a small amount is present on analysis. This oil is further characterised by the poor lubricating quality of its heavier distillates, which is apparently impossible of remedy by subsequent treatment; some of the still heavier fractions are adhesive like glue and have a specific gravity greater than unity.

LATERITE AND BAUXITE.—The peculiar nature of laterite was first clearly recognised in South India by Francis Buchanan-Hamilton so long ago as 1807, when this name was proposed by him for the peculiar brick-like product of rock weathering under tropical conditions. Following Buchanan-Hamilton's observations, an enormous amount of literature was published, especially in India, referring to laterite. In 1898 a new turn was given to the discussion by Max Bauer's recognition of the similarity in chemical constitution between bauxite and the laterite of the Seychelles. Bauer's work inspired a new crop of literature, dealing first with the origin of bauxite, and secondly with the possibility of utilising the highly aluminous laterites of the tropical belt as a source of aluminium. Recently the Geological Survey of India has published a memoir by Mr. C. S. Fox (Mem. Geol. Surv. Ind., vol. xlix. part 1), in which has been gathered together a well-balanced survey of the known facts regarding the bauxites and laterites of the world. Mr. Fox's memoir promises to become the reference work on this subject for many years, as Dr. Fermor's memoir, published through the same medium, is now regarded as the standard work of reference on manganese-ores. Mr. Fox discusses in his first chapter the mode of occurrence, physical characters, mineral constitution, chemical composition, origin, age, and economic uses of bauxitic laterites. His second chapter is a detailed description of the occurrences in India, and the third chapter is a summary of the facts known regarding the bauxites and laterites of extra-Indian countries. The final chapter gives a summary of the chief points of each paper of importance previously published on this subject. In dealing with the constitution and origin of bauxite Mr. Fox has made a definite advance upon the previously recorded ideas, for he has applied the newly developed science of colloid chemistry to the constitution of bauxite, and has directed attention to the remarkable way in which the lateritic hill-caps in Peninsular India fringe, as well as lie on, the Deccan trap area and probably represent the decomposition product of the trap and its outliers.

A NEW ILLUMINATOR FOR EXAMINING METALS.—A new type of vertical illuminator for the microscopic study of metals was exhibited by Messrs. R. and J. Beck, Ltd., at a recent meeting of the Royal Microscopical Society (Industrial Applications Section). Existing illuminators are generally provided with a single adjustment for altering the angle of the reflector in one direction only. In the new Beck model the reflector can not only be moved in two directions at right angles to one another and to the optic axis of the microscope, but can also be tilted about two different axes. Reflectors of different shapes and sizes are provided, and these can be interchanged in the illuminator while it is in actual use. The series includes a set of concave mirrors, which have not been used hitherto for such work. By the use of a suitable type of mirror placed in the best position over the aperture of the object glass, considerable advantages can be gained in metallurgical examination. Thus, a transparent reflector with a small circular opaque spot in the centre effectively eliminates glare without appreciably injuring the resolution, while a silvered opaque reflector can also be used with but slight loss of resolving power. The illuminator can be fitted to any make of microscope, and should prove of considerable assistance to metallurgists.

A NEW "BAKER" MICROSCOPE.—Messrs. C. Baker and Co. (244 High Holborn, W.C.1) have submitted to us an example of their new model R.M.S. microscope. The instrument is of very rigid construction, so important for accurate work, and is quite stable in the horizontal, as well as the vertical, position. The fine adjustment and sub-stage slides are embodied in the limb, ensuring alignment and rigidity, and a substantial platform is included in the casting, to which the stage is attached. The stage is a rotating one, with clamping arrangement, provided with verniers, and having movements of 60 mm. and 30 mm. in the vertical and horizontal directions respectively. The former movement has a clamping device to prevent the stage running down when the microscope is used in the horizontal position. The sub-stage is of new design. Only the ring carrying the optical system swings out, the slide with rack and pinion being stationary. This is done by pressing a small spring and sliding the sub-stage down the left-hand support. On reaching the bottom it can be turned out, and on swinging in again and sliding up the pillar, it comes back truly central and into focus. The body is fitted to an independent slide with clamp to that of the coarse adjustment. This arrangement has two advantages, one being the extra working distance available for very low powers such as 4-in. to 6-in. objectives, the other that the body can be entirely removed and replaced by a high power binocular. A rack and pinion adjustment to the drawtube of the monocular body can be supplied, extending to 250 mm. and closing down to 130 mm. The whole instrument is beautifully finished and is suitable for the most delicate research work and for photomicrography.

ELECTRIC FURNACES FOR HARDENING STEEL.—Messrs. The Automatic and Electric Furnaces, Ltd., Elecfurn Works, 173-75 Farringdon Road, E.C.1, have issued a new catalogue dealing with furnaces operating on the Wild-Barfield system. The special feature of the furnace is the magnetic detector. This consists of a secondary winding superimposed on the main heating winding and connected to an indicator by means of which a visual indication is given to the operator of the magnetic condition of the charge in the furnace. The basic idea is the fact that the temperature at which steel becomes non-magnetic is, for practically all carbon steels, the correct quenching temperature. A secondary feature of practical importance in these furnaces is the excess temperature cut-out. This consists of a loop of silver wire carrying the main heating current and entering the hot zone of the furnace. This loop fuses should the furnace temperature be allowed accidentally to rise beyond a certain point. It is stated that with electricity at one penny per unit, the cost per ton of work hardened has been reduced from 34s. to 26s. per ton on account of the improvements which have been effected in the design of the new furnaces.

THE COLOURS PRODUCED BY BECQUEREL RAYS.—In a communication to volume 20 of the *Zeitschrift für Physik*, Prof. K. Przibram, of the Radium Research Institute, Vienna, sums up the results which have been obtained by himself and his pupils on the nature and behaviour of the colours produced in otherwise colourless substances by the incidence of Becquerel rays on them. The colour is due to extremely small particles produced in the substance, so small that they cannot always be detected by the ultramicroscope. When the substance is an alkali salt, the colour produced is in general that of the vapour of the alkali, and in all cases it appears to approach a limiting value. It may be discharged either by heating or by allowing light to fall on the substance. During the discharge of the colour the substance may become luminescent and photo-electric. The author conceives the process as due to the absorption by a negative ion of the substance of a quantum of radiation and the consequent release of excess electrons. These reach the positive metal ion, and in neutralising it light is emitted and the substance takes the colour of the metal. On heating, the freer motion of the ions results in the return of the electrons to the negative ion and the discharge of the colour.

Meteorological Factors and Forest Fires in the United States.

FOREST fires have long been a source of damage and loss in North America, and for many years the U.S. Department of Agriculture, by the aid of the Forest Service and the Weather Bureau, has sought, so far as possible, to mitigate the amount of havoc by fire control. Necessarily immense difficulties harass the work in many ways, but without doubt the unceasing care and activity of those engaged is telling in its results. A prime feature in the discussion is the forecasting of fire-weather with the object of avoiding the fires or competing with them when necessary. The U.S. *Monthly Weather Review* for the past two years contains many varied articles on the subject, written from different points of view. Only the merest reference can be made to them here in the space available. Occasional articles have appeared for at least ten or twelve years connecting the forest fires with lightning, but it is only in the last two years—1922 and 1923—that the communications have become so frequent and widespread. In 1923 there were at least 12 communications, 7 of which occur in the November number. It is almost invidious to single out those by special authors—all of which are either attached to the Forest Service or the Weather Bureau.

In the *Monthly Weather Review* for March 1921, Mr. E. N. Munns of the Californian Forest Service endeavours to correlate evaporation and forest fires, associating evaporation with temperature, humidity, and wind. In the issue for February 1922, "Climate and Forest Fires in Montana and Northern Idaho, 1909 to 1919," is dealt with by Mr. J. A. Larsen, Forest Examiner, and Mr. C. C. Delavan, Fire-assistant. During the eleven years nearly 5,000,000 acres of land were burned over in this district, with a damage to standing timber estimated at 28 million dollars, and an outlay in fire prevention and suppression of about four and one-half million dollars. Diagrams are given showing for seven sections of the district the average area per fire for each of the eleven years and the mean for the whole period. The years 1910 and 1919 stand out as experiencing the most disastrous fires. The outstanding causes of forest fires appear to be lightning, railroads, campers, and slash burning, of which lightning is the cause of the greatest number; some sections are said to have few fires from any cause except lightning. Sunshine, wind movement, and moisture deficit are much above the average in years of bad forest fires, and there are other meteorological elements which afford very critical weather for forest fires. There is a general belief that forecasts of fire-weather conditions would be invaluable if they could be made sufficiently accurate and localised to be trustworthy.

"The Occurrence of Lightning Storms in Relation to Forest Fires in California" is dealt with in the *Monthly Weather Review* for April 1923, by Mr. S. B. Show and Mr. E. I. Kotok, Forest Examiners. It is asserted that lightning has been proved to be the principal single cause of forest fires in California and throughout the West. In the national forest of California during the years 1911–20 lightning has been responsible for 4363 out of a total of 10,527 fires, or 41·5 per cent. Further study of the storms involving lightning is strongly advocated; 89 per cent. of the lightning fires occur in June, July, and August. Among the number of articles in the *Monthly Weather Review* for November 1923, Mr. H. H. Weidman of the U.S. Forest Service mentions that if the forester knows the different degrees of inflammability of the fuel in terms of differences in its moisture content, it is possible for him to state definitely for to-morrow or the next day what influence the approaching weather will have in making it wetter or drier.

The cause of thunderstorms is now better understood, and with our increased knowledge of the upper air, the knowledge of thunderstorms will be still further advanced and better warnings will be disseminated.

An Analysis of the Jewish Race.[1]

By Dr. R. N. SALAMAN.

THE Jewish communities of the world constitute no pure race, and in their features and physical characteristics represent no single uniform or even average type. An examination into the origins of the Jewish people offers an ample explanation of this diversity of appearance.

The Jewish people to-day are grouped into two stocks, the Ashkenazic and the Sephardic. The first comprises the Jews of Russia, Central Europe, Western Europe, and England; the latter is made up of the Spanish and Portuguese Jews and the Jews of Asia Minor, Egypt, and Arabia. Both groups derive directly from the common source in Palestine and Mesopotamia which, taking different paths in the diaspora, met with different fates. This paper deals with the Ashkenazic, partly because they are the more accessible, but chiefly because in the writer's view they have been far less subject to local intermarriage during their sojournings.

The origin and composition of the Jewish mass up to the first century of this era may be very briefly described as follows: The Abrahamic family were of a tribe, the Ibri, whom the Egyptians knew as Habiru. These were nomadic Semites equivalent to Bedouins. On their return to Palestine they met, conquered, and amalgamated with the Amorites and the Hittites. The monuments as well as philological evidences show that the former were Semites and in appearance not to be distinguished from the Habirus. The Hittites were a people the governing class of which at least were entirely different from both the Amorite and Hebrew and are to-day represented by the Armenians.

Later the Israelites, now a mixed race of Semite and Armenoid origin, took into their midst a third people, the Philistines, a typical Mediterranean race. The Semitic Amorite and Habiru were essentially tall, long-headed people with sloping narrow brow, long face, a long, straight, broad nose with large nostrils, big mouth and heavy, large lips. The characteristics of their facial features are length and heaviness. The Hittite was of medium height, thick build, round-headed, often with a very high, flattened occiput. The features are characterised by their extreme roundness—a large, rounded, hooked, "Jewish" nose, the angles of the face and jaw likewise rounded, the mouth neither large nor the lips coarse.

The Philistines were represented on the walls of Karnak, as their progenitors were on the frescoes of Crete, as a small, delicately built people with long head, very refined clear-cut features, small nose often retroussé, small mouth and refined lips. A facial type characterised by the fine chiselling of the features,

[1] Synopsis of a paper read before the Royal Anthropological Institute on April 15.

the straightness of the nose and brow, the squareness of the nasal outline, and the frontal temporal region: the features are, in a word, short, square, and light.

All the characters grouped together under each of the three racial types, Semite, Hittite, and Philistine, do not pass as a single unit in heredity. The analysis of modern Jewry shows that the characters which make for "roundedness" as opposed to that of "squareness" as well as of length and heaviness as opposed to either, are inherited as simple characters in a Mendelian manner. The results obtained by following the matings of these types show that the rounded Armenoid type of face is dominant to the small, squared, Philistine type, and that the heterozygous form may be often as extreme as the pure Armenoid, though generally it is less so. The Semitic long and heavy type is certainly recessive to the Armenoid, and probably so to the Philistine, but the evidence is scanty in this latter case. The Philistine type breeds pure when mated like to like; the Armenoid likewise, if one or both parents are homozygous, failing which it may split into rounded and squared types as 3 : 1. When the Armenoid Jew is mated to the non-Jew the result is exactly the reverse of that recorded for the mating Philistine × Armenoid. The Gentile (Western European) type is dominant.

Although the Philistine type of face is often identical in appearance with the Western European, nevertheless it is genetically entirely different. In other words, the straight, short, squared features of the Western European are induced by a different chromosomal mechanism from that which induces the like character in the Philistine—the two peoples are then essentially different in origin. The diversity of the Jewish type and its frequent similarity to that of the people of Western Europe receives ample explanation from the kaleidoscopical rearrangements of the original elements which went to compose the Jewish Race before 500 B.C.

The Experimental Explosions in France.

THE arrangements for the experimental explosions next month in France (NATURE, vol. 113, p. 135) are now practically complete.[1] They will be carried out by the military services, though details as to time, etc., have been settled by a committee on which various scientific bodies are represented. There are to be three main explosions, in each of which rather more than ten tons of explosives will be fired on the surface of the ground. The site of the experiments is to be the neighbourhood of La Courtine, about forty miles west of Clermont-Ferrand, and the explosions will be made at three different points about one-third of a mile apart, the centre of the triangle formed by them being in lat. 45° 44·8′ N., long. 2° 14·7′ E. The times have been chosen so that the experiments may be made under different meteorological conditions, the first on May 15 at about 19 h. 30 m. civil time, the second on May 23 at 20 h., and the last on May 25 at 9 h.

Arrangements have been made for the help of observers distributed along the eight principal azimuths from the origin, and they will no doubt be assisted by a very large number of voluntary observers. The most important element is, of course, the time at which the sound is heard, and for this purpose it is suggested that observers should regulate their watches by the hourly signals from the Eiffel Tower. While the ear is a very sensitive receiver and good observations may be made by hearing alone, a simple form of stethoscope would enable the sound to be heard at very great distances. The details which it is suggested that observers should notice are the time as exactly as possible, the apparent direction of the sound both horizontally and vertically, the intensity of the sound according to an arbitrary scale, and also the movement of windows, etc., the nature of the sound whether single, double, rolling, etc., and the meteorological conditions at the time. The earth-waves, it is expected, will be registered at considerable distances from the source, and their records will no doubt add to or confirm our knowledge of the velocities of condensational and distortional waves in the superficial layers (NATURE, vol. 111, p. 585).

If not too late, one or two other points may be suggested as worthy of close attention. Except near the source the air-waves that shake windows are usually different from the sound-waves and near the ground travel with a slightly less velocity (NATURE, vol. 112, p. 602). They seem to take a lower course in crossing the silent zone and in the outer sound-area they precede the sound. It is desirable that the relative order of the sound-waves and the rattling of windows, and the interval between them, should be observed at all distances. In the case of double or multiple reports being heard, the intervals between them and the order of intensity should be recorded. Many of the previous observations of multiple reports are vitiated by the doubt as to the singleness of the original explosion.

C. DAVISON.

[1] The conditions of the experiment are described by M. G. Bigourdan in *Comptes rendus* of the Paris Academy of Sciences, vol. 178, 1924, pp. 25-28, and by Prof. C. Maurain in *La Nature* for March 22.

University and Educational Intelligence.

CAMBRIDGE.—Dr. E. Lloyd Jones, Downing College, has been re-appointed as demonstrator of medicine. The Linacre Lecture at St. John's College will be delivered by Sir Charles Sherrington, president of the Royal Society and honorary fellow of Gonville and Caius College. The lecture will be at 5.15 P.M. on May 6 in the Anatomy School, and the subject will be "Problems of Muscular Receptivity."

GLASGOW.—The following degrees have been conferred:—*Ph.D. in the Faculty of Science:* P. F. Gordon, for a thesis entitled "The Separation of the Components of Petroleum"; and Mr. R. C. Smith, for a thesis entitled "Sintering." *Ph.D. in the Faculty of Arts:* Mr. I. L. G. Sutherland, for a thesis entitled "A Critical Examination of some Current Tendencies in the Theory of Human Conduct." *Ph.D. in the Faculty of Engineering:* Mr. D. S. Anderson, for a thesis entitled "The Evaporative Condenser. A Study of Heat Transmission by Film Evaporation"; and Mr. R. M. Brown, for a thesis entitled "Investigation into some of the Effects of Cold Drawing on the Properties of Iron and Steel."

MANCHESTER.—The extra-mural department of the University has arranged for summer courses of post-graduate study in mathematics to be held at University College, Bangor, from Monday, August 18, to Saturday, August 30. The courses are intended to afford facilities for advanced study in mathematics to teachers and others who are unable to attend courses during the regular University terms. Each course will consist of twenty lectures of one hour each, two lectures being taken on each of ten mornings. The following three alternative courses are proposed: (1) higher geometry, by Mr. H. W. Richmond (King's College, Cambridge); (2) theory of functions, by Prof. L. J. Mordell (University of Manchester), and (3) elements of the theory of relativity, by Prof. Sydney Chapman (University of Manchester). The fee for any of the three courses is three guineas. Application to attend the courses should be made immediately, as the holding of the courses depends to some extent on the number of applications received. A registration fee of half a guinea should be sent with the application to Miss D. Withington, The University, Manchester. This fee will be refunded should the course not be held, or included in the tuition fee if the course is held.

OXFORD.—Trinity Term has now begun, and it is expected that the sittings of the Statutory Commission will give much occupation to the University and College authorities, many of whom will be engaged in preparing draft statutes for the approval of the Commissioners.

The Hope Department has lately received a large and valuable addition to its collection of Lepidoptera by the bequest of the late Mr. A. H. Jones, sometime treasurer of the Entomological Society of London. Mr. Jones's series contains many thousand specimens, mostly collected by himself in various British and European localities, including Russia.

ST. ANDREWS.—The Senatus Academicus has resolved to confer the following honorary degrees at the public graduation ceremonial on June 27:—*LL.D.*: Prof. G. B. Brown, Watson-Gordon professor of fine art in the University of Edinburgh; Mr. Walter De La Mare, author; The Right Hon. James Mackay, Viscount Inchcape of Strathnaver; The Rev. Dr. C. A. Richmond, president of Union College and chancellor of Union University, New York; and Prof. A. M. Stalker, Dundee, emeritus-professor of medicine in the University.

ACCORDING to the Bombay correspondent of the *Times*, Sir Currimbhoy Ebrahim, a well-known Bombay merchant, has offered the University of Bombay ten lakhs of rupees (66,600*l.*) for the promotion of the higher education of Mohammedans.

APPLICATIONS are invited by the Ministry of Agriculture and Fisheries for a number of research scholarships in agricultural and veterinary science, each tenable for three years and each of the annual value of 200*l.* Particulars of the conditions attached to the scholarships, and the prescribed form to be filled up by candidates, may be had from the Secretary of the Ministry, 10 Whitehall Place, S.W.1. The latest date for the receipt of applications for the scholarships is July 15.

THE Yorkshire Summer School of Geography, which was held in 1913, 1914, and 1920, at the County School, Whitby, is to be repeated this year on August 11-23, the work of organisation being undertaken by the University of Leeds. In contrast with previous years, when all aspects of geography have been dealt with, the course this year will be confined to physical geography. The Geological Department of the University will be responsible for the work, and next year the Department of Geography will organise a similar course devoted to the economic aspects of the subject. The course will consist of lectures, laboratory work, field work, and demonstrations. Six formal courses—on topographical maps, geological maps (general), geological maps (special areas), weather charts, surveying, and rocks, minerals, and soils—will be available, and students will be asked to choose four, including that on rocks, minerals, and soils. Particulars of the course can be obtained from the Secretary of the Yorkshire Summer School of Geography, University of Leeds. Applications to attend must be received not later than May 12.

Early Science at the Royal Society.

May 4, 1671. Mr. Oldenburg desired, that Mr. Hooke might be put in mind to observe the obscuration of a fixt star, which would happen according to Mr. Flamstead's pre-advertisement on the 6th of that month of May.

May 5, 1670. Dr. Christopher Wren produced a new contrivance of his for a more convenient winding up of weights by ropes, and serving for wells, mines, and cranes, and thought applicable to clocks.

1686. Anne Taylor, not yet four years old, being grown prodigiously fat and corpulent for that age, was shewn before the Society. She weighed forty-eight pounds and a half.

May 6, 1663. Mr. Hooke was ordered to bring in some experiments . . . concerning the condensation of air in the compressing engine. The queries were ordered to be entered and [among them] were "What variation there will be found in the refraction of the rays of light?" How those [animals] that live endure it? Whether pleasantly or with regret: if it seems painful to them and offensive?

1669. Sir Robert Moray mentioned that Mr. Greatrix had improved his engine for going under water with; and that by means thereof he could sink himself ten fathoms under water, and stay there with ease enough as long as he pleased, going up and down, stooping and working.

May 8, 1661. It was proposed that the Society write to Mr. Wren and charge him in the King's name to make a globe of the moon. *N.B.* The King's command was signified by a letter to Wren under the joint hands of Sir Robert Moray and Sir Paul Neile, dated from Whitehall, the 17th of May 1661. His majesty received this globe with peculiar satisfaction and ordered it to be placed among the curiosities of his cabinet (*see* Ward's "Lives of the Professors of Gresham College").

1672. Mr. Cook produced a piece of steel polished, to be used in the reflecting telescope. Mr. Hooke was desired to make tryal with it, though he said it was falsely polished.

May 9, 1666. It was ordered that the president be desired to write a letter to those of the nobility who were members, concerning their arrears, the occasions of the Society requiring a present supply of money.

1667. Among the experiments, appointed were—To try in St. James's park between that and the following meeting, the experiment of measuring the Earth.

1678. The minutes of the last meeting being read gave occasion of much discourse concerning respiration, and of what use the air might be for continuing sense, motion, and life.

1679. Mr. Hooke produced and read a paper, containing a description of the way of flying, invented and practised by one Mons. Besnier, a smith of Gable in the County of Mayne, the contrivance of which consisted in ordering four wings folding and shutting . . . to be moved by his hands before and legs behind, so as to move diagonally, and to counterpoise each other: by which he was, it was said, able to fly from a high place cross a river to a pretty distance. Mr. Henshaw conceived, that by reason of the weakness of a man's arms for such kind of motions, it would be much more probable to make a chariot or such like machine with springs and wheels to move the wings, that should serve to carry one or more men in it to act and guide it.

May 10, 1665. Mr. Evelyn read a letter from Deal in Kent, concerning Sir William Petty's double-bottomed boat.

Societies and Academies.

LONDON.

Optical Society, April 10.—H. Dennis **Taylor**: The feasibility of cinema projection from a continuously moving film. The film picture may be reflected from a series of mirrors suitably mounted on a drum which is rotated at a definite speed relative to the motion of the film. The various oscillations that may be introduced on the screen image can be minimised or eliminated. As compared with the usual type of projection, continuous projection results in a considerable saving of light, much reduced wear and tear of the film, complete freedom from light and dark flickering and consequent eyestrain, and much greater quietness in running.—E. Wilfred **Taylor**: A new, perfectly anallatic internal focussing telescope. In all surveying instruments, where the distance of an object is deduced from the stadia intercept, the distance so obtained is referred to the "anallatic point," situated either on the axis of the telescope or on the axis of the telescope produced. The introduction of the anallatic lens by Porro automatically referred all distances, deduced from the stadia intercept, to the centre of the instrument, since the latter coincided with the anallatic point. The internal focussing telescope has now been adopted by most instrument makers, and, as the position of the anallatic point varies, a small but variable correction must be made in order to refer distances to the centre of the instrument. A new telescope is now described which, while perfectly anallatic, is of the internal focussing type, and combines the advantages of the Porro construction with those of the internal focussing telescope.

MANCHESTER.

Literary and Philosophical Society, April 1.—A. E. **Oxley**: Physical research in the cotton industry. Experiments which have been carried out at the Shirley Institute, Didsbury, relating to the evenness of single and doubled yarns, high and low draft yarns, the effects of oscillating stresses on yarns, and the connexion between the twists of single and doubled yarn on lustre were described. The periodic variation of twist hardness is due to the intermittent mechanism of the mule, and is present in all mule yarns. Ring yarns do not show this defect, but on the other hand they show greater variations of evenness due to irregularities of the roving. These variations in both mule and ring yarns are of primary importance when single yarns are doubled, the doubling twist being determined by the variations in twists of the singles. The result of this is clearly brought out in photographs showing the brightness or lustre of the doubled yarns, and has an important bearing on the uniformity of the light reflected from woven or knitted fabrics. Introducing a high draft at the ring spinning frame and leaving out either the intermediate or the rover makes little difference.

PARIS.

Academy of Sciences, April 7.—M. Guillaume Bigourdan in the chair.—Paul **Appell**: The derivative of the function $\Psi(x)$ of Gauss, when x is commensurable.—Marcel **Brillouin**: The rigorous mathematical expression of waves which have a given caustic surface of revolution.—Gabriel **Bertrand** and Mlle. Y. **Djoritch**: A new crystallised chromogen, esculetol, extracted from the horse chestnut. From the fruit of *Æsculus hippocastanum* alcohol extracts about 0·25 per cent. of a substance which, after purification, formed colourless crystals. It is not a glucoside, but behaves as a very easily oxidised phenol. It is rapidly oxidised by air in the presence of laccase, forming a yellow colouring matter.—S. **Winogradsky**: The autochtone microflora of arable earth. A study of the micro-organisms present in soil, when the stage representing the rapid action of ferments has been passed, a special point of the method being cultivation in the soil itself and not in the usual culture media.—A. **Blondel**: Abacus for the calculation of the characteristic constants of high-tension aerial transmission lines.—André **Blondel** and Jean **Rey**: The law of perception at the limit of the range of the flashes of luminous signals.—C. **Guichard**: The image at a point and image in a plane of the networks and congruences of a space of order six. Application to the W congruences.—Serge Winogradsky was elected a foreign associate in succession to the late M. Van der Waals.—Herbert **Ory**: Complex numbers with n^2 relative units.—A. **Pellet**: Theorem on equations.—G. **Juvet**: The most general parallel displacement and the formulæ of Frenet.—Alfred **Rosenblatt**: Linear complexes of linear spaces of k dimensions situated in a linear space of r dimensions.—D. **Mordouhay-Boltovskoy**: Some arithmetical properties of the integrals of equations of the first order.—M. de **Séguier**: The maximum divisors of certain Galoisian groups with bilinear or quadratic invariant.—A. **Metz**: Concerning the interpretation of Michelson's experiment. Reply to a criticism of M. Brylinski.—A. **Danjon**: The illumination of the eclipsed moon. Reply to criticisms by W. J. Fisher and by E. W. Maunder.—Sigmund **Stahl**: The secret of the construction of the Italian violin.—Edmond **Bauer**: Interference methods for determining the duration and law of emission of light by atoms.—H. **Buisson**: The series of triplets of the arc spectrum of mercury.—R. **Fortrat**: A new band due to hydrocarbons. A detailed description with measurements of wavelengths of a band in the ultraviolet given by the blue core of hydrocarbon flames ($\lambda = 3143$).—M. **Audibert**: The mechanism of the explosive reaction. In a previous communication it has been shown that the explosive decomposition of nitroglycerol is not instantaneous but progressive. Mixtures of methane and oxygen, or of hydrogen, oxygen, and nitrogen, are now shown to behave in a similar manner, but the detonating mixture $2H_2 + O_2$ gives an instantaneous explosion. From these experiments, the author draws the conclusion that there is no true safe explosive for a dusty mine; it can only be said that under given conditions of use, some explosives are more or less dangerous than others.—P. **Lafitte**: The propagation of the wave of shock.—Raymond **Charonnat**: The stereochemistry of ruthenium.—L. J. **Simon** and M. **Frèrejacque**: The action of bromine on the sulphomethyl esters of phenols. The estimation of sulphur in the esters and phenolsulphonates. The action of bromine at the ordinary temperature on the phenol methylsulphonates gives a monobromo derivative. At 100° C. the sulphonic group is removed as sulphuric acid and replaced by bromine, and the reaction may consequently be applied to the determination of the sulphur in such compounds.—P. **Brenans** and C. **Prost**: The iodo-*m*-oxybenzoic acids.—V. **Thomas**, M. **Bathiat**, and A. **Génet**: Contribution to the knowledge of picryl sulphide: the action of the alkalis. Picryl sulphide with alcoholic potash gives potassium picramate, ethyl picrate, and potassium picrate, with some dinitrophenol and tarry products. With sodium isoamylate in amyl alcohol, the sulphide gives sodium thiopicrate and amyl picrate as the chief products of the reaction.—Mme. E. **Jérémine**: Granite and microgranite with graphical structure, near Périers (Manche), and crushed rocks in the neighbourhood of

Coutances.—Léon **Bertrand** and Léonce **Joleaud**: Some facts relating to the neogene and quaternary formations in the neighbourhood of Antçirabe (Madagascar).—Paul **Corbin** and Nicolas **Oulianoff**: The relations between the massifs of Mont Blanc and the Aiguilles Rouges.—Jacques **Bourcart**: An hypothesis on the formation of the Adriatic.—P. **Lasareff**: New observations on the magnetic anomaly of Koursk (Central Russia).—A. **Boutaric**: The radiation of the atmosphere.—P. **Bugnon**: Leaf dichotomy in *Viscum album*.—René **Souèges**: The embryogeny of the Linaceæ. The development of the embryo in *Linum catharticum*.—Marc **Bridel**: The true nature of the glucoside with methyl salicylate existing in the bark of *Betula lenta*. The glucoside extracted by Schneegans and Gerock from *Betula lenta* (gaultherine) is identical with that extracted by the author from *Monotropa Hypopitys*, and named monotropitine. Gaultherine does not possess the constitution assigned to it by Schneegans and Gerock.—C. **Charaux**: The biochemical hydrolysis of rutine. The hydrolysis of this glucoside from *Ruta graveolens* by a ferment extracted from the seeds of *Rhamnus utilis* gives quercitine and a sugar, rutinose; the latter by hydrolysis with acids gives rhamnose and glucose in equal numbers of molecules.—Mlles. J. **Lelièvre** and Y. **Ménager**: The simultaneous determination of mineral and organic iodine in algæ.—Jules **Amar**: Coagulation and plant life.—Mlle. E. **Le Breton** and G. **Schæffer**: Remarks concerning a note by E. F. Terroine relating to the laws which govern the intensity of metabolism in homeotherms.—MM. **Aversenq, Delas, Jaloustre,** and **Maurin**: The influence of thorium X on the blood formula.—I. A. **Christiansen**, G. **Hevesy**, and S. **Lomholt**: Researches, by a radiochemical method, on the circulation of bismuth in the organism. The use of bismuth in the treatment of syphilis is increasing in importance, and a knowledge of the distribution of this metal in the organism and its elimination is desirable. A radioactive isotope, radium-E, is added to the bismuth salt, and the distribution is followed up by radiochemical measurements. Bismuth is mainly eliminated in the urine. The use of bismuth requires caution, as there is a slow and irregular resorption resulting in poisoning.—L. **Mercier**: Malformations produced in a fly (*Calliphora erythrocephala*) by the action of naphthalene vapour; reappearance of the anomalies in a second generation raised under normal conditions.—L. G. **Seurat**: The animal associations of the middle horizon of the intercotidal zone of Syrte minor.—Armand **Dehorne**: The linocytes of the cælomic liquid of *Glycera convoluta*.—A. **Sartory** and R. **Sortory**: The antiseptic power of potassium bichromate and copper bichromate. Copper bichromate has a more powerfully toxic action on the lower fungi (moulds) than potassium bichromate.—Maxime **Ménard** and **Foubert**: The treatment of fistula by ultraviolet light.

CALCUTTA.

Asiatic Society of Bengal, March 5.—Sunder Lal **Hora**: (1) On certain local names of the fishes of the genus Garra. The fishes of the genus Garra (=Discognathus) mostly live in hill-streams, and, to withstand sudden rush of water, are provided with a suctorial disc on the under-surface slightly behind the mouth. In the hilly tracts of India and Burma these fishes are known under different appropriate names, in which reference is made either to the suctorial disc, to an elongated proboscis usually present on the snout, to the rounded and subcylindrical form of the fish, or to its peculiar mode of feeding and movements. (2) Fish of the Talé Sap, Peninsula of Siam (Part II.). Seventy-two species, of which two are new, are described. Most of the species are marine, and are widely distributed. The Indo-Australian element predominates in the freshwater forms.—H. W. **Fowler**: Fish of the Tai-Hu, Kiangsu Province, China. Twenty-nine species are described, none of which are new but several are rare or interesting.—J. **Hornell**: (1) The boats of the Ganges. The river-crafts used on the Ganges system vary from simple rafts and earthenware pots to the most elaborate cargo carriers, some of which bear a close resemblance to those used on the Nile in ancient Egypt. (2) The fishing methods of the Ganges.—N. **Annandale** and Sunder Lal **Hora**: Fish: recent and fossil.

WASHINGTON.

National Academy of Sciences (Proc. Vol. 10, No. 3, March).—R. C. **Tolman**: Duration of molecules in upper quantum states. Calculations based on the intensity of absorption lines show that the mean life of a molecule may vary for different quantum states from 1 to 10^{-8} sec. The rate of decay is not a simple function of the frequency of the emitted light.—M. **Allen**: On thermal emission and evaporation from water. Water in a nickel-plated copper dish resting on a balance pan is heated electrically, and the water vapour is condensed on the blackened inner surface of a cone kept at a constant temperature. Loss of mass gives the amount of water evaporated, and hence the heat required for evaporation, and the difference between that and the heat input gives the thermal emission from the water surface.—G. L. **Clark** and W. **Duane**: On secondary and tertiary X-rays from germanium, etc. Using silver and germanium as the secondary radiators, the rays from a tungsten target emerging at right angles to the primary beam show (1) scattered rays of the same wave-length as the K-series in the primary beam (no evidence of Compton effect); (2) fluorescent rays characteristic of the element in the radiator; (3) tertiary rays produced by the impact of secondary photo-electrons on atoms in the radiator. The short wave-length limit of the tertiary rays and the angle of reflection from the spectrometer should, by theory, be independent of the angle between the primary and scattered beams of X-rays. This was confirmed. Similar results previously obtained using graphite as a carbon radiator were reproduced with paraffin wax.—C. **Barus**: Exhibit of telephonic excitation of acoustic pressure.—J. W. **Alexander**: (1) New topological invariants expressible as tensors; (2) On certain new topological invariants of a manifold.—A. **Bramley**: Condition that an electron describe a geodesic.—W. E. **Castle**: Linkage of Dutch, English, and angora in rabbits. English and Dutch markings are linked, and English is linked with angora coat. It is now found that Dutch marking and angora show about the same amount of linkage.—A. F. **Blakeslee**: Distinction between primary and secondary chromosomal mutants in Datura. Normal diploid ($2n$) plants of *Datura Stramonium* have 12 pairs of chromosomes in the somatic cells; some 25 recurrent mutants are due to a single extra chromosome in one of the 12 sets ($2n+1$), and can be arranged in 12 groups each consisting of a primary mutant and one or more secondary mutants.—J. **Belling** and A. F. **Blakeslee**: The configuration and size of the chromosomes in the trivalents of 25-chromosome Daturas. The primary 25-chromosome plants have trivalents in which the open V-type predominates; if detached, the odd chromosome is generally straight. In the secondary forms, the trivalents are usually of the closed V-ring type; if detached, the odd chromosome is often rolled into a small ring. There appears to be no difference in chromosome size between a primary and its secondary.

Official Publications Received.

Memoirs of the Bernice Pauahi Bishop Museum. Vol. 8, No. 5: The Material Culture of the Marquesas Islands. By Ralph Linton. (Bayard Dominick Expedition: Publication No. 5.) Pp. iv+263-471+plates 40-84. Vol. 9, No. 1: The Morioris of Chatham Islands. By H. D. Skinner. (Bayard Dominick Expedition: Publication No. 4.) Pp. 140+35 plates. Vol. 9, No. 2: Marquesan Somatology, with Comparative Notes on Samoa and Tonga. By Louis R. Sullivan. (Bayard Dominick Expedition: Publication No. 6.) Pp. 141-249+plates 36-41. (Honolulu, Hawaii: Bishop Museum Press.)

Madras Fisheries Department. Administration Report for the Year 1922-23. By James Hornell. Pp. 58. (Madras: Government Press.) 10 annas.

United States Department of Agriculture. Department Bulletin No. 1201: Plants Tested for or Reported to possess Insecticidal Properties. By N. E. McIndoo and A. F. Sievers. Pp. 62. 10 cents. No. 1204: Dusting Cotton from Airplanes. By B. R. Coad, E. Johnson, and G. L. McNeil. Pp. 40. (Washington: Government Printing Office.)

Transactions and Proceedings of the New Zealand Institute. Vol. 54 (new issue), December 14th, 1923. Pp. xxxi+920. (Wellington, N.Z.: W. A. G. Skinner; London: Wheldon and Wesley, Ltd.)

The Royal Botanic Gardens, Kew. Illustrated Guide. Pp. 64. (Kew: Royal Botanic Gardens; London: H.M. Stationery Office.) 1s. net.

State of Illinois. Department of Registration and Education: Division of the Natural History Survey. Bulletin, Vol. 15, Article 1: The Apple Flea-weevil, *Orchestes pallicornis* Say (Order Coleoptera; Family Curculionidæ). By W. P. Flint, S. C. Chandler, and Pressley A. Glenn. Pp. 37. (Urbana, Ill.)

Bulletin of the American Museum of Natural History. Vol. 47, Art. 3: Carnivora collected by the American Museum Congo Expedition. By J. A. Allen. Pp. 73-281+plates 6-78. (New York City.)

Smithsonian Miscellaneous Collections. Vol. 73, No. 2: Opinions rendered by the International Commission on Zoological Nomenclature; Opinions 78 to 81. (Publication 2747.) Pp. 32. Vol. 76, No. 8: Additional Designs on Prehistoric Mimbres Pottery. By J. Walker Fewkes. (Publication 2748.) Pp. 46. Vol. 76, No. 9: The Brightness of Lunar Eclipses, 1860-1922. By Willard J. Fisher. (Publication 2751.) Pp. 61. (Washington: Government Printing Office.)

Smithsonian Institution: Bureau of American Ethnology. Bulletin 80: Mandan and Hidatsa Music. By Frances Densmore. Pp. xx+192+19 plates. 60 cents. Bulletin 81: Excavations in the Chama Valley, New Mexico. By J. A. Jeancon. Pp. ix+80+65 plates. 75 cents. (Washington: Government Printing Office.)

Department of the Interior: Bureau of Education. Bulletin, 1923, No. 42: Educational Research. By Bird T. Baldwin, assisted by Madorah Smith. Pp. iii+76. 10 cents. Bulletin, 1923, No. 51: Schools and Classes for the Blind, 1921-22. Prepared in the Division of Statistics, Bureau of Education, under the Supervision of Frank M. Phillips. Pp. 12. 5 cents. (Washington: Government Printing Office.)

Department of the Interior: Bureau of Mines. Bulletin 212: Analytical Methods for certain Metals, including Cerium, Thorium, Molybdenum, Tungsten, Radium, Uranium, Vanadium, Titanium, and Zirconium. By R. B. Moore, and S. C. Lind, J. W. Marden, J. P. Bonardi, C. W. Davis, and J. E. Conley. Pp. xviii+325. (Washington: Government Printing Office.) 40 cents.

Carnegie Institution of Washington. Annual Report of the Director of the Department of Terrestrial Magnetism. (Extracted from Year Book No. 22 for the Year 1923.) Pp. 229-266. (Washington.)

Canada. Department of Mines: Mines Branch. Summary Report on Mines Branch Investigations during the Calendar Year ending December 31, 1922. Pp. 273. (Ottawa: F. A. Acland.)

Board of Trade. Catalogue of the British Industries Fair, 1924, The White City, Shepherds Bush, London, W.12, April 28–May 9. Organised by the Department of Overseas Trade. Pp. xxviii+164+102. (London: Department of Overseas Trade, 35 Old Queen Street, S.W.1.) 1s.

Diary of Societies.

MONDAY, MAY 5.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

ROYAL COLLEGE OF PHYSICIANS, at 5.—Prof. K. F. Wenckebach: Angina Pectoris and the Possibilities of its Surgical Relief.

SOCIETY OF ENGINEERS, INC. (at Geological Society), at 5.30.—C. H. J. Clayton: Some Factors of Sea-Defence Work.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—Prof. A. A. Cock: Prayer—the Psychological and Metaphysical Concepts of its Meaning.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (Annual Meeting) (at Chemical Society), at 8.—Dr. A. E. Dunstan and Mr. O'Brien: Utilisation of Bauxite for Refining and its Technical Application.

INSTITUTION OF RUBBER INDUSTRY (London Section) (at Engineers' Club, Coventry Street), at 8.—J. Fairbairn: The Rubber Industry—A Plea for Closer Working.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—M. Terry: From East to West across Northern Australia.

MEDICAL SOCIETY OF LONDON, at 9.—W. Trotter: Certain Minor Injuries of the Brain (Annual Oration).

TUESDAY, MAY 6.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. Barcroft: The Effect of Altitude on Man. (II.) The Circulation.

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 5.30.—Annual General Meeting.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—R. Broom: Some Points in the Structure of the Pareiasaurian Skull.—D. M. S. Watson: The Elasmosaurid Shoulder-Girdle and Fore-Limb.

RÖNTGEN SOCIETY (at Institution of Electrical Engineers), at 8.15.—Short descriptions and demonstrations of New X-Ray Apparatus:—Zenith Diascope Couch—Three Plane Combination, by A. E. Dean and Co.—Some Recent Improvements in Protective X-Ray Apparatus and Accessories, Newton and Wright, Ltd.—A New Portable Apparatus, The Solus Electrical Co.—The Gaiffe Intensionometer, Watson and Sons (Electro-Medical) Ltd.

WEDNESDAY, MAY 7.

MEDICAL SOCIETY OF LONDON, at 2.—Dr. C. W. Buckley: British Spas: Their Waters and Methods of Treatment.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Mrs. Ethel Gertrude Woods and Miss Margaret Chorley Crosfield: The Geology of the Clwydian Range, from Moel Arthur to Gyrn.

ROYAL SOCIETY OF MEDICINE (Surgery Section), at 5.30.—Annual General Meeting.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—L. C. Pocock: Faithful Reproduction in Radio Telephony.

ROYAL MICROSCOPICAL SOCIETY (Biological Section), at 7.30.—F. Martin-Duncan: The Hive Bee, its Structure and Life History.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—J. H. Lane and L. Eynon: Determination of Sugar in Urine by means of Fehling's Solution with Methylene Blue as Internal Indicator.—J. J. Considene: Simple Forms of Hydrogen Electrode.—K. A. Williams and E. R. Bolton: Note on the Recognition of Hydrogenated Oils.—Dr. A. T. Etheridge: Estimation of Copper and Tin and Copper-Tin Alloys.—D. W. Steuart: Notes on the Analysis of Milk Powders and Condensed Milks.

THURSDAY, MAY 8.

IRON AND STEEL INSTITUTE (Annual Meeting) (at Institution of Civil Engineers), at 10.30 A.M.—Presentation of Bessemer Medal to Prof. A. Sauveur.—Sir William Ellis: Presidential Address.—J. P. Bedson: Continuous Rolling Mills, their Growth and Development.—J. H. Andrew and H. Hyman: High Temperature Growth of Special Cast Irons.—At 2.30.—F. C. Thompson and W. E. W. Millington: The Plastic Deformation of α and γ Iron.—H. O'Neill: The Effect of Cold-Work upon the Density of α Iron.—C. A. Edwards and L. B. Pfeil: The Production of Large Crystals by annealing Strained Iron.—A. Westgren and G. Phragmén: X-Ray Studies on the Crystal Structure of Steel. Part II.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—F. Balfour Browne: Social Life among Insects (II.).

CHILD-STUDY SOCIETY (at Royal Sanitary Institute) (Annual Meeting), at 6.—Hon. Sir John A. Cockburn: Chairman's Address.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Annual General Meeting.

OPTICAL SOCIETY (at Imperial College of Science), at 7.30.—E. A. H. French: The Preparation of Coppered Glass Mirrors.—H. W. Lee: The Taylor-Hobson F/2 Anastigmat.

FRIDAY, MAY 9.

IRON AND STEEL INSTITUTE (Annual Meeting) (at Institution of Civil Engineers), at 10 A.M.—W. Dyrssen: Recovery of Waste Heat in Open Hearth Practice.—J. Seigle: Theoretical Considerations respecting Certain Features in the Working and Efficiency of Reversing Regenerators.—K. Honda: On the Forging Temperature of Steels.—K. Honda and K. Takahasi: On the Indentation Hardness of Metals.—A. L. Norbury and T. Samuel: Experiments on the Brinell-tensile Relationship.—At 2.30.—G. S. Bell and C. H. Adamson: Transverse Test Bars and Engineering Formulæ.—E. W. Colbeck and D. Hanson: The Hardening of Silico-Manganese Steels.—D. J. Macnaughtan: Hardness of Electro-deposited Iron, Nickel, Cobalt, and Copper.—L. Aitchison and W. L. Johnson: Notes on the Testing of Metal Strip.—W. N. Hindley: Some Effects of the Penetration of Arsenic and Sulphur into Steel.

ROYAL ASTRONOMICAL SOCIETY, at 5.—B. M. Peek: Occultation of α Tauri, 1924, April 8.—Dr. H. Jeffreys: (*a*) A Possible Increase of Mass of the Sun; (*b*) The Internal Constitution of Jupiter and Saturn.—Prof. S. D. Tscherny: Determination of the Relative Parallaxes of the Stars 32H Camelopardali (A) and Lalande 27742.—M. C. Johnson: Cumulative Ionisation in Stellar Atmospheres.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.—Dr. E. Griffiths and J. H. Awbery: Apparatus for the Determination of the Latent Heats of Liquids of High Boiling Points.—Dr. B. W. Clack: The Study of Diffusion in Liquids by an Optical Method.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—F. W. Follott: Methods of Purifying Water and Sewage.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. V. F. K. Bjerknes: The Forces which lift Aeroplanes.

SATURDAY, MAY 10.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. F. A. E. Crew: Heredity and Sex (II.).

PUBLIC LECTURES.

MONDAY, MAY 5.

UNIVERSITY COLLEGE, at 5.30.—Prof. W. A. Noyes: Positive and Negative Valences.

WEDNESDAY, MAY 7.

KING'S COLLEGE, at 5.30.—Sir Halford Mackinder: The Communications of the Empire.

THURSDAY, MAY 8.

INSTITUTION OF PATHOLOGY AND RESEARCH, ST. MARY'S HOSPITAL, at 5.—Prof. A. V. Hill: The Function of Hæmoglobin in the Body.

FRIDAY, MAY 9.

CHARING CROSS HOSPITAL MEDICAL SCHOOL, at 5.—Prof. J. Van Der Hoeve: Accommodation (in English).

ROYAL SOCIETY OF ARTS, at 5.15.—Prof. E. W. MacBride: Some Causes of a C3 Population (Chadwick Lecture).