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Oil in Navigable Waters.

IN a recent publication ("Oil in Navigable Waters," H.M.S.O., 1925, 6*d*.) the Board of Trade has made a valuable contribution to the problem of abating the pollution of the sea by oil. The inquiries made by the engineering staff show that those ships which carry fuel oil in bulk and use their oil tanks for water ballast are the most likely to cause pollution at present, and in the near future. In these cases a large bulk of water is mixed with oil, and is separable from the oil only with difficulty and uneconomically. It is considered that separators can now be designed to deal with any ordinary mixture of oil and water so efficiently that the water discharged from this mixture into the sea is sufficiently free from oil to be innocuous, and the provisions of the Oil in Navigable Waters Act of 1922 are ensuring that oil-free water from such mixtures is being pumped into the sea at least within the three-mile limit. Nevertheless, if the shores of Britain are to be kept free from oil, it will be necessary to extend the limit to a much greater distance than three miles to restrict the pollution to that oil, which, Lord Bearsted has pointed out in the *Times*, may be escaping from vessels sunk during the War.

It is known (see Orton, NATURE, vol. 90, 1913, p. 700) that continuous strong south-westerly winds will blow the Portuguese Man-of-War (Physalia) and Velella from the sub-tropical Atlantic regions up the Channel on to the southern shores of England, over a distance which must be reckoned at least in several half-hundreds of miles; hence there can be no doubt that continuous strong inshore winds may blow oil from deep water on to the shores, notwithstanding tidal currents. It is also apparent that oil discharged in an estuary outside the three-mile limit, but on an incoming tide, may easily result in an accumulation of oil on the shore.

With regard to this aspect of the problem, Mr. A. W. Bibby has recently pointed out that British merchant ships would be at a still greater disadvantage in comparison with foreign ships, if the limit were extended and applicable only to British ships, and that, therefore, we must look to an international agreement to extend the distance within which oil may not be discharged at sea, say, to ten miles off-shore, to give greater protection to the shore. There are signs that the sensitiveness of nations with regard to any alteration of the territorial three-mile limit is breaking down in the recent Anglo-American agreement to permit examination of British vessels inside a ten-mile limit from the American coast. The influential body comprising the American National Coast Anti-Pollution League —which has passed a resolution "that the dumping of oil waste and refuse is ruining the bathing beaches

situated on the territorial waters of the various countries, that the pollution takes place on high seas as well as territorial waters, that the President of the United States was authorised and requested to call a Conference of Maritime Nations with a view to adopting effective means for the prevention of the pollution of navigable waters "—is also apparently ready to approve an agreement giving greater protection to all shores.

The inquiries made by the Board of Trade brought from local and harbour authorities, coastguards, sea fisheries committees, and district inspectors of fisheries, numerous observations on the deplorable destruction of sea-birds from contact with oil; cases of damage to paintwork of boats, piers, and other permanent structures; risk of fire in enclosed waters, and a variety of opinion on the effect of oil on "fish" life. With regard to opinions on the effect of oil on marine organisms, they are mainly uncritical, but the statement by the North-eastern Sea Fisheries Committee that "crabs, lobsters, shrimps, and prawns are quickly smothered and killed by oil," is worth substantiation, as is also that made by more than one body that oil causes fishing-nets to rot very quickly. There is a general agreement in the replies that pollution has decreased markedly in most areas since the introduction of the Oil in Navigable Waters Act, 1922.

Among the general public there is, fortunately, much interest in problems connected with the loss of oil at sea, and many valuable observations have been made in the Press. Lord Rayleigh has calculated that half-a-million tons of oil could cover the whole ocean with a film, but has not postulated the conditions in which it would do so. Prof. H. E. Armstrong has stated that a film of oil would not deprive marine life of oxygen or light, but might react on that life in an insidious but undefined manner. It has been pointed out that oil bubbles into the Caspian Sea in a perpetual stream, but that although fishing is poor in the locality of the escaping oil, there is heavy fishing in neighbouring parts of that sea, and other writers have observed that oil which has risen to the surface of water in oil-bearing regions, has after a short time sunk again after the evaporation of the lighter constituents. The latter observations are hopeful in considering the fate of floating masses of oil, and are well worth further investigation.

The sum of the information now available on these problems is useful, but might be made still more valuable if followed up by an enumeration and chemical examination of (1) the different kinds of fuel oils, and (2) the waste oils actually discharged from the bilges or tanks of oil-burning vessels. A certain amount of data on these matters exists, but a departmental investigation would collect and place on record together just that kind of information we at present lack.

Primitive Law.

Primitive Law. By E. Sidney Hartland. Pp. vi+222. (London: Methuen and Co., Ltd., 1924.) 7*s.* 6*d.* net.

ANTHROPOLOGY is to most laymen and to many specialists still mainly an object of antiquarian interest. There are, however, certain aspects of it which are of a genuine scientific character, in that they do not lead us beyond empirical fact into realms of uncontrollable conjecture, in that they widen our knowledge of human nature, and in that they are of a direct practical application. I mean such a subject, for example, as primitive economics, important for our knowledge of man's economic dispositions and of value to those who wish to develop the resources of tropical countries, employ indigenous labour and trade with the natives. Or again a subject such as the comparative study of the mental processes of savages, a line of research which has already proved fertile to psychology and might be made useful to those engaged in educating or morally improving the native. Last, but not least, there is the subject of primitive law, the study of the various forces which make for order, uniformity and cohesion in a savage tribe. The knowledge of these forces should have formed the foundation of anthropological theories of primitive organisation and it should have yielded the guiding principles of Colonial legislation and administration. Yet of all branches of anthropology, primitive jurisprudence has received in recent times the scantiest and the least satisfactory treatment. This is the reason why the present book by Mr. Sidney Hartland deserves special attention, devoted as it is exclusively to the discussion of primitive law and written by one who is both a learned anthropologist and a professional lawyer.

Anthropology has not always been so indifferent about savage justice and the methods of its administration as it is at present. About half a century ago there was a positive epidemic of research into primitive law, especially on the Continent, more particularly in Germany. It is enough to mention the names of Bachofen, Post, Bernhöft, Kohler and the other writers grouped round the *Zeitschrift für vergleichende Rechtswissenschaft*, to remind the sociologist of the scope, volume and quality of the work done by them. This work, however, was heavily handicapped. The writers had to rely upon the data of the early amateur ethnographers—modern field-work of the trained specialist, done with method, purpose and knowledge of the problems, was at that time not yet in existence. In an abstract and complex subject, such as primitive law, amateur observations are, on the whole, useless.

The early German students of savage law again were all and one committed to the hypotheses of "primitive

promiscuity" and "group-marriage," just as their British contemporary, Sir Henry Maine, was handicapped by his too narrow adhesion to the patriarchal scheme. Most of these continental efforts in anthropological jurisprudence were directed to—in fact, wasted upon—the task of proving that Morgan's theories are correct. The myth of "group-marriage" was casting its shadow on all their arguments and descriptions and it infected their juridical constructions with the kindred concepts of "group-responsibility," "group-justice," "group-property," and "communism," in short, with the dogma of the absence of individual rights and liabilities among savages.

Underlying all these ideas was the assumption that in primitive societies the individual is completely dominated by the group—the horde, the clan or the tribe—that he obeys the commands of his community, its traditions, its public opinion, its decrees, with a slavish, fascinated, passive obedience. This assumption, which gives the leading tone to most modern discussions upon the mentality and sociality of savages, in the French school of Durkheim, in most American and German works and in some English writings, has survived, as we shall see, right into the present work of Mr. Sidney Hartland.

Thus handicapped by insufficient material and baseless assumptions, the early school of anthropological jurisprudence was driven into an impasse of artificial and sterile constructions. In consequence it proved incapable of real vitality, and the whole interest and work heavily slumped—in fact, almost entirely subsided—after its first short-lived boom. One or two important books on the subject appeared—Steinmetz's inquiries into the beginnings of punishment, Durkheim's analysis of early criminal and civil law—but on the whole, the first impetus has proved so little inspiring that most modern anthropologists, both in theory and in field-work, ignore its very existence. In the standard manual "Notes and Queries on Anthropology," "law" appears neither in the index nor in the table of contents, and the few lines devoted to it under the heading of "Government: Politics," excellent as they are, do not correspond in any way to the importance of the subject. In the book of the late Dr. Rivers on "Social Organisation" the problem of primitive law is discussed only incidentally, and, as we shall see, it is rather banished from primitive sociology than included in it by the author's brief reference to it.

This lacuna in modern anthropology is due, not to any oversight of primitive legality, but on the contrary to its over-emphasis. Paradoxical as it sounds, it is yet true that present-day anthropology neglects primitive law just because it has an exaggerated, and I will add at once a mistaken, idea of its perfection. Thus we read in the present book the following sentences: "The savage is far from being the free and unfettered creature of Rousseau's imagination. On the contrary, he is hemmed in on every side by the customs of his people, he is bound in the chains of immemorial tradition not merely in his social relations, but in his religion, his medicine, in his industry, his art: in short, every aspect of his life" (p. 138). With all this we might agree, except that it seems doubtful whether the "chains of tradition" are identical or even similar in art and in social relations, in industry and in religion. But when, immediately, we are told that "these fetters are accepted by him (the savage) as a matter of course; he never seeks to break forth"—we must enter a protest. Is it not contrary to human nature to accept any constraint as a matter of course, and does man, whether civilised or savage, ever carry out unpleasant, burdensome, cruel regulations and taboos without being compelled to? And compelled by some force or motive which he cannot resist?

Yet this automatic acquiescence, this instinctive submission of every member of the tribe to its laws, is the fundamental axiom laid at the basis of the inquiry into primitive order and adherence to rule. Thus another foremost authority on the subject, the late Dr. Rivers, speaks in the book already mentioned of an "unwitting or intuitive method of regulating social life," which is, according to him, "closely connected with primitive communism." And he proceeds to tell us: "Among such peoples as the Melanesians there is a group sentiment which makes unnecessary any definite social machinery for the exertion of authority, in just the same manner as it makes possible the harmonious working of a communal ownership and insures the peaceful character of a communistic system of sexual relation" ("Social Organisation," p. 169).

Thus here again we are assured that "unwitting" or "intuitive methods," "instinctive submission" and some mysterious "group-sentiment" account for law, order, communism and sexual promiscuity alike! This sounds altogether like a Bolshevik paradise, but is certainly not correct in reference to Melanesian societies, which I know at first hand.

A similar idea is expressed by a third writer, who has contributed towards our understanding of the organisation of savages from the point of view of mental and social evolution more perhaps than any one living anthropologist. Prof. Hobhouse, speaking of the tribes on a very low level of culture, affirms that "such societies, of course, have their customs, which are doubtless felt as binding by their members, but if we mean by law a body of rules enforced by an authority independent of personal ties of kinship and friendship, such an institution is not compatible with their social

organisation" ("Morals in Evolution," 1915, p. 73). Here we have to question the phrase "felt as binding" and ask whether it does not cover and hide the real problem instead of solving it. Is there, with regard to some rules at least, no binding mechanism, not perhaps enforced by any central authority, but backed up by real motives, interests and complex sentiments? Can severe prohibitions, onerous duties, very burdensome and galling liabilities, be made binding by a mere "feeling"? We should like to know more about this invaluable mental attitude at least, but the author simply takes it for granted. Again, the minimum definition of law as the "body of rules, enforced by an authority independent of personal ties," seems to me to be too narrow and not to lay the emphasis on the relevant elements. There are among the many norms of conduct in savage societies certain rules regarded as compulsory obligations of one individual or group towards another individual or group. The fulfilment of such obligations is usually rewarded according to the measure of its perfection, while non-compliance is visited upon the remiss agent. Starting with such a comprehensive view of law and inquiring into the nature of the forces which make it obligatory, it is possible to arrive at much more satisfactory results than taking the question of authority, government and punishment for starting points.

To take another representative opinion of one of the highest anthropological authorities in the United States, we find Dr. Lowie expressing a very similar view: "Generally speaking, the unwritten laws of customary usage are obeyed far more willingly than our written codes, or rather they are obeyed spontaneously" ("Primitive Society," chap. on "Justice," p. 387, English Edition). To compare the "willingness" in obedience to law of an Australian savage with a New Yorker, or of a Melanesian with a nonconformist citizen of Glasgow, is a perilous proceeding and its results have to be taken very "generally" indeed, until they lose all meaning. The fact is that no society can work in an efficient manner unless laws are obeyed "willingly" and "spontaneously." The threat of coercion and the fear of punishment do not touch the average man, whether "savage" or "civilised," while, on the other hand, they are indispensable with regard to certain turbulent or criminal elements in either society. Again, there is a number of laws, taboos and obligations in every human culture which weigh heavily on every citizen, demand great self-sacrifice, and are obeyed for moral, sentimental or matter-of-fact reasons, but without any "spontaneity."

It would be easy to multiply statements and to show that the dogma of the automatic submission to custom dominates the whole inquiry into primitive law. Now with this dogma of automatic obedience there are associated certain more special propositions which are universally current in anthropology and yet fatal to the study of primitive jurisprudence.

First of all, if all the rules of custom are obeyed by the savage through sheer inability to break them, then no definition can be given of law, no distinction can be drawn between the rules of law, morals, manners, and other usages. For the only way in which we can classify rules of conduct is by reference to the motives and sanctions by which they are enforced. So that with the assumption of an automatic obedience to all custom, anthropology has to give up any attempt at introducing into the facts order and classification, which is the first task of science.

We have seen already that Mr. Sidney Hartland regards the rules of art, medicine, social organisation, industry and what-not as hopelessly mixed up and lumped together in all savage societies, both in the native's own comprehension and in the reality of social life. He states this view emphatically on several occasions: ". . . The savage's perception of resemblances differs very much from our own. He sees resemblances between objects which, to our eyes, have not a single point in common" (p. 139). "For the savage . . . the policy of a tribe is one and indivisible. . . . They [the savages] see nothing grotesque or incongruous in publishing in the name of God a code combining ritual, moral, agricultural, and medical with what we understand as strictly juridical prescriptions. . . . We may sever religion from magic, and magic from medicine; the members of the community draw no such distinctions" (pp. 213, 214).

In all this Mr. Sidney Hartland gives lucid and moderate expression to the current views about "primitive prelogical mentality," "confused savage categories," and the general shapelessness of early culture. These views, however, in my opinion, cover but one side of the case, express but a half-truth—as regards law, the views here quoted are not correct. The savages have a class of obligatory rules, not endowed with any mystical character, not set forth in "the name of God," not enforced by any supernatural sanction, but provided with a purely social binding force. The author of "Primitive Law" and most sociologists who share his opinions are not to blame for neglecting these facts of early jurisprudence, for the field-workers have never supplied them with the adequate and relevant material.

In the second place, the dogma of the absolute rigidity of the rules of custom implies an extraordinary over-emphasis of criminal law in primitive communities and a corresponding denial of the possibility of civil law. Absolutely rigid rules cannot be stretched or

adapted to life, they need not be enforced—but they can be broken. So much even the believers in a primitive super-legality must admit. Hence crime is the only legal problem to be studied in primitive communities, there is no civil law among savages, nor any civil jurisprudence for anthropology to work out. This view has dominated comparative studies of law from Sir Henry Maine to the most recent authorities, such as Prof. Hobhouse, Dr. Lowie and Mr. Sidney Hartland. Thus we read in the book under review that in primitive societies "the core of legislation is a series of taboos," and that "almost all early codes consist of prohibitions" (p. 214). The doctrine that primitive norms of conduct are negative, rigid and religious in character pervades all the book. In this again Mr. Hartland is not alone. Steinmetz in his learned and competent analysis of primitive punishment insists on the criminal character of early jurisprudence, on the mechanical, rigid, almost undirected and unintentional nature of the penalties inflicted and on their religious basis. His views are fully endorsed by the great French sociologists Durkheim and Mauss, who add besides one more clause: that responsibility, revenge, in fact all legal reactions are founded in the psychology of the group and not of the individual.[1] Even such acute and well-informed sociologists as Prof. Hobhouse and Dr. Lowie, the latter acquainted at first hand with savages, seem to follow the trend of the general bias in their otherwise excellent chapters on justice in primitive societies.

Here again, I think that it would be futile to blame these writers, who have treated the material available with all the necessary acumen and the soundest scientific methods. It would be also unfair to blame the trained field-worker—often approaching anthropology from natural science or medicine—for his failure to grasp one of the most difficult and slippery problems of primitive sociology. I believe, however, that there is a mine of facts still to be worked out in savage communities, which will, when available, force us to recast all current conclusions. Primitive law is by no means negative only or even predominantly. The positive rules of conduct, the obligations to do, to fulfil are innumerable. They are not based on merely religious sanctions, nor is the "group" the focus of all legal forces.

In my own studies in north-west Melanesia I have found that human nature always rebels against the rigid letter of the law, that the individual will always stretch the rule or try to evade it—and all this while remaining on the "right side of the law," that is, taking good care not actually to break it. Not only that; such attempts are often helped out, abetted by what could be called customary ways of infringement of the law, semi-legalised methods of evasion. So that in reality the "cake of custom" is not a uniform crust, evenly pressing its contents, nor is human nature mere dough, which would passively submit to such pressure.

The natives will defy law at times, but much more readily they will try to circumvent it. The fear or awe of infringing their customs is a figment. We read in Mr. Hartland's book that "the general belief in the certainty of supernatural punishment and the alienation of the sympathy of one's fellows generate an *atmosphere of terror* which is quite sufficient to prevent a breach of tribal customs . . ." (p. 8—the italics are mine). There is no such "atmosphere of terror" unless perhaps in the case of a few very exceptional and sacred rules of ritual and religion, and on the other hand the breach of tribal customs is prevented by a special machinery, the study of which is the real field of primitive jurisprudence. In this, as everywhere else, it would be easy to show that Mr. Hartland is not to blame for his opinion, but that he has given us a clear and judicious summary of the data available from the best records of field-work.

Finally, the fundamental assumption of the rigidity of custom and the savage's automatic compliance with law implies yet one more consequence. It renders quite superfluous any attempt at an analysis of the processes of the adjustment of law to life. If all custom is always obeyed, and obeyed strictly and automatically, then there is no need to study how the formula of law is being adapted to concrete circumstances. All the questions of the latitude, of the laws, of the elasticity of its binding forces of the various readjustments and legal compromises must appear to the writers of anthropological jurisprudence as non-existent.

To sum up briefly the present state of primitive jurisprudence: it is being universally assumed that all custom is law to the savage and that he has no law but his custom. All custom again is obeyed automatically and rigidly by sheer inertia. There is no civil law or its equivalent in savage societies. The only relevant facts are the occasional breaches in defiance of custom—the crimes. There is no mechanism of enforcement of the primitive rules of conduct except the punishment of flagrant crime. Modern anthropology, therefore, ignores and sometimes even explicitly denies the existence of any social arrangements or of any psychological motives which make primitive man obey a certain class of custom for purely social reasons. According to Mr. Hartland and all the other authorities, religious sanctions, supernatural penalties, group responsibility and solidarity, taboo and magic are the main elements of jurisprudence in savagery.

[1] Steinmetz, "Ethnologische Studien zur ersten Entwickelung der Strafe," 1894; Durkheim in *Année Sociologique*, i. pp. 353 sqq.; Mauss in "Revue de l'Histoire des Religions," 1897.

All these contentions are, as I have already indicated, either directly mistaken, or only partially true, or, at least, they can be said to place the reality of native life in a false perspective. Perhaps there is no further need to argue that no man, however "savage" or "primitive," will *instinctively* act against his instincts, or *unwittingly* obey a rule which he feels inclined cunningly to evade or wilfully to defy; or that he will not *spontaneously* act in a manner contrary to all his appetites and inclinations. The fundamental function of law is to curb certain natural propensities, to hem in and control human instincts and to impose a non-spontaneous, compulsory behaviour—in other words, to ensure a type of co-operation which is based on mutual concessions and sacrifices for a common end. A new force, different from the innate, spontaneous endowment must be present to perform this task.

In order to make this negative criticism conclusive, however, it is necessary to add a positive statement of the case, to present the facts of primitive law as it really is, to show in what consists the compulsory nature of primitive legal rules, to lay bare the specific force which makes them into binding law.

The Melanesian of the region which I have studied has unquestionably the greatest respect for his tribal custom and tradition as such. This much may be stated at the outset. All the rules of his tribe, trivial or important, pleasant or irksome, moral or utilitarian, are regarded by him with reverence and felt to be obligatory. But the force of custom, the glamour of tradition, if it stood alone, would not be enough to counteract the temptations of appetite or lust or the dictates of self-interest. Custom is sufficient to carry through the rules of good manner, the rules of order in most situations of daily life or on public occasions—so long as no strong appetite or interest has to be countered. Thus the mere sanction of tradition—the conformism and conservatism of the "savage"—operates often and operates alone in enforcing manners, customary usage, private and public behaviour in all cases where some rules are necessary to establish the mechanism of common life and co-operation and to allow of orderly proceedings—but where there is no need to encroach on self-interest, inertia or to prod into unpleasant action or thwart innate propensities.

There are other rules, dictates and imperatives which require and possess their special type of sanction, besides the mere glamour of tradition. The natives in that part of Melanesia have to conform to a very exacting type of religious ritual, especially at burial and in mourning, and this behaviour is enforced by the special constraint of religious awe and certain definite supernatural and social penalties. There are, again, imperatives of behaviour between parents and children, husband and wife, backed mainly by the natural sentiment of love and affection. There are the rules of art and craft, followed for motives of utility, besides the reverence for tradition. There exists finally the sanction of tribal punishment, due to a reaction in anger and indignation of the whole community. By this sanction human life, property, and, last though not least, personal honour are safeguarded in a Melanesian community, as well as such institutions as chieftainship, exogamy, rank and marriage, which play a paramount part in their tribal constitution.

Each class of rules just enumerated is distinguishable from the rest by its sanctions and by its relation to the social organisation of the tribe and to its culture. They do not form this amorphous mass of tribal usage or "cake of custom" of which we have been hearing so much. The last category, the fundamental rules safeguarding life, property and personality form the class which might be described as "criminal law"—very often over-emphasised by anthropologists and falsely connected with the problem of "government" and "central authority" and invariably torn out of its proper context of other legal rules. For—and here we come at last to the most important point—there exists a class of binding rules which control most aspects of tribal life, which regulate personal relations between kinsmen, clansmen and tribesmen, settle economic relations, the exercise of power and of magic, the status of husband and wife and of their respective families. These are the rules of a Melanesian community which correspond to our civil law.

There is no religious sanction to these rules, no fear, superstitious or rational, enforces them, no tribal punishment visits their breach, nor even the stigma of public opinion or moral blame. The forces which make these rules binding we shall lay bare and find them not simple but clearly definable, not to be described by one word or one concept, but very real none the less. The binding forces of Melanesian civil law are to be found in the concatenation of the obligations, in the fact that they are arranged into chains of mutual services, a give and take extending over long periods of time and covering wide aspects of interest and activity. To this there is added the conspicuous and ceremonial manner in which most of the legal obligations have to be discharged. This binds people by an appeal to their vanity and self-regard, to their love of self-enhancement by display. Thus the binding force of these rules is due to the natural mental trends of self-interest, ambition and vanity, set into play by a special social mechanism into which the obligatory actions are framed.

It is quite clear, I trust, that none of the criticism of this review is levelled against Mr. Sidney Hartland's

own contributions to the problem. His book is not only a most learned and brilliant achievement; it comes also most useful and handy in the present state of our knowledge, for it is a veritable masterpiece of lucid, competent, thorough synthesis of past and contemporary researches and theories of primitive law. Mr. Sidney Hartland is one of the great representatives of the comparative school of anthropology, and, like some other writers of this school, he has been able to vindicate the claims of anthropology to be a genuine science in that he foretold discoveries not yet made at that time. In his Legend of Perseus and his subsequent work of first-class value he has given new and most illuminating contributions to the study of primitive kinship. His "forecast of primeval past," as we might call it perhaps, about the primitive ignorance of paternity has been proved in the discoveries of Spencer and Gillen in Australia, and of the present reviewer in Melanesia. His new work deserves to rank among the best recent contributions to anthropology: it should be read by all those students who recognise that our science has not done justice to the study of primitive law and by all the observers of savage races who wish to work out what will prove, perhaps, the most fertile plot of their field. B. MALINOWSKI.

The Metaphysic of Science.

The Metaphysical Foundations of Modern Physical Science: a Historical and Critical Essay. By Prof. Edwin Arthur Burtt. (International Library of Psychology, Philosophy and Scientific Method.) Pp. ix+349. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., Inc., 1925.) 14*s*. net.

PROF. BURTT has given us a study of the history of modern science from an unusual but very important point of view. He has sought to lay bare the principle underlying and directing scientific discovery rather than to chronicle the discoveries in their objective and practical aspect. He finds that the metaphysic of science when it is laid bare is neither self-evident nor consistent, but in fact highly paradoxical. In his concluding chapter he invites men of science and philosophers to study this metaphysic critically with a view to its fundamental reformation. It is the metaphysics of Newton:

"Wherever was taught as truth the universal formula of gravitation, there was also insinuated as a nimbus of surrounding belief that man is but the puny and local spectator, nay irrelevant product of an infinite self-moving engine, which existed eternally before him and will be eternally after him, enshrining the rigour of mathematical relationships while banishing into impotence all ideal imaginations; an engine which consists of raw masses wandering to no purpose in an undiscoverable time and space, and is in general wholly devoid of any qualities that might spell satisfaction for the major interests of human nature, save solely the central aim of the mathematical physicist."

It is a curious thing that Newton, whose fame in the first half of the eighteenth century as the representative English philosopher resounded throughout the learned world, finds no place in any of the standard histories of philosophy. Voltaire's "Élémens de la philosophie de Newton" was not only widely read but also chiefly instrumental in dethroning the Cartesians and Leibnizians and preparing the stage for empiricism, positivism, and scientific realism. Neither by ourselves nor by others, however, is Newton now placed in the line of the historical philosophical development; he is always ranked as a pioneer of science, deriving his lineage from Copernicus, Galileo, and Kepler. Yet to his contemporaries, to Leibniz, Locke, and Berkeley, he was primarily a metaphysician, and to Kant in the later eighteenth century Newton's concepts of space and time set the task of the transcendental æsthetic.

It is only in recent times, in fact since the nineteenth century advance of the physical sciences, that the history of thought has undergone retrospectively a bifurcation into science and philosophy. The ground or reason of the separation, and for placing Newton in the line of science as opposed to the line of philosophy, was largely the consequence of Newton's own attitude towards physical problems. To emphasise the value of experiments he seemed to decry the method of logical deduction and the appeal to the criterion of consistency. His "physics beware metaphysics" and his "hypotheses non fingo" were everywhere quoted to deprecate philosophical speculation. Then, in opposition to this provocative attitude to philosophy, Hegel was aroused to his contemptible reference to the use of the term "philosophical" which the English, he said, employed to describe scientific instruments. There is a great change in our thought to-day. We are discovering that the divorce between physics and metaphysics is not only irrational but also disastrous, alike in the interests of philosophy and science.

Prof. Burtt brings out in a very striking way the interesting contrast between the mathematical principle which underlay the philosophy of Descartes and his followers in France and the physical principle which predominated in all the seventeenth-century philosophies in England. There was, however, one important thing common to both lines and to both principles. In whatever way philosophers conceived the absolute in Nature, whether as a mathematical or as a physical principle, whether under the form of extension or under the form of ether, it was

never conceived abstractly, for it was always correlated with the concept of God. For example, Newton's absolute space and time are God's sensorium, Berkeley's absolute *esse* is God's *percipi*. Now the absolute of modern science, the real world of physics, is, on the other hand, the concept of an abstract reality, conceived as existing in itself even if there be no God and whether there be one or not. It is this abstract absolute which has been tried and found wanting by the contemporary relativists. The principle of relativity tells us that there is no world which is no one's world, no space-time which is not some one's space-time. The space-time and the ether which are the common world, the world to which our mathematical equations and our physical concepts apply, are a function of the intercourse of observers of Nature co-ordinating their universe each from the point of view of his own system chosen as a frame of reference. It is impossible to visualise the ultimate reality of physics because it does not originate in a sensible image but in a mathematical formulation. It is by active measurements that the reality of physics is provided to science.

Prof. Burtt concludes his most instructive historical and critical review by exposing the extraordinary difficulties of the epistemological theory based on the Cartesian dualism of mind and body, a dualism which in one form or another has persisted throughout the modern period. H. WILDON CARR.

An American View of the Agricultural Situation.

The Agricultural Situation: Economic Effects of Fluctuating Prices. By Prof. G. F. Warren and Prof. F. A. Pearson. (The Price Series.) Pp. xvi+306. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1924.) 15*s*. net.

TO many in Great Britain it will come as somewhat of a surprise to learn that the American farmer finds almost as much difficulty as the British farmer in making both ends meet: indeed, so far as comparisons are possible, he seems to be in a worse plight. There are no better qualified men on this subject than Profs. Warren and Pearson, and they give in this book a very clear exposition of the situation, but the picture is far from rosy and the authors close on a pessimistic note: they see no easy way out of the difficulty.

The trouble arises from the low price received by the farmer for his products in comparison with the high price he has to pay for services and materials received. It required twice as much farm produce to pay the taxes, interest charges, and labour in 1922 as it did before the War. Labour has unfortunately not become more efficient, and farm production has not increased. There are two obvious remedies: farmers might combine and obtain for themselves the same degree of profit that the skilful middlemen in the cities manage to secure: or they can reduce production. Combination among farmers for selling has hitherto proved very difficult, though it is now being tried in Canada: reduced production is the more certain method, but the authors recognise that it is undesirable. As we read the book, we feel that the remedy, even if successful in curing the farmers' ills, would leave the world worse off than before. The authors show that part of the farmers' difficulties arise from the poverty of many people in Europe: instead of eating wheat and meat they live on potatoes and vegetables, and if the prices of farm commodities rose still further, these unfortunate people would be still worse off.

The authors attach more importance to economic adjustment of prices than to scientific advances in methods of production. Indeed they show that plant diseases, insects, and unfavourable weather may even help some farmers by temporarily forcing up prices. Time is the great healer and the only consolation in the present position is the authors' clearly expressed view that "when a period of agricultural depression ends, a period of agricultural prosperity follows." We should have liked the authors' opinions on the method that British scientific workers are advising farmers to adopt: an increase of farm produce per unit area so as to obtain the extra sacks of corn needed to meet the extra charges. Great Britain differs from the United States in importing a great amount of food annually. An increased home production in Britain would lessen the need for imports. In the States, however, a great amount of food is already exported and for any extra production an outlet must be found.

The agricultural student will find the book unusually interesting and stimulating, and its value is enhanced by the number of curves and diagrams presenting the statistical data in a form easily grasped by the reader. E. J. R.

Popular History of Astronomy.

Histoire de l'astronomie. Par F. Boquet. (Bibliothèque scientifique.) Pp. 510. (Paris: Payot et Cie, 1925.) 25 francs.

THERE seems to be a demand in France for popular books on the history of astronomy, as we reviewed a book with the same title, by E. Doublet, a little more than two years ago (vol. 110, p. 600), and a similar work by E. Lebon was published in 1899. M. Boquet does not pretend to have studied the original works of astronomers of past ages, nor the

extensive literature of monographs on special subjects. He merely claims to give a résumé of a number of books, of which he gives a list. His authorities range from original and valuable works like those of Delambre, Grant, and others, down to popular and uncritical books which he would have been better without. For to M. Boquet all authors of printed matter seem to be equally authoritative, and whenever they differ he leaves the decision as to who is right to the reader. An amusing example of this helplessness is found on p. 254. When speaking of Copernicus, the author says that "during the campaign of 1805, some authors say 1806, Napoleon visited the house in which Copernicus was born." Surely it would have been easy to find out whether Napoleon was in Prussia in 1805 or not. As a matter of fact his visit to Thorn was in 1812. There are a great many cases like this throughout the book. The readiness of the author to accept any statement as true, no matter by whom it is made, so long as nobody has been of a different opinion, lets him accept as authentic the picture of "the well of Eratosthenes" published in 1914 in the *Observatory* magazine, as he has overlooked a refutation given in the same volume; and so in many other cases.

The greatest fault of this book is that it devotes far too much space to astronomers who were not of the first rank or even of the second, and far too little to the great leaders. Information of the kind given might have made the book useful as one of reference, if it had been provided with a good index. But there is no index, and even the table of contents is very meagre, filling only one page. Any one hoping to find an account of how our knowledge of the motions and nature of the heavenly bodies has been gradually developed, will be disappointed. The author allows almost exactly the same amount of space, seven pages, to each of the greatest astronomers, except to Hipparchus and Ptolemy, to whom he gives a page or two less, because we do not know anything about their lives. Under Hipparchus, as everywhere else, we find old statements repeated, though they have been refuted. It was not a new star but a comet which appeared in 134 B.C., and the catalogue of Hipparchus did not contain 1080 stars, but only about 850, a matter of some importance, as it helps us to realise that Ptolemy did not simply borrow all his star-places from Hipparchus. M. Boquet is aware that Laplace recognised Ptolemy's catalogue as an independent work, but as usual he does not enter into details, and simply says: "Il est difficile de conclure." How the epicyclic system began and how it was gradually improved until it became the complicated Ptolemaic system, is not described. Similarly, under Copernicus nothing is said as to how he came to discover the motion of the earth, except that we might as well ask why a genius is a genius. "Ici la réponse est difficile." The same is the case when we come to Newton; but here at any rate we find some new information. It appears that Newton competed for a fellowship and obtained eleventh place among eleven candidates. One must agree with M. Boquet, when he says that it was not very brilliant. But where did he get that story from? It is also news to us to hear that it is not known when Newton wrote the "Principia." After that, the reader is prepared to meet with the old fables, how Newton did not know of Picard's results as to the size of the earth until 1682, and how he went mad ten years later, and so on. J. L. E. D.

Our Bookshelf.

Alpine Flora for Tourists and Amateur Botanists: with Text descriptive of the most Widely Distributed and Attractive Alpine Plants. By Dr. Julius Hoffmann. Translated by E. S. Barton (Mrs. A. Gepp). New edition. Pp. xiv + 121 + 43 plates. (London: Longmans, Green and Co., 1925.) 12*s.* 6*d.* net.

A NEW edition of Mrs. Gepp's English translation of this well-known flora will be welcomed by many to whom, though not themselves botanists, the flora of the Alps makes an irresistible appeal. The book itself is a tourists' flora rather than a scientific work. It aims at affording a ready means of recognising the more conspicuous or characteristic species of the Central European Alps—not merely the Swiss Alps. It lacks the "keys" to genera and species found in more scientific floras, such as Schinz and Keller's "Flora der Schweiz," and, for purposes of identification, frankly relies, in the first instance, on its 43 coloured plates, on which the great majority of the species described are figured. Within the limits determined by the plan of the book, the brief descriptions in the text are good. Detailed floral structure is omitted, the diagnostic characters employed being for the most part those of habit, size, leaf, and perianth. Simple technical terms are freely used, but as there is an adequate glossary, amateurs should experience little difficulty. A slip occurs in the description of the species of Anemone, the perianth being referred to in one case as "sepals," and in another as "petals."

Useful notes on distribution, habitats, and altitudes are given. On the whole, the figures give sufficiently accurate representations of the plants for purposes of not too critical identification. The colouring, if a little crude, is distinctly better than that found in many similar works. As is to be expected, the success of the colouring varies a good deal. The colours of *Gentiana acaulis*, for example, have been very fairly reproduced, but one misses the wonderfully haunting blue of *G. bavarica*. In comparatively few examples (*e.g.* on plates 5 and 26) have fruits been figured: some others, such as the very characteristic plumed fruits of *Dryas octopetala*, *Geum montanum*, and *G. reptans*, might well have been included. In the case of very small flowers, too, the addition to a habit figure

of a single enlarged flower (as has been made in a very few cases) would be a decided advantage.

In the present edition one of the original plates has been omitted, but four new ones (including selected rushes, sedges, grasses, ferns, lycopods, mosses, and lichens) form a useful addition. The book is well printed, but is perhaps unnecessarily heavy; considering that it is intended as a travelling companion for tourists, a lighter paper might have been used. The publishers would also do well to look more carefully to the binding: the pages in the review copy show an alarming tendency to break loose from their moorings.

The Chemistry of Enzyme Actions. By K. George Falk. (American Chemical Society Monograph Series.) Second and revised edition. Pp. 249. (New York: The Chemical Catalog Co., Inc., 1924.) 3.50 dollars net.

THIS book retains the main features of the first edition, although it has been approximately doubled in size. Enzyme actions are considered so far as possible as ordinary chemical changes, and the author's views on the theory and mechanism of chemical reactions are applied to them. A preliminary study of his book on this subject would probably be of advantage to the reader, as the sketch of the subject in the introduction to the present work suffers from enforced condensation. Briefly stated, the author is a strong supporter of the addition theory of chemical change. The mode of treatment renders the book rather difficult reading, but there is a constant appeal to the critical faculty which stimulates the reader's interest.

A good account of the recent work bearing on the vexed question of the chemical nature of enzymes is given, including the author's suggestive experiments on the selective action of ester-hydrolysing substances, made to glean indications regarding the chemical nature of the lipases. The whole problem is still in its infancy, and a consideration of the general physical and chemical properties of the enzymes leads only to the tentative generalisation "that an enzyme action is due to a chemical grouping of marked instability present in a complex molecule of colloidal nature." The colloidal character of all known enzymes is thus recognised but is kept carefully in the background in the author's consideration of the nature of enzyme action, since he believes that "fundamentally the chemical reactions of a substance are based upon its chemical properties," although its physical state will naturally modify the relations observed. He even holds out the hope (p. 233) of being able to obtain the "enzyme property" in a crystalloidal or readily dialysable form, thus abandoning the tentative suggestion just recorded.

A somewhat sketchy chapter on the uses and applications of enzymes and a long and detailed account of experiments on enzyme actions of tissues and tumours—the treatment of which is quite out of proportion to that of the rest of the work—are also included in the book, which concludes with a summary of the present status of the enzyme question.

As will be seen, the work is one only for the advanced student or investigator, who is able by the exercise of his critical faculty to enjoy the somewhat novel presentation of familiar facts. A. H.

Bismuth Ores. By Robert Allen. Pp. ix+62. 3*s.* 6*d.* net. *Antimony Ores.* By Edward Halse. Pp. ix+102. 5*s.* net. *Bauxite and Aluminium.* By W. G. Rumbold. Pp. ix+110. 6*s.* net. (Imperial Institute: Monographs on Mineral Resources with special reference to the British Empire.) (London: John Murray, 1925.)

THE above three volumes issued by the Imperial Institute form a further contribution to the series of monographs on mineral resources which the Institute has issued from time to time, and these follow closely the lines upon which their predecessors have been laid down. Each book consists of three sections, the first dealing with the characters and composition of the ores of the metal treated of, the uses and properties of the metal and of its more important alloys, and the metallurgy of the metal, that is, the processes by which it is extracted from its ores. The second section gives an account of the distribution and occurrence of the ores of the metal within the British Empire, these occurrences being described in some little detail; the third section describes the sources from which the ores of the metal in question are obtained from foreign countries, that is to say, countries outside of the British Empire. Statistics of production are usually given, though these are to-day of comparatively little importance in view of the fact that full official statistics are published regularly by the Imperial Mineral Resources Bureau. Each volume, however, concludes with a very useful bibliography of the metal to which the volume refers.

With regard to the individual volumes themselves, there is little to be said. It so happens that the production of each one of the three metals here discussed is in relatively few hands, and that there is accordingly a certain amount of secrecy concerning the processes of extraction employed, their general principles being of course known, though many of the minute details are looked upon as trade secrets; it need scarcely be said that it quite often happens that these minor details may make all the difference in the economic success or failure of a process. In every case the work appears to have been done carefully and painstakingly, and appears to be upon the whole quite accurate. No doubt the information given would not be sufficient for the specialist, but the object of these books is not to provide information of that type, but rather to give a general survey of the subject which will suffice for the objects of the average inquirer, and this purpose is quite well fulfilled by the books before us. It must often happen that the business man requires some general knowledge of the origin and mode of distribution of the materials in which he deals, and the object of these monographs is to supply information of that kind.

Anthropology. By Prof. A. L. Kroeber. Pp. x+523. (London, Calcutta and Sydney: George G. Harrap and Co., Ltd., n.d.) 12*s.* 6*d.* net.

THE professor of anthropology in the University of California has written a notable book—one which deserves to be known and studied in Europe as well as in America. He seeks to provide answers to the questions: When and where did the races of mankind

become differentiated? When and where did they come by their languages? When and where did they acquire their customs, beliefs and ways of living and their manner of doing things? He does not answer these questions by culling quotations from authorities, but, using his well-stocked mind, a wide personal experience, a sane judgment, and a happy gift of expression, returns answers that all who read may understand and, at the same time, feel that they are in touch with the live problems of anthropology. His main aim is to explain how peoples in every land have come by their cultures, particularly how the peoples of the New World, both ancient and modern, came by theirs.

Amongst European anthropologists, that school which regards inventions, beliefs and practices, now widely spread amongst living peoples, as having arisen in single centres, is gaining adherents every day. Prof. Kroeber, while open to the fact that cultures do often spread by borrowings and by migrations, champions the cause of independent and multiple origins. The practice of the *couvade* prevailed in Europe and Brazil. That fact is construed by the growing school as evidence that there had been a culture drift from the Old World to the New. Prof. Kroeber, from the same facts, draws the inference that the natives of Europe and the natives of Brazil were provided with a common impulse, and that under the influence of this impulse they devised a common practice. Although the reviewer's sympathies are altogether against "independent origins," it is well that "migrationists" should be thoroughly acquainted with the other side of their case. They will find that Prof. Kroeber has culled much from the ancient civilisations of Mexico, Maya and Peru which deserves their serious consideration. Beyond all this, the book is one of the most comprehensive and attractive of text-books on anthropology.

Chronique des événements météorologiques en Belgique jusqu'en 1834. Par E. Vanderlinden. Pp. 329. (Bruxelles: M. Hayez, 1924.) 16 francs.

REGULAR meteorological observations are of comparatively recent origin, but mankind has always been interested in the weather, and numerous meteorological references are scattered through the literature of all countries from the earliest times. The importance of collecting these records has been recognised by the International Meteorological Committee, and in recent years several eminent meteorologists have occupied themselves with the task, especially the late A. Angot in France and G. Hellmann in Germany. Last year Sir Richard Gregory presented us with a summary of the early meteorological records of the British Isles, and we have now to welcome an exhaustive compilation of the material from Belgium by the veteran meteorologist, E. Vanderlinden, commencing with the record of a rainy summer in the year A.D. 120, and continuing until the beginning of regular meteorological observations at Brussels in 1834.

The records deal with mild or severe winters, dry or rainy summers, early or late frosts, floods and storms; the most valuable are those which were recorded owing to their agricultural importance. It is interesting to notice that the author recognises three stages in the recording of meteorological notes; in the most ancient medieval chronicles the remarks are generally brief and to the point—"severe winter." Later they become longer and more fanciful, often verse is employed. In the third stage the facts are distorted to fit the narrator's theories or his love of the marvellous, and it is not until the end of the eighteenth century that a scientific character is recovered. The usual historical difficulties were met with, especially in the dating of events which occurred in winter, but the author appears to have performed the critical part of his work with good judgment. The documentation is excellent; for each year, after a brief summary of the phenomena in French the original remark is quoted, followed by a reference to the chapter and page of the authority. At the end of the work the principal phenomena are tabulated.

Einführung in die allgemeine Kohlenpetrographie. Von Dr. Robert Potonié. Pp. x+285. (Berlin: Gebrüder Borntraeger, 1924.) 13*s.* 2*d.*

THIS work is not only of importance in itself, but also derives considerable interest from the fact that it embodies the continuation, by a distinguished son, of work commenced by a distinguished father, for Henry Potonié's work on the structure of coal may be regarded in many respects as a classic. The author describes the object of the work by quoting a definition of Weinschenk to the effect that petrography considers the origin, the characteristics, and the mode of decomposition of rocks, and notes that, from this point of view, but little attention has been paid to the study of coal, so that the petrography of coal is still in its infancy. He further quotes a sentence from Dannenberg to the effect that, for practical purposes, distinctions drawn from a mineralogical or petrological point of view are of but little importance, but he shows that this statement is only true because so little has been done towards the scientific study of the subject of the present book.

Dr. Potonié discusses first the modes of formation of coal, the macroscopic structure of coal and its origin, the microscopic structure of coal and its causes, and then, in some detail, the petrographic constituents of coal, and the various materials from which these have been built up. It need scarcely be said that a very large number of the views which he sets forth will not be universally accepted, our knowledge of the subject being in fact too imperfect to admit as yet of anything like finality, but the book before us undoubtedly constitutes a very important contribution to the study of a subject which is not only of profound scientific interest, but also may well prove to have very important practical bearings.

The Student's Handbook of British Mosses. By H. N. Dixon. Third edition, revised and enlarged. Pp. xlviii+582+63 plates. (Eastbourne: V. V. Sumfield; London: Wheldon and Wesley, Ltd., 1924.) 24*s.*

THIS well-known work has now been re-issued in a third edition which will prove very welcome to bryologists. Thinner paper, improved type, and new drawings for many of the plates serve to make the volume both of more convenient size and also more attractive. Much new material has been incorporated

embodying the essence of recent work on this subject. The glossary and instructions are fuller, and more conveniently placed in reference to the illustrations, while the plates contain a large number of additional details. This is especially noticeable in the illustrations of Bryum, where capsules are now figured for most of the species. *Bryum purpureum* on Plate XLII. should, however, presumably be *B. purpurascens*, and there are also slips in the lettering of Plates XII. and XVII. In the former case (Campylopus) the figures lettered A to E should be C, D, E, A, and B, while in the latter case (Fissidens) the plates D, E, and F are incorrectly described at the foot of the page, although correct in the text. Slight modifications have been made in the treatment of the Sphagna, Dicranum, and Thiudium. Stirton's names are indicated in the synonymy where necessary, but the previous treatment of these names has not always been maintained. *Zygodon teichophilus* Stirt. is now given as *Z. lapponicus* instead of *Z. Stirtoni* (as in the *Journal of Botany*, 1923, p. 69), while *Mollia thrausta* Stirt., p. 245, is not now taken as equivalent to *Trichostomium tortuosum* var. *fragipolium*. The quality of the book is quite maintained at its former high and critical standard, and it will continue to be invaluable to workers in this field.

Industrial Electricity. By Prof. Chester L. Dawes. (Electrical Engineering Texts.) Part I. Pp. xiv+371. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1924.) 11*s*. 3*d*. net.

MANY technical high schools in America have elementary electrical engineering courses. This book has been written for the use of students attending these courses and the author has done his work well. The explanations are clear, and the machines described are all in everyday use. The first five chapters give a good grounding in the elementary principles of magnetic and electric circuits, a large number of illustrative problems being given to show concrete applications of these problems. The rest of the book gives a bird's-eye view of electrical engineering. Owing to the great industrial importance of batteries, as, for example, in radio work and for motor-cars, we are glad that due space has been allotted to describing their underlying principles and how to maintain their efficiency and life. A typical ignition system and a typical lighting and starting system for motor-cars are also fully described. The next volume will discuss direct and alternating current power distribution. The author perhaps states a fundamental law of electrostatics too dogmatically: "For every positive charge in the universe there must exist an equal negative charge." It is a bold thing to draw conclusions about the universe from our terrestrial experiments.

Die Schollen der norddeutschen Moränen in ihrer Bedeutung für die diluvialen Krustenbewegungen. Von Dr. Georg Petersen. (Fortschritte der Geologie und Paläontologie, Heft 9.) Pp. iv+179-274+1 Tafel. (Berlin: Gebrüder Borntraeger, 1924.) 6*s*. 9*d*.

Low level glacial deposits often include large transported masses which are known in Germany as a variety of "Schollen." They there consist of sedimentary blocks ranging in age from the Jurassic to Glacial. The majority belong to strata from the Chalk to the Miocene. These glacial Schollen have been catalogued and described in an admirable monograph by Dr. Georg Petersen of Trier. He deals with 459 examples, including a few from Russia and Denmark: 205 of them have been discovered by bores; the remainder are exposed in cliffs and quarries or on the surface. The largest is a sheet of chalk at Sternitten in Samland, which is 4 km. long by 2 km. wide and 14 to 20 m. thick. The great majority of those measured are less than 10 m. long. The Sternitten Scholl has been carried 4 km. from the bed of the Baltic. As a rule they have been transported a short distance, but one near Leipzig has apparently been brought from Rugen. The author attributes the transport to glacial action, and directs attention to the view of Prof. Keilhack, who has pointed out their resemblance to the results of drifting ice-floes in the Baltic during severe winters. A special feature of the monograph is the author's view that the Schollen afford evidence of widespread Pleistocene earth-movements in North Germany.

Der mittlere Jura im Hinterlande von Daressalaam (Deutsch-Ostafrika): Beiträge zur Geologie und Stratigraphie Deutsch-Ostafrikas III. Von Edwin Hennig. (Monographien zur Geologie und Paläontologie. Serie 2, Heft 2.) Pp. iv+131+4 Tafeln. (Leipzig: Gebrüder Borntraeger, 1924.) 33*s*.

THE Jurassic geology of East Africa affords the main evidence as to the early history of the western part of the Indian Ocean. Hence every addition to the scanty fauna of the East African Jurassic is of importance. Prof. Edwin Hennig, well known from his "Geology of Württemberg" and his contributions to the great monograph on the Tendaguru beds of East Africa, in this monograph describes a miscellaneous collection of fossils from several localities between 70 and 90 miles west of Dar-es-Salaam along the railway to Lake Tanganyika. The fossils are mainly lamellibranchs, of which three new species are described. The horizons are assigned by Prof. Kennig to a continuous series from the Aalénian to the Oxfordian. He recognises that the material is inadequate for these determinations to be free from doubt; but they are consistent with the sequence of localities. In considering the affinities of the fauna he refers to those of Madagascar and India, but does not mention the later literature on the contemporary fossils of Kenya Colony. The price of the book is 33 shillings, which for a paper-bound booklet of 131 pages with 4 cheaply produced plates is very high.

Elementary Physics: for Medical, First Year University Science Students and general Use in Schools. By G. Stead. Pp. xiv+453. (London: J. and A. Churchill, 1924.) 10*s*. 6*d*. net.

IT is quite safe to predict that this book will be much used by medical students, for whom it is primarily intended, for it would be difficult to find one better suited to their peculiar requirements. The mathematics has been reduced to a minimum, and the presentation is probably as attractive as it can be made to students who are not as a rule prepared to take their physics very seriously; that is to say, who are somewhat averse from hard thinking and clear

reasoning. It is very well printed and illustrated, and is remarkably good value.

As a text-book for the general science student it is perhaps a trifle less satisfactory. The logical development is not always above criticism, as, for example, in the introductory paragraph of the section on heat, where the idea of quantity of heat is invoked in order to explain that of difference of temperature. Again, the theoretical justification of Archimedes' principle is not clearly set forth, and it is to be feared that the explanation of Newton's Third Law will leave the student just where he was in his acquaintance with those mysterious twins—action and reaction. Apart from these and one or two other exceptionable items, there is little to criticise and much to commend.

Radio, Beam and Broadcast: its Story and Patents. By A. H. Morse. Pp. 192. (London: Ernest Benn, Ltd., 1925.) 12*s.* 6*d.* net.

THE author gives a good account of the art of radio-communication. In an appendix he quotes British and American patent specifications or gives extracts from them describing the main steps in the evolution of the art. Many wonderfully accurate guesses into the future have been made, but few are so wonderful as Du Maurier's drawing published in *Punch* of 1878 of what appears to be an elaborate home radio set and a lady telling her page-boy to turn on the tap for the concert from Covent Garden, etc., at stated times in the evening. Long-distance broadcasting was anticipated, as one of the panels is marked "Bayreuth." In 1892 Sir William Crookes, in a paper in the *Fortnightly Review*, makes an excellent forecast of radio-telegraphy, suggesting that 50 yards would be a suitable wave-length, and that the instruments for reception would have to be tuned to this wave-length. We are inclined to agree with the author that, in the near future, broadcasting of local urban interest only will be effected over existing telephone or lighting wires and so kept out of the ether. The ether is already becoming congested, mainly due to broadcasting. A single broadcasting station takes as much of the ether as would accommodate at least ten radio-telegraph stations.

Why the Weather? By Dr. Charles Franklin Brooks, with the Collaboration of John Nelson and others. Pp. xvi+310+21 plates. (New York: Harcourt, Brace and Co., 1924.) n.p.

THE aim of this book is to present the elements of the physics of the atmosphere in a simple manner. It covers rather a wide field, and does not delve very deeply into any portion of the subject. The style is chatty, rather than simple, and gives the impression that the author has made a too strenuous effort to write down to the level of his public. While the author states a number of facts which would be unknown to the general reader, his theory is not always reliable. For example, he ascribes the "table-cloth" on Table Mountain to the cooling effect upon the air of the low temperature of the mountain top, instead of to adiabatic cooling of the air blown up the slopes of the mountain. It is stated that the earth has grown from a comparatively small cold body by the addition of mass by showers of meteors falling upon it, a theory which is by no means so widely accepted as might be inferred from the author's bold statement of it. On the whole, the book can be recommended to the general reader as an introduction to the physics of atmosphere. The illustrations, mainly of cloud forms, are very well selected.

Studies in the History of Political Philosophy before and after Rousseau. By Dr. C. E. Vaughan. Edited by A. G. Little. Vol. 1: *From Hobbes to Hume.* Pp. xxix+364. Vol. 2: *From Burke to Mazzini.* With a list of the Writings of Prof. Vaughan, by H. B. Charlton. Pp. xx+6+339. (Manchester: At the University Press; London: Longmans, Green and Co., 1925.) 2 vols., 42*s.* net.

THESE volumes will be valued by all those who knew or who passed under the influence of the distinguished professor who held the chair of English first at Cardiff, then at Newcastle, and later at Leeds before he died in 1922. The books and articles published by him in his lifetime were all of the nature of students' manuals or were aids to study. Apart from his work in the class-room, he was engaged throughout the active period of his life in writing a "History of Political Philosophy," and the studies for this, some of which were left in a finished, others in an unfinished, condition, but none of them marked for press, have now been edited and published. The whole is a monumental work of the first importance.

The Races of Man and their Distribution. By Dr. A. C. Haddon. New edition. Pp. viii+184+10 plates. (Cambridge: At the University Press, 1924.) 6*s.* net.

THIS is a new edition, entirely rewritten, of a small and very useful volume by the pioneer field-worker and veteran anthropologist of Great Britain. In its present form the book is the best succinct statement of the principles of racial classification, of the physical characters of each stock, and of the distribution of the varieties of man. In the analysis of the concept of "race" and the discussion of the main criteria of physical anthropology, which form the first part of the volume, the modern theories and points of view of cultural anthropology have been taken into account. In the description of the main races which follows, the book does not go beyond the limit of physical anthropology. Within these, it is the best and most authoritative statement of the subject. Mainly designed as a text-book for the beginner and the general reader, it will be also valuable as a handy work of reference for the specialist.

The Match Industry: its Origin and Development. By W. H. Dixon. (Pitman's Common Commodities and Industries Series.) Pp. x+150. (London: Sir Isaac Pitman and Sons, Ltd., 1925.) 3*s.* net.

THE author gives an interesting account of the manufacture of matches. The style suffers owing to the breaking up of the text into a large number of very short paragraphs, generally single sentences. The historical part is incomplete and disconnected, and in future editions more attention might be given to this side, and in particular the claims of Walker should be more critically examined.

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.*]

The Ionisation produced in Air during the complete Absorption of Slow Electrons.

A DIRECT determination of the average number of pairs of ions produced by a slow electron of given initial velocity during its complete absorption in a gas has been made possible by the use of high-speed pumps. Electrons are accelerated from a tungsten filament and passed through a capillary tube into an ionisation chamber containing gas at a suitable pressure, the gas issuing from the capillary being removed fast enough to maintain a good vacuum near the filament. The number of electrons entering the ionisation chamber is measured by a movable Faraday cylinder placed inside the chamber very close to the end of the capillary; then after the cylinder has been removed from the path of the beam, the ionisation produced in the gas is determined in the usual way.

If all the electrons had the same energy at the moment they leave the capillary tube, the ratio of the number of ions to the number of electrons would give the average ionisation produced by each electron, the initial energy being determined by the accelerating potential. In practice, it was found impossible to obtain a homogeneous beam, and the present experiments were carried out with beams in which from 40 to 80 per cent. had velocities corresponding to the full accelerating potential; while the remainder were slow compared with these. The homogeneity was determined for each experiment, *in vacuo*, by applying retarding potentials to the Faraday cylinder.

The values found experimentally for the number of ions per electron are therefore too low. A first approximation to the true value may be obtained by increasing the experimental values by a factor $100/P$, where P represents the percentage of full-velocity electrons in the beam. When this is done, it is found that the ionisation per electron in air increases steadily with the initial energy of the ionising electron, over the range from 100 to 1000 volts. Although the experimental error was certainly not more than 10 per cent., uncertainties in the composition of the beam gave rise to a possible error in the corrected values of the order of 20 per cent. The following table gives mean values:

Initial Energy of Electron in Volts.	Pairs of Ions produced in Air.	Energy expended per Ion-Pair in Volts.
200	5·8	35
400	14·5	28
600	24	25
800	35	23
1000	45	22

It will be observed that the average energy expended per ion-pair decreases towards the ionisation potential (17 volts) as the initial energy of the ionising electron increases, and over this range is less than any value previously published. It is, however, comparable with that found by Geiger (33 volts) from measurements on α-particles, where most of the ionisation is due to δ-rays. The behaviour of helium is similar, the energy expended per ion-pair in this case attaining a value much closer to the first ionisation potential (25 volts) than in air, from which it follows that, in this gas, very little energy can be lost in non-effective collisions.

J. F. LEHMANN.
T. H. OSGOOD.

Cavendish Laboratory,
Cambridge, August 3.

Lightning-conductors.

"WHO would have thought that man would succeed in drawing off the lightning and conducting it to an outlet?" The quotation is taken from one of a series of small octavo volumes, written certainly by one intimately acquainted with his subject, and published anonymously in Amsterdam in 1782–3 under the title "Tableau de Paris." The date, which is within about ten years of the "Terror," seemed to promise matter of interest to the student of the French Revolution; and the expectation proved to be amply justified. While the work necessarily contains much that is a sinister omen of approaching catastrophe, it also covers a wide and diversified field of contemporary life and thought; and, in particular, it contains many evidences that a very fine spirit of experimental and speculative research was awake in the France of that period. Each *tableau* has a short chapter to itself, the above quotation being taken from one headed "*Para-tonnerre*." The author's satisfaction with the new discovery would perhaps have been considerably tempered had he known that nearly a hundred and fifty years later the solution of the problem of defence against lightning would be recognised as still far from complete; that the control of the thunder-bolt would furnish cause for anxious study to the scientists of the twentieth century.

In view of the recent severe thunderstorms, the detailed description given of the earliest lightning-conductors erected in Paris may be of interest:—

"These great pieces of apparatus, which modern physics has designed to protect buildings from lightning, are numerous in many towns in the heart of the provinces, but they are rare in the Capital. The Abbé Bertholon, professor of experimental physics of the States-General of Languedoc, showed the greatest zeal in opposing the weapons of science to the attacks of lightning. It was he who superintended the construction of the first lightning-conductors in Paris—an honour due to one who had already erected the superb *para-tonnerres* at Lyons. There are now two to be seen, one placed on the Hôtel de Charost, faubourg Saint-Honoré. It is 185 feet long; while the part in the earth, terminating in water, has a depth of 28 feet. The second is at the other end of Paris, on the convent of the *religieuses augustines Anglaises*. It is 188 feet long; and the portion buried in the earth, which dips under water at the end, has a depth of 90 feet—a depth with which no other lightning-conductor of this kind can be compared."

"The pieces composing this apparatus are joined together with long screws [*à vis profondes*], and the precision of the work is such that all the bars seem to be one piece. Metallic connections, skilfully arranged, are put wherever necessary or useful [*Des communications métalliques, savamment ménagées, se trouvent dans les endroits où elles sont nécessaires ou utiles*]. Thus the lightning has to obey the Abbé Bertholon, and follow the direction which he has prescribed."

Unfortunately, the kind of metal used is not mentioned. One is inclined to think, however, that if copper rods were employed this would not have escaped the writer's notice. This rather doubtful consideration would seem to indicate that the material was probably iron. It is significant, also, that no claim is made on the Abbé Bertholon's behalf, with

respect to the *invention* of the "lightning-conductor." Franklin, whose first "lightning-rod" (1752) anticipated the French *para-tonnerres* by a good many years, was in France somewhere about this time, and their introduction into the latter country was probably due to his initiative.

One other extract may be given for what it is worth. Perhaps the two kinds of lightning observed may have some analogy to the A and B discharges noted by Sir Oliver Lodge :—

"It has been completely demonstrated, by a great number of observations, that the lightning often rises from the earth. If the electricity, the true cause of lightning, is in excess in the clouds, the discharge is earthwards. If, on the contrary, it is accumulated in the bosom of the earth, it escapes to expand itself into equilibrium in the atmosphere. In order that a building may be defended against these two dangers, it is therefore necessary to establish *ascending* lightning-conductors [*des para-tonnerres ascendans*] against the lightning which rises, as they have been established against that which falls. It is necessary to have recourse to the ascending lightning-conductors of the Abbé Bertholon. He has safeguarded in this way a belfry at Lyons, on which the thunder (*sic*) had very often fallen." (The appropriateness of the example cited is very far from clear.)

The extracts are from vol. 6, pp. 238-242, of the work mentioned. H. C. BROWNE.

Dublin, July 27.

Fish Poisons as Insecticides.

IN many widely separated tropical countries it has been the rather curious custom of the natives to catch fish in lakes, rivers, and creeks by means of certain poisonous plants; the leaves, stems, or roots being used for this purpose. The water extract obtained by macerating the appropriate part of the plant is poured into the stream, and the fish being rapidly stupefied by it are readily caught. The practice is now generally discouraged, owing to the heavy mortality ensuing amongst the small and immature fish.

Extracts obtained from some of these plants have been shown to have an insecticidal action of a high order. Among these are different species of Derris and Tephrosia, both of which contain non-nitrogenous constituents highly poisonous to fish. Recently, Mr. R. A. Altson, of the Botanic Gardens, Georgetown, British Guiana, has secured for us two plants employed by the aborigines of that country as fish poisons and known to them as "Black and White Haiari."

Mr. Altson refers these plants to the order Leguminosæ and states that the Indians use them in the following manner: "The roots of White Haiari and the stems of Black Haiari are beaten out into a 'horse-tail' and shaken into water, which afterwards is thrown into the creek. In about ten minutes the fish in that area are either stupefied or killed and float to the surface."

Extracts prepared from Black and White Haiari with water and organic solvents have been recently tested in this laboratory as contact insecticides, and both, but particularly those prepared by the use of organic solvents, have been found to be highly poisonous to aphides.

It is of interest that all of the above plants belong to the order Leguminosæ, while those of other natural orders which are used as fish poisons have not so far proved in our investigations at Rothamsted to be of much interest from an insecticidal point of view.

Various investigators have isolated the poisons from *Derris elliptica* and *Tephrosia vogelii*, but little is known of their constitution although suggestions have been made as to a possible lactone structure. No information is available, so far as we are aware, about the toxic constituents of Black and White Haiari. We have, however, obtained colourless crystalline derivatives from both, which may be of significance in this respect.

Black and White Haiari may prove of economic importance as insecticides. F. TATTERSFIELD.

Rothamsted Experimental Station,
Harpenden, July 15.

X-Ray Diffraction Patterns from Plant Fibres.

DIFFRACTION patterns obtained from plant fibres, ramie, hemp, etc., by using a method similar to that of Hull for crystal powders (*Phys. Review*, 10, 2, 661, 1917), do not agree in certain particulars with the data reported by Herzog and Jancke in *Zeits. für Physik*, 3-3, 196 to 198, 1920. They give a list of eight sets of planes, based on data obtained by using the "white light" radiation from a copper anticathode, and eliminating by inspection the $K\beta$ reflections. In our work, molybdenum radiation was used and a monochromatic beam was obtained by filtering through a zirconium oxide screen.

As will be seen in the table, several interplanar spacings check satisfactorily; others, however, do not. We found that by manipulating the exposure and size of slit, a line which might be accepted as 5·80 under one set of adjustments could be resolved into two lines, 6·10 and 5·40. Similarly, 3·30 and 2·60 lines were resolved as shown in the table. Merely for convenience the lines are designated by the figures which express the value of the interplanar spacings. Certain orientations of the bundle of fibres were also necessary in order to produce the separation of the lines.

INTERPLANAR SPACINGS IN PLANT FIBRES.

Reported by Herzog and Jancke. $K\alpha$Cu=1·54.	New Values.	Remarks.
5·80	6·10 5·40	Resolved
4·02	3·98	
3·30	3·40 3·20	Resolved
2·90		$K\beta$ line
2·60	2·62 2·58	Resolved
2·18 2·01 1·10	2·17 2·03 1·11	

The so-called 2·90 line was readily found when the unfiltered beam was used, but when the $K\beta$ wavelengths were screened out, it failed to appear. The $K\beta$ reflection from the 2·60 planes seemed to have contributed largely if not entirely to that line. Among the thirty odd lines which we found with the monochromatic beam there appears a very faint 2·93, but that line is so weak that it does not seem probable that it is the one which Herzog records.

Only the few lines needed to make the above corrections are reported here; a more detailed discussion of the patterns and the lattice will appear elsewhere. O. L. SPONSLER.

University of California, Southern Branch,
Los Angeles, California.

A Low Frequency Oscillator.

IT may be of interest to readers of NATURE who are working with low frequency to know of a new form of oscillator.

At present I am using a low frequency oscillator which gives excellent results with a delicate adjustment of the frequency to a given value. The circuit used is that in which the oscillations are produced by coupling the grid and plate circuits of a thermionic

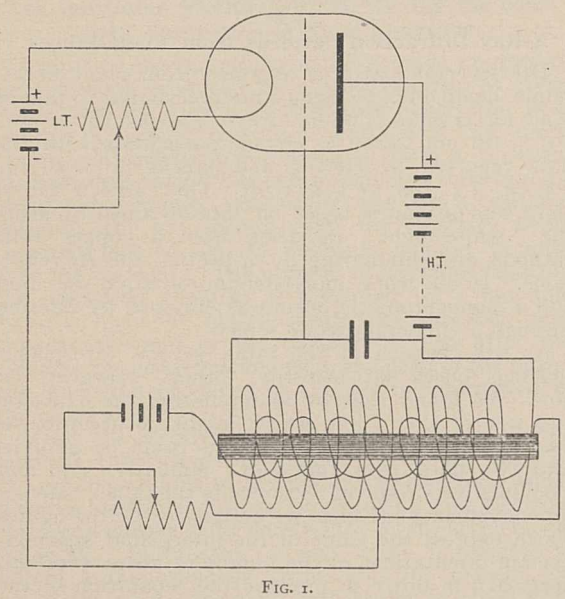


FIG. 1.

valve by mutual inductance and capacity. In the ordinary circuit the frequency is changed by sliding an iron core. In the circuit now described the inductance is altered by passing a D.C. current round an iron core. The pitch of the note for a given capacity changes as the exciting current changes. There are many advantages of this oscillator, one of which is the maintenance of symmetry for the different inductances. A full description with test details is now in course of preparation for publication. The diagram (Fig. 1) gives an idea of the oscillator circuit and how it works.

C. CONSTANÇON.
University of the Witwatersrand,
Milner Park, Johannesburg,
July 1.

Doublet Separation in C II and Si IV.

FURTHER work has been done on the ultraviolet spectrum of carbon and silicon using a diffraction grating having a radius of 192·1 cm. The resultant dispersion of about 9 Å.U. per mm. has enabled us to obtain the following spectral lines in Fowler's [1] series for C^+ as doublets and to measure the separation as shown in the following table :

Line. Bohr's Notation.	$\Delta\nu$ observed.		$\Delta\nu$ as calculated by Fowler.[1]
	2nd order.	3rd order.	
$2\pi_1-3\sigma$, $2\pi_2-3\sigma$ } $\lambda=858$ Å.U.	64	60	58
$2\pi_1-3\delta$, $2\pi_2-3\delta$ } $\lambda=687$ Å.U.	64·5	..	58

The separation of the components of the line at 858 Å.U. was measured in the second order on nine plates and in the third order on three plates, using a comparator reading to 0·001 mm. and taking the average obtained from ten settings on each component. The measurements on 687 Å.U. were made in the second order only and on two plates.

The third member of the first sharp series was not recorded by Fowler, but was found by one of us [2] as an unresolved line at 577·4 Å.U.

We have also measured the separation of the doublets at 1335 and 1036 Å.U., and the results from seven different plates, using the second order, give $\Delta\nu = 65$ for the 1335 doublet and $\Delta\nu = 62$ for 1036. The focussing in the case of the latter was not so sharp as for 1335, but the results seem to indicate that the two separations are the same and that 1335 therefore belongs to C^+ as Millikan [3] has already stated.

In the series of Si IV as recorded by Fowler,[4] we have resolved the doublet $3\sigma_1 - 4\pi$, $3\sigma_2 - 4\pi$ in the second order and find the separation $\Delta\nu = 153$.

The following lines in these series not previously recorded have also been found : $4\sigma - 6\pi$ in first order only and unresolved ; and the single line $4\delta - 7\phi$.

Experimental details will shortly be published.

R. J. LANG.
STANLEY SMITH.
Department of Physics, University of Alberta,
Edmonton, Alberta, Canada, July 11.

The Attraction between Homologous Chromosomes.

IT has been shown that the chromosomes of Datura (*American Naturalist*, vol. 56, pp. 339–346, 1922), Hyacinthus (*Genetics*, vol. 10, pp. 59–71, 1925) and Uvularia (*Journal of Genetics*, in press), for example, are combined side by side, and end to end, at the reduction division. If n is the haploid number of chromosomes, this finding of partners and conjugation of chromosomes points to the presence of $2n$ different attractions. (It is easily demonstrated in Uvularia that homologous ends of each chromosome are opposed, for the ends of the chromosomes differ in appearance.) This is confirmed by the formation of trivalents, quadrivalents, quinquevalents, etc., in triploid, tetraploid,

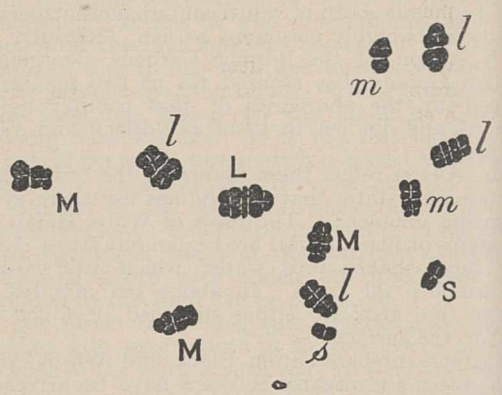


FIG. 1.—Datura chromosomes.

and other plants with more than two homologous chromosomes ; and also by the fact that none of the 12 chromosomes of the haploid Datura pair at the reduction division (Fig. 1). Such a number of attracting forces seems perhaps unexampled in physics.

JOHN BELLING.
Carnegie Institution of Washington.

[1] Proc. Roy. Soc., March 1924.
[2] Trans. Roy. Soc., A, 224, 371-419.
[3] *Phy. Rev.*, September 1924.
[4] Proc. Roy. Soc., June 1923.

Science in South Africa.[1]

By General the Right Hon. JAN CHRISTIAAN SMUTS, P.C.

THE Wegener hypothesis purports to explain the origin, the past and the present of all the continents and oceans of this globe. But for us in South Africa it has a special interest in its account of the origin and distribution of continents in the southern hemisphere. Whether this account is correct or not, the hypothesis has the great merit of focussing attention on many great problems which call for explanation; and it has the further merit of associating these problems and making them parts and aspects of a great common scheme, instead of merely leaving them, as disjointed unconnected items, scattered haphazard over the various special sciences.

For us in this part of the world, the most interesting feature of the scheme is that in it Africa assumes a central position among the continents; it becomes, in fact, the great "divide" among the continents of the southern hemisphere; it appears as the mother-continent from which South America on one side, and Madagascar, India, Australasia and their surrounding areas on the other, have split off and drifted away, have calved off, so to speak. The evidence for all this is strong; but it may well be that the evidence is yet insufficient to account for the whole Wegener hypothesis. It may not be strong enough to prove the actual disruption and separation of the continents in the past which is the essence of the hypothesis. But even so it may be right in assigning to the African continent a central determining position in respect of many of the great unsolved problems of geographical distribution, and in making that position the key which science will have to use in ever-increasing measure if it wishes to unlock the door to future advances. The value of a hypothesis often depends not so much on its correctness as on its fruitfulness. For the present I am prepared to look upon Wegener's hypothesis as a fruitful point of view more than a solution, as a suggestive line of thought and research along which useful work may be done in the future.

One important line of research which it suggests to us is the east/west aspect in addition to the hitherto prevalent north/south line of orientation. Hitherto it is the European affiliations which have guided our thought and our research; we have looked to the north for explanations as well as our origins. In future, on the lines of Wegener's speculations, we shall look more to east and west—to our affiliations with South America, India, and Madagascar and Australasia, for the great connexions which can explain the problems of our past and present. We shall look upon southern Africa as the centre of the southern hemisphere and correlate all the relevant scientific problems of this hemisphere from that new point of view. This new aspect will establish new contacts, and it is generally such new contacts which prove fruitful and creative for scientific progress.

Let me first take the case of geology, a science in which a very high standard of success and excellence has been achieved in South Africa. A great amount of attention has been devoted to the question of the correlation of our geological formations with those of Europe, and although many unsolved problems still remain, the main outlines of the correspondence of our formations with those of the northern hemisphere have been successfully worked out. A good deal has been done, yet quite insufficient to correlate our formations with those of South America, India or Australasia. Yet it is evident that the subject is one of profound interest, both from a scientific and a practical point of view. Several of our formations at the Cape seem to be continued or paralleled by identical or similar formations in India and South America. A proper correlation of the geological systems may lead to most interesting results, and may also throw great light on the past of the three continents. We may thereby be enabled to explain just why they are practically the sole producers of the world's diamonds; why the diamond-fields of South-West Africa are situated on one edge of the Atlantic and those of Brazil on the other; why the coal-fields of these three countries and of Australia are confined to the eastern halves of each of these land masses; and why the curious and ancient banded-ironstones are so widely spread in South Africa, Brazil, peninsular India and Western Australia, though absent from Europe. The results of such a comparative study for the southern hemisphere might be most valuable and might settle many of the problems which still agitate science as to the past of the earth.

It is when we come to the biological sciences, however, that such a comparative study promises the most fruitful results. Here there is a number of momentous problems still awaiting solution. Consider, for example, the problems affecting our botany. We have two distinct floras in South Africa; one, the South African flora which covers most of sub-tropical Africa and is clearly of tropical origin; the other, a temperate flora, found only in the south-west of the Cape Province on the seaward side of the first great mountain barrier, with outliers extending to the north along the mountain systems into the tropics. The two floras are apparently quite different and distinct and are engaged in a mortal conflict with each other, in which the temperate or Cape flora is slowly losing ground. This Cape flora forms indeed a problem of profound and baffling interest. What is its origin, and what its relation to the South African flora? The South African flora is, as I have said, clearly of tropical origin, and consists largely of subtropical derivations and modifications of the tropical forms found farther north in the equatorial regions. Can its origin be traced further back? In the answer to this question we meet again with what I may call the European fallacy, or the fallacy of the European origin. The current idea among botanists is that northern Europe is the source and the north temperate flora of Europe is the origin of both our South African and Cape floras. The north temperate flora of Europe is supposed to have been driven south by the onset of the last great Ice Age in Europe and, in the much cooler climate of the tropics at that time, to have migrated southward along the eastern mountain systems of Africa until southern Africa was reached.

[1] From the presidential address to the South African Association for the Advancement of Science, delivered at Oudtshoorn, Cape Province, on July 6.

This common view of the European origin of our floras will, however, require very careful reconsideration from the viewpoint which I am suggesting here. The correlation of our floras with the other floras of the southern hemisphere may profoundly affect this question of origins, and may throw much fresh light not only on the origin of our floras in Southern Africa, but even on so momentous a question as the origin of the flowering plants and on geographical distribution generally. Even according to our present knowledge, the African floras do not seem to fit in well with the current view of their origin. Apart from the Cape flora in the extreme south, and the Mediterranean temperate flora in the extreme north, the African flora—better known as the Tropical African flora or the Palæotropical African flora—covers the rest of the continent. In this flora an element predominates which is peculiar to this part of the world, but is more or less closely related to the floras of India, Madagascar, Australasia and South America. In other words, the special affiliations of the Tropical African flora are in the southern hemisphere. Similarly the Cape flora has peculiar affiliations with the floras of certain countries in the southern hemisphere. The current view of the northern origin may therefore not be the last word so far as botany is concerned.

On this question we have the following two interesting facts. First, the fact already mentioned that the chief types of the African flora have their affiliations in the southern and not in the northern hemisphere. Secondly, the fact that the chief types of the present Cape flora, such as the Proteaceæ, Rutaceæ, and Restiaceæ, to-day occupy the areas that correspond to the former Gondwanaland, that is to say, exactly the same area which was covered by the Glossopteris flora in Mesozoic times. It is alleged that some fossil types of Proteaceæ have been found in Central Europe in lower Cretaceous deposits, but these finds are disputed. These two facts would seem to point to the conclusion that the two African floras are probably of southern origin and have not been derived from the northern or European flora. Nay, more, the suggestion of Seward that the Mesozoic flora of Europe, which is markedly dissimilar from that of its Palæozoic flora, may have had a southern origin in Gondwanaland, opens up very interesting possibilities. Indeed, in the palæobotany of the southern hemisphere we are only at the beginnings; and who knows whether further discoveries in this largely virgin field of research may not yet give point and substance to Darwin's surmise that the existence far back in the long ages of an extremely isolated Southern Continent is somehow to be linked with the mysterious origin of flowering plants.

Some of the greatest problems of botany, of geographical distribution, and of the past of the earth will have to wait for their solution until palæobotany has made much further advances in South Africa and the southern hemisphere generally. In this connexion a great opportunity lies before science in South Africa. I trust a step will be taken by the establishment of a chair of palæobotany at one or other of our South African universities. It will be a small step, but its significance will be great and its results may be far-reaching.

So far I have only referred to the evidence of palæobotany. But the evidence of our southern palæontology generally is all in the same direction. Still more so is the evidence of the present botanical distribution throughout the southern hemisphere. The present distribution is not only strong presumptive evidence in favour either of a great Southern Continent or great land connexions in the south in the past, but also in favour of the independent origin of the African flora. Dr. Otto Stapf, whose knowledge of African grasses is unrivalled, goes even further in his masterly "Gräsenflora Süd-Afrikas," and would seem to suggest that very special importance is to be attached to the unique character of the Cape flora as distinguished from the African flora. The Cape flora points not only to a southern origin but to an origin even farther south than the ancient Gondwanaland is commonly supposed to have extended. May we not venture the suggestion that the Cape temperate flora is the survival of an Antarctic and sub-Antarctic flora which has perished in the climatic changes of the past? That, at any rate, would account for its marked differences from our sub-tropical South African flora.

Enough has been said to show how important it is that there should be a regular comparative study of the scientific problems of the countries which lie in the southern hemisphere, with South Africa as the centre of the whole group. Such a comparative study promises rich results and will probably give a new direction and a fresh impetus to many branches of scientific work. For this purpose it seems to me not only advisable to devote more attention to palæobotany at our universities, but also essential that South African students and workers should visit other countries of our hemisphere and familiarise themselves with the scientific conditions and problems which obtain there.

Let us now pass on from biological questions to the problems of South African climate and meteorology, which I need scarcely point out are of supreme importance not only in an economic but also in a scientific sense. Here, too, we shall find that the present has its roots deep in the far-off past.

Great ice-ages are known to have occurred far back at the beginnings of geological time before the present sedimentary formations were laid down. To pass to the other extreme, Europe during the Permo-Carboniferous period, when the coal measures were mostly laid down, possessed the climate of a sub-tropical rain-forest, and at a much later date the magnolia and similar tropical plants flourished in Greenland and Spitsbergen. At that time, Europe was mostly covered by shallow seas and its tropical climate was balanced by a cold dry climate which existed in the contemporaneous Gondwanaland of the southern hemisphere. The Glossopteris flora of the latter was the vegetation of a cold dry climate; and the glaciation of many parts of Gondwanaland, of which evidence is visible over a large part of South Africa, shows that great ice-masses must have covered its high table-land. Much other evidence points to the fact that the ancient Africa which formed the centre of Gondwanaland was on the whole a cold and arid country.

Gondwanaland must have been an unpleasant country to live in, not only because of its climate but also because of the vast geological disturbances which were gradually tearing it to pieces. Even if the tearing

asunder and drifting apart of the ancient continent according to Wegener did not take place, there must have been submergence and disappearance under the sea of great land connexions between the countries of the southern hemisphere. Other indisputable evidence of the severe and long-continued convulsions of Africa during the Tertiary times exists. The vast cracks and fissures which rent it from south to north exist to-day still in the chains of great lakes and "rift-valleys," which extend across Africa from the Zambezi to the Red Sea, the Dead Sea and the deep valley of the Jordan. Farther north the crust of the earth folded up slowly like a crumpled scroll, and as a result the huge mountain chains of the Atlas and the Alps, the Taurus and the Himalayas were formed. Volcanoes burst forth in Africa in many places along the lines of weakness, while in the south the diamond pipes were formed. During this prolonged period of change the climate of southern Africa also must have changed considerably, for instead of the cold of Mesozoic Gondwanaland, we find so far south as Kerguelen Island the remains of araucarias which must have flourished there in Tertiary times.

These far-off climatic conditions of the ancient Africa have for us of to-day only a mild scientific interest. But the remarkable changes in terrestrial climate which set in at the end of the Tertiary period are on a different footing and have produced effects which are still felt by us in the present era. A marked elevation took place in the lands of the southern hemisphere, and South Africa ended considerably farther south and nearer to the Antarctic than to-day. Then the snow began to fall and the ice to form on Scandinavia, and the glaciers and ice-fields to extend south into Central Europe. Similar conditions ensued in North America and Antarctica. The last Great Ice-Age had begun, with effects which were felt right across the equator into subtropical southern Africa. The increasing cold in the Antarctic and the subantarctic islands wiped out the entire south temperate flora with the single considerable exception of its most northern outlier in the South-West Cape, where it still survives as a unique relic of the past. The combined effects of the two northern and southern cold areas were reflected in moister conditions and greater rainfall in southern Africa during the Pleistocene than we have to-day.

Throughout the half a million to a million years which cover this period, the land level of northern Europe kept oscillating, and the Scandinavian ice-mantle was growing or dwindling, with mild or even warm interglacial periods between. It was in the last two interglacial phases that man appeared in Europe, not yet *Homo sapiens*, but earlier species of mankind. To locate ourselves properly in the frame of the geological picture we have to envisage ourselves as living in a new and mild interglacial period; we have to remember that Scandinavia is once more rising at the present rate of perhaps a metre or more per century, and that in another ten thousand years or more Europe will possibly be once more in the grip of a great ice-age. South Africa is also rising at a rate which has not yet been determined but is appreciable, our climate will gradually become cooler, until we shall again have more moist and rainy conditions than to-day; and the voices of the Schwarzes will no longer be heard crying in the wilderness which will have passed away. We may regret that we shall not live to see that day, but that regret will be tempered by the further thought that hitherto each interglacial phase has seen the passing away of a lower species of the human genus to make way for a higher one, and that in all probability our present human races will before the next phase have had to disappear and make way for the higher species of humans which it is hoped will occupy the next age.

The factors which affect large divisions and periodicities of climate and rainfall are still a matter of controversy amongst scientists. But there can be little doubt that the formation of the great Scandinavian ice-field, partly at any rate through land elevation at the end of the Pliocene, had the most profound effect on the climate and the history of Europe and Asia during the present geological period. A great anticyclonic storm centre was thereupon established, which displaced the rain-bearing cyclonic belts and thereby produced the most far-reaching changes, which were felt even across the equator of the old world.

The Great Ice-Age in Europe appears to have synchronised with a period of greater rainfall in Africa, including South Africa. The remains of great rivers and lakes in all parts of southern Africa, and the gravel terraces in certain regions which are now waterless deserts, bear witness to the higher rainfall during the Pleistocene and to the consequent accumulation of surplus waters in the sub-continent. The Swedish geologist de Geer has by methods of remarkable ingenuity and accuracy determined that the ice-body finally retreated from Sweden about twelve thousand years ago, and this result agrees very well with the corresponding estimates obtained in North America. We may therefore take it that during the last ten thousand or twelve thousand years South Africa has been experiencing a lessening rainfall; the run-off of the rivers to the ocean has not been properly compensated for by rain. There has thus been a progressive desiccation of the land, and the arid or semi-desert conditions of to-day have probably been in existence for some thousands of years. That is the opinion of Passarge ("Die Kalahari," c. 37), who made a closer study of this question in the Kalahari region than any other worker. At the same time it has to be admitted that we are still ignorant of or in doubt about a number of matters bearing on the past rainfall of southern Africa, and important problems still await the attention of our scientific workers in this regard. Prof. Schwarz's writings have focussed much popular attention on some of these questions, but in scientific circles the matter as a whole has not yet received the attention it deserves. It is to be hoped that this omission will soon be repaired, for there can be no question either of the scientific interest or the practical economic importance of the subject as a whole.

Meteorology ought to occupy a foremost place in our activities as a State and as a country for scientific investigation. The comparative smallness and seasonal uncertainties of our rainfall make this a matter of the greatest economic importance, while our central position in the southern hemisphere carries with it peculiar advantages and responsibilities for meteorological observation and research. Yet very little pure research has so far been done. In his letter to the recent

Drought Investigation Commission, Dr. G. C. Simpson, Director of the Meteorological Office, London, makes the following grave charge against us :

> Of the large land surfaces, the meteorological conditions of Africa are probably the least known ; for except from Egypt we receive practically no meteorological information from this great continent, and South Africa is probably the largest area having a settled civilised Government which publishes little or no meteorological information officially.

and he goes on to make the following recommendation :

> The most hopeful method of attack on the problem of seasonal forecasts is to compare and correlate the records of various meteorological factors ; thus one of the first steps to the attainment of your object will be the formation of a strong meteorological service to gather data of satisfactory reliability from Africa itself, and probably, in connection with other countries in the Southern hemisphere, from the Antarctic continent. I do not think that one country alone should undertake to place meteorological observatories on the Antarctic continent. There should be international co-operation of the countries interested, and the aim should be to establish one or more observatories which can be kept in constant activity along a well-planned programme for an indefinite time.

Here, then, is a very valuable suggestion for us to act on. The Argentine Government has already made a start by maintaining two meteorological stations in the Antarctic, one on the South Orkneys and one in South Georgia. If the Union of South Africa and Australia could agree each to maintain an Antarctic station opposite or to the south-west of their respective territories, and the work of the four Antarctic stations could be co-ordinated, the results might be of the utmost value.

The discussion of our climate and meteorology leads me to mention the subject of astronomy and to refer for a moment to some of the outstanding contributions which have been made to it in South Africa. Here, too, our favourable situation in the southern hemisphere and our meteorological conditions, unrivalled for astronomical research, have enabled South Africa to play an honourable part in the advancement of science. Here it was that in the middle of the eighteenth century the Abbé Lacaille made the first scientific catalogue of Southern Stars. Here, too, it was that early in the nineteenth century our second Astronomer-Royal, Henderson, made the first determination of the distance of a fixed star from the earth, in the case of α-Centauri. Here it was that Sir David Gill made the classic determination of the mean distance of the sun from the earth, a determination the accuracy of which has received only additional confirmation from subsequent determinations.

The Cape is also the birthplace of many other lines of astronomical research. It was at the Cape Observatory that celestial photography had its real beginning. Previous to 1882 it was more an amusement in, than an auxiliary to, astronomy. But in that year Gill, while photographing the great comet, was struck with the power of the photographic plate to picture the faintest stars. Forthwith he conceived the idea of photographing the whole heavens, and thus the most efficient and far-reaching arm in stellar research had its beginnings. From that day photography became the most powerful weapon in the astronomical armoury. The epoch-making departure thus happily initiated will now be further followed up in South Africa with the great resources of the United States of America. We wish the Yale Observatory at Johannesburg under Dr. Schlesinger, and the coming Princeton Observatory at Bloemfontein under Dr. Hussey, all possible success in the important tasks they have set themselves.

Let me mention a second line of astronomical research where South Africa was responsible for taking the initiative. For many years it was the home of variable star research. The first observatory in the southern hemisphere for this special branch of astronomy was built at Lovedale in 1891 by Senator A. W. Roberts. It was at this observatory that he made the first estimates of stellar densities, as well as the earliest determinations of close binary systems and their evolution. This pioneer work has led to most important developments in astronomy which are now rapidly revolutionising our views as to the origin and evolution of the material universe. On all these grounds the record of South Africa in astronomical research is indeed one of outstanding distinction ; and there is no reason why this record should not be maintained for the future in this land of clear skies, of equitable climate, of peaceful days and cloudless nights, where an endless attraction and a rich promise are continually held out to the lover of the heavens.

I now pass on to the last science which I shall refer to as one to which South Africa should, from its central position, be able to make a great contribution in the future : I refer to human palæontology. Three finds of outstanding importance have in recent years signalled South Africa as a great field of research into the human past. The first was the discovery of the Boskop skull, which traced the Strandlooper and Hottentot peoples of South Africa to their prehistoric ancestry. The second was the discovery of *Homo rhodesiensis* at Broken Hill, which Prof. Elliot Smith is reported to have declared one of the most significant finds ever made in human palæontology because by that discovery Africa for the first time realised our firm expectation of providing extinct types of the human family that present problems of exceptional interest. Finally, we have *Australopithecus africanus*, which largely breaks new ground in palæontology.

In *Australopithecus africanus* we have a transitional form between the ape and the human ; we have a creature which is still indisputably an ape, but with certain facial features and a brain development which take it some way towards the human. Looking upon the human and the ape forms as the two extremes which will have to be bridged by palæontology, we note that this can be effected in either of the two ways. We may find fossil forms carrying the human further back into its human or prehuman past, or we may find fossil forms carrying the ape form forward towards some intermediate point on the road towards the human. The Broken Hill skull has done the first, and the Taungs skull has done the second. Together they form an outstanding contribution to the elucidation of a most difficult but most fascinating problem of anthropological science.

It is a remarkable fact that *Homo rhodesiensis*, although apparently a more primitive and simian type than *Homo neanderthalensis*, was found still unfossilised, and among animal remains which belong to still living Rhodesian species. The deduction has been made that *Homo rhodesiensis* was living quite out of his proper geological horizon, and was surviving in South Africa long ages after his compeers in Europe had passed away. In fact he was probably still flourishing in the south when his European "contemporaries" had been dead for thousands of years. But there is really nothing singular in such an idea. After all, such a situation is typical of South Africa in more respects than one. Our Bushmen are nothing but living fossils whose "contemporaries" disappeared from Europe many thousands of years ago. The interest of South Africa as a field for anthropological research is partly just this, that it is possibly ten thousand years behind the times, as measured by the standards of European cultures. In this respect our anthropology does not stand alone, for in botany also we have true "living fossils" like the cycads. In South Africa, therefore, certain biological problems can still be studied from life which in Europe can only be deduced with difficulty from the fossil records of the past.

That is by no means, however, the only or the best claim that South Africa can put forward as a fitting place for palæontological study and research. Discoveries already made point to the possibility that South Africa may yet figure as the cradle of mankind, or shall I rather say one of the cradles? As we have seen, it is not only one of the oldest land surfaces but also, since the end of the Mesozoic period, it has generally enjoyed a fairly habitable though, on the whole, dry climate. While in Tertiary and Pleistocene times most of Europe and much of Asia and North America were intermittently under ice or shallow seas, southern Africa was very much as it is to-day. No wonder, therefore, that it should contain some of the most ancient fossil records of the human race, and that among its living races it should include what are "fossils" in other continents. Its little Bushmen are unique; its little pigmy population that hide in the tropical and subtropical parts are the representatives of the long-vanished human past. Going a little further back, we find in Africa the home of the great anthropoid apes which are nearest to us in the affinities of life. Here then we are clearly near to the great origins. These and other considerations point to the vast importance of Africa from a palæontological point of view, if not to the possibility that here may yet be found some intimate connexion with the far-off beginnings of the human race. The scope for scientific work in South Africa in this department of knowledge is therefore immense.

Science has in South Africa a splendid field of labour: other nations may well envy us the rich ores of this great "scientific divide" which is our heritage. I trust that South African science will rise to the height of its great opportunities, and that this sub-continent will yet earn for itself that scientific leadership of the southern hemisphere to which its central position and its great scientific assets and opportunities entitle it.

The Crystalline Structure of Inorganic Salts.[1]

By Prof. W. L. BRAGG, F.R.S., Langworthy Professor of Physics, University of Manchester.

THE examination of crystalline bodies by means of X-rays has enabled us to discover the positions of the atoms in the crystal. In the earlier period of X-ray analysis it was only possible to do this when the atoms were arranged according to a simple pattern of high symmetry. Experience has increased the range of substances to which the new methods can be applied, and we can now assign structures to relatively complex crystals, basing the proposed structure on the manner in which the crystal diffracts the radiation.

The study of the crystalline structure of organic and inorganic compounds has revealed certain broad distinctions between these two classes of crystals. The crystalline arrangement throws new light on those differences in the structure of the molecule which have made it convenient to distinguish organic from inorganic chemistry. No exact line can be drawn between the two classes of crystals, and yet the main features are sufficiently different to make the classification useful. The organic crystal appears to be composed of definite molecules. Inside each molecule the atoms are bound together by forces so local, and so rigid, that an addition to one part of the molecule scarcely affects the rest; these molecules are then massed together by comparatively weak forces into a crystalline structure. The form of the inorganic crystal suggests that the bonds between atom and atom are not limited to certain directions; the molecule is more fluid, and an addition to one part profoundly disturbs the relationship of all the rest. It must be this molecular fluidity which makes it so hard to apply the ideas of stereochemistry to inorganic compounds although they have been so successful in explaining the organic compounds.

Our powers of X-ray analysis are as yet very incomplete and it is difficult to find the positions of the atoms in complex structures. The complexity of a structure depends on the number of parameters, or degrees of freedom permitted by the symmetry, which fix the positions of the atoms in its pattern. At the present time any structure with more than half-a-dozen of these independent parameters presents a difficult problem. Crystals with two or three parameters are comparatively simple. For several reasons the inorganic salts can be analysed more completely than organic compounds. In the first place, the number of atoms in the inorganic molecule is generally smaller than that in the organic molecule, and owing to the power of readjustment in the former class of compound which has already been mentioned, the atoms often take up a symmetrical arrangement and this symmetry makes the X-ray investigation more easy. Every requirement of symmetry which must be satisfied by the atom reduces the number of variable

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

parameters in the structure, and confines the atom to certain planes, lines, or points from which it cannot move. Further, in a series of inorganic crystals it is often possible to replace one atom by another of similar chemical properties without altering the crystalline structure. Now the heavier atoms scatter X-rays more than the lighter atoms. If, therefore, we wish to find the position of the metal atoms in an inorganic salt, and a crystal of the series is available in which the metal has a high atomic weight compared with the other constituents, it is an easy matter to fix its position. The same process can often be carried out with a heavy atom in the acid radical and a light one in place of the metal. In order to aid the X-ray examination we are using a method which is precisely like the staining, by means of suitable dyes, of certain parts of a microscopic preparation. In the organic crystal the atoms of carbon, oxygen, and nitrogen are almost indistinguishable by means of X-rays since they are so close in the periodic table, and, with the exception of one or two compounds, it has so far been impossible to fix their positions.

The inorganic salts are interesting not only because we know more about their structure, but also because they lend themselves more readily to mathematical treatment. We may compare this case of crystal equilibrium to the engineering problem of calculating the stresses to which the members of a girder system are subjected. If the number of constraints is the minimum requisite for rigidity, these stresses can be directly calculated by simple laws of mechanics. If the whole structure is too rigid, much more detail must be known about the structure in order to calculate the stresses. The inorganic crystal represents the structure with the minimum number of constraints. We can try to explain the properties of the crystal as a whole by making certain simple assumptions about the forces between the atoms. It is certain that the real atomic properties are more complex than those represented by these simple assumptions, but it is interesting to see how far one can get towards an explanation with their aid. For example, a number of crystalline properties can be explained by assuming an atomic model of the following kind.

(*a*) The atom consists of a symmetrical electronic structure surrounding the nucleus in which the charges on the electrons and on the nucleus do not balance, so that the sum of the charges is sometimes positive, sometimes negative.

(*b*) When the atoms approach within a certain distance of each other a force of repulsion between their outer electronic structures sets in very rapidly and prevents closer approach.

(*c*) When the atom is placed in an electric field it becomes polarised. Its positive and negative parts are drawn in opposite directions and it is surrounded by a field like that of an electrical doublet.

With the aid of these assumptions, qualitative explanations have been given of the formation of inorganic compounds (Kossel) and quantitative explanations of the heats of formation, heats of solution, latent heats of evaporation, and elastic properties of the inorganic crystals (Born and Landé, Madelung, Fajans, and others). Their highly interesting investigations have been applied to crystals of a symmetrical and simple type, such as the rock-salt structure. The quantitative agreement between calculated and observed data is most striking and shows that the assumptions which have been made are not far from the truth. I do not wish to discuss their results here; I quote them to show how far this atomic model explains the facts, as I wish to use it in examining the more complex salts which we have analysed by X-rays.

The force which causes two atoms to repel each other when they approach closely is very interesting. We do not know its origin, but it is clear that it sets in very sharply and increases rapidly as the centres of the atoms get closer together. This is so much the case that each atom in the crystalline structure appears to be surrounded by a domain which it occupies to the exclusion of other atoms. We cannot define the size of this domain exactly because the distance of closest approach of two atoms will always depend on the strength of the force driving them together, but the domain varies within narrow limits for the range of forces ordinarily present in a crystal. A knowledge of the domain associated with the atoms and molecular groups is most important in crystal analysis since it limits the possible configurations and confines the atoms to certain regions where they do not overlap too greatly. In a Friday evening discourse at the Royal Institution four years ago, I gave some empirical figures for the radii of these atomic domains and tried to show how these figures could be used to aid crystal analysis. I wish to take this opportunity of saying that I have considerably altered my views on this question; other workers who have dealt with the subject have given alternative estimates of the domains, which I believe to represent the physical facts far better than did my original figures, and in addition a more complete knowledge of crystal structures has shown how elastic the atomic domain is and what care is necessary in using the conception to help analysis. Nevertheless, its very great importance must not be lost sight of, for it is one of the principal aids we have in tackling a difficult crystal structure.

We do not know the exact dimensions of the electronic orbits, but such estimates as can be formed suggest that in a crystal such as rock-salt there are large spaces between the outermost orbits of neighbouring atoms. Each atom has its system of orbits quite distinct and widely separated from those of its neighbours. This is generally true where the charged atoms are of a symmetrical type and held together by electrostatic attraction. On the other hand, where the chemical evidence points to a linkage of the homopolar type, crystal analysis shows the atoms close together as if the electronic orbits were actually linked up.

A series of atomic structures such as O^{--}, F^{-}, Ne, Na^{+}, Mg^{++}, Al^{+++} are supposed by Kossel to have a common configuration resembling that of neon itself. The charges on the atoms are due to the addition or removal of electrons required to give them the correct number for a neon structure. The scale on which the atoms are built must diminish from oxygen to aluminium, owing to the increasing nuclear charge, Al^{+++} being on about one-half the scale of O^{--}. The idea of an atomic domain can only be a very rough approximation to the truth, for in actual fact there must be a different law of force for

every given pair of atoms; in this approximate sense, interatomic distances in simple crystalline structures are in agreement with the supposition that they obey an additive law and that the dimensions of the domain are proportional to those of the atomic structures in a series such as has been given above. I directed attention to this additive law as an empirical fact in the discourse referred to above, but made the domain of the positive ions too large and those of the negative ions too small. A better interpretation of the significance of the law was given by Wasastjerna in a paper on the "Radii of Ions" in which due weight was given to the relative dimensions of the electronic structures. Recently, Jones, in a series of highly interesting papers, has linked up the fields which give the repulsion between atoms of an inert gas, and the fields of the corresponding ionic structures in crystals.

Again, in the case of the very simple crystals, good quantitative agreement between calculation and observation of crystal dimensions can be obtained by certain simple assumptions about the nature of the repulsive field due to their electronic structures. In the more complex crystals the concept of an atomic domain is by itself sufficient to explain the general configuration of the crystal. Cases which are especially interesting are those where the domain of one ion is much larger than that of the other. The structure of aluminium oxide, Al_2O_3, is an example. Since the oxygen ion is so much larger than the aluminium ion, the structure is that of a series of oxygens in a close-packed arrangement (hexagonal) with aluminium atoms in the interstices acting as a cement to bind the whole together. In spinel, $MgAl_2O_4$, the oxygen atoms are in a cubic close-packed arrangement. In cadmium iodide, CdI_2, the large iodine atoms are in hexagonal close-packing with cadmium atoms lying between alternate layers perpendicular to the hexagonal axis. Tin tetraiodide is another case where a quite complex structure approximates closely to a cubic close-packed arrangement of iodine atoms. Such crystals give a great deal of information about the forces between atom and atom.

In a few cases it has been possible to determine the shape of the acid radical. In CO_3^{--} and NO_3^- the oxygen atoms are arranged at the corners of an equilateral triangle around the central atom, and the arrangement must be very nearly the same in ClO_3^-. Though we do not know the arrangement of the oxygen atoms round the sulphur atom in SO_4^{--} with such certainty, they must be nearly at the corners of a regular tetrahedron, and the arrangement also holds in such groups as ClO_4^-, MnO_4^-, SeO_4^{--}. In an ion such as $PtCl_6^{--}$ Wyckoff has shown that the six chlorine atoms are arranged at the corners of a regular octahedron around the platinum atom. The simple geometrical shape in each case is interesting, and it is difficult to avoid the conclusion that the outer atoms are all related in the same way to the inner one. Kossel regards the inner atom as having a large positive charge, and holding the negatively charged outer atom by electrostatic attraction. Although the actual bonds may be of a more complex type, it is interesting to see how much this idea explains. The dimensions of the group are in accord with the idea that the large oxygen ions are grouped around a relatively small atomic structure with a high positive charge in the centre, and that the size of the group is mainly determined by the repulsive forces between the oxygens. Certain optical properties can be explained by the same conception. The refractivity of the acid group is got by assigning a value of about 3·3 to the ionic refractivity of each oxygen, and a very small value to the central atom. The strong negative double refraction of carbonates and nitrates, where the groups of oxygen atoms lie in parallel planes, is explained quantitatively by the influence on each other of the oxygen atoms arranged in a triangle. On the other hand, most sulphates have a very small birefringence. This may be explained by the regular tetrahedral arrangement of oxygens around the sulphur, for such a group on account of its symmetry is optically isotropic.

The problem of the other type of binding between atoms, in which the electronic structures seem to fuse together so that the atoms approach each other closely and are rigidly connected, has yet to be solved. In acid groups such as CO_3^{--} and SO_4^{--} the atoms may retain separate electronic systems, or the other type of binding may have come into play. In any case the atoms must be greatly distorted by their unsymmetrical location. X-rays can only tell the positions of the atomic centres, the skeleton of the structure, since the interference between waves scattered by the electrons is so complex. The centres can be fixed with considerable certainty, however, and cases of undoubted homopolar combination can be examined. The interest of the inorganic structures lies principally in the fact that they can be analysed with some degree of completeness, and it is to be hoped that they will tell more about the binding forces. They present a fascinating series of problems for solution.

Southampton Meeting of the British Association.

LOCAL ARRANGEMENTS.—II.

VISITING members of the British Association are requested to book for Southampton West Station, where men wearing distinctive armlets will be in attendance on the station platforms to render assistance to members on arrival and to afford information. The idea of a special train from Waterloo on the Tuesday, the day before the opening of the meeting (as previously announced), has been dropped because the existing means of communication to Southampton, on further examination, were found to be amply sufficient. Baggage may be deposited at the Reception Room if desired for conveyance to the address in Southampton where the member will be staying. Tickets of membership may be obtained at the Reception Room.

The Reception Room is at King Edward VI. Grammar School in the Marlands, two minutes' walk from the West Station. Here the following facilities will be provided for members: ticket and information bureau, where a representative of the Southern Railway will be in attendance; telephones; smoking and writing room; ladies' rest rooms; post office;

exchange of communications between members; cloak room; press bureau; bookstall; administrative rooms, etc.

The official restaurant for the meeting will be the Coliseum, situated in Portland Terrace, three minutes' walk from the Reception Room. Special arrangements have been made with Messrs. Price Bros., caterers, for the convenience and advantage of the members. Luncheons and teas will be available. For the convenience also of members of the sections meeting at the University College, Highfield, the College refectory will be open for lunches and teas.

Rest rooms for ladies have been very kindly provided at each of the following houses: (1) Y.W.C.A. in Portland Terrace; (2) The "Barova Restaurant," at Messrs. Tyrrell and Green, Ltd., Above Bar Street near the Junction; (3) Messrs. E. Mayes and Son, Ltd., 173-178 High Street, below the Bargate; (4) The Central Hall, at the bottom of East Street. Accommodation for both ladies and gentlemen will also be available at the Central Hall. An excellent and well-illustrated booklet, "Southampton and the New Forest," compiled by Messrs. Russell and Co., will be presented to each member. Therein on p. 5 will be found a street map of Southampton, and likewise on p. 75 a full list of places of worship.

Badges, which members are particularly requested to wear on all occasions, will be handed them at the Reception Room, and will prove most valuable for identification of membership. The Corporation Tramways Committee has generously decided to extend the privilege of free use of the tramcars and omnibuses of the municipality to members during the period of the meeting.

The Royal Southampton Yacht Club, the Constitutional Club, and the Portswood Conservative Club have kindly offered honorary membership during the week to all members of the Association; while the Rotary Club of Southampton invites all visiting Rotarians to the luncheon on the Friday in the South-Western Hotel, and the Masonic Lodges of the town have offered to their brethren in freemasonry and their ladies a reception at the Chantry Hall on the Monday, when afternoon tea will be served. A civic reception will be given by His Worship the Mayor and the Mayoress of Southampton at the Pavilion, Royal Pier, on Thursday evening at 8 o'clock, and it is hoped that members will make a point of attending this function. A reception will be given by Lord and Lady Swaythling at their mansion, Townhill Park, on Sunday, August 30, at 8 P.M., when a special omnibus service will be run in connexion with the event. Garden parties will be given by Lord and Lady St. Cyres at Walhampton near Lymington on Friday, August 28, at 3 P.M., and on the same afternoon by Sir John and Lady Power at Newlands Manor near Lymington, New Forest.

The Cunard Co. has very generously invited the British Association to visit the R.M.S. *Aquitania*, and have tea on board on Friday, August 28; the White Star Line has extended a similar invitation, to the R.M.S. *Majestic*, on Monday, August 31; while Commander C. B. Fry has thrown open for inspection the Training Ship *Mercury* on the Hamble River on Saturday, August 29, at 3.30 P.M.

Invitations for parties from the British Association to see over their works have been received from the following firms: The International Cold Storage and Ice Co., Ltd., the Docks; Pirelli General Cable Works, Ltd.; Auguste Pellerin, Ltd. ("Le Dansk" Margarine Factory); The Southern Railway Co. for the Docks; Messrs. Harland and Wolff, shipbuilders, the Docks; The Ordnance Survey Office, The Avenue; Messrs. Toogood and Sons, seedsmen.

Two organ recitals have been arranged to be given in the New Central Hall: (1) a grand organ recital on the Saturday, August 29, at 7.45 P.M. (admission 6d.), when a large number of seats will be specially reserved for members of the Association; (2) a special organ recital on the Sunday afternoon, August 30 (admission free), from 3 to 4.15 P.M. This performance will be broadcasted by the British Broadcasting Co. and all members of the British Association are heartily invited.

General excursions have been arranged as follows:—

Thursday, August 27.—Messrs. Toogood and Sons, Ltd., Seed Warehouse, "Blighmount," Millbrook, at 3 P.M.; Pirelli, Ltd., Cable and Tyre Works, Western Esplanade, at 2.30 P.M.

Friday, August 28.—The s.s. *Aquitania*: invitation from the Cunard Co. to inspect the vessel and have tea on board, 3 to 5 P.M.; New Forest trip, including garden party, by Lord and Lady St. Cyres, at Walhampton, near Lymington, at 3 P.M. (on the return journey, Beaulieu Abbey and House will be visited by invitation from Lord and Lady Montagu); New Forest trip, including garden party, by Sir John and Lady Power, at Newlands Manor, Lymington, at 3 P.M.; Ordnance Survey Office, The Avenue, Southampton, 2 to 4 P.M.

Saturday, August 29.—Isle of Wight (whole day): by steamer to Cowes then motor via Newport, Sandown, Ventnor, where lunch will be served, Alum Bay, Carisbrooke, where tea will be had, and back to Cowes; Stonehenge (whole day): via Romsey and Salisbury, returning by Winchester; T.S. *Mercury* on the Hamble River by steamer (leaving at 2.30 P.M.) down Southampton Water; Winchester: leaving at 2.30 P.M., half day excursion.

Sunday, August 30.—Reception at Townhill Park by Lord and Lady Swaythling at 8 P.M.

Monday, August 31.—The s.s. *Majestic*: invitation from the White Star Line to inspect the vessel and have tea on board, 3 to 5 P.M.; Auguste Pellerin, Ltd., "Le Dansk" Margarine Factory, Northam, at 2.30 P.M.; Southampton Gaslight Co., Ltd., tea at 3.30 P.M. at the works; Ordnance Survey Office, The Avenue, Southampton, 2 to 4 P.M.

Tuesday, September 1.—General visit to Southampton Docks at 2.30 P.M.; Messrs. Harland and Wolff's Ship Repairing Works, the Docks, at 2.30 P.M.; the International Cold Storage Co., Ltd., the Docks, at 3.30 P.M.; Goughs Ice Co., Ltd., Canute Road, Southampton, at 5 P.M.; Ordnance Survey Office, The Avenue, Southampton, 2 to 4 P.M.

The following sectional excursions have been arranged:

Thursday, August 27.—K, Hythe and Beaulieu; G, Southampton Docks; K (Forestry Subsection), Messrs. Howard Bros. Timber Yard, Northam; C, The Ordnance Survey Office, The Avenue, Southampton.

Friday, August 28.—L, South Stoneham House, (garden party); E, Portsdown Anticline; G, Southampton Waterworks at Otterbourne; C, Bournemouth.

Saturday, August 29.—C, Isle of Wight (whole day); D, Beaulieu via Southampton Water and the Solent (whole day); K, Meon Valley and Portsdown (whole day); H, Salisbury and Stonehenge (whole day); M, Sparsholt Farm Institute (whole day).

Sunday, August 30.—C, Lulworth Cove (whole day); K, New Forest (whole day); L, Winchester.

Monday, August 31.—D, Hayling Island; E, Northern Part of the New Forest; G, Calshot Aerodromes and the Agwi Petrol Works at Fawley; I, Antigas School at Tipnor; K (Forestry Subsection), Durley Saw Mills (Messrs. F. Houghton, Ltd.); B, Holton Heath Cordite Factory.

Tuesday, September 1.—D, New Forest; G, Railway Works at Eastleigh; G, Supermarine Aviation Works, Southampton; G, Avro Works at the Hamble; K, Hurst Castle; M, Fruit Farm, Botley; I, Fort Grange Aerodrome, Gosport; C, Hordle and Barton.

The evening discourse will be given by Mr. R. V. Southwell on "Aeronautical Problems of the Past and of the Future," at 8 P.M., in the Central Hall, on Friday, August 28. Citizens' lectures have been arranged as follows:

(1) Major A. G. Church, on Thursday at 7.30 P.M., on "Science and the East African Commission" at the Central Hall; (2) Prof. E. V. Appleton, on Saturday at 8 P.M. at the Avenue Hall, on "The Rôle of the Atmosphere in Wireless Telegraphy"; (3) Capt. P. P. Eckersley, on Monday at 8 P.M. at the Central Hall, on "Some Technical Problems of Broadcasting"; (4) Mr. C. J. P. Cave, on Tuesday at 8 P.M. at the Central Hall, on "The Highway of the Air."

Lectures for Young People at the Central Hall are arranged as under:

(1) Dr. F. A. Dixey, on Saturday at 3 P.M., on "Mimicry in Relation to Geographical Distribution"; (2) Mr. W. H. Barker, on Monday at 3 P.M., on "The Development of Southampton in Relation to World Commerce"; (3) Prof. W. J. Dakin, on Tuesday at 3 P.M., on "Whaling in the Southern Ocean."

W. RAE SHERRIFFS.

Current Topics and Events.

PROF. J. G. MCKENDRICK, F.R.S., the distinguished emeritus professor of physiology in the University of Glasgow, reached the age of eighty-four years on August 12; Sir William Tilden, F.R.S., eminent as a chemist, celebrates his eighty-third birthday on August 15. The former was born at Aberdeen and educated there at the University. For thirty years he was professor of physiology in the University of Glasgow; he was sometime Fullerian professor of physiology at the Royal Institution and president of Section I (Physiology) of the British Association. At the Oxford meeting, in 1894, of the British Association, he exhibited and demonstrated a working model intended to illustrate the mechanism of the cochlea. With Dewar and Ramsay he conducted researches on the physiological action of the chinoline and pyridine bases. Sir William Tilden, a Londoner, was a science master at Clifton College, 1872–80, leaving to take up the chair of chemistry at Mason College, Birmingham, a post which he held for fourteen years. On leaving Birmingham he became professor of chemistry at the Royal College of Science, London, retiring in 1909. He was awarded the Davy medal of the Royal Society in 1908. In organic chemistry he has made highly important researches on the terpenes, for example, on the hydrocarbons from *Pinus sylvestris*, and on terpin and terpinol. Author of many scientific memoirs, he has also published several well-known chemical manuals.

THE report of the Electricity Commissioners in Great Britain for the year 1924-1925, which has just been published, is of considerable interest. In public supply undertakings the output for the year is 7415 million units, which is an increase of about 16 per cent. on the output of the preceding year. In private plants the output would probably be about half as much. The increased output has been obtained at an appreciably higher efficiency. Last year the average coal rate per unit generated was 2·53 lb. In the two preceding years it was 2·67 and 2·78 lb. respectively. This steady progress is satisfactory but there is plenty of scope for improvement. The new Barton station at Manchester shows the highest efficiency, namely, 1·51 lb. of coal per unit generated, and its thermal efficiency is practically twenty per cent. The coal consumption at the gas producer stations ranges from 1·81 to 3·69 lb. per unit generated, the average being 2·60 lb. per unit. The largest Diesel engine oil-driven station (1940 kilowatts) has a thermal efficiency of 26·6 per cent. For small stations internal combustion engines are the most efficient. Water power only contributes about 0·7 per cent. of the total supply of electricity in Great Britain. Several large plants are now being constructed, but the total possible water power is, unfortunately, small.

THE transmission of photographs by means of telephone circuits has recently been perfected to so great a degree that the picture as received is practically a perfect reproduction of the original and shows no signs of the process of transmission. The principle of the method is well known, namely, two cylinders, one at each end of the circuit, rotating synchronously and moving axially so that a spiral line 0·01 in. wide is made to cover the surface dealt with. The sending cylinder has within it a photo-electric cell; the photograph in the form of a transparency or film is attached to the transparent surface of the cylinder, and a small spot of light falls upon the photograph so that the illumination of the photo-electric cell and the current produced are proportioned by the density of the photograph. The current produced is too feeble for transmission, therefore it is amplified, and then, by means of a vacuum tube modulator, imposed on a high frequency carrier current. At the receiving end the current passes through a narrow flat conductor which covers a small hole and is deflected by the current,

opening the hole more or less according to the strength of the current. Light passes through this hole and impinges upon a sensitive film carried on the surface of the rotating cylinder. The exposed film is developed as usual. Mr. Mervyn Thompson states (*British Journal of Photography*, July 24, 439) that a 7 × 5 inch photograph is transmitted in 7½ minutes irrespective of the distance, which may be, for example, from San Francisco to New York, which is more than three thousand miles.

DR. S. E. SHEPPARD, of the Eastman Kodak Company's Research Laboratory, has succeeded in identifying the constituent of gelatine that enables it to confer the extraordinary sensitiveness on silver bromide in the modern photographic dry plate, and gives an account of his work in the Royal Photographic Society's Journal for August. Four emulsions prepared by the same method but with different gelatines were found to be almost identical except in sensitiveness, the fastest being about nine times as fast as the slowest. Evidently some gelatines are much more "photographically active" than others. Mr. R. F. Punnett found that an extract might be prepared from an "active" gelatine, which, when added to a relatively inert gelatine, rendered it active, and the question was to find this active ingredient. It was found that the acid deliming liquors used in the preparation of gelatine contained it, and several thousand gallons were treated for its extraction. "Gelatine-X," as Dr. Sheppard calls it, was found also in many plant materials, especially in black mustard seeds. It was now closely identified with either allyl mustard oil or allyl sulphide. Tests of various allyl compounds showed that the sensitising power was not due to the allyl group, though "gelatine-X" was finally proved to be allyl isothiocyanate (allyl mustard oil) or allyl thiourea. Active gelatines were found to contain about one part of the organic compound in from 300,000 to 1,000,000 parts of gelatine. It is this substance that produces the sensitivity centres, that is, the points where development starts, in the particles of silver bromide, and these sensitivity centres consist of silver sulphide, though allyl sulphide itself was found to be inactive. Certain selenium and tellurium compounds are effective sensitisers and give sensitivity centres that consist of silver selenide and telluride. Further details of this important discovery are to be published later.

IN our issue of March 7, p. 346, a note appears which deprecates the too sanguine statements made by politicians about the possible economies that can be effected by erecting very large electric generating stations. To illustrate this we quoted with approval several statements made by S. S. Wyer in a report published by the Smithsonian Institution of Washington, in which a comparison is made between the systems adopted on the Canadian and on the American side of the Niagara Falls. We also quoted a statement made by Mr. Wyer that the service in Ontario is not taxed, so that the lowering of the cost to the consumer is done at the expense of the tax-payers of the districts in which the property is located. Naturally we thought that a statement of this gravity would not be made in a publication of the Smithsonian Institution unless all the facts of the case were known and had been studied. We have received a letter from Sir Adam Beck, the Chairman of the Hydro-Electric Power Commission of Canada, dated July 20, in which he states that Mr. Wyer's assertion is unfounded. He also sends us a pamphlet entitled "Misstatements and Misrepresentations derogatory to the Hydro-Electric Power Commission of Ontario contained in a report published by the Smithsonian Institution entitled 'Niagara Falls: its Power Possibilities and Preservation,' under the authorship of Samuel S. Wyer, examined and refuted by Sir Adam Beck." He states categorically that the Power Commission pays taxes both to municipalities and to the Provincial Government to the extent of hundreds of thousands of dollars annually.

THE Soviet authorities issue a Weekly News Bulletin of the U.S.S.R. Society of Cultural Relations with Foreign Countries, and a recent issue suggests great activity. Active preparations are being made to celebrate the bicentenary of the Russian Academy of Science on September 5-14 in Leningrad and Moscow. According to the programme which has been issued, the celebrations will commence on the evening of September 5 with a reception in the rooms of the Academy of Science at Leningrad. On September 6 there is to be a meeting in the grand hall of the Academy, followed in the evening by a banquet. The morning of September 7 is to be devoted to visits to the scientific institutes of the Academy, while on the following day the observatory at Pulkovo and other institutions around Leningrad will be inspected. On September 9 the Soviet Government will receive the delegates. After further visits and festivities the delegates will leave on September 10 for Moscow, arriving the next day in time for a reception at the Institute of Physics. September 12-13 will be devoted to a meeting at the Conservatoire and to visits to the museums at the Kremlin and to scientific institutes in Moscow. The celebrations conclude on September 14 with a luncheon given by the "Maison des Savants." In connexion with the celebrations, the authorities are issuing the unpublished works of Lyapunov on mathematics and physics, the syntaxis of Shakhmatov, and the Osset dictionary of Miller, which should be a very valuable publication. It is a matter for regret that there must be scores of other important works and papers, which have been lying in manuscript for years, for want of funds. The Bulletin referred to above gives some quite interesting brief outlines of archæological work in various parts of Russia, and states that a number of scientific expeditions are being sent to some of the lesser known parts of the country.

WE have received a long letter from Dr. C. G. S. Sandberg in reference to the notice of his book, "Geodynamische Probleme," in NATURE of May 23, p. 791. He wishes it made clear that the pressures which, according to his view, produce earth movements, are not and cannot be lateral, but are hydrostatic, as

they are due to vapour tension. He remarks that Alpine and other similar folding has, according to his theory, been caused by vapour tension hydrostatic pressure, which, finding relief in the directions of least resistance, convey the impression of having been brought about by lateral tangential pressure. Dr. Sandberg also remarks that the diagram from Lugeon, which was reproduced in his book, was inserted to demonstrate the inseparable relation between tectonic structure and metamorphism; and the remark in the review that such diagrams, whatever may be the ultimate cause of the pressure, indicate that the actual movements are due to lateral compression, is an argument of the reviewer's, and not of Dr. Sandberg. Dr. Sandberg also points out that he does not deny some contraction in the earth as a whole, but emphatically rejects the so-called contraction theory.

THE sixty-second annual meeting of the British Pharmaceutical Conference was held in Glasgow on July 27-30. In his address, entitled "Recent and Coming Developments in British Pharmacy," the chairman, Mr. E. White, dealt with the present and future problems of pharmacy both on the educational and administrative side. He gave some account of the proposals of the Pharmaceutical Society to found a laboratory for the physiological testing of drugs, and emphasised the need for such a laboratory. He also referred to the results achieved in the recent deliberations of the International Federation at Lausanne. In speaking of proprietary medicines, Mr. White said that this had been discussed at the Lausanne Conference, and gave it as his opinion that legislation on this subject would not be long delayed; he considered that the Pharmaceutical Society must take an active part in the initiation of such legislation. Mr. White then spoke of the meeting of the International Conference to be held in Brussels in September, when the standardisation of potent drugs will be considered, and referred to the great advantage to be gained by an international agreement on certain cardinal points in the practice of pharmacy. Mr. White said he believed that a serious effort to unify pharmacy in the English-speaking communities would yield encouraging results. In the Science Section of the Conference, nineteen papers were communicated. Among these were papers on the picrates of the opium alkaloids, on the identification of alkaloids and of drugs containing tannins, on the chemical examination of the oleo-resin of Indian valerian root, and on West Australian sandal-wood oil.

AT a recent meeting of persons interested in the Peking Union Medical College, which is financed by the China Medical Board of the Rockefeller Foundation, an organisation called the Yu Wang Fu Association was formed. It was decided that the purpose of the Association shall be, by frequent informal meetings, to stimulate good fellowship and to continue and increase interest in the welfare of the College in those who have at any time or in any capacity worked in Peking in connexion with it, and have now entered other pursuits. Dr. Franklin C. McLean, the organiser and first Director of the College, was elected president, Dr. E. V. Cowdry, secretary-treasurer, with Dr. A. B. Macallum, Dr. Charles Packard, and Dr. Donald D. Van Slyke, members of the council. It is intended to establish branches of the Association, of which New York is the headquarters, wherever such may be justified, but particularly in Chicago, San Francisco, London, Tokyo, and Shanghai. The first meeting of the Association will be held at the Marine Biological Laboratory, Woods Hole, Massachusetts, on August 1, when an address will be delivered by the secretary of the Rockefeller Foundation, Mr. Edwin R. Embree. Those wishing to join the Association are requested to communicate with Dr. E. V. Cowdry, at the Rockefeller Institute, 66th St. and Avenue A, New York.

ON July 12 a new Geophysical Observatory at Jakutsk ($\phi = 62° 01'$, $\lambda = 129° 43'$ from Greenwich) commenced work. Organised by the Geophysical Central Observatory, Leningrad, the new observatory represents a local branch of the Central Observatory and consists meanwhile of two sections, dealing with meteorological and the aerological work respectively. It is expected that in due course the observatory will be equipped for actinometric, optical, and magnetic observations.

SIR CHARLES S. SHERRINGTON, Waynflete professor of physiology in the University of Oxford, has been appointed a member of the Medical Research Council as from September 30 next. The vacancy is caused by the retirement of Dr. Henry Head, who leaves the Council under the provisions of the Royal Charter governing the rotation of membership.

THE Council of the Royal Meteorological Society has awarded the Howard Prize for 1925 to Cadet H. W. Barnett of S.A.T.S. *General Botha*, South Africa, for the best essay on "Icebergs: their Distribution and Drift."

THE following committee has been appointed "to advise as to the proper scope of the Broadcasting Service and as to the management, control, and finance thereof, after the expiry of the existing licence on December 31, 1926": The Earl of Crawford and Balcarres (chairman), Lord Rayleigh, Lord Blanesburgh, The Right Hon. Ian Macpherson, The Right Hon. W. Graham, Sir Thomas Royden, Dame Meriel Talbot, Sir Henry Hadow, Captain Fraser, Mr. Rudyard Kipling, with Mr. W. E. Weston, of the General Post Office, as Secretary.

ON Monday, August 10, the national memorial to Capt. R. F. Scott and his four companions who died on the return journey from the South Pole early in 1912, was unveiled on Mount Wise, Devonport. A memorial fund was opened in 1913 by the Lord Mayor of London, and the response has been so generous that, in addition to the memorial at Devonport, a large sum has been set apart to augment Government provision for the sustenance of the families of the deceased men, the outstanding liabilities of the expedition have been discharged, a considerable sum

put aside for the publication of the scientific results obtained, and an institute for polar research has been established at Cambridge. The memorial takes the form of a granite pylon surmounted by a symbolic group in bronze with portrait medallions of Capt. Scott and his four comrades below.

WE learn from *Science* that Dr. Raymond Pearl has been appointed director of an Institute for Biological Research established by the Rockefeller Foundation, through its Division of Studies, at the Johns Hopkins University, Baltimore. Dr. Pearl will retain a connexion with the department of biometry and vital statistics of the School of Hygiene, as research professor in this subject, and will continue as professor of biology in the Medical School. The whole time of the staff of the new Institute will be devoted to research on general problems of biology, but with especial attention to the biology of life duration and its control, and to the experimental study of the population problem. Dr. Lowell J. Reed has been made professor of biometry and vital statistics and head of the department in the School of Hygiene at Johns Hopkins.

THOSE interested in cinematography will read with interest, and doubtless with profit, a communication by Dr. K. C. D. Hickman to the Royal Photographic Society on "Colour Vision and the Design of Kiné Theatres," which is published in the July issue of the Society's Journal. He gives no new experimental results, but brings together many physical and physiological facts and discusses their effects on practical results.

AT the end of a review entitled "Industrial Research in Cotton" (NATURE, August 1, p. 164) it was stated that the volume under notice, the Shirley Institute Memoirs, is not purchasable. We now learn that bound copies of the Memoirs can be obtained, price one guinea, from the secretary of the British Cotton Industry Research Association, Shirley Institute, Didsbury, by non-members of the Association.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned: A lecturer in transport in the University of Birmingham—The Secretary (August 20). A lecturer in the department of electrical engineering of the Bradford Technical College—The Principal (August 29). A professor of education at Armstrong College—The Registrar, Armstrong College, Newcastle-upon-Tyne (September 8). A professor of civil engineering in the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (September 14). A lecturer in bacteriology in the University of Birmingham—The Secretary (September 26). A second laboratory assistant in the department of Biochemistry, Oxford—The Department of Biochemistry, University Museum, Oxford. An assistant bacteriologist at the Wellcome Tropical Research Laboratories, Khartoum—The Director, Wellcome Tropical Research Laboratories, c/o The Controller, Sudan Government, London Office, Wellington House, Buckingham Gate, S.W.1. A half-time demonstrator in botany in McGill University, Montreal—The Secretary.

Our Astronomical Column.

PHOTOMETRIC METHODS APPLIED TO VARIABLE STARS.—Dr. W. J. S. Lockyer, Director of the Norman Lockyer Observatory, Sidmouth, has recently contributed a very interesting study of the interesting star ϕ Persei ("The Spectrum of ϕ Persei, Type BoPe," Monthly Notices, R.A.S., 85, 580, May 1925). The principal feature of the spectrum is the composite nature of the hydrogen lines and of the ionised lines of several metals, of which iron is the most prominent. For example, H_β consists of a broad absorption band on which is superposed a bright emission band of lesser width, on which, again, is superposed a sharp absorption line. The ionised metallic lines, however, do not show the broad absorption band associated with the hydrogen lines. From observations, made more than twenty years ago, on the cyclical positional changes of the absorption lines, the star was recognised as a spectroscopic binary with a period of 126½ days. Lockyer's recent observations refer more particularly to the components of the bright emission bands—of H_β, for example. The relative intensities of the two components were measured by the wedge method, employed in the determination of spectroscopic parallaxes. In this way, cyclical changes were detected, and the resultant period found by Lockyer agrees precisely with the period derived from various line-of-sight investigations.

It would appear that this is the first occasion on which the periodicity of a star has been determined by the wedge method. There are indications, in addition, that, superimposed on the 126½ day period, there is a subsidiary period of 21 days; further observations would appear to be necessary to establish this definitely and more precisely. An interesting suggestion from Lockyer's paper is that ϕ Persei should be a variable star of period 126½ days, and it is hoped, by means of photometric observations, to test this suggestion in the near future.

NEW STAR ATLAS, SHOWING FAINT STARS.—Mr. Max Beyer, in conjunction with Prof. K. Graff, of Bergedorf, is bringing out a very useful set of star maps, including all stars down to magnitude 9·3 and fainter ones if meridian places are available. The first 12 sheets are now ready; they comprise the equatorial zone from +22° to −23°; each sheet covers 2 hours of R.A., the scale being 1 cm. to a degree. The epoch is 1855, but as centennial precession is marked at six points on each map, reduction to other epochs is easy. Nebulæ and star clusters are marked with crosses. There is no lettering or nomenclature on the maps themselves, but stars can be quickly identified by their co-ordinates. A slight blemish is the absence of indication of variability. Thus Mira Ceti is shown as an ordinary star of the sixth magnitude (its mean value). These maps should be of great assistance in finding comets and minor planets, or in recognising variables or Novæ. The price of the 12 sheets is only 15 marks—little more than a shilling a sheet—and a reduction of twenty per cent. is made to those purchasing three sets. The whole sky north of Decl. −23° will be completed in 30 charts. The scale is of course less than that of the Bonn maps, but it is sufficient for the identification of objects.

Research Items.

BRUNO'S METAPHYSICS AND GEOMETRY. — "La Doctrine Métaphysique et Géométrique de Bruno," by Dr. Xenia Atanassievitch (Paris: Les Presses Universitaires de France), is not only a fascinating historical study of the great sixteenth-century pioneer of modern science but it is also of first-rate present scientific interest. Dr. Atanassievitch would appear to be a pupil or a colleague of Dr. Petronievics, the professor of philosophy at Belgrade, recently in Great Britain working at the reconstruction of Archæopteryx, and advocate of a finitistic theory of space, that is, the theory that space is composed of discrete units and is not continuous. Dr. Petronievics holds that only by means of such a theory is it possible to reconcile the paradoxes of Zeno, and we may discover the original form of his argument in this study of Bruno. Like Lucretius, Bruno set forth his philosophical arguments in metrical form, and there can be no doubt that his writings influenced very definitely the mathematical and physical sciences in the seventeenth century. The change which took place in the method of scientific research under the lead of Galileo and Descartes was largely to the credit of mechanical inventions,—the telescope and the microscope,—and it is of extraordinary interest to compare the unaided speculations of Bruno with the new form the theories assumed under the control of experiment. All the distinctions which exercised the philosophers of the seventeenth century—the distinction between the mathematical, the physical, and the metaphysical unit, the geometrical difficulty Descartes encountered in his conception of subtle matter and his rejection of the void, the difficulty for physics which Malebranche discovered in the idea of a minimum sensibile, the metaphysical difficulty Leibniz met with in relating God to the monads—are expounded in Bruno, mixed up indeed with much fantastic mythology. In the valuable criticism which follows her able exposition, Dr. Atanassievitch claims for Petronievics that his reconstitution of Bruno's idea is the only satisfactory solution of modern fundamental physical problems.

AN ETHNIC THEORY OF CASTE.—Dr. S. Ghurye makes an important contribution to the discussion of the question of caste in India, in a paper appearing in Vol. 4 of *Man in India*, in which he considers the bearing of the anthropometric data upon this problem. If endogamy is taken as the distinctive feature of caste, arising from a desire of the Aryans to keep themselves free from aboriginal blood, anthropometry should show that the physical type of their representatives in Hindustan proper approximates to what may be assumed to have been the original physical type of the Aryans. This is the long-headed and fine-nosed type found among the castes of the Punjab and Rajputana regions. These regions, from their geographical position, must have been the site of Aryan settlements. The aboriginal type, on the other hand, may be deduced from the Musahar who, not being within the pale of Hinduism, are like the jungle tribes of Southern India, their chief characteristics being the broad nose and a head which is frequently long but is distinguished from the Aryan head in its absolute measurements. As a result of a comparison of types in the castes, it appears that the Brahman of the United Provinces has essentially the same physical type as the Punjabis and the ancient Aryans. In physical affinity to the Brahman the castes show a gradation corresponding with social status, and there is a similar state of affairs in Bihar. In Bengal and Bombay, however, there is no correspondence between social gradation and physical differentiation. As one section —the Brahmans—kept itself free from aboriginal blood, while there are intermediate types between it and the representatives of the aborigines, it would appear that the immigrant Aryans of Hindustan tried to impose upon themselves endogamous rules; but only a section carried them out, while others mixed with the aborigines to a greater or less extent.

INSECT FAUNA OF THE BRITISH ISLES.—In the issues of the *Entomologists' Monthly Magazine* for April, May and June there are records of several interesting additions to the fauna of the British Isles. In the April number of that journal, Prof. E. V. Theobald describes seven new species of aphides from various parts of the country. In the same issue, Mr. E. G. R. Waters records three species of small tineid moths, which although known previously from Germany and other countries, had not until recently been detected as British. The species *Brachmia lutatella* H.-S. occurs on the Dorset coast; *Coleophora antennariella* H.-S. was found in beech woods in Oxfordshire; and *Phyllocnistis tremulella* (F.R.) Zell. seems to be more widely spread and has been apparently confused in collections with an allied species. There is also an article by Mr. J. Edwards recording the capsid bug *Miris trispinosum* Rent. as British. In the May and June issues, Mr. G. T. Lyle enumerates several parasitic Hymenoptera of the family Braconidæ as new to the British Isles. The June number of the journal also contains a paper by Mr. J. V. Pearman, who brings to notice four species of "book lice" (Psocoptera) which have not previously been known as British, and one of these, *Embidotroctes rectivenis*, is described as new to science. In the same issue, also, Mr. K. J. Morton records a caddis fly (*Mystrophora intermedia* Klap.) not previously known as British—the species being found in the Lake District. It is not a little remarkable that so many additions to our well-worked fauna should have been recorded in such a short period; there are evidently still many species in the more obscure groups awaiting recognition.

THE SWARMING OF ANNELIDS.—L. Fage and R. Legendre continue (*Comptes rendus Acad. Sci. Paris*, t. 180, p. 1373, May 1925) to give results of their experiments in fishing for swimming annelids in the sea by attracting them to strong lights hung in the water. In the present communication, they describe the swarming of the mud-burrowing worm *Scalibregma inflatum* Rathke in the Bay of Concarneau. The worms were sexually mature and swollen with eggs and spermatozoa, the latter being discharged into the water by the bursting of the body wall. The worms gathered round the submerged light and maintained constant and very active revolving and serpentine movements. They were found in October, November and December 1923, but the observations were not sufficiently frequent to determine whether in this case there was any lunar periodicity in the swarming of the sexual shoals, such as the authors had previously shown to exist for certain other annelids.

LOCATING HERRING SHOALS BY AIR-CRAFT.—A series of experiments was undertaken during the month of July 1924, by the Scottish Fishery Board, with the co-operation of the Air Ministry, to ascertain the practicability of locating herring shoals in Scottish waters by means of air-craft. An account of these experiments, prepared by the two observers, Messrs. Henry Wood and George McGee, has now been

published by H.M. Stationery Office (Fishery Board for Scotland, Scientific Investigations, 1925, No. 1. Edinburgh and London: H.M. Stationery Office, 2s. 6d. net.). Three flying boats were used, based on Invergordon, and repeated flights were made over the whole area of the Moray Firth. The weather conditions were on the whole favourable, but only on one evening (July 31) during the course of the experiments was a shoal of herring definitely observed, playing at the surface. Although the experiments were pursued with great diligence and care, and many observations of interest were made, the report shows clearly that the use of air-craft for the purpose of locating fish in these northern waters cannot be considered as a practical commercial proposition.

FLORA OF THE MALAY STATES. — The first local flora for the Federated Malay States is that recently published for Taiping by I. H. Burkill and M. R. Henderson in the *Gardens' Bulletin*, vol. 3, Nos. 9-12, for March 1925. In 1894 C. Curtis published a list of plants and ferns for the Island of Penang, and in 1900 H. N. Ridley published his flora of Singapore, both these appearing in the Journal of the Straits Branch of the Royal Asiatic Society; the present authors point out that the fact that Sir Hugh Low was Resident at Taiping from 1877 until 1889, coming there from Borneo, from whence he had already introduced many interesting species into cultivation, has had the natural result that the materials are already available for a relatively complete account of the flora of this area in the Federated Malay States. In the flora, 1980 species of flowering plants are recognised, 41 of these have been introduced, 1939 are natural to the country. The authors contribute a brief account of the habitat and ecology and an analysis of the probable sources of the flora with a very interesting discussion of the 860 species endemic to the Malay peninsula.

ORIGIN OF PETROLEUM.—Strong evidence in support of a micro-biological origin of petroleum emerges from the results of a recent geological survey of a large district occurring to the west of Los Angeles, California. Both Eocene and Miocene shales here abound in the remains of minute organisms which at death sank to the bottom of the sea and formed oozes composed essentially of their own remains. Of these organisms, diatoms with their characteristic siliceous tests are the most conspicuous; calcareous tests of foraminifers, together with a few siliceous radiolarian skeletons, have also been identified. The oozes thus formed are, according to Mr. W. S. W. Kew (Bulletin 753, United States Geological Survey), probably comparable to the diatom, globigerina and radiolarian oozes now in process of formation in the ocean, though not necessarily in deep water. The process of formation of petroleum from the organic matter from within the siliceous and calcareous tests is bound up with chemical change influenced by geological conditions of pressure and moderate heat. An indirect proof of such an origin of oil in this region is furnished by the fact that commercial quantities are recoverable from sandy reservoirs which overlie or are associated closely with these diatomaceous shales, and in the case of the Sespe formation (Eocene-Oligocene) oil is never found unless the Eocene shales are present beneath it. In view of the enormous quantities of petroleum recently produced from the Los Angeles region, it is noteworthy that the author is of the opinion that a first essential to the accumulation of oil "over all of California" is that the mother-rock of the oil is present; in other words, that oil has not migrated from great stratigraphical or geographical distances. In most cases in this region, the mother-rock is involved in the very structures from which petroleum is ultimately obtained.

SIZES OF CRYSTAL UNITS.—Recent redeterminations of the sizes of the crystal units of cæsium tri-iodide and dibromo-iodide by R. M. Bozorth and L. Pauling, recorded in the Journal of the American Chemical Society for June, are not in agreement with the values determined by Clarke and Duane (1923). The latter authors used a new method of crystal analysis which they had devised; since Bozorth and Pauling adopted the spectrum and Laue photographic method, the above discrepancy in results is of some importance.

THE ACTION OF RADIATION ON GASEOUS MIXTURES.—It has been shown by Franck and Cario that, when hydrogen containing mercury vapour is illuminated with light from a mercury arc lamp so as to excite the mercury atoms, the hydrogen becomes dissociated by a secondary reaction due to collisions of the second kind. In the *Zeitschrift für Physik* of June 30, Dr. H. Senftleben describes an investigation in which this fact is made use of to study the change in heat conductivity of hydrogen when dissociated. A mixture of dry hydrogen and mercury vapour is introduced into a glass tube with a quartz window, or into a quartz tube, through which passes a wire heated by an electric current to about 100° C. above room temperature. The resistance of the wire is measured while the heating current flows, and the tube is illuminated with a mercury arc lamp. Owing to the increase in heat conductivity of the illuminated hydrogen, the temperature of the wire fell, as indicated by a drop in its resistance. The results are of a preliminary nature, but show that the observed effect is really due to alteration in the thermal conductivity of the hydrogen, due to dissociation produced by the incident light. Theory shows that the coefficient of thermal conductivity depends on the number of degrees of freedom of the gas molecule, the mean molecular velocity and the molecular diameter. All these are altered when dissociation takes place, and the effect of alteration of the last quantity is the most important, since conductivity varies inversely as the square of the molecular diameter, so that dissociation results in an increase in conductivity.

HIGH FREQUENCY INDUCTIVE ELECTRIC FURNACE.—M. G. Ribaud describes in the *Comptes rendus* of the Paris Academy of Sciences for June 8, an electric furnace with which temperatures above 3000° C. can be obtained, which can easily be opened when hot and can be used repeatedly without renewal of parts. It consists of a cylinder of graphite, which is heated inductively by means of a high-frequency current, and a cylinder of porous carbon made of large grains, only slightly compacted, and forming a very poor conductor both for heat and electricity. This cylinder forms a continuation of the graphite one, and is closed by a plug of the same porous carbon with a central piece, closed by a glass plate, through which a current of inert gas circulates to remove all fumes and facilitate photometric pyrometry. If the portion of the furnace composed of porous carbon is long enough, at least 8 cm., it is possible to remove it by hand, even when the interior of the furnace is at a temperature of 3000° C. Temperatures higher than this have been obtained using 10 kilowatts, with a volume of 100 c.c., 2500° with 500 c.c., and 1800° with 3000 c.c. As compared with this, a resistance furnace formed of rings of graphite piled one on another, studied at the National Physical Laboratory by Rosenhain and Pryor, gave 1700° C. in a volume of about 500 c.c., with 10 kilowatts.

The Third International Congress of Entomology.

THE third International Congress of Entomology, held at Zurich on July 19-26, was attended by about 200 representative entomologists and about 50 guests including 40 ladies. The Congress proved a great success. More nations were represented than at Brussels or Oxford, and it was a matter of regret that France, Italy and Belgium were not officially represented. One is glad to add, however, that the rate of exchange unfavourable to these countries was a contributory cause to the absence of men who will be welcomed at the next conference three years hence. During the Congress, members had opportunity of examining the fine collections in the adjoining Entomological Institute and the University Zoological Museum, as also the collection of Prof. Standfuss and the palæarctic collection of Dr. Corti. The Concilium Bibliographicum also received its quota of admiring visitors.

The town of Zurich itself, in the fine weather of the week, with its famed Lake, received the usual meed of praise, and especially it showed to great advantage as it was viewed during the ascent of the Uetliberg by funicular railway on one of the Congress excursions; while in the descent in the dark, the lights of the numerous buildings dotted all over the hillside suggested so many majestic glow-worms.

The Congress was opened by Dr. A. von Schulthess, its popular president, who took occasion to emphasise the successes of the early Swiss entomologists. He was followed by the Rector of the University, Prof. Dr. Bleuler, who gave the delegates a cordial welcome on behalf of the Canton of Zurich and of the University. Dr. Bleuler, besides emphasising the great importance of insects in the spread of various diseases, referred to the psychic problems underlying insect life and habits, a branch of the subject to which Swiss entomologists have made valuable contributions.

The forenoons were devoted to general meetings, the afternoons to sectional ones. It is impossible to name all the papers presented as this summary can only be a general one. As regards the forenoon meetings, Dr. F. Ris (Switzerland) read an interesting paper on the geographical distribution of insects in Switzerland, dealing first of all with the effects of glacial times, when Switzerland was covered with ice, and going on to quote examples of the influence of man on the relationship between animals and plants. Prof. Leiper, of the London School of Tropical Medicine, spoke on "Some Outstanding Questions in Medical Entomology." He quoted instances of the already proved relationship between diseases due to protozoa and worms conveyed by insects or arachnids, and named numerous other important diseases in which a "vector" insect or arachnid host might be justly suspected. More accurate knowledge regarding these is greatly desired, and a strong plea was made for the co-operation of the parasitologist and the economic entomologist.

The fascinating subject of mimicry never fails to attract a large audience. As regards the explanation of specific instances—teleological, physiological, chemical, mechanical, and so on—one can only say "*Tot homines quot sententiæ.*" On the present occasion, Prof. E. B. Poulton, of Oxford, who has done so much for the success of the three International Congresses, and Prof. van Bemmelen, of Holland, were the protagonists. The debate between these two experts was a model of how such a controversy should be conducted. Their mode of presentation of the subject, and their manner of differing, won the listener, who was tempted to throw logic to the winds and wish or even declare that the debaters were both right, as of course up to a point both were. Prof. Poulton illustrated, by means of coloured figures and actual specimens, mimicry in African butterflies of the nymphaline genus Charaxes, and pointed out new aspects of the subject. The genus Charaxes is one of powerful fliers and yet there is much mimetic association. They often mimic each other in pattern, as is most evident in the females of the smaller species, which resemble the males as well as the females of larger species. Dr. Richard van Someren has proved by breeding from known female parents that three of these mimics in Uganda, although totally different in appearance, are the females of the same species. Mr. C. F. M. Swynnerton has shown that the quality mimicked in this case is the quality of "fighting weight" and toughness, rendering the butterflies, and especially the larger species, very difficult to hold and reduce to a condition in which they can be comfortably swallowed. Prof. van Bemmelen argued that different mimetic patterns are derived from a common ancestral pattern and need not imply any mimetic association.

At another meeting mimicry was brought up again by the veteran Father Wasmann, in his address on the staphylinids which live in happy association with certain ants. This was only one of several weighty pronouncements from Father Wasmann, as, for example, his contribution to the discussion on Dr. H. Eidmann's paper on "The Foundation of Colonies in Ants." Setting aside the foundation of a new colony by secession, there are two principal types of sexual reproduction of an ant colony. One is the independent or autonomic colony foundation where the fertilised female is able to found a colony by herself and without any aid. In the other case the female requires, for rearing her young larvæ, the help of other ants. One type of these is the red slave-working ant *Formica sanguinea*, which lives in mixed colonies with workers of *Formica fusca*. Eidmann isolated a fertilised queen of *F. sanguinea* and after a fortnight put her into an artificial nest consisting of some twenty workers and one hundred cocoons of *F. fusca*. The introduced queen attacked the workers, killed one after the other in severe fight, and took possession of the cocoons. She looked after the cocoons and in a short time had a little troop of newly issued slave ants to help her to rear her eggs and larvæ.

Mr. F. Balfour Browne, of Cambridge, spoke on "The Evolution of Social Life among Caterpillars," basing his argument on a number of illustrated cases chosen from the Lepidoptera, beginning with the silk-spinning habit as protective and going on to feeding nest or web, and then to home nests. C. B. Williams, of Egypt, spoke on "Some Unsolved Problems of Butterfly Migration," quoting interesting examples and inviting co-operation and exact observation.

Instructive papers on the history and progress of the study of entomology in different countries, in its various branches, were given by Escherich for Germany, Tragardh for Sweden, Mokozecki for Poland, Fletcher for India, and Urich for the West Indies.

As regards the sectional meetings, many valuable papers were read, and it may safely be hazarded that the volume of the Proceedings of the Congress will be found very helpful to entomological workers all over the world. It is impossible in this summary to mention all the individual papers. The sections were: (1) Morphology, Anatomy and Physiology; (2) Systematic and Geographical Distribution; (3) Nomenclature and Bibliography; (4) Biology and Development; (5) Applied Entomology; and it must

suffice to say that there was no lack of material or of discussion. As the various sections met at the same hour, it was not easy always to decide which paper to miss, so that with a choice of good things one often wished, like Boyle Roche's bird, to be in two places at the same time. Of such papers as I managed to hear myself, I may mention Horn of Berlin on systematic entomology, Edwards on the phylogeny of nematocerous Diptera, the Aphid papers of Börner, Davidson and Munro, Pictet on parthenogenesis, Prell on Polyeder diseases of insects, Brun on the anatomy of the brain, and Jablonowski's papers in the Economic Section. To listen to Jablonowski "annihilating time and tearing a passion to tatters" was one of the treats of the Congress. The wide appeal of the Congress will be gauged if in addition to the names already given I mention Handlirsch of Vienna, whom one was glad to see taking an active part again, Nuttall and Scott of Cambridge, Ettringham of Oxford, Carlier of Birmingham, Heymons, Schwartz and Schuberg of Berlin, Eckstein of Eberswalde, Reh of Hamburg, Everts of Holland, Johannsen of the United States, Lord Rothschild and Jordan of Tring (the Congress owed much to Jordan's organisation and committee work), Marshall and Neave of the Imperial Bureau of Entomology, Waterston and a worthy representation from the British Museum, Blendowski of Poland, Rennie from Scotland, Turati from Italy, Kryger from Denmark, and Monzen of Japan, and a naturally large representation of well-known Swiss entomologists. A special tribute must be paid to Dr. L. O. Howard, of the United States Department of Entomology. Always in a position to help and using his position to help, Dr. Howard has earned the gratitude of entomologists everywhere. Capable and kindly, always with the right word, and with tact as his middle name, Howard gives one the feeling that were there a dozen representative ambassadors like him in the political world, we would soon have, what some of us long for, the United States of Europe, each nation no longer at enmity with the other but working out its own salvation following the lines of its own culture and psychology. Certainly there was a spirit of friendliness and goodwill at the Congress, attesting that science has no limited boundaries but is international.

Much hard committee work was done during the week, and the Section on Entomological Nomenclature has so co-ordinated opinions from various sources that hopes are high for general agreement. The nomenclature question is in some ways an appalling one to tackle, and it is surprising the amount of time and labour expended in trying to reach an international system that would be clear and consistent.

The position of systematic entomology and the status of the systematist in university and museum were also subjects of committee work, and the Congress passed resolutions that are satisfying. In the economic sections also, attention has been focussed on the need for a recognition of the deeper problems underlying entomological research, and the Congress passed the following resolution: "The Congress considers it essential that the problems underlying Applied Entomology should be studied, and desires to impress upon Governments and Institutions concerned with investigations in Applied Entomology that time must be devoted to Systematic Entomology and fundamental research, such as Insect Physiology, Ecology and Pathology, since only by the study of these can insect control be placed on a sound basis."

This report is already long else one would have liked to mention some of the more humorous features of the week's meeting. Only one can be mentioned. A steamer heavily laden with the members of the Congress, in a sail round Lake Zurich, reached a certain little town at dinner-time. "The Assyrians came down like a wolf on the fold," or, entomologically, the locusts swarmed ashore to find that the village Chief of the Commissariat had blundered and food failed. But this was a meeting of biologists, and soon was seen in practice Natural Selection working through the struggle for existence and the survival of the fittest—the badge of the fit taking the guise of half a sausage. Whether the raiding habits developed in the struggle will become an acquired character time alone can show. One is glad to add, however, that as opposed to "Nature red in tooth and claw" the co-operative and ethical aspect of the struggle for existence received due illustration.

On the evening preceding the close of the Congress a banquet was held and every one enjoyed the night's social leisure. On the last day of the Congress two papers were read and the Congress then resolved itself into a Business Meeting. The president was heartily congratulated on a highly successful meeting.

Several extra excursions were arranged to follow the close of the Congress, *e.g.* to the Rigi Summit and the Jung Frau. R. STEWART MACDOUGALL.

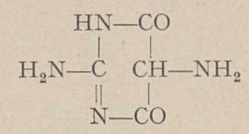
Lathyrism.

OF the chronic diseases which are directly related to the food supply and only indirectly connected with the presence of infective agents, most attention has in recent years been paid to that group in which the symptoms are due to the *deficiency* of some element in the diet, more especially that of one of the vitamins; scurvy, beri-beri, and probably rickets are among the diseases in this class. The other group, of which ergotism is the best known example, is due to the *presence* in the food consumed of small quantities of some poison, which after prolonged administration affects various organs of the body with the production of symptoms. The chronicity of the disease distinguishes this group from cases of acute poisoning due to bacterial products taken with the food or to the ingestion of some well-known poisonous substance.

The occurrence of lathyrism, which has been met with in India and in countries bordering on the Mediterranean, has been for long ascribed to the consumption of the seeds of pulses of the genus Lathyrus. In India the seeds of *Lathyrus sativus*, known in the vernacular as *khesari*, occupy a large place in the diet in certain districts, in which also a form of paralysis is frequently seen, especially among those who utilise the pulse as the staple article of their diet. L. A. P. Anderson, A. Howard, and J. L. Simonsen (*Indian Journ. Med. Research*, 1925, vol. 12, p. 613) have recently conducted an investigation into this disease, from the results of which certain important conclusions can be drawn. At the outset of their work, the investigators recognised that the crop of *Lathyrus sativus* is scarcely ever grown in pure culture, but is frequently contaminated with various weeds; the seeds of one of these, the vetch *Vicia sativa*, L. var. *angustifolia*, were present in every sample of *khesari* obtained from districts in which lathyrism is common; attention was thus attracted especially to this weed, which is known in the vernacular as *akta*. As the result of both chemical analysis and feeding experiments with ducks and monkeys, the important conclusion was reached that pure *khesari* seeds contain no alkaloids; in fact they form a nourishing diet for these animals.

Quite different results were obtained with the seeds

of the vetch *akta*. Chemical analysis has confirmed the results of previous investigators; at least two glucosides are present; one vicianin, closely related to amygdalin; the other, vicine, yielding on hydrolysis δ-glucose and the base divicine. The latter is an oxy-amino derivative of pyrimidine with the formula



Animal experiments have shown that divicine sulphate or hydrochloride is definitely toxic; doses of 0·6 mgm. per gm. body weight injected subcutaneously into young guinea-pigs produced convulsions lasting for about an hour, followed by paralysis and death in a few hours; post-mortem examination disclosed congestion of many of the organs, especially the central nervous system, and a peculiar rose-pink staining of the medulla of all the bones; this colour is the same as that assumed by solutions of divicine hydrochloride on exposure to the air, and its occurrence is considered by the authors to be evidence that the base is actually absorbed after injection. Injections of vicine or vicianin in similar amounts produced no ill effects which could be attributed to the substance injected; the experiments do not exclude the possibility that larger doses may be harmful or that if vicine is taken with the food it may be hydrolysed into glucose and divicine during digestion.

The feeding experiments with ducks and monkeys also appear to be almost conclusive. In the case of the former, only birds on a diet containing *akta* have shown any symptoms, and the majority of those on these diets have been affected. The syndrome is characteristic, the symptoms being referable to an affection of the nervous system and including ataxia and paresis; early death is the rule. The incidence of symptoms in the case of monkeys on diets containing *akta* has not been quite so general, and the symptoms themselves have usually been less well defined, but in every case they can be referred to a lesion of the nervous system; no characteristic symptoms have been shown by any animal on *khesari* unless *akta* was also present in the food. In neither case are the symptoms those of typical lathyrism in man, although some of those occurring in the monkeys have been observed in human beings. But so frequently do the effects of similar agents differ in animals and man, that the difference observed here seems to be no objection to the application of the authors' results directly to the latter. Thus the important conclusion is reached that lathyrism is due to the consumption of the seeds of the vetch *Vicia sativa*, a weed which frequently contaminates the crop of the pulse *Lathyrus sativus*. Hence it should be possible to exterminate the disease by ensuring that the crop is grown pure.

The Museums Association.

ANNUAL CONFERENCE.

THE thirty-sixth annual conference of the Museums Association was held at Exeter on July 6-11, when more than 120 delegates attended. A civic welcome was extended to the delegates by the Mayor of Exeter. The president of the Association for the year 1924–25 was Mr. F. R. Rowley, the Royal Albert Memorial Museum, Exeter. The president in his address [1] gave a brief résumé of the museum movement in Exeter, and traced the development of the Museum from its small beginnings more than a century ago. He then discussed the question of a Royal Commission on museums. In pressing the claims of the provinces to a wider measure of support, he said they are actuated by no spirit of antagonism to the claims for increased expenditure which is being advanced by museums in the metropolis. Following on this he dealt with the wasteful destruction of wild life which threatens the very existence of some of our indigenous plants and animals.

Mr. Robert T. Jackson, of Peterborough, U.S.A., read a paper on "Ink and Paper for Museum Labels," giving his experiences over a long period on this subject. Major Stanley S. Flower contributed a paper and opened a discussion on "The Scientific Value of Small Aquaria." He emphasised the value of keeping data with regard to the animals kept in small aquaria, as much information about the longevity of these animals might thereby be obtained.

A paper on "Botanical Modelling for Museum Purposes" was read by Mr. W. E. Mayes, Leicester. He described in detail the process of modelling various specimens and showed examples of his own work in this connexion. Dr. F. A. Bather discoursed on "A Cargo of Notions from America," and described in detail the system adopted in American museums to aid visitors in their survey of the various departments. He emphasised the fact that the museums in the United States are far ahead of those in England in the use of electric light for the lighting of museum cases. Mr. W. Stanley Lewis, head of the Department of Geography in the University College of Exeter, read a paper on "The Place of Museums in the Teaching of Geography." He suggested that good might result from a conference between such bodies as the Museums Association and the Geographical Association. The last paper was by Mr. E. Rimbault Dibdin, who discussed "The Proper Function of a National Gallery." He remarked that the authorities of the National Gallery complain of lack of space, but he considered that it would be better if the Gallery was given up wholly to foreign art and all British pictures were transferred to the British Gallery at Millbank.

Several trade exhibits were displayed during the Conference as well as exhibits by individual members. Of exceptional interest was a special exhibit of Old Exeter and Devonian Silver of the sixteenth, seventeenth and eighteenth centuries. The social side of the conference was not neglected. On Tuesday evening the Mayor gave a reception to the delegates at the Royal Albert Memorial, while the local committee entertained the delegates to lunch. The local programme included a visit to the Exeter Historical Museum and the Cathedral, where a short organ recital was given by Dr. E. Bullock. The party was afterwards conducted over the Cathedral. The delegates also paid visits to places of interest in the city. Miss M. Tothill, the curator, addressed the party on the St. Nicholas Priory, and an inspection was made of the Hall of the Weavers, Fullers and Shearmen, the Hall of the Vicars Choral and Bampfylde House. An address on the city muniments and regalia was delivered by the Town Clerk (Mr. H. Lloyd Parry) in the Guild Hall. An excursion took place to Bradfield, the home of the Waldron family, by invitation of Commander and the Hon. Mrs. Adams, while the Sheriff of Exeter entertained all the delegates at a garden party in the Rougement Gardens.

[1] The presidential address and the papers and discussions will be published in the *Museums Journal*, commencing August 1925.

University and Educational Intelligence.

CAMBRIDGE.—Mr. J. A. Carroll, Sidney Sussex College, has been appointed University lecturer in astrophysics. Mr. G. U. Yule, St. John's College, has been reappointed University lecturer in statistics. Dr. A. H. Evans, Clare College, has been appointed a member of the Council of the National Trust for Places of Historic Interest or Natural Beauty. A. Lourie, St. John's College, has been nominated to the Choate Memorial Fellowship at Harvard University. W. A. H. Rushton, Emmanuel College, has been elected to the Michael Foster Research Studentship in Physiology. C. S. Deakin, Queen's College, and W. B. C. Perrycoste, Sidney Sussex College, have been awarded the John Winbolt Prize for a joint dissertation on the "Theory of Transverse Oscillations of Girders."

The Botanic Garden Syndicate reports the addition of 85 specimens of rare species of the genus Rosa, presented by Mr. C. C. Hurst, also a valuable collection of species of Iris, mostly collected wild, from the executors of the late Hon. C. N. Rothschild. An alpine house has been presented to the Garden by Mr. J. Cherrington.

On the occasion of the meeting of the International Astronomical Union at Cambridge, the honorary degree of Sc.D. was conferred upon President Campbell, M. Baillaud, Prof. de Sitter, Prof. Nagaoka, and Prof. Schlesinger.

The joint coal-mining diploma of the Universities of Cambridge and Birmingham has been approved by the Board of Trade.

DR. G. M. SHRUM, who has been associated with the low temperature laboratory at the University of Toronto since its inception, has been appointed assistant professor in physics at the University of British Columbia, Vancouver, B.C.

THE following awards for the year 1925–26 have been made by the Salters' Institute of Industrial Chemistry and approved by the Court of the Company:—1924–25 fellowships have been renewed to Mr. H. H. Evers, University of Liverpool; Mr. K. Knight Law, University College, Nottingham; Mr. H. S. Pink, University College, Nottingham, and University of Oxford; and Mr. V. E. Yarsley, the University of Birmingham. Fellowships have been awarded to Dr. R. Campbell, Armstrong College, Newcastle-upon-Tyne, and University of Oxford, and Mr. R. O. Gibson, University College, London. The Salters' Institute has also awarded 70 grants in aid to young men employed in chemical works in or near London to facilitate their further studies.

AT Budapest an English College is to be established under the auspices of the Ministry for Religion and Public Instruction. Each year twelve students of the College will proceed to Great Britain for further study in one or other of the Universities of Oxford, London, and Aberdeen. Three years ago, Hungary's economic situation was so desperate that an inter-university committee was formed to save scientific workers from having to abandon their work owing to lack of equipment and means of subsistence. In a report by Prof. Emile de Grósz on the three years' activities of this committee, it is stated that the Rockefeller Foundation has made grants for travelling scholarships and sends 70 periodicals in the English language, while a German society sends 261 German publications for the use of the universities, and the American Science Extension Committee proposes to arrange exchanges of American and Hungarian scientific workers.

Societies and Academies.

COPENHAGEN.

Royal Danish Academy of Science and Letters, October 17.—C. **Wesenberg-Lund**: Contributions to the anatomy and biology of the genus Zoothamnium. During two years' study of *Z. geniculatum*, special attention has been paid to the so-called macrogonidia, their origin and significance for the formation of new colonies.

December 12.—N. E. **Nørlund**: A table of the Riemann zeta function.—Harald **Bohr**: New proof of a general theorem of Kronecker on diophantine approximation.

January 9.—N. **Bjerrum** and L. **Ebert**: On some recent investigations concerning transference numbers and amalgam equilibria in mixtures of strong electrolytes. Some new experimental investigations, which have been regarded as incompatible with the hypothesis of complete ionisation of strong electrolytes, are discussed and explained from the view-point of this hypothesis.

January 23.—C. G. Joh. **Petersen**: How do whales swim? Whales swim by moving the caudal fin up and down; this is accomplished by means of the tail with its strong muscles, whereas the proper muscles of the caudal fin give this fin the rigidity suitable to the speed. When the speed is high, only small movements are made, for which reason the animal then only appears to quiver; the movements, therefore, are difficult to observe.

February 6.—Th. **Mortensen**: Antarctic zoogeographical studies. The study of the marine fauna, especially the echinoderms, supports the theory of a previous land connexion between Antarctica and South America (the Magellanic region). The Kerguelen group must also have been directly connected with that region. On the other hand, the so-called "subantarctic" islands, New Zealand, the Auckland-Campbell Islands, do not, as regards their echinoderm fauna, belong to the subantarctic region, but form a part of the New Zealand region. The correspondences between the Australian and the New Zealand echinoderm faunas would seem to be more naturally explained through Wegener's continental drift theory.

February 20.—N. **Bohr**: On the law of conservation of energy. The attempts to develop an atomistic interpretation of directly observable phenomena have led us to recognise the necessity of revising the ideas hitherto underlying the description of natural phenomena. Our present conceptions would not seem to allow of a detailed description of atomic processes which presumes the law of conservation of energy, which occupies a central position in the classical description of Nature.—C. Tate **Regan**: Dwarfed males parasitic on the females in oceanic anglerfishes (*Pediculati Ceratoidea*). (Proc. Roy. Soc. London, B, vol. 97, 1925.)

SYDNEY.

Royal Society of New South Wales, June 3.—A. R. **Penfold**: The essential oil of *Boronia citriodora* and the occurrence of citronellol. *B. citriodora* belongs to the snow regions where it thrives, being especially abundant around Cradle Mountain, Moina, Tasmania. The leaves and terminal branchlets yielded from 0·75 per cent. to 0·93 per cent. of a sweet odoriferous oil containing citronellol (80 per cent.), citronellol esters (principally acetate with some valerianate, d-a-pinene, sesquiterpene, a paraffin (m.pt., 64-65° C.), etc.

WASHINGTON.

National Academy of Sciences (Proc. vol. 11, No. 6, June).—O. E. **Glenn**: A note on the abundance of differential combinants in a fundamental system.—C. N. **Moore**: On the application of Borel's method to the summation of Fourier's series. Borel's method is not so effective as Cesàro's in summing Fourier's series but is more effective than ordinary convergence.—S. **Lefschetz**: (1) Intersections of complexes on manifolds. (2) Continuous transformations of manifolds.—H. S. **Vandiver**: Laws of reciprocity and the first case of Fermat's last theorem.—E. W. **Berry**: A species of Musa in the Tertiary of South America. Fossil seeds of a species of Musa have been found in the coal measures of the Cerros de Guadalupe and Montserrate, Colombia, in a horizon probably oligocene. The discovery supports the statements of old writers that the banana was a staple food in America in pre-Spanish times.—P. **Sushkin**: Outlines of the history of the recent fauna of palæarctic Asia. The fauna is divided into two groups characteristic respectively of the northern zone and the southern or High Asian zone. In the northern zone, the indications are that the pliocene climate was humid and mild; later there was local glaciation followed by a dry, continental period with steppe invaded by woodland. High Asia is characterised by desert, mountain and dry highland types; they are of ancient origin, but their present dominance is recent. Types with broken distribution are characteristic of more fertile conditions. There was no large inland basin in High Asia, during the Tertiary.—A. H. **Compton**. On the mechanism of X-ray scattering. Bennett, using two point counters, one to receive the recoil electron and the other the scattered quantum, finds many simultaneous impulses, in accordance with quantum theory predictions. Simon and Compton, using stereoscopic cloud expansion photographs showing a recoil electron and a secondary β ray track produced by the scattered X-ray quantum, find that the tracks in the majority of photographs are in accordance with the quantum theory prediction. The evidence is thus against any spreading wave theory of radiation, which requires that there should be no correlation between the direction of the recoil electron and that of the effect of the scattered quantum.—D. C. **Miller**: Ether-drift experiments at Mount Wilson (see NATURE, July 11, p. 49).—H. N. **Russell**: The intensities of lines in multiplets. I. Theory; II. Observed data (see NATURE, May 30, p. 835).—R. A. **Millikan** and I. S. **Bowen**: New light on two-electron jumps. Whenever a given type of spectral line progresses linearly with atomic number (irregular doublet law), the electron jumps originating it take place between orbits of the same total quantum number. Hot-spark electrometry shows that series of two-valence atoms are characterised by five nearly equally spaced bars; three-valence atoms show four bars. These characteristics are due to the simultaneous jumping of two electrons. The movement of one electron disturbs the system, causing a fellow-electron to make a similar jump.—H. M. **Evans** and G. O. **Burr**: The anti-sterility vitamin fat soluble E. Rats fed on synthetic food mixtures of fat, carbohydrate and protein with an appropriate salt mixture and vitamins A and B grow well, but sooner or later develop complete sterility. In the male there is complete destruction of germ cells, but in the female ovulation continues though gestation is interrupted by the death and resorption of the developing. This condition can be remedied by feeding with certain single natural foods containing the new food factor, vitamin E. Vitamin E is fat soluble and remarkably stable to heat, light and chemical change; it is present in many animal tissues, abundant in leaves and seeds and especially in the wheat embryo. Cod-liver oil is notably lacking in vitamin E.—Grace **MacLeod**, Elizabeth E. **Crofts** and F. G. **Benedict**: The racial factor in metabolism. Measurements on seven Chinese and two Japanese women in American colleges showed that the average metabolism of these orientals was about 10·4 per cent. less than that taken for American women. Even granting the latter should be decreased by 5 per cent., there seems to be a specifically lower metabolic rate for Chinese and Japanese women.—C. **Voegtlin**, J. M. **Johnson** and Helen A. **Dyer**: Protoplasmic action of copper and gold. In view of the relative mass of protoplasm and of salts of these heavy metals, and of the relatively large surface exposed, it is considered that even in very diluted solutions (1 in 10^7), sufficient metal ions are present to exert a toxic effect by chemical means. Glutathione and cysteine have a protective effect, suggesting that the normal toxicity is due to "asphyxia" from loss of the glutathione normally present in small quantities in tissues.—G. H. **Parker**: Activities of colonial animals. III. The interrelation of zooids in soft corals. A mechanical stimulus or light induces only local response in gorgonians: the zooids of Renilla are all affected by a local stimulus, suggesting an interconnecting nerve-net.—Lucy G. **Taliaferro**: Periodicity of reproduction, infection and resistance in bird malaria. Periodicity of occurrence of high values of mean size of parasites is unaffected throughout the infection, indicating that the rate of reproduction remains constant. Some destruction of merozoites always occurs, and this natural resistance factor increases in potency at the crisis and is maintained through the latent period.—Emma L. **Fisk**: The chromosomes of *Zea Mays*. A haploid number of 10 chromosomes and a corresponding diploid number of 20 have been found, except in Black Mexican sweet corn, which generally has 22 chromosomes.—F. G. **Pease**: Measurement of the spectroscopic binary star Mizar with the interferometer. The determinations are in good accord with the results from spectroscopic data.—F. H. **Seares** and P. J. van **Rhijn**: Distribution of the stars with respect to brightness and distance from the Milky Way (see NATURE, June 20, p. 948).—G. **Strömberg**: The general distribution of cosmical velocities. Group motion varies from 12 km. per sec. for the Cepheids of long period to about 300 km. per sec. for stars of maximum velocity dispersion, globular clusters and spiral nebulæ; thus the solar motion is dependent on the class of object to which its motion is referred.

VIENNA.

Academy of Sciences, May 14.—F. **Kerner-Marilaun**: The influence of the variable elements of the earth's orbit on the form of the European temperature chart during the Tertiary epoch. By means of Spitaler's calculations for the temperatures of extreme land and sea climates, and by means of the author's own method of geographical temperature analysis, it is possible to fix limits to the range within which the distribution of temperature oscillated in Tertiary Europe. The influence of the astronomically determined temperature change on the plant world of the Tertiary is indicated, and the floral migrations of deciduous and evergreen plants.—G. **Sachs**: On decomposition of azimenthines by mercury. The actions on benzalethylamin, on benzal-benzylamin, and on benzalanilin of mercury chloride and of mercury acetate.—H. **Handel-Mazzetti**: New Chinese plants (xxxiv.). Includes five sorts of Quercus and three of Vaccinium.

June 12.—K. **Przibram**: On coloration and luminescence by Becquerel rays.—H. **Benndorf**: Outlines of a theory of the earth's electric field (I.).—F. **Knoll**: On pan-algebraic manifolds.—W. **Olbrich**: New problems in projection.—G. **Weissenberger**, F. **Schuster** and J. **Lielacher**: On organic molecular compounds (xiv.). Chlorophenol and bromoform.—M. **Kohn** and G. **Soltesz**: On a new tri-bromo-phenol, the 1-oxy-3,4,5-tri-bromo-benzol, and a new tri-bromo-cresol, the 1-methyl-2-oxy-4,5,6-tri-bromo-benzol. (Sixteenth communication on bromo-phenols.)—M. **Kohn** and L. **Schwarz**: Preparation of brominated α-naphthochinon. (Seventeenth communication on bromo-phenols.)—R. **Dworzak**: Preparation of di-brom-acet-aldehyd-acetal by direct bromination of paraldehyde.—J. **Schorn**: Macroseismic study of the earthquake of March 26, 1924, and of its after-shocks.—A. **Schedler**: Microseismic study of the earthquake of March 26, 1924.—F. M. **Exner**: On the interaction of water and gravel in rivers. Theoretical, experimental and photographic work on the sandbanks of the River Mur, south of Graz.—H. **Handel-Mazzetti**: New Chinese plants. New species of Hydrangea and Senecio.—A. **Tauber**: On the integration of linear differential equations. (Fifth contribution.)

June 18.—G. **Weissenberger**, F. **Schuster** and J. **Lielacher**: On organic molecular compounds (xv.). Aromatic amines.

June 25.—M. **Chiba**: On the tongue-jaw reflex of the same side and crossed sides.—H. **Neudorfer**: Construction of the principal tangent curves on net-surfaces.—H. **Jacobi**: Influence of various stimuli on the growth of morphologically dissimilar parts of plants. Weak solutions of potassium chloride and other salts were used and experiments made with Impatiens, Syringa and Phaseolus. Resting plant organs were made to grow. Similar salts influence the growth of pollen-tubes.—L. **Mirskaja**: Changes in plants produced by removing the blossoms.—A. **Smekal**: On the influence of the pores of solid bodies on molecular mobility and rigidity. Crystals are generally considered to have a solidity which they do not really possess; the lattice structure is liable to microscopic or submicroscopic interruptions and the rigidity of the apparent crystal is much less than the real molecular rigidity. Self-diffusion in solid salts may be an internal surface process.—G. **Klein** and J. **Kisser**: The assimilation of nitrates by higher plants. An inquiry into the stages between nitrate and amino-acid. On feeding Phaseolus and Zea with $-NO_3$ in sterile culture solutions, $-NO_2$ and NH_4- appeared in the culture medium, and NH_4- also within the plant.—F. **Trauth**: Geology of the northern Radstätter-Tauern and their foot-hills.

July 2.—M. **Kohn** and L. **Schwarz**: On the chinoid product of oxidation of benzal-di-β-naphthol.—E. **Emich**: Further remarks on the rubidium- (cæsium-) silver-gold-halogen salts.—J. **Vogel**: Investigations on rubidium- (cæsium-) silver-gold-halogen salts.—E. **Reichl**: Contributions to the knowledge of the isomorphic relations of the cupro- and silver halogen salts.

Official Publications Received.

Berichte der Naturforschenden Gesellscha.t zu Freiburg i. Br. Herausgegeben von Prof. Dr. J. L. Wilser. Vierundzwanzigster Band. Erstes Heft. Pp. 123+92+46+63. Zweites Heft. Pp. 28+16+8+20. (Freiburg i. Br.: Speyer und Kaerner.)

Marconi's Wireless Telegraph Co. Ltd. Report of the Directors and Statement of Accounts for the year ended 31st December 1924; to be Presented at the Annual General Meeting of the Company, to be held at the Hotel Victoria, Northumberland Avenue, London, W.C.2, on Friday, the 31st July 1925, at 12 o'clock noon. Pp. 8. (London: Marconi House.)

University of Cambridge: Solar Physics Observatory. Twelfth Annual Report of the Director of the Solar Physics Observatory to the Solar Physics Committee, 1924 April 1–1925 March 31. Pp. 7. (Cambridge.)

The North of Scotland College of Agriculture. Guide to Experiments and Demonstration Plots at Craibstone, 1925. Pp. viii+60. (Aberdeen.)

University of Bristol. Prospectus of the Faculty of Engineering which is Provided and Maintained by the Society of Merchant Venturers in the Merchant Venturers' Technical College. Seventeenth Session of the Faculty and Seventeenth Session of the College, 1925–26. Pp. 32. (Bristol.)

City and Guilds of London Institute. Report of the Council to the Members of the Institute, 1925. Pp. liii+95. (London: Gresham College.)

Ministerio da Agricultura, Industria e Commercio: Directoria de Meteorologia. Causas Provaveis das Sêccas do Nordeste Brasileiro. (Conferencia realisada no Club de Engenhatia no dia 20 de Dezembro de 1924.) Pelo Dr. J. de Sampaio Ferraz. Pp. 30. (Rio de Janeiro.)

Union of South Africa: Department of Agriculture. Division of Chemistry Series No. 53, Science Bulletin No. 36: Some Experiments on the Solubility of Saldanha and Grahamstown Phosphates in the Soil. By A. Stead. Pp. 15. 3*d*. Division of Chemistry Series No. 55, Science Bulletin No. 37: Comparative Results of Analyses of Spirits and Brandies. (Read before the Cape Chemical Society on the 22nd August 1924.) By F. Fevrier. Pp. 8. (Pretoria: Government Printing and Stationery Office.)

Proceedings of the Royal Society of Victoria. Vol. 37 (New Series), Part 1, May 28th. Pp. iii+129+16 plates. (Melbourne.)

Loughborough College, Leicestershire. Calendar, Session 1925–26. Pp. xiv+220+59 plates. (Loughborough.) 2*s*. 6*d*. net.

South Australia: Department of Mines. Mining Review for the Half-Year ended Dec. 31st, 1924. (No. 41.) Pp. 93+9 plates. (Adelaide: R. E. E. Rogers.)

Astronomical Papers prepared for the Use of the American Ephemeris and Nautical Almanac. Vol. 10, Part 1: Positions and Proper Motions of 1504 Standard Stars for the Equinox 1925.0. Pp. 167. (Washington: Government Printing Office.) 40 cents.

Department of the Interior: United States Geological Survey. Bulletin 759: Geology of the Bristow Quadrangle, Creek County, Oklahoma; with Reference to Petroleum and Natural Gas. By A. E. Fath. Pp. iv+63+13 plates. 40 cents. Bulletin 760-D: Pedestal Rocks in Stream Channels. By Kirk Bryan. Pp. ii+123-130+plates 31-32. Bulletin 763: Geology and Ore Deposits of the Aravaipa and Stanley Mining Districts, Graham County, Arizona. By Clyde P. Ross. Pp. vi+120+13 plates. 25 cents. (Washington: Government Printing Office.)

Department of the Interior: Bureau of Education. Bulletin, 1924, No. 34: Statistics of City School Systems, 1921–22. Prepared under the Direction of Frank M. Phillips. Pp. ii+222. 25 cents. Bulletin, 1925, No. 7: Kindergarten Legislation. By Nina C. Vandewalker. Pp. iii+32. 5 cents. (Washington: Government Printing Office.)

Department of the Interior: United States Geological Survey. Professional Paper 132-I: Origin of the Boghead Coals. (Shorter Contributions to General Geology, 1923–1924.) By Reinhardt Thiessen. Pp. ii+121-138+plates 27-40. Professional Paper 132-J: Aniakchak Crater, Alaska Peninsula. (Shorter Contributions to General Geology, 1923–1924.) By Walter R. Smith. Pp. ii+139-149+plates 41-44. (Washington: Government Printing Office.)

Department of the Interior: United States Geological Survey. Water-Supply Paper 509: Surface Water Supply of the United States, 1919–1920. Part 9: Colorado River Basin. Pp. v+269+2 plates. 25 cents. Water-Supply Paper 537: A Study of Coastal Ground Water, with Special Reference to Connecticut. By John S. Brown. Pp. viii+101+7 plates. 20 cents. Water-Supply Paper 560-B: Chemical Character of Ground Waters of the Northern Great Lakes. By H. B. Riffenburg. Pp. ii+31-52. Water-Supply Paper 560-C: Index of Analyses of Natural Waters in the United States. By W. D. Collins and C. S. Howard. Pp. ii+53-85. (Washington: Government Printing Office.)

Ministry of Finance, Egypt: Survey of Egypt. Geology of Egypt. Vol. 1: The Surface Features of Egypt, their Determining Causes and Relation to Geological Structure. By Dr. W. F. Hume. Pp. xliv+408+122 plates. (Cairo: Government Publications Office.) 50 P.T.

Mines Department. Third Annual Report of the Safety in Mines Research Board, including a Note regarding Matters dealt with by the Health Advisory Committee, 1924. Pp. 72. (London: H.M. Stationery Office.) 1*s*. net.

Ministry of Public Works, Egypt: Physical Department. The Climate of Alexandria. By Mahmoud Hamed. (Physical Department Paper No. 19.) Pp. iii+62+8 plates. (Cairo: Government Publications Office.) 5 P.T.

Memoirs of the Geological Survey of India. Palæontologia Indica. New Series, Vol. 8, Memoir No. 3: The Perissodactyla of the Eocene of Burma. By Dr. Guy E. Pilgrim. Pp. iii+28+2 plates. (Calcutta: Government of India Central Publication Branch.) 1.9 rupees; 2*s*. 9*d*.

Memorie della Pont. Accademia delle Scienze Nuovi Lincei. Serie Seconda. Volume Settimo. Pp. iv+399. (Roma.)

Department of the Interior: Bureau of Education. Bulletin, 1925, No. 14: Record of Current Educational Publications; comprising Publications received by the Bureau of Education to April 1, 1925. Pp. ii+59. (Washington: Government Printing Office.) 10 cents.

Department of Commerce: Bureau of Standards. Scientific Papers of the Bureau of Standards, No. 506: Theory and Interpretation of Experiments on the Transmission of Sound through Partition Walls. By Edgar Buckingham. Pp. 191-219. (Washington: Government Printing Office.) 10 cents.

Union Géodésique et Géophysique Internationale. Deuxième assemblée générale, Madrid, Octobre 1924. Procès-verbaux des séances de la section de météorologie. Pp. 184. (Rome: Imprimerie Pio Befani.)

Year Book of the Academy of Natural Sciences of Philadelphia for the Year ending December 31, 1924. Pp. 93. (Philadelphia.)

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, St. Lucia, 1923. Pp. iv+25. (St. Lucia.) 6*d*.

Cambridge Observatory. Annual Report of the Observatory Syndicate, 1924 May 19–1925 May 18. Pp. 4. (Cambridge.)

Department of Agriculture, Ceylon. Bulletin No. 72: The Control of Shot-Hole Borer of Tea (*Xyleborus fornicatus*, Eichh.). By F. P. Jepson and Dr. C. H. Gadd. Pp. 46. (Peradeniya.) 40 cents.