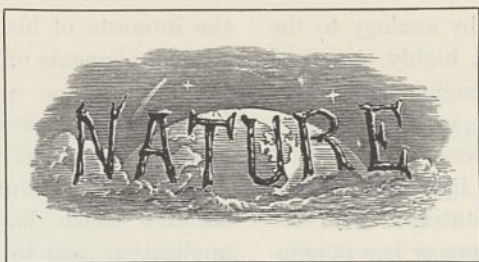


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## Science and Political Responsibility

AS these pages pass through the press and come to the hands of our readers, Great Britain once more lies under the stress of one of those periodically recurring emotional crises in which the future policy of government of the country for a period of greater or lesser duration is determined by popular vote. The gravity of the issues involved on this occasion needs no stress ; but it may well raise the question whether the machinery of democratic government is such as to adapt itself to that scientific approach to the solution of the problems of government and administration, which the course of events in the last ten or fifteen years has shown to be a necessity of this modern age. In the hundred years which have elapsed since the introduction of the Reform Bill, thanks in great measure to the British political genius for compromise, the ultimate control of the destinies of the nation has passed from what was virtually an oligarchy to the people as a whole without the more violent pangs which marked the birth of democracy in less fortunate conditions. No longer, however, is the electorate confronted with the relatively simple issues of 'party'. The problem of the future in an increasing degree must be the manner in which, and at what stage, the scientific and technical considerations, which it would seem must enter more and more largely into the shaping of public action, are to be brought home to democracy.

John Stuart Mill, with the characteristic optimism which underlay the logical exactitudes of the Philosophic Radicals, declared that the individual exercise of the franchise was to be preferred to all the advantages that might accrue from the most benevolent despotism ; and the nineteenth century, also holding to the belief in the ultimate perfectibility of the individual

through education, elected to follow him. The Great War struck the final blow at the barriers, comparatively few as they were, which still stood in the way of equality of status and opportunity for all. Of these the most formidable, perhaps, was the inequality of the position of women. By the irony of circumstances, however, that great upheaval also destroyed the conditions in which these opportunities were to come to fruition. The War revealed the enormous forces which it was possible to set in motion and direct to a given end by organisation, especially on a national basis, and the complexity of the problems arising from day to day, which could no longer be localised and isolated, but were liable to affect the whole world, even to its remotest parts, through the speeding up and improvement of communication and transport.

The optimism of the post-War period of reconstruction was short-lived. The stability of civilisation had suffered a shattering blow ; and throughout the world it was apparent that it was no longer possible to meet the issue by the traditional methods of party politics. The situation called for measures that were at once more drastic and more flexible, if the methods of science were to be applied to the problems of government. Action, when once a logical conclusion had been attained, was not a matter for further debate.

Even now it is too early to pass judgment on the means, some of them drastic, which have been adopted to cope with the crisis, and are still in some measure on their trial. The extended application of the results of scientific research in every field of production to meet human needs—this, too, has given rise to problems all its own—and the more highly organised methods of industry and commerce in the pursuit of efficiency and the



elimination of waste, have led by analogy to the concept of the corporate State, highly organised on scientific lines as a unit, bringing with it the inevitable consequence of the institution of a dictator as a condition of success, whether that dictatorship were held by an individual, as in Italy and Germany, with limitations as in the United States of America, or more or less in commission as in the early stages of the National Government in Great Britain, or, in theory, in Russia.

The outcome, as is familiar to all, through the repercussion of economic and political factors, has been the intensive cultivation of the national spirit, to which concessions were made at the close of the War in the interests of justice and peace, but which has now become a source of irritation and danger greater than the injustices which it was fostered to remove. To the justification of political and economic exclusiveness has now been added the doctrine of race, with the implication of racial superiority and inferiority, which in Germany has been made the basis of internal policy to subserve the purpose of commercial and economic rivalry between Jew and Christian, and in the United States has served as an argument in favour of discriminatory laws regulating immigration and imposing disabilities on certain classes of the population in social legislation.

If, however, exclusive nationalism claims to base itself upon a scientific racial theory, over against it must be set the movement towards internationalism, which has found material expression in the League of Nations. If, according to the one school, the nation is regarded as one stage in what is claimed to be a Darwinian struggle for existence, in the view of the other, it represents a phase from which we are said to be on the point of emerging in an evolution of the social organism in an ascending scale of complexity, which begins with the family, passes to the tribe and will culminate in some form of great commonwealth vast enough and elastic enough to embrace the whole of mankind.

If those who claim to speak with the authority of science may voice views so widely divergent, the puzzled layman may well ask where in all this controversy does science itself stand. Now science as such is not concerned with 'moral values', which in the long run determine the policy of the statesman, but with truth; and the man of science, as such and apart from his standing as a citizen, has no special claim to speak on the issues of political controversy, except in so far as his standing and

the interests of his pursuits are affected as constituent elements of the community. When, however, the name and principles of science are invoked in support of political policy, it is to the interests of himself and of science in general—and indeed it is his duty—to examine and test the theories which have been invoked and their application, and to see not merely that they are correctly stated in accordance with the facts, but also that in their application they have not been distorted to fit the views of the partisan.

A lesson as to the true function of the man of science in relation to political controversy may perhaps be drawn from two recent publications dealing with the theories and practice of anthropological science. Of these one, "We Europeans" by Dr. Julian Huxley and Dr. A. C. Haddon, is the subject of notice in another column of this issue of NATURE (see page 736), but it may be pointed out here that in this book the authors have effectually pricked the bubble of 'race' as applied in justification of the nationalism rampant in Europe to-day. They track down the 'Aryan Race' theory to its origin in a misinterpretation—it might indeed be said a perversion—of ethnological theory, and finally cut away the ground from under 'racial' theory by demonstrating that, when examined in the light of modern methods and modern doctrines of genetic studies, race becomes virtually a meaningless expression.

In the second of these publications\*—an excellent review by Mr. Penniman of the history of anthropological thought from its beginnings with the investigations of Herodotus down to the present day—the racial fallacy is traced to its origins in the writings of de Gobineau and others in the last century. It is instructive to note how, from the earliest times and long before anthropology had become an organised discipline, philosophers and political thinkers were drawing from the more or less systematic observations of travellers and historians the formularies upon which to base theories of the political and ethical ends of man.

At present, the trend of events is that the statesman must rely, in an increasing degree, on the findings of science in the interests of good government. If freedom and democracy are to endure, this constrains the man of science to hold a watching brief, lest the name of science be taken in vain and the power of the franchise abused in an uninstructed electorate.

\* *A Hundred Years of Anthropology*. By T. K. Penniman. (Duckworth's 100 Years Series.) Pp. 400. (London: Gerald Duckworth and Co., Ltd., 1935.) 15s. net.



## Industrial Reorganisation and International Obligations

### The Next Five Years: an Essay in Political Agreement

Pp. xvi+320. (London: Macmillan and Co., Ltd., 1935.) 5s. net.

LAST year two manifestos appeared in the Press under the title "Liberty and Democratic Leadership". They represented in effect the expression of large schools of thought in all political parties of their abhorrence of *il-liberal* and undemocratic forms of government, and their determination to solve present-day problems by methods of persuasion and without curtailment of liberty. Not content with mere manifestos of good intentions, a number of the signatories have now published this book which, they claim, presents a far-reaching but attainable programme of action for the next five years. Apparently, the signatories would welcome the formation of another National Government, the centre of gravity being nearer the left-centre than the one we have known since 1931. As to how this coalition is to be brought about, the book is silent. Be that as it may, it will be welcomed in all quarters as a successful attempt to display the vast agreement which exists as to the programmes that are necessary for the organisation of a world order freed from the menace of war, the development of an economic system freed from poverty and unemployment, the safeguarding of political liberty and the revitalisation of democratic government.

In the economic sphere, a Cabinet Planning Committee is advocated of ministers without portfolio aided by an Economic General Staff composed of the best brains in the ranks of industrialists, financiers, trades unionists and experts to survey the resources of Great Britain and recommend the reorganisation of our industries to meet present-day needs. The authors set great store on the increase of our export trade, and this they believe to be possible by our participation in the formation of a 'low-tariff club'. By this means, they maintain, it will be possible in five years to return to the 1929 level of trade and thus reduce the number of unemployed by about a million. They also attach considerable importance to the inauguration of large schemes of public works, including housing, road construction and the electrification of suburban railways, as an immediate method of coping with the problem.

In view of the present international crisis, however, the reader will probably turn first to the four excellent chapters dealing with international

relations. In a well-reasoned statement, the authors reject the policies of armed isolation, balance of power and alliances as being impracticable or dangerous, or both, and pin their faith to the collective system based on the Covenant of the League of Nations as the only sure method of achieving a lasting peace.

It is emphasised that peace can only be secured if international anarchy is replaced by law and order, and furthermore that if peace is to be lasting, the state of law and order from which it results must be founded not on the *status quo* as it exists at any one time, but on justice. The prime necessity for the observance of international obligations is recognised and for sanctions to enforce those obligations, and also the necessity for adequate machinery for the peaceful settlement of disputes and the revision of the law to meet new conditions.

First, then, as to sanctions: it is agreed that they are morally justifiable, "used solely to prevent or put a stop to breaches of the peace with the minimum of lasting injury". Further, they are politically necessary and desirable if collective security is to be made effective. But to do this, sanctions must possess three essential qualities. "They must be *predicable* enough to serve as a deterrent to a would-be aggressor and as an assurance to those in fear of attack". "They must be *potent* enough to stop the peace breaker, surely, quickly and with a minimum of lasting injury". "They must be so conditioned and *limited* as not to impose an intolerable burden upon those who have to contribute to them".

At the present time, the sanctions on which international law depends fall far short of these requirements. They are not predicable because they depend for their use on the whims and vagaries of national Governments. Would Italy have attacked Abyssinia if she had known for a certainty that she would have to resist the moral, economic and physical strength of the combined nations in the League?

The question still remains, How are sanctions to be organised so as to fulfil these conditions? There is only one answer. The League itself should be endowed with an International Police Force. That is the key to the problem of sanctions. It is also the key to the problem of security and therefore of disarmament. Indeed, the authors recognise that if military aviation and the menace of aerial bombardment are to be abolished, it may be necessary to establish an



international air police force. The dangers of rearmament which Europe is to encounter during the next five years may yet convince even the most reactionary of us that it is only by transferring force from national control and placing it at the disposal of international justice that peace can be preserved.

The authors recognise "that provision for peaceful change of the status quo is indispensable". "The society of nations, like society within a nation, must find peaceful means of adjusting conflicts between rigid law and the changing needs and conceptions of justice". They recognise the need for a settlement of Hungary's territorial claims, of Japan's case for expansion, of some alterations with regard to Danzig and the Polish Corridor. War, or the threat of war, is the very worst instrument for settling such disputes or affecting such changes.

The authors do not consider that the Permanent Court at The Hague is a suitable body for deciding

political, as distinct from legal, issues. "The most radical method is, of course, for states to entrust to an international authority the task of giving a binding decision not simply on the basis of existing law but on broad grounds of equity and balance of advantage"; and for this purpose they recommend the appointment of *ad hoc* commissions to deal with such questions.

This marks a great advance. It is a step towards endowing the League with a permanent tribunal in equity composed of men who by their uprightness, character and disinterestedness are capable of giving a just and impartial decision as between the disputants and in consonance with the interests of the international community as a whole.

These are undoubtedly the necessary instruments of the reign of law—a court and a policeman. When the League is so equipped, the world will enter upon an era of just and lasting peace such as it has never enjoyed in the past.

DAVIES.

## The Racial Myth

### We Europeans :

a Survey of 'Racial' Problems. By Dr. Julian S. Huxley and Dr. A. C. Haddon. With a Chapter on Europe Overseas, by Prof. A. M. Carr-Saunders. Pp. 299 + 4 plates. (London and Toronto : Jonathan Cape, Ltd., 1935.) 8s. 6d. net.

THIS book, the result of a happy collaboration, comes as an opportune prophylactic against the spreading virus of racialism. Its nine chapters contain a historical survey of the development of anthropology and racial ideas, a simple but sufficient account of human genetics, an examination of the bases and follies of ethnic classification, a review of European ethnic groups considered broadly and nationally, a careful demographic summary of European emigration and a recapitulation of the practical applications of the inquiry.

Its uniform excellence leaves little room for criticism, but the chapter on the "Ethnic Composition of European Nations" could have been improved by more systematic treatment; and that by Prof. Carr-Saunders creates the unfortunate impression that Australia, New Zealand and North America form a series of overseas Europes, practically untouched by other immigrant and endemic mores and genes. Yet the North American population, regarded as a whole, is somewhat obviously Eur-Afro-Asiatic, and one fails to follow the curious argument that the

indigenes of these areas can be "disregarded" as they "have played no part in the building up of the communities which now inhabit" them.

The main utility of the book is that it demonstrates with incontrovertible clarity (and it is a reflection on human sanity that such demonstration should still be necessary) that the racial concept is a myth, and *race* "a pseudo-scientific rather than a scientific term". It has been so extensively used "to rationalize emotion, and to bolster up the appeals of prejudice" that the authors employ the expression *ethnic groups*, an advance on Prof. Boas's proposal to substitute 'populations' for 'race'. Of course, all this has been said before, but it bears saying again; and it is to be hoped that it will have a restrictive effect on the growth of ethnomania and proposals to elevate the primary, phenotypic divisions of mankind to specific rank. A large section of exploited humanity should be grateful to Drs. Huxley and Haddon for helping to deprive this prospective taxonomic exuberance of any semblance of biological foundations. For even its limited acceptance would help to relegate the Negro, already regarded by numerous morons as 'subhuman', to the category of the gorilla in the Western mind; and it would stimulate a revitalised outbreak of social ineptitude.

Other fallacies associated with racial mythology are also exposed, such as Nordic superiority,



measurable differences in innate group ability, the biological evils of miscegenation, and the equation of 'race' with 'nation', which Sir Arthur Keith is still fond of emphasising from his sylvan retreat at Downe. "The idea," they write, "of a British, a French, a German or an Italian 'race' is a political fiction, and a dangerous one at that".

In dealing with miscegenation, however, the authors express themselves 'cautiously'. They say, boldly enough, that supposedly biological reasoning against ethnic mixture is a cloak for aggrandisement and discrimination; they show, with significant lack of emphasis, that the unfortunate characteristics so often observed in 'hybrids' are associated with economic, social and cultural factors of which prejudice is perhaps the most effective; they almost follow Mr. Bernard Shaw in the timid statement that from "a purely biological standpoint it might conceivably be a

good thing to undertake mass crossing between say the British and the Bantu . . ." One expects the obvious conclusion that a rational attitude towards miscegenation would be concerned with the improvement of the factors affecting it, rather than egocentric attempts to prevent relations which have proved to be unpreventable at least since the late palæolithic period. For social ills there are social remedies—and one must presume that white groups are educable. But we are informed that "It may well be that in many cases the discouragement of 'racial crossing' may be the correct policy". It rather seems as if Dr. Huxley suddenly remembered the manifesto of the Eugenics Society and his position on its council, but it comes too late to be really effective; and a single lapse from the "appeal to fact" is surely excusable in a book otherwise so attractively radical.

CEDRIC DOVER.

## Scientific Study of Place-Names

### The Place-Names of Essex

By P. H. Reaney. (English Place-Name Society, Vol. 12.) Pp. lxii+698. (Cambridge: At the University Press, 1935.) 25s. net.

ESSEX is generally reputed to be the one county of England which has best preserved among its peasantry the traditional outlook of an earlier day, just as its buildings are richer in characteristic examples of early styles of domestic architecture. The impression of a certain remoteness which compels attention outside the urban areas is intensified by a flavour, an archaic quality, in the names of its smaller towns and villages, which seem to recall more insistently than elsewhere a countryside which was part of a social order based on church and manor very different from that of the twentieth century.

Even when every tangible evidence of antiquity has vanished before the advance of suburban London, the names remain. Stratford—not the "Stratford-atte-Bowe", which lies across the river in Middlesex—still marks where the Roman street crosses the river, although its neighbour Leyton is no longer, at the request of its mid-nineteenth century inhabitants, the "Low'tun on the Lea"; and it comes as something of a surprise that names so familiar to the suburban as Chingford and Billericay have an antiquity which has left no trace of their derivation.

It is one of the functions of inquiry pursued in the scientific spirit to confirm or destroy impres-

sions. The volume of the Place-Name Society which deals with the county of Essex brings together an imposing array of current names—to say nothing of those no longer in use—of a more than respectable antiquity. They point to a general continuity of long tradition throughout the county area which here and there, in names that defy etymological analysis, may stretch beyond the bounds of recorded history.

Of the Celts, notwithstanding the seat of the great British kingdom at Colchester, there are few traces—names such as Camulodunum itself, Colne, Lea, Pant, Stour and a few others of Celtic origin, as well as names imposed from outside, such as Walton or Walden, "the wood of the serfs", or more probably, "the Britons". Early political or geographical conditions may be responsible. It does not necessarily follow that the earlier inhabitants were completely evicted by the East Saxons, whose kingdom, with its capital in London, embraced the modern county and Middlesex as well. From these East Saxon settlers and their descendants the majority of Essex place-names are derived, memories of the Roman occupation appearing in Colchester, Chesterton and others now no longer in use. On these Saxon names is superimposed a stratification of racial and social history in names of Scandinavian, Norman-French, French and English origins, in which descriptive, locative or functional elements are embodied, as well as derivatives from personal and family names.



Exposed as the county was to entry from the sea by way of its many creeks and estuaries, as the Saxon settlement had shown, it was inevitably raided by Scandinavians; but they do not seem to have been disposed to settle as they had farther north. Scandinavian derivations are not common, though they are seen in such names as Audley End, Kirby, Skighaugh and, more doubtfully, in Clacton, Thorpe-le-Soken and Frowick. No county, however, shows more strongly the effect of the Norman invasion. Many names derive from feudal and manorial custom, or are survivals of the personal and family names of barons of the county, such as Grays from Henry de Grey, its baron in 1194, Helion Bumpstead, Hadfield Peverell or Woodham Ferrers. Names that are of purely French derivation, such as Pleshey and Beaumont, are relatively not infrequent.

However great the interest to the historian of the later evidences of the growth and organisation of society which have been collected by students of Essex place-names, the archæologist will return again and again to the indications of great age and of early settlement to be found in county nomenclature. In evidence of both these Essex is especially rich. As the distribution of the earliest forms, those ending in *ge* and *ingas*, would show, the earliest Saxon settlements were along the estuaries and river-valleys, Thames, Lea, Blackwater, Crouch and Colne, as well as along the coast, now marshy, but then more attractive, with a tidal level thirteen feet lower than it is to-day. To this group belong such settlements as Farninghoe at the mouth of the Colne and Dengee on the coast between the Blackwater and the Crouch. Later, from these isolated settlements they spread along the Roman roads and to the less easily worked lands, and to woodland clearings which they at first had avoided, until settlement was general throughout the county. It is significant that it is in the wooded areas, and especially towards the heavy soils of the north-west, that the Saxon names are latest in form and that traces of the survival of a Celtic element are found.

Of paganism there is evidence in the worship of Thunor and Woden which appears in Thundersley and the lost Thunderlow and Wodnesfeld in Widdington. High Ongar and Little Wakering were probably once places of worship, while in Broxted and Hertisheued in Lindsell there is suggestion of heathen sacrifice. The familiar Teutonic water-sprite is responsible for Nickerslands in Stanford Rivers and Nickersmadwe in Greenstead by Colchester. The general distribution of these and similar names points to a widespread settlement of the county area while paganism still flourished.

The attention given to the names of fields in recent volumes of this series has been carried further in the study of Essex. In the long list given here much information may be gleaned bearing on social and economic conditions. Of such, for example, are names which point to the dedication of certain fields to specific services of the church, or the presentation of land to the bride on the morning after the wedding.

The publications of the Place-Name Society go from strength to strength, and the Essex volume is an advance on a standard already high. It is recognised how much of the excellence of the volume is indebted to the labours of such great scholars as the late J. H. Round and R. C. Fowler. It affords a technical equipment, including an excellent series of distribution maps, which will be of the greatest assistance to further research.

#### Parasitism and Disease

By Theobald Smith. (Published on the Louis Clark Vanuxem Foundation.) Pp. xiii + 196. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1934.) 9s. net.

IN these lectures the late Prof. Theobald Smith reviewed the knowledge and experience of nearly fifty years of fruitful devotion to research on infective disease in man and animals. The book contains an analysis of the complex interactions of host and parasite and a commentary on the very varied aspects of the subject. Starting with the maxim that the most effective factor in the evolution of parasitism is the continued life of the host, the writer maintains the thesis that parasitic diseases have begun by the straying of the invader into a new tissue or animal, where it may be at once destroyed or may set up an unwonted cycle with serious consequences for the host; after this phase and perhaps after many such attempts, a new recurring disease may be started, and finally a mutual tolerance established with little inconvenience to host or parasite, and so the continuance of both attained. The four essential stages of parasitism are laid down as entrance of the parasite, multiplication in the new environment, exit and transit to fresh hosts. The modifying influence of host on parasite and the converse, and the origin of races of parasites peculiar to special hosts are discussed.

The author derives the need for active public health measures from the axiom that Nature abhors a crowd and reduces superabundance by disease, but he points out that freedom from disease exacts the price of constant vigilance and readiness to use new tactics to avert renewed attacks in the constantly changing ecology.

The book is full of interest to all biologists as well as to medical men and veterinarians, for the matters discussed have been passed through the mind of a master who had no small share in the original observations and in their elaboration.



**Faraday's Diary :**

being the various Philosophical Notes of Experimental Investigation made by Michael Faraday, D.C.L., F.R.S., during the Years 1820-1862 and bequeathed by him to the Royal Institution of Great Britain, Now, by order of the Managers, printed and published for the first time, under the editorial supervision of Thomas Martin. Vol. 6 : Nov. 11, 1851-Nov. 5, 1855. Pp. xiv+495+8 plates. (London : G. Bell and Sons, Ltd., 1935.) 7 vols., £12 12s. net.

THIS, the penultimate volume of Faraday's Diary, covers the period from November 1851 to November 1855. In the main, the topics treated are lines of magnetic force, the construction of a magnetic torsion balance and the measurements made therewith, electrodynamic induction in liquids and magneto-crystalline action. The MS. of this section of the Diary is noteworthy as containing a number of "the actual specimens prepared by Faraday in 1851 to illustrate the delineation of lines of magnetic force by iron filings. The filings were fixed on cartridge paper by means of gum water, sometimes mixed with a solution of 'the red ferro-prussiate of potassa' (apparently potassium ferricyanide), which was found to leave a blue impression of the pattern after the filings had been removed or worn off". A number of the specimens have survived the changes of more than eighty years, and this volume contains collotype reproductions of some of the more suitable specimens. The frontispiece is a reproduction of the famous painting which represents Faraday giving the Christmas lectures of 1855-56 before the Prince Consort, the Prince of Wales and Prince Alfred.

The volume maintains the interest of its predecessors. Detailed consideration of its contents is deferred until the appearance of the concluding volume, when opportunity will be taken to discuss the whole work.

A. F.

**Die Blutsverwandschaft im Volk und in der Familie :** ein Beitrag zur menschlichen Lebenskunde (Anthropologie). Von Dr. Walther Jankowsky. Pp. viii+166+12 plates. (Stuttgart : E. Schweizerbart'sche Verlagsbuchhandlung (Erwin Nägele) G.m.b.H., 1934.) 6 gold marks.

DR. JANKOWSKY here enters upon an investigation of no little general interest, as well as of importance in the present standing of racial studies and the question of human inheritance. His central problem is that of resemblances in appearance, both as between members of a family and as between individuals who are not known to be personally related. He also brings into consideration the biological character and significance of such phenomena of resemblance. He discusses successively the concepts of blood relationship, resemblance factors, individual heredity and pseudo-resemblances. Further, he examines and sets out the methods of investigation applicable to the investigation of the specific problem. One of the most important aspects of the question, on which his views will be found of no little interest to the ethnologist and the student of human heredity, is that of the degree to which significance is to be attached to

resemblances without personal relationship in the light of the theory of chance and with special reference to the conditions of descent within a given population.

Dr. Jankowsky's cautious conclusions and well-marshalled arguments, in what is admittedly an obscure field, will serve as a useful corrective of over-hasty generalisations which too frequently go beyond what a scientific interpretation of the evidence would admit.

**Anorganisch Chemisches Praktikum :**

für Studierende der Chemie und anderer Naturwissenschaftlicher Fächer. Von Prof. Dr. Wilhelm Manchot. Pp. viii+103. (Dresden und Leipzig : Theodor Steinkopff, 1935.) 4.30 gold marks.

THIS course, by one who has made important contributions to inorganic chemistry, is based on the axiom that a student of chemistry should be given the opportunity of becoming acquainted with the appearance and reactions of as many materials as he can in the time available, since this opportunity may never be available in his later career. By combining a course on qualitative analysis with preparative experiments he has attempted to provide a wider basis of instruction, and since this course has been followed in his own institution at Munich, it is obviously a possible one. The order seems at first sight unusual, since experiments on potassium compounds, for example, are followed by halogens, these by silica and silicates, and hydrogen peroxide comes between oxyacids of sulphur and the oxides of nitrogen. Whilst this arrangement may have some advantages as proceeding from less to more difficult experiments, it would seem to conflict with the usual order of lecture courses and would probably not be found satisfactory in English universities.

**The Socialization of the Electrical Supply Industry**

By G. H. (Published for the New Fabian Research Bureau.) Pp. 104. (London : Victor Gollancz, Ltd., 1934.) 3s. 6d. net.

THIS survey of the electric supply industry is published under the auspices of the New Fabian Research Bureau, but the author alone is responsible for the views expressed. The conclusions are substantially in agreement with those in the Labour Party Policy Report No. 3. The ownership of local authority and company undertakings will be transferred to a reconstituted Central Electricity Board. The Central Electricity Board would issue new bonds secured on the revenue from the whole supply industry of the country in payment for the ownership. Difficulties in the way of doing this are clearly explained. Similar difficulties will arise in the socialisation of all industries. The present average yield on electric lighting shares is about 4 per cent; this would be replaced by redeemable bonds giving  $3\frac{1}{2}$  per cent and so the capital charges would be reduced by about 12 per cent. The advantages of mutual co-operation between gas and electricity supply are pointed out. One advantage of railway electrification would be to cheapen the cost of supply from the grid. The book is well written and free from dogmatism.



## The Psychological Approach to the Problem of Road Accidents\*

By Dr. Charles S. Myers, C.B.E., F.R.S.,  
Principal of the National Institute of Industrial Psychology

IT is well recognised that the problem of road accidents may be approached from various aspects, for example, the statistical and the engineering aspects. In this paper I consider the approach made by the psychologist—whose special training should render him expert in considering and advising on the part played by 'the human factor' which, it has been estimated, enters into eighty to ninety per cent of road accidents.

The psychologist cannot, of course, neglect the value of statistical data; indeed he is bound frequently to use them. Nor is he by any means unconcerned with engineering and other similar mechanical factors. But all these must be his servants rather than his masters; he has to regard them in their subservient relation to his psychological and physiological knowledge—his knowledge of the living mind and body.

Many statistical data, for example, appear to the psychologist as vitiated, if not valueless, because they have been collected and treated without the foresight of pitfalls, and without the care in framing questions, which would have been employed by one trained in psychological experiment and in psycho-physical methods.

So, too, the merely mechanical perfection, say, of car signals and of car controls (levers and pedals) does not content the psychologist. He would institute an inquiry into which of their manifold forms and positions best and least satisfy the human requirements of the driver or pedestrian; no such investigation has yet been made, at all events in Great Britain.

Or again, while recognising the proved value of traffic signals, the psychologist would ascertain their best mode, form, height, etc., again in relation to the human factor in their percipients. For example, it would be easy for him to overcome the dangers of defective colour-vision among road users by instituting differences in shape of the red and green traffic signals, and it appears to him worth while to investigate the problem whether the present system of unwarned changes from one colour signal to another is not deserving of improvement.

In regard to the lights of roads and cars, the psychologist is not content with the desirability of merely increasing their intensity: his familiarity with the physiology of vision compels him also to

take into expert consideration the dangers of contrast, shadows, glare and the like, and individual differences in speed of adaptation to sudden gross changes in illumination.

The various traffic regulations—in respect of direction, speed and signals—are each, doubtless, individually justifiable, when based on scientific experimental evidence. The psychologist would, however, also investigate the combined, total effect of these various regulations on the driver. Is there no danger of their becoming so numerous as to impose excessive strain on his attention by increasing his distraction, and thus to enhance his liability to accident? May they not also so seriously affect his peace of mind that, when he escapes from their zone into less crowded thoroughfares, he tends immediately, in his irritation, to reckless driving and again to enhanced liability to accident?

The psychologist fully recognises the value of incentives and deterrents—rewards and punishments—in promoting good behaviour, but experiment and experience have taught him much concerning the value of their various forms; and it is becoming increasingly recognised that his help should be invoked to determine whether or not an offender deserves to be wholly or partly excused from punishment or to receive other forms of treatment. This help is rendered by the psychologist not merely by inquiries into the conscious and unconscious mental and bodily make-up of the offender; he must also investigate the remote, as well as the direct, causes of the accident—the effects of predisposing previous strain, fatigue, worry and irritation, and of such drugs as alcohol. He would also ask to be allowed to extend his inquiries into dangerous behaviour on the part of road users which might have resulted, although it did not actually result, in accident; and he must be in a position to recognise the mental and physical abilities and the temperamental qualities required for a safe driver, to assess those abilities and qualities, and to assert whether a driver possesses them in adequate measure for him to follow with fair safety his unquestionably dangerous occupation or amusement. Finally, he should be allowed to advise the prospective or the inefficient driver as to those of his defects, revealed by psychological tests, which might be improved by special training.

\* A paper at a joint discussion in Sections G (Engineering) and J (Psychology) of the British Association read at Norwich on September 10, 1935.



At present, motor drivers are selected merely on the basis (a) of freedom from gross physical disabilities, (b) of their knowledge of traffic regulations and signals, and (c) of their ability properly to start, stop, turn and reverse their vehicle, and to overtake, meet or cross the path of other vehicles. At present about eleven per cent of the applicants for car licences fail in this examination. But it will be at once recognised that, like most other examinations, this is one that can be passed by unsatisfactory people after sufficient 'cramming' and repeated entry, and that it is not an adequate test of the qualifications required for a really safe driver.

There can be no doubt that certain people are more liable to accidents than others. Some psychologists have assumed that there exists in various degrees among mankind one and the same *general* liability to accidents, whatever be the employment or activity in which accidents may occur. Acting on this hypothesis, the Industrial Health Research Board has devised a series of tests which have been uniformly applied to fitters, plumbers, carpenters, engineers, as well as to the drivers of certain public vehicles, with the ultimate object of eliminating those who are most liable to accidents in these various occupations. These tests are, generally and broadly, tests of the accuracy and speed of hand-and-eye co-ordination; and, as might be expected, the scores obtained from them prove to be closely related to manual and mechanical efficiency. Undoubtedly the ablest workers sustain the fewest accidents; but it seems also that there really exists in every individual in a certain degree a general susceptibility to the very different kinds of accidents that may occur in widely different occupations.

Nevertheless, those who have had the most experience in vocational selection have come to place greater reliance on tests which have been devised after a special study of the conditions and requirements of the particular occupation to which they will be applied. It is therefore also a possible, and it may well be a more promising, line of research to study the special qualities required for the successful avoidance of accidents in any one particular occupation and then to devise methods for the assessment of those qualities in that occupation. This has been the method adopted by the National Institute of Industrial Psychology in regard to the selection of car drivers.

In any event, before applying them to new applicants, the psychologist will test his tests by applying them to drivers good, bad and indifferent, in order to ascertain the correlation between the scores made by them at the tests and the known frequency of their accidents on the road. This

correlation reaches a satisfactory degree in the case of the Institute's methods.

The motor-driving tests which have been devised and installed at the National Institute of Industrial Psychology assess separately—speed of appropriate reaction to a given signal, resistance to distraction, the ability to 'attend to several things at once', vision, judgment of size and speed, and also self-confidence, road behaviour and manipulative ability. Although no single mental test, whatever its nature, can ever be absolutely infallible, together these tests appear to afford a sufficiently reliable criterion of driving ability. They assess certain important, innate qualities, of which some will doubtless appreciably improve with practice, but others of which are not susceptible of such obvious improvement. They do not pretend to determine that a driver who passes them satisfactorily will never be prone to reckless conduct; but they do claim to select those drivers who possess the necessary abilities to extricate themselves from a dangerous situation when it confronts them; in other words, such tests when applied to the selection of drivers do reduce their liability to accident. Similar tests applied to drivers in the Paris omnibus service have, according to the most recent data published, reduced the accidents to these vehicles by 66 per cent between the years 1929 and 1933, although the number of omnibuses had meanwhile increased by 77 per cent and their speed limit by 44.5 per cent. During the same period, the total number of motor-vehicles in Paris increased by only 35 per cent, but their accident rate *increased* by 5 per cent. This difference has been attributed to the use of selection tests. No comparable data are available in Great Britain. But it is noteworthy that in the Metropolitan Police District of London, between April and the first half of August of this year, the total number of persons killed and injured from all road accidents was reduced only by about 9 per cent, as compared with the same period during the previous year; while the number of licensed motor vehicles throughout Great Britain increased by about 7 per cent.

If the application of such selective tests results occasionally in the exclusion of good drivers, whether public or private, some hardship must be incurred individually. But surely from the point of view of the community, it is far better to inflict occasional hardships on the individual than to admit by our present far less efficient methods of selection, those who will afterwards reveal their unsuitability as drivers by injuring or killing their fellow-citizens. Even if public opinion is not ready to concede this, these tests will still undoubtedly prove helpful in the case of 'border-line' entrants to the Ministry of Transport's examination, in



confirming the unfitness to drive of those whose conduct has resulted in threatened or actual accidents, or in indicating what is amiss in them and what may be amenable to correction. They will also prove useful in selecting the best applicants for driving public vehicles and vehicles owned by commercial or industrial companies.

If stringent selection is impossible, and if proper mechanical safeguards have been introduced, training is the next most important prevention against accidents. Clearly, the pedestrian and the bicyclist cannot be selected; it is therefore essential that they, above all others, should receive instruction how to avoid accidents from motor traffic. There is one truth which the experienced industrial psychologist never tires of asserting, that no one should be permitted to pick up his methods as best he can—not even the road user! Systematic training is essential for all road users, including the car driver. Yet at present no systematic training is required even from the latter.

A still wider problem of psychological importance relates to the most effective forms of propaganda and of appeal to the public for the improvement of road behaviour. The methods devised by the industrial psychologist in market research would prove of great value here. These methods have hitherto been employed to save the waste of time,

effort and expense which is so often incurred when the psychologically untrained industrialist places an advertisement or a new design or package of goods in the market in the mere *belief* that it will be commercially successful. Market research consists in ascertaining systematically and directly what the general public desires and prefers, and in ascertaining the differences in desire and preference due to sex, age, social level, etc. Experience in such market research has enabled the industrial psychologist to avoid various pitfalls which await the inexpert, untrained person. If his methods were applied to the discovery from all angles of the most attractive, least resented forms of propaganda and appeal to the general public in regard to the avoidance of dangers on the road, this would prove to be yet another psychological approach to the problem of road accidents.

Thus there are many ways in which the special abilities and training of the applied psychologist can be utilised—in the design of traffic and car signals and car controls, in the nature and multiplicity of traffic regulations, in the illumination of roads and vehicles, in incentives, propaganda and instruction of road users, in inquiries into accidents and defective road conduct, and in the selection and rejection of drivers.

## Progress in the Gas Industry

PEOPLE are so accustomed to having gas on tap, requiring only the aid of a match to give them heat or light, that they are prone to forget the gas industry is a progressive one, continually improving on the production side, in quality of product and in the efficiency and adaptability of the apparatus used to burn it. It is a proud boast of the industry that gas excels all other public services in reliability.

In this Jubilee year it is appropriate to summarise the developments throughout the industry during a quarter of a century: this has been happily done in the summer number of *West's Gas Journal*, which contains articles by several leading experts in the various sections of gas engineering. A brief epitome of the developments should be of interest to a wider public, since coal and its carbonisation form one of the major problems of Great Britain. The use of raw coal in the domestic grate and many other appliances, including the factory boiler and furnace, has been condemned for years, and a prior treatment advocated to recover the volatile constituents leaving the smokeless fuel—coke—for burning. The old customs die but

slowly though there now appears to be an acceleration in the disuse of raw coal, judging particularly from the statistics of railway traffic.

Gas is made by carbonising coal in horizontal or vertical retorts or in large chambers. In 1910 vertical retorts were newly introduced; they have since made great strides. The methods of charging the coal and discharging the coke have been greatly improved, as also the manner and economy of heating the retort settings. As a consequence, the number of gaseous therms per ton of coal carbonised has considerably increased.

Since the Gas Regulation Act of 1920, gas has been sold on a declared calorific value and charged for by the therm instead of by volume, though it is this which is actually measured by the meters. The London undertakings have tended to keep a higher calorific value (of 500 B.T.U.) than the provinces, in part owing to the necessity of getting a higher duty out of their distribution mains. It is desirable to emphasise that the great gas companies send out a gas of constant heating value, at a constant pressure, of a constant density and low in sulphur, so that it burns in suitable apparatus



without any regulation. Coke at one time was regarded as a by-product and its quality varied accordingly; to-day it is standardised as carefully as is gas and distributed graded as to size, ash content and burning capacity, so that it requires a minimum of supervision when burnt in closed stoves. A great amount of scientific work has been applied to realise these high standards of quality of gas and coke, and the achievement is no mean one. The penetration of the chemist into the gas industry largely coincides with the Jubilee period: he is being regarded more and more as one of the key men in the industry and there are not wanting those who regard its future as largely on the chemical side.

The gas engineer continues to develop improvements in detail and to organise gas matters on a larger scale, including carbonising, purification and distribution. Condensing practice has changed in favour of the horizontal tube form of welded steel construction, electric precipitation removes the last traces of tar. Centrifugal and static type washers are in use, and it has become customary to remove naphthalene and benzole by washing. Unfortunately, the ammonia recovery has received a setback owing to the fall in price due to the competition of the synthetic product. Purifying is almost exclusively done with oxide of iron, which enables the sulphur to be recovered in a marketable form; in some cases the sulphur is almost completely removed by a catalytic process, though generally this problem is still left for the future. For storage purposes, the waterless holder now competes with the old-fashioned gasometer: in Great Britain it is still in the experimental stage in regard particularly to economy of maintenance and the extra supervision required,

though both on the Continent and in America it has become widely adopted.

High pressure distribution of gas has brought new problems, largely solved by the use of welded steel tubes. The introduction of spun cast iron pipes has increased their length and given a more homogeneous material than ordinary cast iron.

For a long time the output of the industry increased each year. Latterly, there has come a great change in the domestic habits of the people, and gas also has to face intense competition from other sources of light and heat. In consequence, there is an awakening to salesmanship with the provision of show-rooms. In particular, a great stimulus has been given to the improvement of gas-cookers and fires which, since 1910, have been bettered in all respects almost beyond recognition. The same applies to water heating and to the use of gas for industrial heating, a field in which there is great development taking place. Lastly, gas holds its own for street lighting, as an evening in the streets round Whitehall or in South London will testify. Here the physicist has been called into co-operation so that the maximum light can be directed along the length of the road.

This brief sketch indicates the virility of what is now an old industry, largely due to the more scientific outlook which it is showing towards its problems. There is a tendency to concentrate the industry in larger units, either by regional absorption or amalgamation of the smaller companies by the larger, or by the purchase of isolated companies by holding groups. The former plan obviously makes for greater efficiency and benefit to the consumer; the latter move is regarded with some unrest by many.

## Chemotherapy of Malaria\*

By Colonel S. P. James, F.R.S.

WITH the distressing effects of the malaria epidemic and famine in Ceylon still fresh in our minds, the subject of the chemotherapy of malaria may very appropriately be discussed at the present time. The area affected was not so large as Yorkshire, but the cost of relief measures was about £350,000, and during the six months from November until April, 14½ tons of quinine, costing £50,700, was used. About £20,000 was also spent on the new antimalarial remedy called atabrin. The epidemic reminded the world once

again that no royal road or short cut to the prevention of malaria has yet been found. During recent years similar reminders have come from British India, Malaya, East and South Africa, Nigeria, the Sudan, Mauritius, Trinidad, Barbados and other British territories overseas. A few years ago an epidemic in British India prostrated the whole population of an area twice as big as England. The ordinary business of large cities was interrupted, no labour could be obtained, transport was disorganised, and even sellers of food ceased to carry on their trade. In one group of towns and villages the deaths during the month

\* Opening of a discussion in Sections B (Chemistry) and E (Geography) of the British Association at Norwich on September 9, 1935.



of October, instead of being as in a normal year about 6,840, were 76,250.

The financial losses due to such an epidemic, or to the recent epidemic in Ceylon, are quite incalculable, but some idea of the cost of malaria is indicated by the amount of money spent in ineffectual attempts to combat it. For example, the island of Mauritius has spent more than  $3\frac{1}{2}$  million rupees on antimalarial measures since 1909, but the prevalence of the disease has not appreciably decreased, and local experts have recently suggested that the whole question should be studied anew with the object of discovering some less costly method of checking the scourge. Lagos, the capital of Nigeria, has spent even more money with less success, for the present position is that every native inhabitant of the town above one year of age has the disease.

Perhaps the most striking examples of failure to prevent malaria by applying the teachings of existing knowledge occurred during the War. One example must suffice. In June, 1916 a British division moved forward from Salonika to occupy the valley of the Struma river in Greek Macedonia. About a fortnight after entering the valley the troops of the division began to go down with malaria at the rate of more than 100 a day. During July and August there were 5,000 cases; in the whole year there were 30,000 and the next year 70,000. A French army corps under General Sarrail held the line next to our troops. That army entered the valley 115,000 strong, but within the next few months 60,000 were down with malaria, and by the end of the year only 20,000 were left in the line. General Sarrail reported to the French Government that his army was immobilised in hospital. The German army on the same front suffered equally, but it is not difficult to picture what would have happened if either of the opposing forces in that war region had been able to keep its soldiers free from the disease.

In view of these and other examples it has to be admitted that, despite some remarkable discoveries, existing knowledge on the prevention of malaria is not sufficient. Direct war on the malaria-carrying mosquito is too difficult and too costly for general use, and quinine has failed to maintain its old reputation as the sovereign remedy which meets all needs. More knowledge is needed in many different directions, one of them being chemotherapy, in which subject British chemistry has as yet played only a very small part. This seems surprising when we reflect that, of the  $3\frac{1}{2}$  million deaths from malaria recorded in the world every year, the great majority occur in the British Empire, and that the British Empire alone spends every year about £450,000 on quinine.

Quinine has been in general use for nearly a hundred years, but no one knows, and scarcely anyone is trying to discover, how this remarkable natural remedy acts. Even yet its merits and defects as an antimalarial agent are very imperfectly understood, and it has been said that there are almost as many methods of treating malaria with it as there are physicians who use it. To a considerable extent it satisfies the practising physician because it promptly stops most clinical malarial attacks, but it has grave defects from the point of view of preventive medicine for it does not prevent infection of either the human host or the mosquito, and it does not prevent relapses. These defects became strikingly evident during the War, and in consequence it was realised how advantageous it would be to have antimalarial remedies which would be effective for particular purposes for which quinine is known to fail.

To discover and prepare such drugs is the chief aim and object of antimalarial chemotherapy. What is aimed at is not to supplant quinine, but to supplement it with additional weapons for use in particular circumstances and for particular purposes. In Germany, two synthetic antimalarials, plasmoquine and atebirin, which to a considerable extent fulfil that requirement, have already been discovered, and now it is hoped that Great Britain will make adequate arrangements to pursue the subject in the same intensive way and with the same objects in view. Up to the present the chemical industries of this country have not concerned themselves with the matter, and the grants which have been allotted by Government during the last few years to assist antimalarial chemotherapeutic research have amounted to less than a two hundredth part of the Empire's annual bill for quinine.

If and when adequate arrangements for antimalarial chemotherapeutic research are made in Great Britain it will, of course, be one of the tasks of the biologist to tell the chemist all that he knows of the life-history and biological properties of the various species of malaria parasite, and for what particular purposes he is desirous of being supplied with drugs that are superior to quinine. As Sir David Prain said a few years ago: "When medicine is in a position to tell chemistry exactly what medicine requires, the chemist will in due course deliver the goods". Prof. Robinson has said much the same thing in other words, so I shall now give some indications on that subject by pointing out the chief defects of quinine as an antimalarial agent, and some of the merits of atebirin and plasmoquine as additional antimalarial weapons.

The first and by far the most important defect of quinine is that it does not prevent infection:



it is not a true causal prophylactic. What we want is a drug which, taken in non-toxic doses, will entirely destroy the organisms injected by infected mosquitoes before these organisms begin to continue their developmental life-cycle in the human host. Until a few years ago quinine was thought to be effective for this purpose. It was thought that if persons in malarious places would take a dose of quinine at sunset and another at sunrise, all the germs injected by a mosquito which had bitten them during the night would be killed and they would not suffer from malaria. Clinical observations give no support to that belief. For example, the temperature chart of a person who took ten grains of quinine shortly before being bitten by mosquitoes, the same dose shortly after being bitten, and the same dose daily thereafter for ten days showed that these prophylactic doses had no effect in preventing or delaying the malarial attack. Another trial with larger doses of quinine showed the same failure. The attack occurs, even when prophylactic doses of 45 grains (3 grams) of quinine are used.

It is interesting and important that the same trials with either of the new synthetic preparations plasmoquine or atebtrin give a quite different result. In a comparative trial with quinine and atebtrin and plasmoquine against infections of malignant tertian malaria, all the controls who took no prophylactic drug and all those who took quinine as a prophylactic had their attack of malignant tertian malaria within the usual incubation period, but none of those who took atebtrin or plasmoquine had any malarial attack.

Atebtrin and plasmoquine do not work so well as true causal prophylactics against benign tertian malaria as they do against malignant tertian, but lack of time prevents my giving details on that subject. The point I wish to make is that these drugs are not simply substitutes for quinine: they are new weapons with a specific action on a phase of the parasite against which quinine has no effect.

A second defect of quinine is that it is not equally effective against all species and strains of the human malaria parasite. This defect is common to all known antimalarial remedies, and is the chief reason why it is desirable to have several drugs at disposal for treatment in order that, when one fails, another may be tried. For example, some strains of malignant tertian malaria are not at all susceptible to quinine, but are very susceptible to atebtrin. On the other hand, some strains of benign tertian malaria react quicker to quinine than to atebtrin, and for this reason many clinicians prefer to 'break the fever' (as they say) with quinine, and to continue later with atebtrin.

A third defect of quinine is that it is not very

effective in preventing the relapses which are such a troublesome feature of some cases of malaria. Here again a chief difficulty arises from the fact that different species and strains of the malaria parasite react differently to the various anti-malarial remedies at present known. In malignant tertian malaria, relapses may often be entirely prevented by treatment with atebtrin instead of with quinine. On the other hand, the relapses of benign tertian malaria are much more difficult to prevent. The most important type is that which occurs about eight months after recovery from the primary attack. It is the type which causes what is called 'the spring rise of malaria' in northern Europe and other countries. It was the type responsible for the second wave of the recent malaria epidemic in Ceylon. No drug treatment yet known will prevent this type of relapse.

Lastly there is the problem of preventing the spread of malaria by what is called gametocyte therapy. Gametocytes are the forms of the malaria parasite which infect mosquitoes, and it has long been known that in malignant tertian malaria quinine is quite ineffective in preventing the infection of mosquitoes which feed upon persons suffering from this disease. Plasmoquine, on the other hand, is so effective against the gametocytes of malignant tertian malaria that doses even as small as two centigrams are sufficient to prevent mosquito infection. For this purpose, therefore, plasmoquine is a new antimalarial weapon of proved efficacy. But a further requirement in this category is a drug that will prevent the production of gametocytes in the human host and their appearance in the peripheral blood from which they are sucked into the stomach of the mosquito when it feeds on infected persons. Plasmoquine kills gametocytes *after they have been produced and have appeared in the peripheral blood*, but it does not arrest their birth and development.

From these few examples it will be evident that the epoch-making discoveries made by Prof. Schulemann and his colleagues at Elberfeld have placed in our hands new antimalarial weapons of great power and precision, but that there is still ample scope for further research in Great Britain and other countries. It is not expected, of course, that in England funds available for chemotherapy research will ever be provided on the same scale as in Germany, but the British Empire with its vast malarious territories in Africa, India and the Far East is more concerned with the provision of effective antimalarial agents than is any other group of nations in the world and, having regard to the humanitarian, economic and imperial interests at stake, it is greatly to be hoped that something will be done about it.



## Obituary

General A. W. Greely

**A**DOLPHUS WASHINGTON GREELY, whose death was recently announced, was born in Massachusetts in 1844, and in 1867 joined the Signal Corps of the regular army. In 1881 he was placed in command of the United States expedition to Lady Franklin Bay, Smith Sound, which was one of the two American circumpolar stations in connexion with the first International Polar Year. Greely and twenty-five officers and non-commissioned officers of the United States Army, with two Eskimos, were landed at Lady Franklin Bay on August 18, 1881, and a station, named Fort Conger, was erected. The ship then departed, her commander intending to return the following summer and not expecting any difficulty in again reaching the station. Admiral Nares had taken the *Alert* farther north, off the same coast, in 1875; but these ice-infested channels are seldom navigable, as the British expedition organised by Shackleton's younger son found only last year. Scientific observations were begun, and much game, especially musk-oxen, was seen. Some of these cattle were shot, and eaten during the winter.

In 1882 Lieut. Lockwood made a sledge journey along the north of Greenland, on which he discovered and charted about 125 miles of new coastline, beyond the farthest point reached by Beaumont of the Nares Expedition. Lockwood reached the record latitude of 83° 24' N. in long. 40° 46' W. Greely himself made even more interesting discoveries in the interior of Ellesmere Land, including Lake Hazen, more than fifty miles long, mountains, rivers and a number of Eskimo bone instruments. The relief ship failed to arrive and a second winter had to be spent at Fort Conger, as other parties, less well supplied, have done. There were caribou as well as musk-oxen, and salmon in the Lake Hazen district.

In April 1883, Lockwood followed Greely westwards, but completely crossed Ellesmere Land to Greely Ford, where he discovered a weird and wonderful cañon country. As the ship again failed to arrive, the outlook was serious and a retreat southwards was begun on August 18. News was found that the ship had been lost. Greely's party reached Cape Sabine on October 12 with very little food, and in this district game was scarce. In November the rations were reduced to 14 oz. a man a day, and in January 1884 the first man died. Lockwood kept his meteorological record until April 7 and died two days later. On May 24 all the food was finished, except for seaweed and shrimps, though the men became too weak to procure them. One man had to be shot for stealing on June 6. The seven survivors, including Greely, were rescued on June 22.

Greely gave the results of the expedition in his "Three Years of Arctic Service" (2 vols., 1886), which is worthy of comparison with the greatest works of other explorers. Work in the Signal Corps then

claimed Greely, who eventually became Major-General and Chief Signal Officer. In 1909 he published a "Handbook of Polar Discoveries", in 1912, "True Tales of Arctic Heroes", in 1927, "Reminiscences of Adventure", and the following year, "The Polar Regions in the Twentieth Century". In 1923-24 D. B. MacMillan placed a tablet on Cape Sabine in memory of the disaster; and in 1934 Greely was awarded the Congressional Medal of Honour. The Royal Geographical Society recognised his services by the award of the Founders' Medal in 1886. He was one of the founders of the American Geographical Society, to which he bequeathed his Arctic collections. Greely did excellent work in his day and set an example, not always followed, of careful and accurate detail. He was an explorer of whom the United States may well be proud.

J. G. H.

Dr. F. E. Rowett

TECHNICAL education in London has suffered a great loss by the death of Dr. F. E. Rowett, principal of the North Western Polytechnic. His career is an excellent example of the use of the facilities offered by our modern educational system, for a youth having ability and perseverance, to climb the academic ladder.

Dr. Rowett was the son of Capt. J. Rowett of the Board of Trade. His early life was spent at Portsmouth, after which the family moved to Gillingham, where he attended the Wesleyan Elementary School until he entered H.M. Dockyard, Chatham, at fourteen years of age, as an engine-fitter apprentice. Besides attending the Dockyard School, he went to Gillingham Technical Institute in the evenings and eventually obtained a Whitworth exhibition. After spending one year at East London College under Prof. D. A. Low, he obtained a Whitworth scholarship, the first year of which he spent at the Royal College of Science under Prof. Perry and the remaining two years at St. John's College, Cambridge, where he took his degree in 1914 on the research side, working under Prof. Bertram Hopkinson. In 1915 he joined the research staff of the engineering laboratory of the Royal Naval College, Greenwich, under Sir James Henderson, where he did good work on war problems for the Navy and Air services until 1918, when he was appointed principal of the Medway Technical Institute, Gillingham.

In this new post, Rowett left his mark as an organiser and teacher by re-equipping the laboratories and raising the standard to the requirements of the Board of Education, and when the new North Western Polytechnic was erected in London, he was selected to be its first principal. He planned the equipment, he gained the confidence of the Governors, the loyal co-operation of his staff and the affectionate regard of the students.

While at the Medway Institute, Rowett had taken the B.Sc. degree, London, in 1919, with first class



honours, and his D.Sc. degree in 1921 for a thesis on "Accurate Viscosity Determination of Fluids". His published papers deal with elastic hysteresis in steel, elastic properties of steel at moderately high temperatures, and viscosity of liquids; but his research work at the Royal Naval College has not been published.

Dr. Rowett was of a very retiring and modest nature, a skilful engineer and an ingenious research worker of great ability, very thorough in all he did. His work was his hobby, and forms a lasting memorial to him. Ill-health overtook him in his prime and he died at the early age of forty-six years. J. B. H.

WE regret to announce the following deaths:

Prof. A. V. Fomine, director of the Botanical Museum of the Ukrainian Academy of Sciences, and professor of botany in the University of Kiev, an authority on the Cryptogams and plant geography, on October 16, aged sixty-six years.

Prof. J. G. Goodman, emeritus professor of civil and mechanical engineering in the University of Leeds, on October 28, aged seventy-three years.

Prof. Frederick L. Ransome, professor of economic geology in the California Institute of Technology, on October 6, aged sixty-seven years.

## News and Views

Sir Charles Sherrington, O.M., G.B.E., F.R.S.

THE official announcement of Sir Charles Sherrington's retirement from the Waynflete professorship of physiology at Oxford recalls the simple but moving ceremony which took place at the Oxford meeting of the Physiological Society in July. Sir Charles was then presented with an address recording his long association with the Society, and expressing the esteem and affection of his fellow members. These feelings are world-wide. Sir Charles's studies of the nervous system will command the admiration of neurologists for years to come, but those who have been privileged to know him personally have far more to admire. During his tenure of the chair at Oxford, the conception of the nervous system which he originated has become part of the classical doctrine of physiology. At the same time, his more recent studies have made Oxford the chief centre in Great Britain for research on the central nervous system. He has been president of the Royal Society, has served on countless scientific committees, and recently has done much for the improvement of scientific bibliography. Though we may regret the loss from active work of such a leader, we cannot grudge a rest and change of scene to one whose example has so enriched the scientific life of our time.

### Progress in Medical Science

IN his Sir Halley Stewart Trust Lecture on October 31 in the Memorial Hall, Farringdon Street, London, E.C.4, Prof. Edward Mellanby, secretary of the Medical Research Council, discussed recent developments in medical science. He said that it is only in the past hundred years that medicine has made substantial advance. This relatively dormant state of knowledge lasting over a period of thousands of years was due partly to the idea that disease was caused by the invasion of the body by evil spirits—a view held by the Egyptians, Babylonians and Assyrians—and partly to the belief that man's body was of no account as compared with his soul—a view held

throughout the Middle Ages. Landmarks of medical advancement were introduced on the anatomical side by the Italian school as represented by Vesalius and on the physiological side by Harvey, who gave the first classical demonstration of the possibilities of acquiring knowledge by the experimental method. By the time of Pasteur, the field was set for development and intensive study. Pasteur's work on enzyme action immediately opened up a new chapter of knowledge and led to the work of Lister on antiseptics and of Koch on bacterial disease in general. In the present century, medical research has become more and more intense. In Great Britain, the Medical Research Council was initiated in 1913 and, besides using its own public funds, it has the privilege of working in close association with the efforts of private benefactors such as the Lister Institute of Preventive Medicine, founded by Lord Iveagh, the Rockefeller Foundation, and the trusts formed by Sir Otto Beit and Sir Halley Stewart. On the administrative side, the greatly increased activities of the Ministry of Health and local health authorities have resulted in the application of new knowledge acquired by research to the practical problems of health.

PROF. MELLANBY gave some results showing the effect of advancement in medical science on mortality rates. The infant mortality rate in the period 1896–1900 was 156 per 1,000 births registered; in 1934 it was 59. The mortality rate of men between 45 and 55 years of age was 20.3 per 1,000 males in the period 1870 to 1875; in the period 1926–30 it was 11.7. Progress in medical science has tended in recent years to centre round three types of knowledge affecting: (1) Problems of infection—protozoal, bacterial and virus—and their control by raising the immunity. In this way such diseases as smallpox, measles, diphtheria, meningitis and scarlet fever have been influenced. In a group of 399 London children recently treated by immune serum, not one had died of measles, whereas in a control group the death rate



was 5 per cent. (2) Diseases due to abnormality of internal secretion, such as diabetes, pernicious anæmia, Addison's disease, myxœdema, cretinism and simple goitre, tetany and osteitis fibrosa cystica. As an example, reference was made to the latest results obtained in the treatment of pernicious anæmia by the pure or nearly pure anti-anæmic principle of liver as recently isolated by Dakin and West. So little as 0.2 gm. injected once weekly has a remarkable curative effect on this otherwise deadly disease. (3) Nutritional disease: Dr. Mellanby illustrated this subject by showing how discoveries leading to the cause, prevention and cure of rickets had been obtained. He also dealt with the problem of defective teeth and said that dental decay will remain a scourge in Great Britain unless methods are adopted of feeding infants and children on diets which would produce perfectly formed instead of the present imperfectly formed teeth. He described the beneficial effect of such substances as abundant milk, egg-yolk, fish and animal fats on dental structure, as compared with the harmful effect of cereals such as oatmeal, flour and other similar substances unless balanced by sufficient milk.

#### The Case Against Vaccination

IN his Chadwick Public Lecture delivered at the Royal Society of Tropical Medicine and Hygiene, on November 1, Dr. C. Killick Millard discussed the vaccination question. In the past, one either had to believe in vaccination or to disbelieve in it. Dr. Millard said that his faith in vaccination, as a means for protecting the individual against smallpox, is just as strong and unassailable as ever it was, but he recognises that, as a State institution for protecting the community, infant vaccination has been largely a failure. Until recently, it was taught that the neglect of infant vaccination entailed serious and imminent risk of a return of smallpox mortality. The experience of the City of Leicester, which abandoned infant vaccination fifty years ago, and yet where, during the last thirty years, there have been only two deaths from smallpox, makes such a belief difficult. Since the War, an ultra-mild form of smallpox has appeared in Great Britain and considerable spread has taken place. It has now been officially recognised as a distinct variety, which breeds true, and it has been accorded a separate name, 'variola minor', to distinguish it from the severe form of smallpox, 'variola major'. As a matter of fact, although not officially recognised as such, variola minor existed in Great Britain long before the War, and in certain countries, under the name of 'alastrim', it has existed from time immemorial. Variola minor presents quite a different administrative problem from variola major. Compared with the latter it is non-fatal, non-disfiguring, non-loathsome. In some ways it is no more serious than vaccination, so that no case can be made out for retaining compulsory vaccination merely on account of variola minor. Dr. Millard concluded by expressing the opinion that the repeal of the vaccination Acts is now over-due.

#### Liberation of the Electron

FOR his Friday evening discourse at the Royal Institution on November 1, Mr. C. C. Paterson took as his subject "The Liberation of the Electron". He described how the whole art of electrical engineering had been born again when the electricity, which the older engineers had confined to wires and cables, was liberated from them by the physicist and handed back to the engineer to be exploited in the wire-less valve, the photo-electric cell, the cathode ray tube, and other devices which use 'free electrons'. He demonstrated the essential causes which enabled these devices to establish broadcasting, long-distance telephony, television, and similar social services. The secret of the revolution is that a stream of free electrons, whether in a vacuum or a gas, can be manipulated with such facility that the electricity can be increased or decreased at the rate of millions of times per second, or alternatively as slowly as desired, and no limit is set to the amount of energy which can be so controlled. So much of what we see and hear consists, if analysed, of extremely rapid happenings. The eye and the ear are unconscious of these high-speed fluctuations and vibrations, although sensitive to them. In order that we may faithfully reproduce and transmit these very rapid oscillations and variations, it is necessary to make exact electrical copies of them. This is done by suitably controlling a stream of free electrons. Mr. Paterson went on to point out how the free electron is also being used in astounding ways in the art of electric lighting. The many coloured luminous discharge tubes used for display purposes in the streets are due to the action of 'free electrons'. They have led the way to more brilliant and more efficient industrial light sources. Some of them give much more light for the electricity consumed than existing filament lamps. The effects are the result of high-speed (up to six million miles an hour) encounters between free electrons and the gas atoms in the tubes.

#### Science and Unemployment

IN his presidential address to the Institution of Electrical Engineers delivered on October 24, Mr. J. M. Kennedy dealt mainly with the subject of the distribution of electricity. It is obvious that hand labour is gradually being replaced by mechanical power, and that a large fraction of the labour so displaced is unable to find further employment. There are certain depressed areas in which unemployment is particularly rife owing to the dying out of industries or their transfer to more suitable areas. It is now generally recognised that lack of forethought and absence of planning for the future during the recent rapid industrial development has been one of the main factors that has allowed these industrial troubles to develop. Absence of initiative and the policy of letting things drift often prevent real progress from being made. Mr. Kennedy discussed the relation between advancing applications of science and unemployment. He does not agree with those who fear that any steps taken to plan industry so as to re-absorb the present number of unemployed



will cause difficulty in the event of a great revival of trade. So far as the electrical industry is concerned, those employed in manufacturing, contracting and supply have grown in number from 200,000 to 330,000 in the last ten years. Scientific and technical development soon find a remedy for any potential shortage of work by increasing the rate at which power is developed and utilised. He reminded his hearers that electricity is a commodity in everyday use, and that it is unnecessary to fill up complex forms before it can be supplied. If the present rate of progress is to be maintained, more intensive effort and in many cases an appreciable reduction of tariffs is required.

#### School Dieteries

THROUGH the laxity of their parents in nutritional matters, nearly all children go to boarding schools as 'damaged goods'. This accusation, which is broadly true, is made by Prof. H. E. Armstrong in No. 7 of the gastronomical quarterly *Wine and Food*, in which he reviews Dr. Friend's book "The Schoolboy. A Study of his Nutrition, Physical Development and Health". Schools may not be able to repair the injury inflicted by parental carelessness, but at least they should not add to it, as they commonly do, by providing ill-planned dietaries during the crucial period of adolescence. For more than twenty years resident medical officer at Christ's Hospital, Dr. Friend has striven to better the physical condition of the boys passing under his care by improving the biological quality of the school diet. These experiments have been watched and encouraged by Prof. Armstrong in his capacity as a governor of the school. Prof. Armstrong is constantly directing his stinging wit and pungent criticisms at first one and then another public nuisance. The problem with which he is exercised at the moment is:

"How should the little busy boy  
His belly daily fill?"

Prof. Armstrong urges the introduction of wholemeal bread; far more vegetables, particularly in a raw state; a comprehensive sausage including some of every kind of 'innards'; milk and milk products, of course. For the better provision of bone-forming minerals and vitamins, the milk should be from herds on lime-treated pastures, and in winter-time the cows should be fed on hay made from rapidly dried young grass.

THE large boarding school of the future will call for the exercise of special activities and of special intelligence on the part of the staff. The training of the child's character will be through that most wonderful House of Assembly, the 'tummy', and not through the pursuit of cricket and foot balls and dead languages. The school farm will be as carefully watched as the school classroom. Precious hours of daylight will not be wasted indoors or the health-giving power of light be annulled by over-clothing. Dr. Friend initiated a great work, and Prof. Armstrong has been his staunch supporter, but

how many boys' or girls' schools have such enthusiastic medical officers or governors? Though it is an improvement on customary school diets, the Christ's Hospital diet is still far from ideal: sugar is too plentiful; fresh fruit and vegetables too scarce; not all the bread is wholemeal, and more milk and potatoes might with advantage be included. The progress of experiments with improved diets is hampered in schools, and may be invalidated by the unintelligent opposition of the school teaching and domestic staff, and by lack of co-operation from the boys and girls, who resent food changes, and protest if their expenditure on the 'tuck shop' is curtailed. In spite of these obstacles, we hope the time is near when schools will ensure health not by fighting disease with an array of clinical thermometers and antiseptics, but, by means of proper food and sunlight, building sound bodies resistant to infection.

#### An Experiment in Political Education

THE 'educated electorate' dreamed of by the liberal statesmen of two generations ago is still to seek; the great mass of voters to-day are probably no better qualified than their ancestors of Gladstone's day to form independent judgments of the merits of rival candidates for election to Parliament. A similar deficiency stultifies democratic government on the other side of the Atlantic. The problem how to help the masses to achieve that critical thinking postulated by democratic theory was discussed in a stirring address delivered on July 26 at the University of Minnesota by Dr. J. W. Studebaker, United States Commissioner of Education. Attention was directed in the address to a remarkable experiment now in operation in Des Moines, Iowa, where the local education authority has inaugurated a public forum for adults. Its objectives are, (1) exchange of information and points of view, (2) development of tolerance and open-mindedness and (3) development of critical intelligence. It is recognised that the leader of such a forum must be a man of eminence in the academic world, with both the theoretical and practical knowledge of current affairs which would command respect and, above all, "that serene detachment which alone can guarantee clarity of judgment". The basic conception of the forum is educational with emphasis upon critical thinking as opposed to the emotional appeal and obscurantism of the demagogue. Such forums, Mr. Studebaker thinks, ought to be found in every city and village throughout America; and he forecasts support by the Federal Government for schemes for establishing them. University extension discussion classes in Great Britain were started with similar aims, but failed to attract as participants more than a minute proportion of the electorate. It will be interesting to see whether Mr. Studebaker's suggestions fructify.

#### Origins of Some Mechanical Inventions

FOR his presidential address to the Newcomen Society delivered on October 16, Mr. C. F. Dendy Marshall took the subject of "The Germs and



Development of Some Mechanical Inventions". His address, he said, followed a well-beaten track, but as many uncritical accounts and inaccurate illustrations have been published regarding the early history of pumps and engines, he thought it would be of interest to consider some of the earliest printed records. Recent research has shown that much less is known of such men as Ctesibius and Heron than our fathers thought they knew; and even in the case of Heron, the earliest manuscripts are posthumous to the extent of more than a thousand years. The first printed edition of his "Spiritalia" was in Latin and was published at Urbino in 1573. In this is described the first known application of heat to produce motion in fluids, a device for opening temple doors by the agency of heat, and the famous æolipyle. The word 'æolipyle' has been used by writers in three senses, namely, (1) for a vessel shaped like a retort for producing a jet of steam, (2) for Heron's engine and (3) for a wheel impelled by steam as invented by Branca. The word means the doorway of Æolus, that is, that of the cave in which the winds were kept. After touching upon some of the inventions described by Agricola, Porta, de Caus, Branca, D'Acres, von Guericke, Boyle and the Marquis of Worcester, Mr. Dendy Marshall made some interesting remarks on Papin and his invention of the safety valve. To the plug valve, Papin added the lever and moveable weight, but he did not propose it as a safety valve or hint that it might be useful to prevent explosions. From Papin, Mr. Dendy Marshall turned to the work of Savery and Newcomen on the steam engine, and concluded with some remarks on the early history of tramways, railroads and mechanically propelled vehicles.

#### Road Traffic in the United States

IN a recent radio talk given over the Columbia Broadcasting System, Prof. S. S. Steinberg, of Maryland University, discussed the highways of the United States. With more than 25 million motor vehicles, the business of highway transportation is one of the largest in the country. Last year, holiday motorists in the United States spent almost 600 million pounds. Highway facilities are still far from complete; only five per cent of the three million miles of rural roads are hard-surfaced, while only thirty per cent have received any kind of improvement. In many places, need for reconstruction is urgent, and the mileage of secondary light traffic roads required is very great. The loss of life due to accidents is high, as almost a hundred persons are killed every twenty-four hours, and last year one out of every hundred of the population was injured in a road accident, one of the gravest risks being the 'railroad grade' crossings, of which there are 240,000. About 1,500 persons are killed annually at these crossings; at least 30,000 such crossings are dangerous, and it will take many years before they can be made safe. Congress has provided sixty million pounds of emergency relief funds for this purpose, and the development of 'farm to market' roads will be a great boon to the country. The work will provide

employment for many at present unemployed as the cost of constructing roads is mainly for labour. Mr. Robinson points out that the highways affect everyone vitally as they are the arteries which carry the life-blood of agriculture, commerce and industry, as well as bringing many social and educational amenities.

#### London and Home Counties Joint Electricity Authority

UNDER the Electricity Acts of 1919 and 1922, joint electricity authorities were set up, which were to be representative in these districts of the authorised undertakers, the local authorities, the county councils, the large consumers and other interests. In a pamphlet describing the opening of new electricity showrooms in Sutton, a list of those composing the Joint Electricity Authorities for London and the home counties is given, and a record of the progress that has been made since the Authority took over the undertaking. The list of the members is thoroughly representative, and wonderful progress has been made in developing the industry. By instituting two-part tariffs, assisted wiring and hire and hire-purchase schemes, the electric supply has been made available to the poorest people in the district served, which is mainly residential. The supply area covers 190 square miles and is divided into an inner and outer zone, consumers in the latter having to pay slightly more. The work was taken over in July 1932, and in July 1935 the number of consumers had increased by 89 per cent, the load having more than trebled. The Authority has done much useful work in standardising the apparatus and systems it has inherited. The whole of Surbiton has been changed from direct current to alternating current, and in Sutton the supply is being converted from 200 volts to the standard 230 volts. Practically the whole of the supply is being received in bulk from the Central Electricity Board. The bulk supply from the Grid is taken at 33 kilovolts, transformed at the Grid substations to 11 kilovolts and then transmitted to the Authority.

#### Climate and Health

AT the Harrogate Congress of the Royal Institute of Public Health, Mr. L. C. W. Bonacina delivered an address on "The Study of Weather and Climate in Relation to Public Welfare", which has been published in the *Journal of State Medicine* (43, No. 10). He points out that the effect of climate on general well-being is so complex that it is not possible to discriminate between the different elements, but that in Great Britain the general effect is distinctly favourable. Hence it follows that the effect of a marked change of climate, even if superficially an improvement, as for example a doubling of the amount of bright sunshine, might not really be to our advantage. The great importance laid on sunshine is "probably only an exaggerated response to the evil consequence of smoke-vitiated light and air in the great industrial centres, and the curative results in proper doses of natural or artificial sunlight". The wind and the rain, by cleansing the air, are also of great value,



and Mr. Bonacina is in full agreement with the trend of modern ideas in emphasising the importance for health of frequent contrasts of weather, and especially of temperature and wind. He ends on a practical note by insisting that the open-air study of weather and especially clouds also makes for health by training the powers of observation and inference. Forecasts 'on tap' by wireless are a very good thing, but there are occasions, for example in mountaineering, when much discomfort or even risk might be avoided by the ability to foresee a storm an hour or two ahead.

#### Meteorology of Southern Rhodesia

THE annual report of the Meteorological Department of the Department of Agriculture of Southern Rhodesia for the year ended June 30, 1934, follows the general lines of previous reports (Salisbury: Department of Agriculture, 1934). In the rainy season of 1933-34, as in that of the preceding season, there was substantially less rain than usual, although the formula used for predicting the season's fall had indicated an excess of rain. During the five years for which this computation has been made, this was the first occasion on which the sign of the departure from the normal was not correctly given by the formula. An Aircraft Weather Service that had been organised for Imperial Airways operated satisfactorily during this year, and it was decided to extend the service to all aircraft. Arrangements were made to transfer the observatories at Salisbury and Bulawayo to the aerodromes, where they will be maintained by a staff of two, who will prepare regular weather reports and forecasts, and make observations of the upper winds. According to the report, the provision of an adequate weather service for aircraft is now regarded as the most important function of the Meteorological Department. The number of tables in the report has been reduced owing to financial stringency; but among those included is an interesting one showing the average Rhodesian rainfall for thirty-six years. In the first season, 1898-99, the fall was based on the records of seven rain-gauges, and in the most recent (1933-34), on three hundred and forty-four.

#### A Totalising Anemometer

IN the *Hydrographic Review*, 12, No. 1, Dr. J. N. Carruthers describes a suggested totalising anemometer for oceanographers, the records of which he considers likely to be of value in climatology. Although the ordinary Robinson anemometer is a totalising instrument in so far as it registers the number of miles and fractions of a mile of air that have flowed past the anemometer in a given time, it does not distinguish between the different wind directions, and its records can only be used for obtaining the total run in particular directions in the case of the more complicated self-registering form of this instrument that records automatically both the run and the direction, and then only after laborious calculations. In the instrument described by Dr. Carruthers, a wind vane is used which rotates a vertical rod

bearing at its lower end a circular tank divided radially into eight equal compartments, each of which has a draw-off tap. A separate mast carries a 4-cup anemometer which makes and breaks an electric circuit after a certain run of wind past the cups. When the circuit is made, it energises a solenoid and the latter rocks a small pipe which is pivoted on the rim of a tank in which water is maintained at a constant level by means of an ordinary ball valve. This pipe carries a dipper which delivers a definite quantity of water through it into whichever of the eight compartments of the circular tank is beneath at the time. At the end of a period of observation, the total run of air in each of the eight directions is readily obtained by drawing off and measuring the quantity of water in each compartment.

#### Co-ordination of Scientific Surveys

AT the recent meeting at Norwich of the British Association, Mr. E. Wyllie Fenton made an interesting plea, in a paper read before Section K (Botany), for the extension and co-ordination of the existing Ordnance and Geological Surveys into a wide body to carry out periodic surveys not only of topography, rocks and soils but also of vegetation, agriculture and animal life. Mr. Wyllie Fenton's illustrations of the wider need were mainly botanical, as for example, the invasion of valuable land in Scotland by bracken moving downhill to the better land "like a series of plant glaciers", and the association of this fact with changes in land settlement and agricultural practice. A plea was advanced for a prompter recognition of these significant changes in vegetation and in the results of changes in population, distribution, etc., with the argument that a more scientific utilisation of the land, in housing development, in agriculture and in forestry, etc., would be possible if such a general scientific survey service provided the data. Mr. Fenton recognises, however, the ambitious nature of such a proposal, and suggests that a start might be made by the attachment of a few botanists to the Geological Survey.

#### Metals in the Chemical Industry

IN his Jubilee Memorial Lecture of the Society of Chemical Industry delivered before the Yorkshire Section at Leeds on November 6, Dr. C. H. Desch took as his subject "Metals in the Chemical Industry". The range of both ferrous and non-ferrous metals available for the purposes of chemical industry has been immensely widened in recent years. Resistance to chemical attack is one of the first considerations, and as no one material is resistant to all chemical agents, a choice must be made in each instance, for which ample data now exist. Corrosion fatigue, caused by the simultaneous action of fluctuating stress and of a chemical agent, is quite different from the sum of the actions of fatigue and corrosion, and is responsible for many unexpected failures. Special conditions arise where high temperatures and pressures are involved. Resistance to 'creep' is required as well as chemical resistance, and internal changes may cause progressive weakening. Not only chemical



composition, but also texture, determine the degree of resistance to all these factors. The qualities of metals required for chemical purposes may be improved by (a) the elimination of impurities, (b) adding other metals in such quantities as to produce substantially new alloys, or (c) adding very small quantities of foreign elements which produce an effect great in proportion to their amount.

#### Neolithic Camp in Sussex

DISCOVERIES which will have a bearing of no little importance on the future study of the neolithic age in Britain are reported from Whitehawk Camp, near Brighton. Mr. E. Cecil Curwen, acting on behalf of the Sussex Archaeological Society, with the assistance of Miss Leslie Scott, who has worked at Maiden Castle, Dorchester, has held an archaeological watching brief while the Corporation of Brighton has been engaged in constructing a road across the camp. Whitehawk Camp, which is scheduled under the Ancient Monuments Acts, is one of the largest and best surviving specimens of the neolithic camp of concentric interrupted ditches. In places, the original ramparts still stand seven feet high. The line of the road cuts the line of all four ditches on both sides of the camp, and these are now being cleared down to the bottom and the original chalk. According to a report in *The Times* of November 4, up to the present, the inner ditch has proved rich in neolithic pottery, also yielding great quantities of animal bones, flint flakes, saws, scrapers and a flint axe. Two small pits full of neolithic pottery and animal bones appear to be unconnected with the ditches. Another interesting discovery is a piece of chalk scored with a chess board pattern, similar to a device found on the wall of a pit shaft on Harrow Hill, near Cissbury. Several post-holes on the ramparts appear to have supported palisades, and a similar structure is indicated as forming a side wall to the entrance passage through the outer rampart. These are unique in British neolithic camps. The pottery, which is of modified Windmill Hill type and a type with whipped cord impressions, suggesting Peterborough ware (Neolithic B), should prove an important addition to existing material.

#### Etruscan Forgery in the British Museum

MEMORIES of an ancient controversy are revived by the action of the Trustees of the British Museum in withdrawing from exhibition in the Department of Greek and Roman Antiquities at Bloomsbury the widely known "Cervetri Sarcophagus". The revived and extended interest in Etruscan antiquity, marked especially by the recent publication of Dr. D. Randall-MacIver's researches in the history and affinities of Etruscan culture, is, no doubt, largely responsible for the removal of a piece of which the antiquity and authenticity can no longer be held to be a matter of question, in view of the more critical examination to which details of design, structure and style can now be submitted in the light of greatly extended knowledge. Doubt as to the genuine character of the sarcophagus, indeed, was raised very soon after its acquisition by the British Museum as part of the

Castellani collection in 1873; and it was pointed out in March of the following year that the inscription on its lid was derived in part from a gold brooch in the Louvre, while another inscription, which had been misread, was indicated later as another possible source. The spurious character of the inscription has been admitted even by some who were prepared to argue for the sarcophagus as a genuine ancient example of Etruscan art. Now, however, the recognition of anachronistic and incongruous details in form and design stamp it as a forgery beyond dispute. There can be little doubt that the story to which reference is made in *The Times* of November 2 embodies the truth which came out in the quarrel between the brothers Pennelli, of whom Enrico, employed at the Louvre, boasted that he had made the sarcophagus, while Pietro had sold it to Castellani, stating that he had excavated it at Cervetri. It is unfortunate that the inquiry demanded by Sir Charles Newton, keeper of the Department at the time, was not pressed home.

#### *The Realm of the Stars*

*The Realm of the Stars*, or *Říše Hvězd*, is the title of a monthly journal edited by Dr. Hubert Slouka and published by the Czechoslovak Astronomical Society, which now has more than a thousand members. One of the objects of the Society and its journal is to encourage a wider appreciation of astronomy among educated Slav peoples, and from the journal it is evident that Czechoslovak astronomers are familiar with modern progress and with the latest instruments in use elsewhere. In the last few issues of the journal there are recent photographs showing the appearance of the moon's surface, some spectrographs taken in Czech observatories and a number of illustrated semi-popular contributions and reports. One issue is mainly devoted to the proceedings of the international astronomical meeting held in Paris during July. Czechoslovak astronomers have interested themselves in such subjects as sunspots, the atmospheres of planets, and celestial bombardment. In the annual report for last year it is stated that 11,797 people and 130 school groups visited the Štefánik Observatory, near Prague. The Society also has observatories and branches in several provincial centres, and noteworthy observations from these groups are reported in *Říše Hvězd*, but being in the Czech language they can appeal only to their own members and, in a limited degree, to colleagues in other Slav countries.

#### Nature Protection in Poland

A CENSUS of the wild creatures in the famous Polish National Park of Bialowicza gives the present numbers as 4 wolves, 9 lynx, 3 otters, 5 martens, 4 foxes, 5 badgers, 82 wild boars, 29 stags, 72 roebucks and many hares (*Quarterly Information Bulletin concerning the Protection of Nature in Poland*, 5, II; 1935). In the Park, there now exist 17 European bison, including half-bred individuals, and in Poland as a whole there are 21 of pure breed, out of the 70 known to exist in the world. The State Council for the Protection of Nature in Poland has issued three



small albums, each containing 12 picture postcards of the natural features and the animal and plant life of the parks and reservations, which should help to spread the knowledge of these magnificent natural areas. It is curious to look upon these activities in Poland and the interest of the State and people in them, and to consider that in our more highly populated land, where the need for protection is greater than in Poland, there is no national park at all, and no State attempt to protect the disappearing land mammals, which were once as varied in kind as those of Poland now are.

#### Campaign against Noise in New York

THE New York campaign against noise officially started on October 1, when the Mayor instructed the police to warn offenders and to educate the public without making arrests. The sounding of motor horns between 11 p.m. and 7 a.m. is prohibited, and citizens have been instructed to keep their wireless apparatus at a moderate level. During the first three days, 4,071 warnings were given and 9 summonses were issued. The League for Less Noise has established an office for investigation of complaints, among which motor horns and barking dogs are most frequently mentioned.

#### Early Frost in 1835 and 1935

THE note entitled "The Horticultural Society" which appeared in NATURE of October 19, p. 654, refers to the occurrence of a severe frost (27° F.) on October 20, 1835. Miss E. Armitage, writing from Dadnor, Ross, Herefordshire, remarks that the first frost this season took place on October 20, 1935, with 6° F. of frost. All tender autumn flowers were killed, and, in particular, some spikes of *Kniphofia maxima globosa*.

#### Canadian Earthquake of November 1

FROM the brief account of it that has so far been received, the earthquake that disturbed eastern Canada and New England shortly after 1 a.m. on November 1 seems to be one of great interest. The epicentre is placed by Canadian seismologists at a point about 250 miles north of Ottawa. The shock was severe throughout the whole northern Abitibi region, and at one place railway lines were torn up and twisted. The earthquake is remarkable, however, not so much for its intensity in the central district, which does not seem to have been unusual, as for its large disturbed area. To the south, it was felt at Chicago, Washington, New York and Boston. The northern limit of the disturbed area may be difficult to trace, as it traverses a sparsely inhabited country, but the total area probably exceeds three-quarters of a million square miles, an amount not often surpassed in North American earthquakes.

#### Announcements

THE Mackinnon research studentship of the Royal Society has been awarded to Dr. G. W. Brindley, assistant lecturer in physics in the University of Leeds, for his research on X-ray reflections from metals in relation to atomic vibrations.

MR. P. L. O. GUY has been appointed Director of the British School of Archaeology in Jerusalem for the year ending September 30, 1936, on the retirement of Mr. J. W. Crowfoot. Mr. Guy was formerly chief inspector of antiquities for the Government of Palestine, and has had many years experience of field work and excavation. He has already taken up residence in Jerusalem.

DR. S. I. LEVY will deliver the Brauner Memorial Lecture of the Chemical Society on November 14, at 8, in the rooms of the Society at Burlington House, Piccadilly, London, W.1.

A DISCUSSION on "Some Aspects of the Interaction between Gases and Solids" will be held at the Chemical Society on November 21 at 8 p.m. The discussion will be opened by Prof. E. K. Rideal, who will be followed by contributions from Dr. J. K. Roberts and Dr. R. M. Barrer.

A COMMITTEE has been formed under the presidency of J. A. van Heuven in connexion with the celebration of the three hundredth anniversary of the foundation of the University of Utrecht in 1636.

ERRATUM.—In the last line of the letter by Prof. A. I. Alichanow, A. I. Alichanian and M. S. Kosodaew entitled "Emission of Positrons from a Thorium-Active Deposit" published in NATURE of September 21 (p. 475), the words "per cent" should have been inserted after "0.02-0.03".

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

A lecturer in chemistry in the Sir John Cass Technical Institute, Jewry Street, Aldgate, London, E.C.3—The Principal (Nov. 20).

A civilian technical officer in the Admiralty Technical Pool (engineering or physics)—The Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (Nov. 22).

A principal of the Municipal College, Southend-on-Sea—The Director of Education (Nov. 25).

A deputy director of agriculture in East Sussex, who will also act as vice-principal of the School of Agriculture, Plumpton—The Director of Agriculture, County Hall, Lewes (Nov. 25).

A lecturer and research assistant in the Department of Higher Degrees and Research in the Institute of Education, Southampton Row, W.C.1—The Secretary (Nov. 25).

A head of the Physiology Department of the Rowett Research Institute, Bucksburn, Aberdeenshire—The Secretary (Nov. 30).

A director of the Laboratory of Bacteriology and Pathology in Adelaide Hospital, who will also act as Director of Medical Research in the University of Adelaide—The Agent General for South Australia, British Industries House, Marble Arch, London, W.1 (Dec. 12).

A University professor of statistics in the London School of Economics—The Academic Registrar, University of London, S.W.7 (Jan. 31).



## Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 761.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS

### Radioactive Indicators in the Study of Phosphorus Metabolism in Rats

RECENT progress in the production of radioactive isotopes by neutron bombardment makes the radioactive isotope of phosphorus  $^{15}\text{P}^{32}$  easily accessible. This isotope, which has a half-life value of 17 days, can be utilised as an indicator of inactive phosphorus in the same way that the radioactive isotopes of lead, bismuth and so on were formerly used as indicators of these elements. If, for example, we add active  $^{15}\text{P}^{32}$  to 1 mgm. of inactive phosphorus in such quantity that the Geiger counter registers 1,000 impulses per minute, carry out with the phosphorus activated in this way any sort of chemical or biological reaction and then find that the product obtained gives 1 impulse per minute, we may conclude that 1/1,000 mgm. of the phosphorus originally introduced is present in the product investigated.

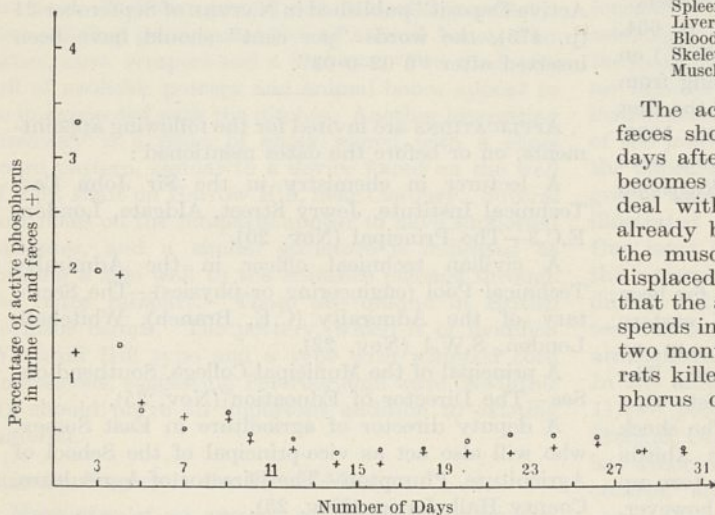


FIG. 1.

(On the first day, 7.4 per cent of phosphorus was found in the faeces and 5 per cent in the urine)

Rats were fed with a few milligrams of sodium phosphate containing  $^{15}\text{P}^{32}$  as indicator. The radioactive phosphorus present in the urine and faeces was then investigated for a period of a month. The result is shown in Fig. 1, which shows the percentage of the 2 mgm. of phosphorus taken, found daily in the excrements. The rat was killed, and, after ignition, the phosphorus content of the different organs was investigated. The result of an experiment in which the rat was killed 22 days after being fed on active phosphorus is seen in the first column in Table 1. The largest part of the phosphorus taken is present in the bones, and the smallest in the kidneys. When, however, we take into account the very

different weights of the different organs and calculate the phosphorus content of the latter per gram after drying, we obtain a very different picture, as seen from the second column in Table 1. The spleen, kidneys, and the brain are found to contain per gram most of the active phosphorus. During one of the experiments, the rat produced six offspring on the seventh day, of which five were eaten by the mother; this caused a large increase in the active phosphorus content of the excreta in the following three days. The presence of 2 per cent of the 2 mgm. active phosphorus taken by the mother was revealed by the analysis of the remaining offspring.

TABLE 1.  
Distribution of the active phosphorus in the rat

	Per cent	Per cent per gm.
Urine .. .. .	26.3	
Faeces .. .. .	31.8	
Brain and Medulla .. .. .	0.5	14.7
Spleen and Kidneys .. .. .	0.2	18.2
Liver .. .. .	1.7	13.9
Blood .. .. .	0.4	1.8
Skeleton .. .. .	24.8	2.8
Muscles and fat .. .. .	17.4	7.4

The active phosphorus content of the urine and faeces shows great fluctuations during the first few days after the intake of the preparation. Later, it becomes fairly constant; and we have obviously to deal with the excretion of phosphorus which has already been deposited for a while in the skeleton, the muscles, or other organs, and which has been displaced again. From our experiments, it follows that the average time which a phosphorus atom thus spends in the organism of a normally fed rat is about two months. This is also supported by the fact that rats killed about a month after the intake of phosphorus contain only about half the active phosphorus found in those killed after a week's time. This result strongly supports the view that the formation of the bones is a dynamic process, the bone continuously taking up phosphorus atoms which are partly or wholly lost again, and are replaced by other phosphorus atoms. In the case of an adult rat, about 30 per cent of the phosphorus atoms deposited in the skeleton were removed in the course of twenty days.

In another set of experiments we investigated the different parts of the skeleton. No conspicuous differences in the active phosphorus content could be found, with the exception of the teeth. The front teeth, which grow rapidly in rats, contained a larger part of the 2 mgm. phosphorus taken than the average of the whole skeleton, the ratio being about 10 : 1 in the case of adult and 6 : 1 in that of half-adult rats, whereas the molar teeth took up less than the average per gram of the skeleton, the ratio being 1 : 2 in the most extreme case. A detailed account of these and further results will be published elsewhere.



We wish to express our thanks to Prof. Niels Bohr for the kind interest he has taken in this work. For the preparation of the radioactive sources, and helpful assistance in making the measurements, we would also like to thank Mr. J. Ambrosen and Mr. S. Høffer-Jensen.

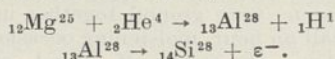
O. CHIEWITZ.  
G. HEVESY.

Finsen Hospital and  
Institute of Theoretical Physics,  
Copenhagen.  
Sept. 13.

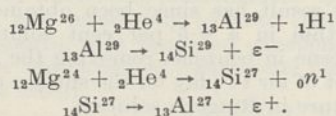
### Induced Radioactivity by Bombarding Magnesium with $\alpha$ -Particles

THE publication of the full details of the following experiments will be somewhat delayed owing to the departure of one of us to Canada. We wish, therefore, to state briefly our main results.

We have examined in detail the induced radioactivity produced by bombarding magnesium with  $\alpha$ -particles. The main effect is due to the well-known body  $\text{Al}^{28}$ , which emits  $\beta$ -rays and has a period of 137 sec.



In agreement, however, with Curie and Joliot<sup>1</sup>, and with Eckardt<sup>2</sup>, we have found the induced radioactivity to be complex, and by analysing the emission with a magnetic field, we have been able to identify two other bodies, present in only small quantities, one emitting  $\beta$ -rays with a period of about 11 minutes, and the other emitting positrons with a period of 5-7 minutes. We suggest these bodies are respectively  $\text{Al}^{29}$  and  $\text{Si}^{27}$ , formed as follows:



By investigating the relative yield of these three bodies when produced by  $\alpha$ -particles of different energies, we are led to believe that  $\text{Mg}^{25}$  has a strong resonance level for  $\alpha$ -particles of energy less than  $5.4 \times 10^6$  volts, and that either  $\text{Mg}^{24}$  or  $\text{Mg}^{26}$ , or both, have a resonance level for  $\alpha$ -particles of energy between  $5.4$  and  $6.1 \times 10^6$  volts.

Using  $\alpha$ -particles of energies up to  $6.6 \times 10^6$  volts to bombard a thick layer of magnesium, we find that the cross-section (integrated over all energies) for proton emission from  $\text{Mg}^{25}$  is about thirty times that for proton emission from  $\text{Mg}^{26}$ , and about three hundred times the cross-section for neutron emission from  $\text{Mg}^{24}$ .

While  $\text{Al}^{29}$  has a period of 11 minutes and  $\text{Al}^{28}$  only 2.3 minutes, yet we find that the  $\beta$ -rays from  $\text{Al}^{29}$  are more penetrating than those from  $\text{Al}^{28}$ . This suggests that  $\text{Al}^{28}$  undergoes a 'permitted' transition (no change of spin) while for  $\text{Al}^{29}$  the transition is 'non-permitted' (change of spin). The strong  $\gamma$ -ray emission from  $\text{Al}^{28}$  shows that the  $\text{Si}^{28}$  nucleus is usually formed in an excited state, whereas our experiments suggest that  $\text{Si}^{29}$  is usually formed in the ground state.

The discussion of these results will be deferred until the publication of the full details of the experiments.

C. D. ELLIS.  
W. J. HENDERSON.

Cavendish Laboratory,  
Cambridge. Oct. 29.

<sup>1</sup> Curie and Joliot, *J. Phys.*, 5, 153; 1931.  
<sup>2</sup> Eckardt, *Naturwiss.*, 30, 527; 1935.

### ${}_{19}\text{K}^{43}$ and the Radioactivity of Potassium

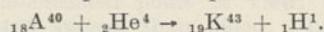
It has recently been suggested by Newman and Walke<sup>1</sup> and Klemperer<sup>2</sup> that the natural  $\beta$ -radioactivity of potassium is due to an isotope  ${}_{19}\text{K}^{40}$  present in very small abundance. Sitte<sup>3</sup>, however, has come to the conclusion that another relatively rare isotope of potassium exists which is the source of the  $\beta$ -particles, and this, he states, can only be  ${}_{19}\text{K}^{43}$ .

It is to be noted in this connexion that  $\beta$ -ray emission occurs from isotopes in which too many neutrons are present, so that we should anticipate, in general, that when two or more  $\beta$ -radioactive isotopes of a single element exist, that those with the higher number of neutrons would have the shorter lives. This is clearly indicated by the unstable isotopes of thallium:

${}_{81}\text{Tl}^{210}$ (RaC'')	1.32 min.
${}_{81}\text{Tl}^{208}$ (ThC'')	3.20 min.
${}_{81}\text{Tl}^{207}$ (AcC'')	4.76 min.

Hence it appears probable that  ${}_{19}\text{K}^{43}$  would have a shorter period than  ${}_{19}\text{K}^{42}$ , since it has a higher number of nuclear neutrons. As the period of  ${}_{19}\text{K}^{42}$  is 16 hours, it is apparent that  ${}_{19}\text{K}^{43}$  could not be the source of the natural radioactivity of potassium.

The period of this isotope could probably be tested by preparing it artificially. Rutherford and Chadwick have observed the emission of protons from argon when bombarded with  $\alpha$ -particles. Since  ${}_{18}\text{A}^{40}$  is 160 times as abundant as  ${}_{18}\text{A}^{36}$ , it is almost certain that the protons are produced by the reaction:



Thus by bombarding argon with strong sources of  $\alpha$ -particles it should be possible to detect the  $\beta$ -radioactivity of  ${}_{19}\text{K}^{43}$ .

Finally, it is to be noted that Nier<sup>4</sup>, using a special type of mass-spectrograph, has detected  ${}_{19}\text{K}^{40}$  present in normal potassium to the extent of about one part in 8,600, whereas he found no trace of either  ${}_{19}\text{K}^{42}$  or  ${}_{19}\text{K}^{43}$  and concluded that these isotopes, if they exist at all, were present in abundance less than one part in 150,000.

It is apparent, therefore, that the hypothesis of Newman and Walke<sup>1</sup> and Klemperer<sup>2</sup> is confirmed by mass-spectrographic evidence, whereas that of Sitte<sup>3</sup> is not.

*Note added in proof.* The existence of  ${}_{19}\text{K}^{40}$  has been confirmed by Brewer (*Phys. Rev.*, 48, 640; 1935), who estimates the ratio  $\text{K}^{39}/\text{K}^{40}$  as  $8,300 \pm 100$ .

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University of California,  
Berkeley.  
Sept. 12.

<sup>1</sup> Newman and Walke, *NATURE*, 135, 98; Jan. 19, 1935. *Phil. Mag.*, 19, 767; 1935.

<sup>2</sup> Klemperer, *Proc. Roy. Soc., A*, 145, 638; 1935.

<sup>3</sup> Sitte, *NATURE*, 136, 334, Aug. 31, 1935.

<sup>4</sup> Nier, *Phys. Rev.*, 48, 283; 1935.

### A Molecular Map of Resorcinol

ALL those organic compounds which have until now yielded to quantitative X-ray analysis display some element of molecular symmetry in the crystal. The structure of the complete chemical molecule can then be built up from a fraction by symmetry operations, thus greatly simplifying the analysis. But some of the most interesting structures have a lower symmetry, and in these cases the molecule must be treated as a whole. This applies to resorcinol, space



group  $C_{2v}^0$  ( $P_{na}$ ),  $a=10.53$ ,  $b=9.53$ ,  $c=5.66$  A., where the asymmetric unit consists of one chemical molecule. A quantitative analysis of this compound has now been carried out, and the preliminary results have been refined by a double Fourier synthesis which is shown in Fig. 1.

Although the benzene ring is inclined at a high angle to the plane of this projection, it can be seen to answer the tests of a regular plane hexagon. Now if we assume the usual C-C interatomic distance of 1.41 A., the complete orientation of the molecule in the crystal can be calculated from this diagram. The centres of the OH groups are then found to be situated at 1.35 A. from the benzene nucleus. The line joining the OH groups, lying in the plane of the ring, makes angles of  $134^\circ$ ,  $46^\circ$  and  $101^\circ$  with the  $a$ ,  $b$  and  $c$  crystal axes, and the line perpendicular to this, also in the plane of the ring, lies at  $63^\circ$ ,  $77^\circ$  and  $149^\circ$  to these axes.

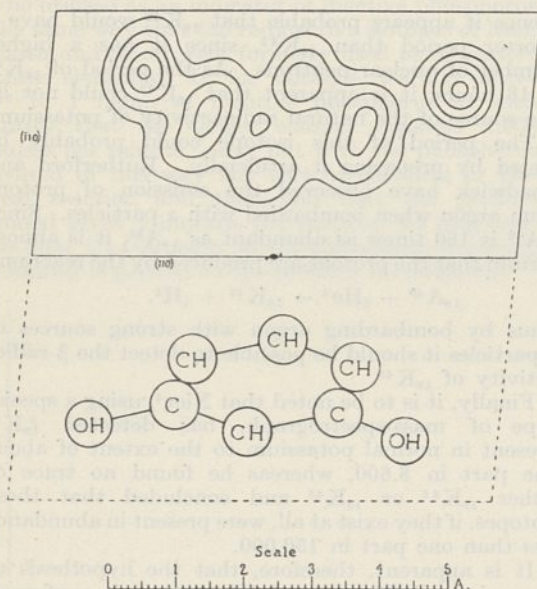


FIG. 1. Resorcinol,  $c$  axis projection. Each contour line represents a density increment of two electrons per square A.

Perhaps the most interesting aspect of the structure is the close approach of the hydroxyl groups on adjoining molecules (not shown in Fig. 1). These groups are arranged in spiral formation about the dyad screw axes, and the distances between successive groups belonging to neighbouring molecules are 2.66 A. and 2.76 A. Now these distances are much less than the observed approach distances for molecules of hydrocarbons (3.4-3.8 A.), where only residual or van der Waals' forces are acting. In benzoquinone, the minimum distance between oxygen atoms on neighbouring molecules is 3.62 A. It is evident that some type of secondary valence force must be assumed between the hydroxyl groups of adjacent resorcinol molecules. From the order of the distances this would appear to be either a strong 'hydroxyl bond', or something intermediate between the Huggins and Pauling hydrogen bond and the hydroxyl bond recently discussed by Bernal and Megaw<sup>1</sup>.

J. MONTEATH ROBERTSON.

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Oct. 12.

<sup>1</sup> *Proc. Roy. Soc., A*, 151, 384; 1935.

## Lecithin as a Dispersing Agent for Dibenzanthracene

DURING the course of experimental work in connexion with his study of cancer at this Institute, Dr. M. J. A. des Ligneris expressed a desire to study the effect of dibenzanthracene on tissue cultures *in vitro*, and invited the co-operation of the Biochemical Department in devising a suitable means of introducing this substance into tissue culture media.

Since dibenzanthracene is insoluble in aqueous media, the preparation of a colloidal solution was considered. Orthodox methods of dispersion from alcoholic solution were unsatisfactory because the low solubility of dibenzanthracene in even boiling alcohol necessitated the addition of so much of the alcoholic solution that toxic concentrations of alcohol were attained. Moreover, in physiological salines no dispersion occurred unless protective colloids such as serum proteins were present.

Familiarity with the properties of lecithin suggested the possibility of using it as a protecting agent. As a preliminary experiment, 100 mgm. lecithin (crude acetone-insoluble lipid from egg-yolk) and 50 mgm. dibenzanthracene were ground together in an agate mortar for half an hour, moistening occasionally with distilled water. By means of 50 ml. of Ringer's solution the mixture was then transferred to a bottle and shaken for two hours. The resultant fluid was yellowish than a solution of 100 mgm. of lecithin alone in 50 ml. of Ringer and remained so on standing a few days despite the settlement of a yellow deposit.

Although aseptic precautions had not been observed, the fluid proved to be sterile on bacteriological control, and was passed on to Dr. des Ligneris for use. His results will be published shortly.

A similar result has since been obtained by dissolving lecithin in a 0.5 per cent solution of dibenzanthracene in benzene, removing the solvent by causing a jet of air to play on the surface and taking up the mixture in Ringer's solution.

No attempts have been made to determine optimum proportions of lecithin and dibenzanthracene, since the above solution appeared to be sufficiently stable for the purpose intended and the examination of colloidal solutions is not regularly undertaken in this laboratory.

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Sept. 23.

## Chemical Nature of the Amino Acids excreted by Leguminous Root Nodules

SOME years ago we showed conclusive evidence that considerable amounts of nitrogenous compounds appear in the medium in inoculated, but otherwise sterile, cultures of leguminous plants. Since then we have tried to isolate these nitrogenous compounds and to determine their chemical nature. The nitrogen compounds were extracted from the quartz sand with water and found to consist chiefly of amino acids. Amino nitrogen determinations according to van Slyke—the reaction mixture being shaken for 30 minutes—showed that 87-98 per cent of the total nitrogen was amino nitrogen. The amino nitrogen values varied to some extent in different extracts.

Further analysis of the amino acid mixture has now led to the following results. About 50 per cent of the total nitrogen consists of amino nitrogen of aspartic acid. This amino acid has been estimated



quantitatively by the aspartase enzyme, and identified qualitatively in the form of the copper salt. Approximately the other half of the nitrogen (40-50 per cent) is precipitable by phosphotungstic acid. Since cystine, arginine, histidine and aromatic amino acids are absent, it is probable that this fraction consists of lysine. Further work is in progress to determine the nature of the compounds precipitated by phosphotungstic acid.

In an earlier paper<sup>1</sup>, it was mentioned that aspartic acid is not present in the amino acid mixture. This erroneous conclusion is ascribable to the fact that, owing to the small amount of material available, the determination was made from the solution from which ammonia had first been distilled off according to van Slyke, in which process aspartic acid seems to be precipitated as a calcium salt.

The composition of the excreted amino acid mixture is very interesting in several respects. In the first place, it confirms our earlier view that the excretion is not ascribable to decomposition of the nodules or the roots. According to our recent investigations the nodule protein contains a variety of different amino acids (tryptophane, tyrosine, arginine, etc.). Hence it follows that, should the excretion be due to decomposition of this protein, the amino acid mixture in the medium would also contain several different amino acids. In view of the fact that the rate of excretion is highest at an early stage of growth, it seems very likely that the excreted compounds represent the primary amino acids formed in the fixation of nitrogen. Since aspartic acid is formed from fumaric acid through a well-known enzymatic reaction, the excretion of large amounts of aspartic acid is a most interesting phenomenon. On the other hand, it is also interesting to note that, in sterile cultures, aspartic acid forms an excellent source of nitrogen for uninoculated leguminous plants, as we have earlier found.

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Oct. 8.

<sup>1</sup> Virtanen, v. Hausen and Karström, *Biochem. Z.*, **258**, 106; 1933.

### Quantitative Determination of Ascorbic Acid

At the sixth Caucasus Congress of Physiologists, Pharmacologists and Biochemists, held in Erivan, Armenian S.S.R., on October 11-17, 1934, a communication was made by A. G. Jonnissian under the title of "Über den Chemismus des Vitamin 'C'".<sup>1</sup>

Amongst other conclusions of the author occurs the statement "Fructose und Arabinose geben mit dem Reagens nach Tillmans [*sic*] ein positives Resultat".

Tillmans recommended the use of 2:6 dichlorophenolindophenol, which has been found by many workers to be a quantitative reagent for ascorbic acid. It is known not to be strictly specific, but the number of naturally occurring substances that have so far been found to interfere with the determination of ascorbic acid by this dyestuff is not great, and methods have been evolved for eliminating their interference. If it were true that widely occurring sugars also interfered, the value of the reagent would be severely limited, and doubt might be cast on much published work.

Using the ordinary technique, we have examined specimens of purified *l*-fructose and *l*-arabinose, and in neither event have we been able to detect the slightest reducing action on Tillmans's reagent. We have no explanation to offer of Jonnissian's results, but we thought it might be of interest to publish the above facts, in case that author's statements should lead other workers to under-value what has come to be recognised as an extremely useful reagent.

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London, N.W.1.  
Oct. 18.

<sup>1</sup> *Proc. 6th Cauc. Cong. Phys. Pharm. Bio.*, Academy of Sciences Press, Moscow and Leningrad, 101; 1935.

### Colloid Osmotic Pressure of the Body Fluids of Marine Animals

EXCHANGES of water between blood and tissues are generally believed, since Starling's work, to be regulated by the equilibrium of two forces, namely, hydrostatic capillary pressure which drives water out into the tissues, and blood colloid osmotic pressure which draws it into the vessels. Based on clinical and experimental investigations, I pointed out several years ago that this assumption leaves out of consideration the role of the tissues, which are, from a physico-chemical point of view, a much more complicated system than blood. In my opinion, the hydration of tissues determines the colloid osmotic pressure of blood, this pressure being but an intermediary between the different tissues<sup>1</sup>.

Comparative physiology has furnished a strong argument in favour of this view. According to Krogh<sup>2</sup>, "when the body is immersed in water the hydrostatic pressure is everywhere counterbalanced and all the capillary systems can be considered as being at the level of the heart. This is probably of some importance for large aquatic animals such as whales which should therefore, in spite of their enormous size, require only a low colloid osmotic pressure in the blood to prevent filtration". This presumption should, *a fortiori*, be valid also for animals of smaller size. I have therefore measured the colloid osmotic pressure of the body fluids of marine animals (serum of fishes, hæmolymph of Crustaceans, Molluscs and Tunicates, cœlomic fluid of *Sipunculus*). The following average values have been given by 140 measurements:

	Colloid osmotic pressure (cm. H <sub>2</sub> O)	
<i>Sipunculus nudus</i>	0.95	(0.7-1.2)
Lamellibranch Molluscs	1.0	(0.8-1.2)
Gasteropod Molluscs	1.5	(1.2-1.9)
Cephalopod Molluscs	3.3	(2.8-3.8)
Decapod Crustaceans	3.6	(2.1-4.4)
Tunicates	1.7	(1.2-2.3)
Elasmobranchs	4.6	(3.1-6.4)
Teleosteans	19.1	(14.6-25.0)

These results show conclusively that neither the postulate of Krogh's theory, nor consequently its reasoning, can be correct: the blood of Teleosteans has a colloid osmotic pressure only a little inferior to that of the blood of the large terrestrial mammals (horse: 22.5-29.0 cm. H<sub>2</sub>O).

What is the explanation of the difference of colloid osmotic pressure of the different animals? An answer to this question is suggested by the striking differences between Elasmobranchs and



Teleosteans. It is well known that not only the skeleton, but also the circulation, respiratory and excretory systems of these two classes of fishes are very different. I incline to the conclusion that the colloid osmotic pressure of the body fluids of an animal is but an expression of its general organisation. With one exception, all the values recorded above can be arranged in the order of phylogenetic development. The only exception to this rule not only does not weaken this argument, but even strengthens it: adult Tunicates are animals degenerated by fixation; their organisation is comparable to that of the gastropod Molluscs; the colloid osmotic pressure of their hæmolymp has indeed the same value as that of this class of animals.

PAUL MEYER.

Station maritime de Biologie,  
Tamaris-sur-Mer,  
and  
Laboratoires Lumière, Lyon.  
Oct. 16.

<sup>1</sup> *Ergeb. Physiol.*, **34**, 18; 1932.

<sup>2</sup> "Anatomy and Physiology of Capillaries". 2nd ed., p. 305. New Haven, 1929.

### Function of the Labral Glands in *Chirocephalus*

MISS NICHOLSON and Prof. Yonge, in their letter in NATURE of October 12, claim to have obtained experimentally the same results that I described<sup>1</sup> from the study of sections of fixed material of the Fairy shrimp, *Chirocephalus diaphanus*. They maintain that they have demonstrated that what I described as the coagulated labral gland secretion is, in fact, the contents of the gut regurgitated as a result of the action of the fixative. But what are the facts? They fed an animal on carmine and then fixed, or rather, killed it, by placing it in a solution of Bouin, and observed that during this process its gut showed a periodic antiperistalsis by which the gut was emptied through the mouth. Now while Bouin is an excellent fixative for isolated pieces of tissue, it is a very bad fixative for an active animal of the size of *Chirocephalus* as it takes far too long to act. I tested it last week and found that one specimen was wriggling violently after a minute, and even after two minutes was still jerking its half-dead limbs. Is it surprising therefore if, during its death struggle, it vomits?

The killing agent in which my animals were fixed was a boiling saturated solution of corrosive sublimate, and it is, without doubt, the high temperature rather than the chemical which produces the coagulation of the tissues. Now in this solution fixation is instantaneous. Even if this word is objected to, it must be admitted that the first parts of the animal to be fixed will be the outer parts, which would include any secretion around the mouth, the mouth parts and the œsophagus. Hence even if, during the 'split' second while fixation is taking place, the animal desired to regurgitate, it would find the way blocked by a fixed œsophagus. On the grounds, therefore, of the totally different technique employed, it is difficult to see why any similarity should be expected between the results obtained in the two cases.

Miss Nicholson and Prof. Yonge go further and maintain that sections of their animal "revealed no essential difference between the distribution" of the regurgitated food and the mass of material that I described as the secretion of the labral glands. Prof. Yonge very kindly lent me his sections, and I was

able to see at once that, on the contrary, they show no real similarity.

I described the arrangement of the coagulated mass as extending backwards from a mass underneath the head region and mouth parts beyond the tip of the labrum where it is sucked against the inner surface of the first two pairs of trunk limbs. In this latter region "it forms a blanket over the anteriorly directed food current converting the anterior part of the food groove into a functional tube". The tube so formed makes its exit around the sides of the labrum through the coagulum. Further, in the atrium oris, that is, in the region where the labral glands open, I described the coagulum as a diffuse scattered mass extending to the actual mouth. Now is it likely that a *Chirocephalus* could regurgitate the contents of its gut and arrange them in this complicated manner? Apart from this, however, the sections which Prof. Yonge sent me showed merely a very large mass of material, completely filling the atrium oris and the food groove as far back as the sixth trunk limb, and even entering the inter-limb spaces, so that it appeared on the wrong side of the filter setæ. There was no trace of the functional tube which I described in detail and illustrated by photomicrographs. The sections showed, in fact, just what one might expect from the crude technique employed. I have photographed the critical sections and can supply copies to anyone interested for comparison with the photographs published in my own paper.

The *a priori* reasons given by Miss Nicholson and Prof. Yonge for opposing my views appear to be based on an erroneous idea of the anatomy of the labral glands and even of the function in forms where this has been established. They state that "All the unicellular glands of the 'Entomostraca', including the labral glands, have essentially the same structure" and suggest that they all produce "a substance of low surface tension which sets as a hard cement on contact with water". But Ostracods are included among the 'Entomostraca' and in this group there is one genus, *Conchoecia*, which is classified on the differences between its unicellular glands, while there are many Ostracods the labral glands of which produce a luminous secretion, and this can scarcely be described as a cement. More important, however, is the fact that the labral glands of *Chirocephalus* are not unicellular. Sections of well-fixed material show at once that they are complex structures (Cannon, 1922)<sup>2</sup> quite different from the other glands occurring on the trunk limbs and food groove. In fact, it is doubtful if the labral gland of any Branchiopod is unicellular.

H. GRAHAM CANNON.

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Manchester.

<sup>1</sup> Cannon, *Proc. Roy. Soc.*, B, **117**, 455; 1935.

<sup>2</sup> Cannon, *Quart. J. Mic. Sci.*, **66**, 213; 1922.

### Persistence of Sperms to a Later Mating in *Gammarus*

MRS. SEXTON'S recent criticism<sup>1</sup> of my views on the above subject gives me an opportunity of citing further evidence in their favour. So far as I can see, only three explanations of the appearance of the anomalous black-eyed individual (for particulars see my previous note<sup>2</sup>) are possible: that a reverse mutation had occurred, that the individual had been accidentally introduced owing to careless technique, and the one advanced at the time (fertilisation of a single egg by sperm persisting from a previous mating).



No certain data exist on the frequency of mutation in *Gammarus*, but white-eye, the most mutable locus in *Drosophila*, only changes once in about 300,000 individuals, and no mutation has ever been seen in the laboratory in *Gammarus*. Yet a number of curious cases of the type given in my previous note<sup>2</sup> have been observed by different workers. It therefore seems unlikely that they are due to reverse mutations.

With regard to the second possibility. It is the rule in Oxford, as in Plymouth, to give the female in a cross mating a fresh bowl, etc., after her moult. Pipettes are always well washed out and examined, and where possible dried, before being used for another stock. In these circumstances, I consider it very unlikely that the results are due to contamination from other pots.

Fortunately there is in this case definite positive evidence for the third explanation, for the anomalous individual appeared a whole day before the rest of the brood, strongly suggesting that the egg from which it arose had been fertilised before the rest. I do not know how much, if any, of the lining of the oviduct is shed at the moult, but I think that the possibility of sperm persisting in the mesodermal region, and fertilising one egg on its way to the brood-pouch cannot be excluded, and is much the most reasonable explanation of the results observed.

Mrs. Sexton suggests that if this explanation were true, all the genetic work so far done on the species would be valueless. An added precaution is always taken in this laboratory to ensure the authenticity of the offspring. It is clearly necessary to discard the first family, which may have been in the pouch before the female was mated up, but here either the next brood is also discounted or some other precaution to the same effect is taken, and little doubt can be cast on results on this score.

With regard to the statement that Mrs. Sexton had never met a comparable case, it may be mentioned that only in a proportion of instances could the persistence of sperm in this manner be detected.

K. W. YARNOLD.

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Oct. 15.

<sup>1</sup> E. W. Sexton, NATURE, 136, 477, Sept. 21, 1935.

<sup>2</sup> K. W. Yarnold, NATURE, 135, 832; 1935.

### Overlapping of Speech Sounds

THE piece of sound film reproduced in Fig. 1 shows the last part of the vowel and the first part of the consonant in a registration of *ash*. The vibratory bits that characterise the vowel can be traced in ever-diminishing strength to the third line in the reproduction. The mixture of regular and irregular vibrations that characterise the consonant can be traced back to the middle of the first line. The end of the vowel and the beginning of the consonant are seen to be overlapped.

Fig. 2 reproduces macrophonic registrations of the pressure of the breath at the mouth during *a*, *sh*, *e*, *s* and *ashes* spoken on one occasion. Comparison shows that the word *ashes* was spoken with the sounds *sh* and *s* slightly overlapped, and the two vowels mounted on top of them. The overlapping is indicated by the heavy horizontal lines at the bottom of Fig. 2.

As it is not possible to produce two sounds in succession and then by a reversal of time push the later one forward, the overlapping must occur before the sounds are spoken. This indicates that the central—or inner—activity that originates what is spoken has not only dimensions of time and pro-

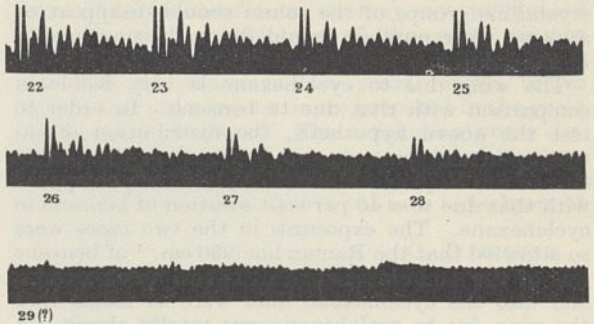


FIG. 1.

minence but also a dimension of breadth that provides for simultaneous events.

The overlapping clears up a mystery. It is well known that the character of a speech sound may depend on a sound that appears later in the printed word. How a sound could work backward against

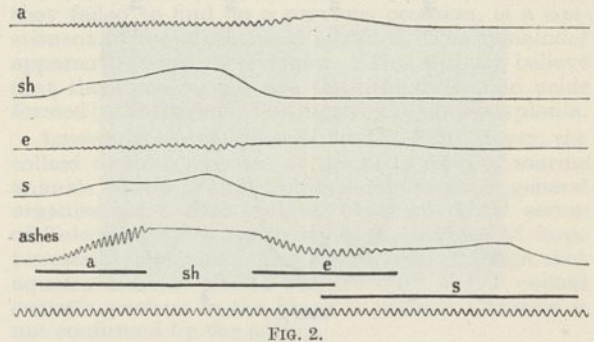


FIG. 2.

time was unexplainable. The difficulty disappears if sounds can be overlapped in the word to be spoken. This principle may well prove fertile in explaining the phenomena of sound change.

E. W. SCRIPTURE.

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### Origin of the Wing accompanying the Rayleigh Line in Liquids

It has been recently reported by Gross and Vuks<sup>1</sup> that, in the light scattered by some organic crystals, there are a few lines or bands very close to the Rayleigh line. The origin of these lines has been attributed to lattice oscillations in the crystals. It has been further pointed out by these authors that these lattice oscillations persist even in the liquid state, but, owing to the looseness of the oscillations in the liquid state, these lines spread out so as to form a continuous wing on both sides of the Rayleigh line. According to these authors, the major portion of the wing is thus due to the persistence of these lattice oscillations in the quasi-crystalline groups present in the liquid, and only the portion very close to the Rayleigh line which increases in intensity with



the rise of temperature may be connected with the rotation of the molecules in the liquid. If this hypothesis be correct, the intensity of the portion of the wing very close to the Rayleigh lines should increase and that of the other portions should diminish on dissolving a liquid in a solvent which itself gives a very feeble wing, because the quasi-crystalline groups of the solute should disappear or at least their number should diminish considerably in the solution.

The wing due to cyclohexane is very feeble in comparison with that due to benzene. In order to test the above hypothesis, the distribution of intensity in the wing due to benzene on the Stokes side of the Rayleigh line 4046 Å. has been compared with that due to a 40 per cent solution of benzene in cyclohexane. The exposures in the two cases were so adjusted that the Raman line  $990\text{ cm.}^{-1}$  of benzene was of the same intensity in the two spectrograms, and also the cyclohexane lines were so feeble that the wing due to cyclohexane was totally absent. A Fuess spectrograph producing absolutely no coma on the Stokes side was used. The microphotometric records of the spectrograms due to pure benzene and the mixture are reproduced as Figs. 1 (a) and 1 (b) respectively.

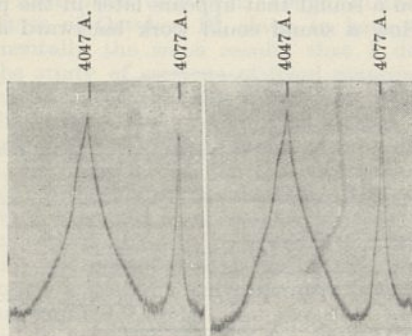


FIG. 1.

It will be seen from these figures that on dissolving benzene in cyclohexane, the intensity of the portion of the wing very close to the Rayleigh line *diminishes*, while that over a short region from about  $50\text{ cm.}^{-1}$  from the centre of the Rayleigh line *slightly increases*, and also the total width of the wing *remains practically unchanged*. These facts are contradictory to the hypothesis of Gross and Vuks mentioned above. In fact, the intensity of the portion of the wing very close to the Rayleigh line *diminishes* also with the rise of temperature in the case of benzene<sup>2</sup>.

It may be briefly mentioned here that the Raman spectra of diphenyl ether and naphthalene in the solid and liquid states and also dissolved in cyclohexane have been studied by me, and it has been observed that the width of the Raman lines or bands lying very close to the Rayleigh line in the case of the solid state increases only slightly in the case of solution. The intensity of the strongest of these lines *diminishes only slightly* in the case of diphenyl ether and *considerably* in the case of naphthalene on dissolving these substances in cyclohexane. These facts suggest that these lines are not due to lattice oscillations but may be due to oscillations of very small groups of molecules which are more stable in the case of polar than in the case of non-polar mole-

cules. These points will be discussed in more detail in a paper which will be published shortly in the *Indian Journal of Physics*.

My thanks are due to Prof. D. M. Bose for his kind interest in the work.

S. C. SIRKAR.

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92, Upper Circular Road,  
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Sept. 20.

<sup>1</sup> NATURE, 135, 100, 431; 1935.

<sup>2</sup> S. C. Sirkar and B. B. Maiti, *Ind. J. Phys.*, 9, 323; 1935.

### Back to Minkowski

A REVIEW of my recent work on "Relativity" appeared in NATURE of October 19 under the above title. There is just one reference which might give a wrong impression, namely, where the reviewer says that the author of the work considers "that the apparent regression of the nebulae may be interpreted as a progressive diminution in the velocity of light". This evidently refers to an article which I contributed to *Engineering* in 1933 and which I had reprinted as Appendix IX of the book in question.

I wish to point out that the implication of the article in question was not to suggest the explanation given but to make it clear that no experiment that could be devised would distinguish between an expansion of the universe and a progressive diminution in the velocity of light. I advanced no argument or theory in favour of one or the other. Philosophically the question is one involving the relativity of magnitude.

F. W. LANCHESTER.

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Birmingham.  
Oct. 25.

THE reference which Dr. Lanchester thinks may give a wrong impression was founded on his Appendix IX, interpreted by the aid of p. x of the preface—"the later discussion (Chapter xiii), in which the doctrines of general curvature and expansion are discredited"—and of pp. 13 and 124—"it is clearly without meaning to talk of the expansion of the Universe unless some part of the Universe be excluded from the general expansion with which to make comparison, and then it is no longer an expansion of the Universe". If my interpretation was wrong, I must express my regrets.

H. T. H. P.

### South and East African Stone Age Typology

IN my letter in NATURE of September 21, p. 475, in the fifth paragraph, I said that the oscillation which marks Bed III at Oldoway and the Intrapluvial in Pluvial II, in Uganda, "may be equated with that between the Kamasian and Gamblian" of Kenya. That was wrong, for it has recently become clear that following the Uganda Pluvial II oscillation, and separated from it by a considerable thickness of sediments, there were two less marked breaks. Study of the implements from these two non-pluvial beds reveals the fact that the last actually represents the break equivalent to that between the Kenya Kamasian and Gamblian pluvials, since in it were



some tools (Late Acheulean) comparable to the Nanyukian. The latter stage was found by Dr. J. D. Solomon on the slopes of Mount Kenya in a rubble which was regarded as marking the Kamasian-Gamblian Interpluvial.

Therefore, the first climatic break in Pluvial II, Uganda, and as recorded in Bed III Oldoway, was a much earlier affair than I suggested.

T. P. O'BRIEN.

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Oct. 19.

### Kelvin and the Age of the Sun

WHEN the age of the sun is discussed, it is often assumed that Kelvin asserted quite dogmatically that the age of the sun could not exceed 20,000,000 years. It is well, however, to turn to his own words on

"The Age of the Sun's Heat" in a lecture printed in *Macmillan's Magazine* in 1862 and reprinted in his "Popular Lectures and Addresses" (vol. 1), published by Messrs. Macmillan and Co. On p. 368, he wrote that it seemed most probable that the sun had not illuminated the earth for 100,000,000 years and almost certain for not exceeding 500,000,000 years. "As for the future, we may say, with equal certainty, that inhabitants of the earth cannot continue to enjoy the light and heat essential to their life, for many million years longer, unless sources now unknown to us are prepared in the great storehouse of creation." The concluding words display the prescience of this great man of science, much of whose work has now become so familiar that we have forgotten that it had ever to be brought into being.

C. TURNBULL.

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Sept. 21.

### Points from Foregoing Letters

THE average time that an atom of phosphorus spends in the body of a rat which has been fed with sodium phosphate is about two months. This is the conclusion to which O. Chiewitz and Prof. G. Hevesy have come by feeding rats with small quantities of sodium phosphate containing radioactive phosphorus as indicator, and analysing the excreta of the animals and their organs after death. The authors further believe that the formation of the bones is a dynamic process, involving continuous loss and replacement.

By the bombardment of magnesium with  $\alpha$ -particles, Dr. C. D. Ellis and W. J. Henderson have obtained, in addition to aluminium of mass 28, already known, two other radioactive products. One of these emits electrons of 11 min. period and the other positrons of 5-7 min. period; the authors suggest that these two radioactive products are, respectively, aluminium of mass 29 and silicon of mass 27.

H. J. Walke suggests that potassium of mass 43 should have a radioactivity of less than 16 hours, which is the radioactive period of potassium of mass 42; it could not, therefore, account for the long-period radioactivity of ordinary potassium. This has been attributed by Newman and Walke and by Klemperer to radioactive potassium of mass 40, and H. J. Walke now directs attention to recent publications supporting this latter hypothesis.

An electron density map of a molecule of resorcinol is given by Dr. J. Monteath Robertson. This is the first example of an organic molecule which has yielded to quantitative X-ray analysis without the aid of symmetry components in the molecule itself. The complete structure is determined, and it is shown that the hydroxyl groups belonging to adjoining molecules approach to within 2.66 Å., indicating the presence of hydrogen or 'hydroxyl' bonds between the molecules.

A suitable method for preparing colloidal dispersions of a cancer-producing substance, dibenzanthracene, for injection into experimental animals and for tissue cultures, has long been desired. H. D. Barnes describes such a method, in which he employs lecithin, a constituent of egg-yolk, as dispersing agent.

Further analysis of the amino acids which, according to Prof. A. I. Virtanen and T. Laine, are excreted in the soil by nodules of leguminous roots, have convinced these investigators that aspartic acid, which they failed to find on a previous occasion, is a constituent of the amino acid mixture. The remainder apparently consists of lysine. The authors believe that these compounds are the primary amino acids formed in the fixation of nitrogen by leguminous plants.

According to experiments by Dr. Paul Meyer, the colloid osmotic pressure of the body fluid of marine animals shows a close relationship to their general organisation. The values obtained with serum of Teleosteans are nearly as high as those of large terrestrial mammals. The assumption of Krogh that aquatic animals should require only a low colloid osmotic pressure in the blood to prevent filtration is not confirmed by the author.

Miss Nicholson and Prof. Yonge, disagreeing with Prof. H. Graham Cannon's views as to the function of the labral glands of the fairy shrimp, *Chirocephalus*, have stated that the material described by Graham Cannon as coagulated gland secretion was in fact the regurgitated contents of the gut. Graham Cannon now answers that there are essential differences between the coagulated mass described by him and that observed under different conditions by Nicholson and Yonge.

Sound-film tracks and breath-pressure records of speech-sounds, submitted by Prof. Scripture, indicate that successive speech-sounds may overlap one another in the spoken word. This may explain how the character of a speech sound can depend upon a sound that appears later in the printed word.

The outer portions of the 'wings' accompanying the Rayleigh line in the Raman spectrum of the light scattered by certain organic liquids such as benzene have been ascribed by Gross and Vuks to the persistence of quasi-crystalline lattice oscillations, rather than to the rotation of the molecules. Dr. S. C. Sirkar points out that one may then expect the intensity of the outer portions of the wings to diminish when benzene is mixed with a liquid like cyclohexane, which has feeble 'wings'. This, however, he finds does not occur.



## Research Items

### Neolithic Civilisation of Manchukuo

As part of the work of the Japanese first scientific expedition to Manchukuo, archaeological investigations, not however of an intensive character, were carried out in the province of Jehol. Some twenty-four sites in southern Jehol produced results, mainly pottery, but associated with implements of chipped or polished stone. In a report on the results of this reconnaissance by Ichiro Yawata (Rep. of the First Scientific Expedition to Manchukuo, June to October, 1933, Sect. 6, Pt. 1, Waseda University, Tokyo. In Japanese with summary in English) the pottery is classified into four main groups: (i) yellowish-brown and dark brown of rather coarse fabric, some plain, but a large proportion with cord-marked or banded ornament; (ii) grey, brown or black ware of fine paste, wheel-made, with slip, and polished and in some instances with painted designs; (iii) grey, bluish or black, wheel-made, and baked to a fine texture, commonly known as Han type pottery; (iv) reddish-brown, of fine texture, containing a large proportion of talc powder. The distribution of the groups varied, but on most of the sites examined two or three of the groups were present and sometimes all four. So also polished as well as chipped stone implements were found sometimes on the same site. At Ho-Tung, Chen-teh, on a hillock on which relics were found from foot to summit, quantities of groups i and iii with small quantities of ii and iv were associated with spindle-whorls, chipped and polished stone axes and stone knives; and on a hill to the north-west of Lwang-ping, with groups i, iii and iv, stone knives, a grattoir, and some pieces of iron were found. The axes collected included one perforated specimen. Near Pei Piao a fragment of a bronze vessel was discovered. This appears to have had a high ringed foot. The bottom was divided into three panels, each with a double dragon design. An analysis gives a composition of copper, 66.98; tin, 8.62; lead, 21.64; nickel, 0.05; arsenic, trace. The results of chemical and metallurgical examination point to a pre-Han origin.

### Methods of Psychodiagnosis

*Character and Personality* (3, No. 3) contains an article entitled "The Development Test as Applied to Infants in the Service of Psychodiagnosis" by Hildegard Hetzer and Anneliese Braun, Educational Academy, Elbing. It gives a short report of the Vienna developmental tests carried out by Ch. Bühler, H. Hetzer and others. With these tests, consisting of seventeen series each containing ten tasks, they claim to "provide one means for the psychodiagnosis of infants useful for pediatricians, psychologists, educationalists and practitioners of healing methods for children". They check the performances of one to six years' old children in six chief lines of human behaviour: sensory perception, body control, sociability (language), learning capacity (memory and imitation), capacity to deal with a given material, intellectual productivity. The quantitative degree of development in each of these at a certain age is noted. Thus they find the develop-

mental quotient in the same way as one finds the intelligence quotient. This quotient indicates "a general habit" and not inborn efficiency in a limited field of behaviour alone. An analysis of three practical cases illustrates the method. The results are checked by a doctor's opinion and general observation. They throw light on character traits and factors influencing character and personality, reveal errors of everyday judgment and give hints for therapy.

### American Ground Squirrels and Pneumonic Plague

THE most extensive outbreak of plague among ground squirrels since the peak of the animal epidemic in California between 1907 and 1919 is being experienced on the west coast of the United States. Dr. W. H. Kellogg states that not only is ground squirrel infection not decreasing after thirty years, but rather it is increasing and spreading over a wider territory, so that from the Coast Range it has penetrated to the interior valleys of California and even to the Sierras (*J. Amer. Med. Ass.*, Sept. 1935). Thus a permanent endemic rodent focus has clearly become established. Equally disturbing is the fact that the plague shows renewed virulence and an increasing pulmonary tendency in the prevailing strain of the plague bacillus, and pneumonic plague, more deadly to man than bubonic, is thought to be directly related to the plague in ground squirrels and ground hogs. Once pneumonic plague has obtained hold in highly populated human areas, its spread becomes independent of ground squirrel or the flea which acts as carrier, because the bacilli are in the sputum and transfer may take place by droplet infection.

### A Remarkable Dipterous Insect

THE discovery of a remarkable type of fly in Japan by Mr. M. Tokunaga was announced by him in 1932, when he gave it the name of *Nymphomyia alba*. Since this insect did not come within the limits of any known family of Diptera, the new family Nymphomyiidae was established for its reception. Mr. Tokunaga's preliminary paper appeared in *Annotationes Zoologicae Japonenses* of 1932 and a brief account of this communication appeared in our columns (*NATURE*, 132, 68; 1933). In the *Philippine Journal of Science*, February 1935 (pp. 127-210), the same writer contributes a long and detailed study of this insect's morphological features. Although *Nymphomyia* possesses brachycerous antennae, it is regarded as belonging to the series Nematocera on the basis of the wing venation and other general characters. Its specialisation isolates it from any known families of Diptera, and on the whole, its primitive features mark it as being among the lower assemblage of the order. A study of its larval structure is greatly needed and, until this is available, definite conclusions as to its nearest affinities lack an important possible link in the evidence. A very peculiar feature of the insect is that the wings are deciduous, being easily broken off along a definite line, as in termites and ants. Whether or not this is a normal occurrence in life is as yet undetermined.



### Sense-Organs of Spiders

Two almost simultaneous papers make a noteworthy contribution to our understanding of the sense-organs on the legs of spiders. B. J. Kaston (*J. Morphol.*, 58, 1, 189-207; 1935) describes the histological structure of the lyriform or slit organs, and concludes that they probably function as chemoreceptors, stimulated by odorous vapours. They closely resemble the sensilla on the antennæ of insects. In an exceptionally interesting paper, H. Blumenthal (*Z. Morphol. Okol. Tiere*, 29, 5, 667-719; 1935) has made a full histological and experimental study of the tarsal organ first noticed by Dahl in 1883. This organ, which lies dorsally on the tarsi of legs and palpi in both sexes of all but a few families, appears, like the slit-organs, to react to vapours. Spiders were found to respond to the arrival of a drop of water by approaching and drinking it, but this did not happen if the tarsal organ was excised. The organ may also function as a detector of taste, for spiders were apparently able to distinguish between pure water, sugar solution and brine. It is suggested that its chief biological value is in the search for drinking-water, in the finding of a mate and in the tasting of captured prey. The organ is comparable in structure to the Haller's organ of the ticks and the chemoreceptors described by Minnich on the legs of insects.

### Growth and Moulting of Lobsters

KNOWLEDGE of the development of lobsters is a matter of great importance, for legislation fixing size limits and close seasons ought to be founded upon the natural history of the species. Some observations upon the growth of young lobsters have been made by W. C. Smith at Port Erin Marine Biological Station (*Trans. Liverpool Biol. Soc.*, 48, 51; 1935), though the fact that the conditions were artificial warns against acceptance of the results as of general significance. It was found that moulting and mortality in lobsters from about a year to 2½ years old were almost confined to the summer months, with temperatures above 10° C., and that death rate reached a maximum with temperature. Moulting occurred from two to five times during the second year, generally three times; and two or three times in the third year. After the fifth to the eleventh year there is only one moult annually. Sizes were, at end of first growth period, 26-32 mm., at end of second year 42-57 mm., in autumn of third year 70 mm., but the numbers measured were very small. One female lobster was ten years old before reaching the legal fishery size of 9 inches, although a male of five years may reach the legal size for catching after next moult.

### Pruning of Mature Apple Trees

MANY apple growers continue to prune mature trees as a matter of routine. It has been assumed that pruning is an indispensable foundation for fruitfulness in trees of all ages, but the conclusions expressed in a recent publication by Joseph Oskamp (*Bull. 624, Cornell Univ. Agr. Exp. Sta., Ithaca, N.Y.*, March, 1935) do not support this view. The bulletin handles a formidable collection of detailed records, extending over a period of twelve years, which refer to trees about twenty-five years old. No significant effect of pruning on yield of fruit, or on its size, colour and freedom from blemish has been

found. It is suggested that mature trees should merely be kept within bounds, so that the fruit is not difficult to gather, and that sufficient attention be given to the mechanical ability of branches to bear heavy loads of apples. The need for light at the centre of the tree also makes it necessary to remove whole branches as they tend to fill up the space within the crown of the tree too tightly.

### Methods of Orientation in Ancient Babylonia

DR. ECKHARD UNGER appends to an account of ancient Babylonian maps and plans which have survived on clay tablets certain indications of the methods of orientation emerging from their examination (*Antiquity*, September). A world map, for example, shows, especially by the 'dark' fifth region in the north, that the north-west was at the top of the map. It has been shown that the Sumerians originally based their system on the direction of the prevailing winds in Mesopotamia, these being approximately north-west, north-east, south-east, south-west. They determined the individual character of these winds, and interpreted them as manifestations of gods of a like nature. The manifestation of the gods through the winds played an important part in the orientation of the temples set up to them, but owing to wind variation, the direction was the arc of a quadrant. The rising of the sun in the north-west quadrant at the summer solstice was the time for determining orientation in Babylon, the run of the streets, etc., affording an astronomical time-gauge, occurring once a year and providing a basis for the adjustment of the calendar by an intercalary month. The moon and stars also afforded systems of orientation; but in all the system was inclined, and did not follow the cardinal points as we understand them. This shows that the tradition of a deity associated with the wind survived. In practice, owing to wind variation, orientation was checked by the position of certain stars. 'Sunrise' and 'sunset' imply a similar orientation by quadrant, indicating not the direct easterly or westerly points, but the complete quadrant within which the sun rose or set.

### Seismology in New Zealand

SOME interesting reports on earthquakes in New Zealand have recently been published. Dr. C. E. Adams and Dr. J. Henderson describe the earthquakes of the year 1934 (*Dominion Obs. Bull. No. 102; 1935*), twenty-four in number, one of which, on March 5, was of destructive intensity. Its epicentre lay in lat. 40° 95' S., long. 176° 8' E., about thirty miles off the east coast of the North Island. The earthquake caused considerable damage in the south-east portion of the North Island, and slightly disturbed the face of the country in the districts round Pahiatua and to the east. Dr. L. Bastings (*Bull. No. 103*) gives a list of the destructive earthquakes in New Zealand during the century 1835-1934. They are sixty-nine in number, six of intensity 10, fourteen of intensity 9 and forty-nine of intensity 8 (Rossi-Forel scale). Taking account of earthquakes of all three intensities, the author claims for New Zealand a seismicity twice as great as that of Japan. Mr. R. C. Hayes (*Bull. No. 104*) considers the annual and diurnal frequency of earthquakes in New Zealand. For all earthquakes (1848-1934), the maximum number occurs in June, and for strong earthquakes (intensities 7-10) during the hours 0-3 a.m.



## Oxidation of Metals

G. D. PRESTON and L. L. Bircumshaw (*Phil. Mag.*, Oct.), working at the National Physical Laboratory, have investigated the oxide films found on metals and alloys at low temperatures up to 400° C., using electron diffraction patterns to identify the thin films produced. The oxide film on copper, formed at room temperature, at 100°, and at 183°, showed the structure of Cu<sub>2</sub>O, the thinner films showed a marked tendency to orientation with a (111) plane parallel to the polished surface of the metal, but orientation disappeared with the thicker films. A brass (30 zinc : 70 copper) formed a Cu<sub>2</sub>O film at 183° C. and ZnO at 400° C., an aluminium brass gave a film of Cu<sub>2</sub>O, the absence of any record of Al<sub>2</sub>O<sub>3</sub> being ascribed to the amorphous nature of the substance. Magnesium and its alloys gave cubic films of MgO. It is suggested that the orientation observed with Cu<sub>2</sub>O (and less markedly with MgO) is such that the plane in the oxide having the higher density of metal atoms tends to lie on the polished surface.

## Absorption of Short Wave-Lengths

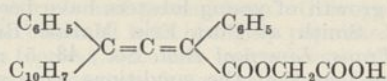
IN a paper published by the Bangalore Press on the transparency of the atmosphere in the ultra-violet and a possible means of extending the solar spectrum in the region 2200–2000 Å., K. R. Ramanathan and L. A. Ramdas, of the Meteorological Office, Poona, have collected together many of the results obtained by different workers on the absorption of short wave-lengths by various agencies, particularly by oxygen and ozone. In the light of these results, they discuss the possibility of extending the solar spectrum beyond the limit attained up to now in the ultra-violet, which limit is stated to be 2863 Å., reached by Paul Götz in Switzerland. Measurements of the absorption coefficients for ozone suggest that if the sun radiates as a black body at about 6,000° Abs. there should be a revival of the solar spectrum beyond the Hartley absorption band at about 2200 Å. if ozone is the only absorbing agent. Herzberg, one of the investigators of the absorption of very short wave-lengths by oxygen, has suggested that the failure to detect any such revival is due to absorption by oxygen. This paper analyses some of the measurements of transparency of long horizontal columns of the atmosphere of the order of 1,000 metres that have been made by various workers, and a table is given which shows the absorption coefficient between 2893 Å. and 1855 Å. after the effects of haze, molecular scattering and ozone have been allowed for approximately, based on measurements by Jausseran and Rouard. In another table are shown the values of the intensity of solar radiation at 2900, 2200, 2063 and 2000 Å. at the surface, at 16 km. and at 20 km., assuming that the sun radiates as a black body at 6,000° Abs., that the quantity of ozone in the atmosphere is 0.2 cm. at normal temperature and pressure, that the absorption coefficients for ozone below 2300 Å. found by Meyer in 1903 are correct, and that the coefficients for atmospheric air are those found by Buisson, Jausseran and Rouard. The figures suggest that at 16 km. the solar spectrum might be photographed beyond 2200 Å., if spectrographs of the same power as those used at the surface could be employed, but that it is very doubtful whether we could go beyond 1950 Å. It is pointed out that a height of 16 km. is attainable by sounding balloons and even by manned stratosphere balloons.

## New Kinetic Theory of Gases

IN the "Physics Forum" of the September issue of the *Review of Scientific Instruments*, Dr. I. I. Rabi of Columbia University directs attention to the new experimental facts with respect to gases which have been discovered by the use of molecular beams, and to the revision of the kinetic theory of gases which these facts have rendered necessary. While the hard sphere picture of the collision of two molecules is retained, wave mechanics requires the addition to it of a de Broglie plane wave of wave-length equal to Planck's constant  $h$  divided by  $mv$ , where  $m$  is the reduced mass  $m_1m_2/(m_1+m_2)$  and  $v$  is the relative velocity of the two molecules. The effective area of the collision cross-section is changed from the  $\pi a^2$  of the older theory to  $4\pi a^2$  for small relative velocities and to  $2\pi a^2$  for high velocities. The mean free path thus becomes a function of the temperature of the gas as well as the pressure, and there is no necessity to assume an attractive force between the molecules, which formerly meant the introduction of an assumed constant into the theory. The author concludes that the molecular radii and laws of force between molecules deduced from the older theory "have no real basis in fact".

## Resolution of an Allenic Compound

IT is now known that allenic compounds in which at least one of the hydrogen atoms on each of the terminal carbon atoms of allene has been replaced by a substituent, can be obtained in optically active forms (Mills and Maitland, *NATURE*, 135, 994; 1935). Another example is furnished by the resolution of an allenic acid:



by E. P. Kohler, J. T. Walker and M. Tishler (*J. Amer. Chem. Soc.*, 57, 1743; 1935). The acid was first prepared by Lapworth and Wechsler in 1910, in one of the earliest of the many attempts to prepare an allenic compound suitable for resolution. The acid chloride has now been prepared, and also the glycolic acid derivative, which was resolved by means of the brucine salt. The acid, which melts at 195°, is a racemate or racemic mixture of two optical opposites which melt at 145°–146° and in ethyl acetate have the rotation  $[\alpha]_D = 29.5^\circ$ .

## Late Type Variable Stars

IN the October *Observatory* (58, 285), Mr. A. D. Thackeray contributes an article on the observational facts which are known about the late type variable stars. We have here a field of astronomical work in which an enormous wealth of observational material is at hand with which theory has been unable to deal adequately. The complexity of the variations in magnitude, radial velocity and in spectral phenomena is very great, and there are many features which present grave difficulties to any attempts at a theoretical explanation. In particular, the presence of bright lines in the spectra is very difficult to account for in view of the very low temperatures of these stars, and the most hopeful line of attack must be an explanation in terms of chemical luminescence. This article should prove very useful, as it gives a summary of the known facts, with extensive references to the original works.



## Theories of Vision

By Dr. F. W. Edridge-Green, C.B.E.

**T**HOUGH the subject of theories of vision has been under discussion for many years, it has been suggested to me that a useful purpose would be served by a statement of the case for the visual purple theory in comparison with the duplicity theory. The visual purple view is that the cones are the sole percipient elements of the retina, being stimulated by the photochemical decomposition of the liquid surrounding them, the rods not being percipient elements but nerve elements regulating the supply of visual purple to the liquid surrounding the cones. Direct stimulation of the colourless transparent cones is against all photochemical laws, and these colourless transparent cones are surrounded by a highly absorbent photochemical substance, the visual purple, which when decomposed must produce an effect.

Visual purple was found in liquid form in the retina surrounding, but not in the cones, by Devereux Marshall and me with monkeys' retinæ examined immediately after removal of the eyes. This experiment is supported by the fact that Kuhne found visual purple in a fluid form in the retina and poured it out on a plate.

There are numerous physiological facts, as, for example, the control of vision by the nervous system, the removal of waste products and the resensitisation of the cones, which are inexplicable on a direct stimulation hypothesis<sup>1</sup>. If the rods and cones were distinct percipient elements there should be a distinct qualitative difference between the portion of the retina containing only cones and that containing rods, but von Tschermak, Hering, Hess, Garten and others have found only gradual quantitative differences in the sight between the foveal and the extra foveal area. The Purkinje phenomenon, the alteration of optical white equations by the state of dark adaptation, the colourless interval for spectral lights of increasing intensity, the different phases of the after-image, all exist, not only in the extra foveal, but also, only gradually diminished, in the foveal region. In certain conditions the colour of the positive after-image of any colour or white is purple<sup>2</sup>.

Helmholtz pointed out that the evidence only proved that the cones were percipient elements and that there was no evidence that the rods were percipient elements. At a later date this view was reaffirmed by Nagel.

The eye resembles a photographic apparatus, and actual photographs have been taken on the retina and fixed by Kuhne. It will be noted that on the duplicity theory there is a very unsatisfactory correspondence with the film of a photographic apparatus. Photographers know that the sensitiveness of this film must be under control and a different sensitiveness is required for different intensities of light, but on the duplicity hypothesis there is only a mechanical arrangement. Bauer has shown that the visual purple is regenerated more rapidly under the stimulus of light than it is in absolute darkness, so that it must have a function

in the daytime. If, however, we suppose that the function of the rods is to regulate the sensitiveness of the photographic film, that is to say, they are the nerve elements which liberate the visual purple into the liquid surrounding the cones, making this film more or less sensitive in accordance with the requirements of vision, we have an explanation of every known fact of vision.

The decomposition of the visual purple surrounding the cones causes stimulation of the cones and a visual impulse is set up. It is difficult to see how from the stimulation within the cone hypothesis the waste products can escape and a cone return to a condition in which it is able to receive further stimulation. It is probable that even in the early forms of vision, stimulation of the nerve ends took place not through the direct stimulation of the nerve end by light but indirectly through some light-absorbing substance which when acted upon by light gave off products which stimulated the nerve end. This appears to be the case even with the vision of insects.

The following are given as facts supporting the duplicity theory:—(1) that certain animals have only cones and others have only rods; (2) that the periphery of the retina is colour-blind; (3) that the eye is totally colour-blind in dark adaptation; (4) that the Purkinje phenomenon and the recurrent image are not found with the fovea; (5) that Porter-graphs consist of two branches, one the branch corresponding to light above 0.25 metre-candle, corresponding to the cones, and the branch for light below 0.25, corresponding to the rods. With regard to these, I make the following comments:—

Though I have examined numerous collections, I have never been able to find any animal with only rods or only cones, neither have I met anyone who has seen such a retina. The tortoise is the most quoted; it is stated to have only cones. The rods and cones in the retina of the tortoise are as clearly defined and distinct as in the human retina. The periphery of the retina is not colour-blind when colours of sufficient intensity are used. This can readily be tested with a doctor's red lamp, which, it will be found, can be seen as red to the extreme periphery. In dark adaptation the eye is not totally colour-blind. Further, there is no scotoma or blind area corresponding to the rod-free portion of the macula which is equal to a visual angle of about three degrees. The Purkinje phenomenon and recurrent image are found with the fovea.

Frank Allen states that in his experiments all branches of the Porter-graphs were obtained on the same central area of the retina where rods are fewest in number or are altogether absent, the flickering at the point of fixation being specially noted. The presence of *B* branches in the graphs obtained under these conditions is therefore quite adverse to the duplicity theory. The larger number of branches of the Porter-graphs and their identification with enhancing and depressing reflex actions seem to remove the graphs completely from their support of the duplicity theory.



Secondly, facts which are explained in some measure by the duplicity theory can be explained in a far better manner by the visual purple theory. For example, the Purkinje phenomenon is found with other photochemical substances so that it is only a photochemical phenomenon. The visual purple gives a curve which is very similar to that of many other photochemical substances. We know that with photochemical substances the chemical effect is not proportional to the intensity of the light: a different curve is obtained with weak light from that which is formed with light of greater intensity. It is reasonable, therefore, to suppose that the visual purple which is formed by the pigment cells under the influence of a bright light would be somewhat different in character from that which is formed in darkness. Again, from the chemical analogy just given, even if the visual purple were of the same character we should not expect similar curves with different intensities of light. It is probable that both factors are in operation.

On the duplicity theory, the decomposition of the visual purple is supposed to stimulate the rods directly, but what other organ in the body produces a secretion which stimulates itself?

The fact that a small star is seen more clearly on the para-foveal region than with the foveal region has been given as a strong fact supporting the duplicity theory, but the yellow pigment of the yellow spot has been entirely overlooked. This absorbs light, particularly blue, and would account for the phenomenon. Pertz has shown that the dark adapted fovea is more sensitive to red light than the periphery, and yet red light bleaches the visual purple. Again, the most sensitive portion of the dark adapted retina forms an oval with its long axis horizontal, the oval being ten degrees in its vertical axis and fifteen to twenty degrees in its horizontal axis. This is just at the edge of the yellow spot where there are few rods. If this were a rod phenomenon, the light should appear much brighter farther out where the rods are much more numerous. The phenomenon is also found with the light adapted eye. If two discs of white paper each of a diameter of a sixteenth of an inch be pasted on black cardboard an inch apart and viewed from a distance of twelve to eighteen inches it will be found that the one that is directly looked at (with one eye) appears much darker and yellower than the other.

Congenital night blindness has been supposed to be due to absence of rods, but a better explanation is that the cones are not so sensitive as normal to a feeble stimulation, especially as this condition can be produced by continuous exposure by day to a bright light, as, for example, that reflected from snow. Congenital day blindness has been supposed to be due to absence of the cones, but a better explanation is that the mechanism of light adaptation is defective, probably from defective development of the rod and cone apparatus. This is supported by the fact that many of these persons see red imperfectly, and the rods are not supposed to convey impulses leading to the perception of colour.

In light adaptation, more visual purple is used up, but more is formed. In dark adaptation, though less is formed, much less is used up and so accumulates in the peripheral regions. The sensitisation of the foveal region from the periphery appears to be directly under the control of the nervous system.

We now come to facts which are inexplicable by the duplicity theory: the presence of visual purple

in liquid form in the retina and surrounding but not in the cones; the fact that vision is plainly under the control of the nervous system is not explained.

At one moment the fovea appears the least sensitive portion of the retina and at the next moment may be the most sensitive portion of the retina. Helmholtz, whilst recording the fact, confessed that he was quite unable to suggest an explanation. The following simple experiment illustrates this:—On opening an eye on awaking in the morning and looking at the ceiling the central portion is seen as an irregular, circular, rhomboidal or star-shaped black spot. On closing the eye again a bluish violet circle appears at the periphery or middle of the field of vision, contracts and then after breaking up into a star-shaped figure and becoming brighter disappears, to be followed by another contracting circle. If the eye be opened when the star figure has formed in the centre it will appear as a bright, rose-coloured star, much brighter than any other part of the field of vision. If, however, we wait until the star has broken up and disappeared before opening the eye, it will be found that only a black spot is seen in the centre. This is explained on the theory that when there is visual purple in the fovea this is the most sensitive portion of the retina; when there is none there it is blind. It also shows that the fovea is sensitised from the periphery.

There are numerous methods by which currents in the field of vision which are not due to the circulation can be seen. The currents carry the visual quality, colour and brightness of the region from whence they come into an after-image. They also tend to move an after-image towards the centre; if we have two similar after-images, one situated in the centre and the other a short distance from the centre, the one external to the centre may be carried into the centre and combine with the one already there. These currents are formed by the flow of sensitised liquid.

The following simple experiment shows the influence of the para-foveal regions on the foveal region of the retina. Let a piece of black cardboard eight inches square be taken and place this on a wallpaper with a coloured pattern. The light in the room should not be too bright. The black cardboard should be viewed with one eye at a distance of six feet, the eye being kept as immovable as possible. It will then be noticed that portions of the colours of the wallpaper will appear to detach themselves from the wallpaper and move with a slow spiral motion into the black area. This will go on until the whole black area has completely disappeared, the surface being covered with a mixture of colours similar to those on the wallpaper.

There are numerous variations of the experiment. If a piece of yellow paper be placed on a blue ground and viewed as above, it will be noticed that the blue will invade the yellow until the latter appears quite white and then gradually becomes blue.

The bending of the re-current image at the fovea discovered by Hess is not explained by the duplicity theory. The duplicity theory fails to explain the change in position in the field of vision of after-images on movement of the eye.

The cones, therefore, are the sole percipient elements, and on being stimulated start impulses which are conveyed along the optic nerve to the brain and stimulate certain cells of the visual centre causing a sensation of light, and other cells causing a sensation of colour.

<sup>1</sup> "The Physiology of Vision" (G. Bell and Sons, 1920). "Science and Pseudo-Science" (Bale, 1933).

<sup>2</sup> NATURE, 136, 302, Aug. 24, 1935.



## Molecular Structure of Carbohydrates

THE British Association discussion at Norwich on September 5, in Section B (Chemistry), on the molecular structure of carbohydrates, following the presidential address to the section, revealed both the variety of the important problems which still await solution, and the diversity of methods now employed in the attack on these problems. The discussion was opened by Prof. W. N. Haworth, president of Section B, whose presidential address constituted a survey of the present position of polysaccharide chemistry. It was shown that the recognition of the pyranose structure of ordinary glucose—a discovery barely ten years old—led the way in the elucidation of the ring structures of the disaccharides and afterwards of the polysaccharides.

Cellobiose (4- $\beta$ -glucopyranosido-glucopyranose) and maltose (4- $\alpha$ -glucopyranosido-glucopyranose) are of special importance respectively in the chemistry of cellulose and of starch. Both these polysaccharides consist essentially of chains of glucopyranose units linked through positions 1 and 4, the glucosidic link being  $\alpha$ - in starch and  $\beta$ - in cellulose. Chains of glucopyranose units appear also in glycogen and in lichenin. In xylan there occur chains of  $\beta$ -xylopyranose residues; and chains of manno-pyranose units (mutually linked through positions 1 and 6) and galactopyranose units (linked through positions 1 and 4) occur in polysaccharides synthesised *in vivo* by the action of certain moulds on glucose solutions. All the above are of the pyranose type, but the furanose structure is also found in polysaccharides, and recent work shows that its occurrence is widespread. An arabofuranose unit forms the terminal portion of the xylan molecule; chains of fructofuranose units with mutual linkages in the 1:2 positions constitute inulin, whereas fructofuranose units linked through positions 2 and 6 are found in levan, an important bacterial polysaccharide, and in a closely related polysaccharide which occurs in grass.

The work of the Birmingham school has, however, gone beyond the elucidation of the molecular structures of the polysaccharides and has succeeded in determining by purely chemical methods the molecular size of the giant molecules. For example, by gravimetric assay of the tetramethyl glucose formed on hydrolysis of the fully methylated polysaccharide, the chain-length of methylated cellulose has been fixed at 100–200 glucose units, and that of starches of diverse botanical origin at 26–30 units. Use of this 'end-group' method has served for the allocation of chain-lengths to glycogen, xylan, inulin, levan, and other polysaccharides. In many examples, this chemical molecular weight is in striking disagreement with the figure obtained on the basis of Staudinger's viscosity method, and the causes for this divergence were discussed with particular reference to the important case of the amylose and amylopectin constituents of starch, in which aggregation of the macro-molecules takes place. Special emphasis was laid on the need for clear differentiation between the chemical molecule and aggregates of such molecules which function as physical units.

Other methods of attack on the problem of molecular weights are also being employed, and in a

subsequent paper Dr. S. R. Carter described results of osmotic pressure measurements on methylated and acetylated derivatives of inulin and lichenin. One of the principal difficulties in the use of this method lies in the choice of suitable semipermeable membranes, but by use of a disc of 'viscabelle' of adjusted porosity in specially designed apparatus, accurate measurements of osmotic pressure were obtainable. The figures for inulin were of particular interest, since they are in complete agreement with the chemically determined chain length (30 fructose units), whereas the viscosimetric measurements indicated only one-third of this value (10 units). In this case the failure of the viscosity method may be connected with the special conformation of the fructose units in the polysaccharide molecule.

Prof. Haworth's address concluded with a reference to investigations which have been commenced on the constitution of plant gums. These are of particular interest in that a derivative of gum arabic is known to possess properties resembling those of the specific polysaccharide of Type III pneumococcus anti-serum. The recent discoveries of such polysaccharides having immunological properties are of great importance, and the elucidation of the chemical structure of these substances must be of the greatest possible service to medicine.

In the paper which followed, Dr. W. T. J. Morgan discussed the function of polysaccharides in immunological specificity. He described the early discoveries concerning the specific precipitant for pneumococcus antibacterial immune serum, which led to the recognition that the capsular substance, different for each kind of bacterium, contains a complex polysaccharide which is the specific agent responsible for the serological reactions of the organism with the homologous antibody. Considerable progress is being made in inquiries into the chemical location of the specific characteristics, and it appears that the latter depend upon (a) the nature and stereochemical arrangement of the component sugars; (b) the mode of linkage of the sugar residues; and (c) the nature and position of substituent groups in the sugar residues. The mode of combination by which the reducing group of a glycuronic acid molecule forms a glycosidic union with the terminal primary alcoholic group of a glucose (or galactose) molecule, appears to have special significance in immunological chemistry. In addition, the specific properties of the polysaccharide-protein complex are closely governed by the presence in the polysaccharide of appropriately situated substituent groups, such as acetyl.

The two remaining papers were concerned with the intimate structure of the simple sugars. Dr. E. L. Hirst considered the possible correlation of structure with optical rotatory power in the sugar group. Although many empirical rules relating structure and rotation have been enunciated, their validity is always severely restricted to a small group of substances, and exceptions are frequent. It was shown that measurements of the rotatory power in the ultra-violet region of the spectrum sometimes give clues to the causes of departures from the rotation-rules. Three typical problems were discussed. (a) The abnormal rotations in the mannose series of



sugars were found to be ascribable entirely to the mutual influence of the two *cis* hydroxy groups on  $C_2$  and  $C_3$ . (b) The negative rotations of tetramethyl  $\gamma$ -mannonolactone in organic solvents were explained by the nature of the rotatory dispersion, which requires for its representation a two-term Drude equation with terms of opposite sign, the induced term being positive both in water (where the lactone rule is obeyed) and in organic solvents. (c) The sign of the induced term in the rotations of amides can be correlated with the configuration of  $C_2$  for those substances which obey the amide-rule, but exceptions occur which necessitate special explanations.

Mr. E. G. Cox gave an account of recent progress in the crystallography of carbohydrates. X-ray studies of a number of simple and methylated sugars lead to the conclusion that the six-atom ring in the pyranoses, unlike the hexamethylene ring, does not possess the Sachse form, but contains five nearly co-planar carbon atoms, the oxygen atom being displaced out of their plane. Various chemical and physical properties of carbohydrates find a satisfactory explanation in terms of this ring conformation; for example, there is much evidence that hydroxyl groups which, according to the Haworth structural formulæ, are *cis*, are actually contiguous in space. This is true for the ring form deduced from the X-ray data, but it is by no means necessarily so with a Sachse ring.

The configuration on the first carbon atom of the cyclic forms of the sugars is not established by the same rigid methods which are applied to the remainder of the molecule; the confirmation by X-ray methods of the configurations usually ascribed to the  $\alpha$ - and  $\beta$ -forms of glucose is therefore a matter of considerable importance.

## Educational Topics and Events

CAMBRIDGE.—At Emmanuel College, Dr. T. S. Hele, fellow of the College and University lecturer in biochemistry, has been elected into the mastership.

A. C. Bartlett, of Emmanuel College, has been approved for the degree of Sc.D.

P. H. Blair, of Emmanuel College, has been appointed an assistant lecturer in archæology and anthropology.

EDINBURGH.—The Rockefeller Foundation has made a grant of £1,500 to the Department of Medical Chemistry, to provide for the expenses of Prof. Barger's research work on vitamin  $B_1$ , for a period of three years from October 1935.

It has been agreed to offer accommodation in the University for the meeting of the International Union of Geodesy and Geophysics, which is to take place in Edinburgh on September 15–26, 1936.

SHEFFIELD.—The following appointments have recently been made: Prof. C. J. Patten, formerly professor of anatomy, and Prof. Miles H. Phillips, formerly professor of obstetrics and gynaecology, as emeritus professors; Dr. H. A. Krebs, as lecturer in pharmacology; Mr. H. E. Collins, as lecturer in mining; Dr. M. Ritchie, as assistant lecturer in chemistry; Mr. J. Harwood, as research assistant in fuel technology; Dr. J. W. Rodgers, as Iron-mongers' Company research fellow (for one year).

## Science News a Century Ago

### Meeting of the Medico-Botanical Society

THE first general meeting of the session for 1835–36 of the Medico-Botanical Society was held on November 10, Earl Stanhope being in the chair. After the reading by Dr. Sigmond of an eulogium on the character of the late Gilbert Burnett, professor of botany to the Society, Mr. C. Johnson delivered a lecture on the importance of botany to medicine. He contrasted the present knowledge with that of the practitioner of former days, and dwelt on the necessity of giving to the vendor of drugs an education superior to what they had and of making the study of botany indispensable.

### The Paris to St. Germain Railway

THE first railway to be authorised in France was that from Paris to St. Germain, and on November 14, 1835, the *Athenæum* said of this line that it "is to commence near the Church de la Madeleine on the Boulevards, and afterwards pass through a tunnel under the Commune of Les Batignolles Monceaux. This tunnel will be 907 yards in length. There are to be three stations for receiving and delivering luggage. The number of bridges or viaducts to be erected over streets and roads, between the point of departure and the Seine will be twelve. Altogether, it is considered that this railroad will be one of the best constructed, and most useful of any yet projected, not excepting those now in progress in England. It is expected, that the steam carriages on this road will be able to travel at the rate of thirty miles an hour, and according to this calculation, the distance between Paris and St. Germain will be performed in twenty-four minutes. It now occupies one hour and forty minutes."

### Darwin at Tahiti

ON November 15, 1835, H.M.S. *Beagle* arrived at Tahiti, where she remained until November 26, when she sailed for New Zealand. Both Capt. FitzRoy and Darwin wrote interesting accounts of the island and its people, and Darwin said:

"I was pleased with nothing so much as with the inhabitants. There is a mildness in the expression of their countenances which at once banishes the idea of a savage; and an intelligence which shows they are advancing in civilisation. . . . On the whole, it appears to me that the morality and religion of the inhabitants are highly creditable." Of those who attacked the work of the missionaries among the islanders and its effect, he said: "They forget, or will not remember, that human sacrifices, and the power of an idolatrous priesthood—a system of profligacy unparalleled in any other part of the world—infanticide a consequence of that system—bloody wars, where the conquerors spared neither women nor children—that all these have been abolished; and that dishonesty, intemperance, and licentiousness have been greatly reduced by the introduction of Christianity. In a voyager to forget these things is base ingratitude. . . ."

On November 26, when the ship sailed, Darwin wrote: "In the evening, with a gentle land-breeze, a course was steered for New Zealand; and as the sun set, we had a farewell view of the mountains of Tahiti—the island to which every voyager has offered up his tribute of admiration."



## Societies and Academies

## PARIS

Academy of Sciences, October 7 (*C.R.*, 201, 573-628).

LOUIS LAPIQUE: The nomenclature of chronaxies modified by the action of the nerve centres. Reasons are given for rejecting the terms static chronaxy and dynamic chronaxy. F. GANTMACHER and M. KREIN: Oscillatory matrices. RENÉ DE POSSEL: The abstract derivation of functions of ensembles. VLADIMIR BERNSTEIN: Concerning the methods of search for singular points of functions defined by Dirichlet series. ARNAUD DENJOY: Minkowskian functions. PAUL MONTEL: A theorem of Jacobi. EDOUARD CALLANDEAU: Corrective functions in the neighbourhood of the Rankine-Lévy solution of the heavy mass supported by a rectilinear wall. SERGE NIKITINE: Suction by volumetric pumps. Discussion of the relations between the yield of a pump and the number of strokes per minute. MIROSLAV NÉNADOVITCH: The influence of the inter-inclination of one of the wings on the aerodynamic characteristics of rigid biplane cells of infinite span. ANDRÉ COUDER: The cellular construction of telescope mirrors. The deformations observed in cellular mirrors are much larger than would be expected from a study of the elastic properties and are probably due to the thermal conditions existing during polishing. MAURICE DÉSIANT and JULES DUCHESNE: A new emission spectrum of sulphur in the photographic infra-red. Mlle. YVETTE CAUCHOIS: New measurements and observations relating to the *L*-emission spectrum of platinum. V. DOLEJŠEK and M. HYLMAR: The fine structure of the  $L_{III}$  absorption discontinuity of the rare earths. GABRIEL VALENSI: The kinetics of the oxidation of metallic wires. M. BOBTELSKY and MME. BOBTELSKY-CHAJKIN: The catalytic decomposition of hydrogen peroxide in the presence of mixtures of salts of manganese and copper. MME. MARIE FREYMANN and PAUL RUMPF: The absorption spectra in the near infra-red of amines and amides. Use of the phenomenon of dissimulation in the search for amphoteric ions. The influence of neighbouring groups. The presence of an absorption band at  $1.04\mu$  is taken as a proof of the existence in a compound of the NH group. JEAN TIMMERMANS and GUSTAVE POPPE: The mutual solubility of heavy water and organic liquids in systems possessing a curve of negative saturation. MARIUS SAUVAGEOT and EDMOND ROUSSEAU: The transformation points of nickel steels. At the beginning of the transformations produced by heating, nickel steels undergo a very marked segregation: the first portions of austenite formed are highly charged with nickel, corresponding to a metal the transformation point of which is below  $0^{\circ}\text{C}$ . Manganese may give rise to similar phenomena. VLADIMIR FROLOW: The dissolved salts in the Sandjak waters. The electrical resistance of twenty-five waters from various sources has been studied as showing the variations in the content of dissolved salts. PIERRE DANGEARD: The identity of *Laminaria Lejolisii* and *L. iberica*. PIERRE P. GRASSE and Mlle. LOUISE LESPERON: The accumulation of acid colouring matters in the silkworm by different tissues according to the mode of access. GEORGE BEADLE and BORIS EPHRUSSI: The differentiation of the colour of the *cinnabar* eye in *Drosophila melanogaster*. A. PAILLOT: A new ultra-virus disease (polyhedra disease) in the larvæ of *Vanessa urticae*. V. A.

KOSTITZIN: A relation between the sex and the number of parasites in the same host. A mathematical study of the data on this subject given by A. Vandel. MME. PAULETTE CHAIX: The kinetics of the attack of glucose and of lactic acid by small bacterial masses. The idea of minimum active mass.

## WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 21, 517-559, Sept. 15). CLAUDE E. ZOBELL: The assimilation of ammonium nitrogen by *Nitzschia closterium* and other marine phytoplankton. Provided small concentrations (0.2 millimol and less) of ammonium, nitrite and nitrate are compared, multiplication of the diatoms first becomes manifest with ammonium nitrogen. In cultures containing both ammonium and nitrate, the ammonium was the first to be depleted, and a trace of nitrite appeared. It is suggested that the diatoms in the sea reduce nitrate to nitrite extracellularly in the course of nitrogen assimilation and that nitrification, hitherto regarded as an essential to nitrogen assimilation, is rather a regulatory or storage process. G. A. MILLER: Groups in which the squares generate a subgroup of index less than seven. A. D. MICHAL: "Riemannian" differential geometry in abstract spaces. E. FISHER: Asymptotic representations of confluent hypergeometric functions. A. D. MICHAL and V. ELCONIN: Completely integrable differential equations in abstract spaces. CHARLES H. FAY: A refinement of the Heisenberg theory of ferromagnetism, applicable to simple cubic crystals. The micro-crystal is regarded as built up of units larger than the atom but containing sufficiently few atoms to allow calculation of their unperturbed energy levels. The method treats half the interaction rigorously, instead of none as previously, and the remainder by an average energy approximation similar to that used in the 'simple' Heisenberg theory of ferromagnetism. E. HUTCHISSON, T. H. OSGOOD and R. E. FEARON: Electrical conductance of short gaps in air. Apparatus was devised whereby two nearly flat surfaces could be brought into gradual contact, and very small potential differences, below the ionising potential of the common gases of the air, were used in order to avoid sparking. It was found that appreciable current can pass surfaces of approximately 4 cm. diameter separated by 10,000 Å. in air, and that the current is proportional to the square of the applied potential difference, suggesting conduction by charged dust particles. When the plates are brought gradually closer, the current changes from an ionic to an ohmic one, the latter being probably due to metallic prominences on the opposed surfaces. SVEN PH. CARLSON: The colour changes in *Uca pugilator*. If the eye-stalks of the fiddler crab are removed, the animal becomes pale, an effect the reverse of that which occurs in most crustaceans. Extracts from the middle part of the eye-stalk of the crab cause the animal to grow dark again. The active substance seems to come from the blood-gland of Hanström and is probably the eye-stalk hormone common to crustaceans, though its effect on the fiddler crab is the reverse of that on other crustaceans. JANE M. OPENHEIMER: Processes of localisation in developing *Fundulus*. By means of localised vital staining, it has been possible to trace the position of embryonic tissues and the movements by which their cells attain their final position. TRUMAN L. KELLEY: An unbiased correlation ratio measure.



## Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

## Sunday, November 10

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—Dr. A. T. Hopwood: "Fossil Mammals".\*

## Monday, November 11

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—J. D. Macdonald: "Birds".\*

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Prof. G. Barbour: "The Evolution of the Yangtze Kiang".

## Tuesday, November 12

BEDFORD COLLEGE FOR WOMEN, at 5.15.—C. A. Mace: "The Experimental Study of Incentives".\*

KING'S COLLEGE, LONDON, at 5.30.—H. W. Dickenson: "The History of Mechanical Invention" (succeeding lectures on November 19 and 26).\*

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.30.—Prof. A. Smithells: "The Teaching of Chemistry" (Harrison Memorial Lecture).

## Wednesday, November 13

BRITISH SCIENCE GUILD, at 4.30.—(at the Goldsmiths' Hall, Foster Lane, London, E.C.2).—Sir Josiah Stamp: "The Calculus of Plenty" (Norman Lockyer Lecture).

ROYAL SOCIETY OF ARTS, at 8.—Sir Albert Howard: "The Manufacture of Humus by the Indore Process".

## Thursday, November 14

ROYAL SOCIETY, at 4.30.—G. L. Brown and Sir Henry Dale: "The Pharmacology of Ergometrine".

M. J. D. White: "The Effects of X-Rays on Mitosis in the Spermatogonial Division of *Locusta migratoria*, L."

D. E. Sladden: "Transference of Induced Food Habit from Parent to Offspring".

ROYAL ASIATIC SOCIETY, at 4.30.—Dr. M. Gaster: "Maimonides and his Works".

CHEMICAL SOCIETY, at 8.—Dr. S. I. Levy: Brauner Memorial Lecture.

## Friday, November 15

ROYAL SOCIETY OF MEDICINE, at 8.15.—Discussion on "The Recent Epidemic of Malaria in Ceylon", to be opened by Sir Weldon Dalrymple-Champneys, Dr. Wigglesworth and Dr. P. H. Manson-Bahr.

ROYAL INSTITUTION, at 9.—Prof. Robert Robinson: "The Synthesis of a Natural Colouring Matter".

## Official Publications Received

## Great Britain and Ireland

The Journal of the Institute of Metals. Vol. 56. Edited by G. Shaw Scott. Pp. 306+31 plates. 31s. 6d. net. Metallurgical Abstracts (General and Non-Ferrous). Vol. 1 (New Series). Edited by G. Shaw Scott. Pp. vi+780. With Vols. 54 and 55 of the Journal, £4. (London: Institute of Metals.) [1910]

Malvern College Natural History Society. Twelfth Report, 1935. Pp. 36. (Malvern: Malvern College.) 1s. [2110]

Ministry of Health. Housing Act, 1935. Memorandum A: General. Pp. 19. 4d. net. Memorandum B: The Prevention and Abatement of Overcrowding. Pp. 30. 6d. net. Memorandum C: The Redevelopment of Overcrowded Areas. Pp. 11. 2d. net. Memorandum D: Financial Provisions. Pp. 8. 2d. net. Memorandum E: Consolidation of Housing Conditions and Accounts. Pp. 24. 4d. net. (London: H.M. Stationery Office.) [2310]

Miscellaneous Publications of the International Tin Research and Development Council. No. 3: The Functions of a Technical Information Bureau. By Dr. E. S. Hedges and Dr. C. E. Homer. Pp. ii+8. (London: International Tin Research and Development Council.) Free. [2310]

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1651 (T. 3603): Comparative Measurements of Turbulence by Three Methods. By the Staff of the Aerodynamics Department, National Physical Laboratory. Pp. 17+8 plates. 1s. 3d. net. No. 1652 (T. 3582): Experiments on Servo-Rudder Flutter. By Dr. W. J. Duncan, D. L. Ellis and A. G. Gadd. Pp. 30+8 plates. 2s. net. No. 1654 (T. 3455 revd.): Spinning of a Bristol Fighter Model including Effect of Wing Tip Slots and Interceptors. By H. B. Irving, A. S. Batson and J. H. Warsap. Pp. 19+14 plates. 2s. net. No. 1655 (F.M. 194): Statistical Measurements of Turbulence. By Dr. H. C. H. Townend. Pp. 10+4 plates. 9d. net. (London: H.M. Stationery Office.) [2310]

The National Smoke Abatement Society. Sixth Annual Report, 1935-1936. Pp. 30. (Manchester: National Smoke Abatement Society.) [2410]

Ministry of Agriculture and Fisheries. Agricultural Statistics, 1934. Vol. 69, Part 1: Acreage and Production of Crops and Number of Live Stock in England and Wales. Pp. 91. (London: H.M. Stationery Office.) 1s. 6d. net. [2510]

## Other Countries

The Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 5: List of Publications on Indian Entomology, 1933. Compiled by the Officiating Imperial Entomologist, Pusa. Pp. ii+29. (Delhi: Manager of Publications.) 9 annas; 1s. [2110]

Report of the Twenty-second Meeting of the Australian and New Zealand Association for the Advancement of Science, Melbourne Meeting, January 1935. Edited by G. W. Leeper. Pp. xlvii+561+10 plates. (Sydney: Australian and New Zealand Association for the Advancement of Science.) [2110]

Department of Agriculture: Territory of New Guinea. Bulletin No. 2 (Leaflet 70): The Possibility of Developing an Economic Cacao Industry in the Mandated Territory of New Guinea after a Study of the Industry in Trinidad, and a Suggested Policy for that Development. By E. C. D. Green. Pp. 72+2 plates. (Canberra: Commonwealth Government Printer.) [2110]

Forest Bulletin No. 91: Damage by Frost at New Forest, Dehra Dun, during the period 1930 to 1934. By Bachaspati Nautiyal. Pp. iii+18+4 plates. (Delhi: Manager of Publications.) 12 annas; 1s. 3d. [2110]

Tanganyika Territory. Mining Publicity Pamphlet. Issued by the Department of Lands and Mines. Pp. 45. (Dar es Salaam: Government Printer.) 50 cents. [2110]

Bulletin of the Buffalo Society of Natural Sciences. Vol. 17, No. 1: New Fossils from the Western New York Devonian. Pp. ii+45+8 plates. (Buffalo, N.Y.: Buffalo Society of Natural Sciences.) [2110]

Egyptian University. Bulletin of the Faculty of Science, No. 1: Transpiration and Stomata in Desert Plants. By A. H. Montasir and A. M. Migahid. Pp. 33. Bulletin of the Faculty of Science, No. 2: The Development of the Adult Mid-Gut of Coleopterous Insects and its bearing on Systematics and Embryology. By Dr. K. Mansour. Pp. ii+34+5 plates. Bulletin of the Faculty of Science, No. 4: Egyptian Freshwater Algae. By A. A. El-Nayal. Pp. vi+106+1 plate. Bulletin of the Faculty of Science, No. 5: A Preliminary Study of the Egyptian Soil Fungi. By Younis S. Sabet. Pp. ii+29. (Cairo: Egyptian University.) [2110]

Polar Arboken 1935. Utgitt av Norsk Polarklubb. Pp. 163. (Oslo: Gyldendal Norsk Forlag.) [2210]

Proceedings of the Academy of Natural Sciences of Philadelphia Vol. 87. The Occurrence of Flints and Extinct Animals in Fluvia, Deposits near Clovis, New Mexico. Part 1: Introduction, by Edgar B. Howard; Part 2: Age of the Clovis Lake Clays, by Ernst Antevs. Pp. 299-312. Descriptions of New Birds from Bolivia, with Notes on other Little-known Species. By M. A. Carriker, Jr. Pp. 313-341. (Philadelphia: Academy of Natural Sciences of Philadelphia.) [2510]

India Meteorological Department. Scientific Notes, Vol. 6, No. 64: Some Observations on the Thermal Structure of Cumuliform Cloud. By Flt.-Lieut. R. G. Vervard. Pp. 87-112. (Delhi: Manager of Publications.) 14 annas; 1s. 6d. [2510]

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 58: Certain Aspects of Investigations on Black-end Disease of Bananas in Australia. By Shirley Hoette. Pp. 22+1 plate. (Melbourne: Government Printer.) [2610]

University of California Publications in Botany. Vol. 17, No. 5: Critical Notes on C. D. Darlington's "Recent Advances in Cytology". By John Belling; with reply by C. D. Darlington. Pp. ii+75-110. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 1s. 3d. net. [2810]

Division of Fish and Game of California: Bureau of Commercial Fisheries. Fish Bulletin No. 44: The Commercial Fish Catch of California for the Years 1930-1934, inclusive. By the Staff of the Bureau of Commercial Fisheries. Pp. 126. (Terminal Island, Calif.: California State Fisheries Laboratory.) [2810]

Thirteenth, Fourteenth and Fifteenth Annual Reports of the Research Council of Alberta, 1932, 1933, 1934. (Reports Nos. 28, 29 and 32.) Pp. 87. (Edmonton, Alta.: Research Council of Alberta.) [2810]

## Catalogues

Watson's Microscope Record. No. 36, September. Pp. 24. (London: W. Watson and Sons, Ltd.)

Catalogue of Important and Rare Books on Ornithology, Zoology, Botany and Geology, including a fine collection on Indian and Oriental Birds from the Library of E. C. Stuart Baker. (Scientific List 36.) Pp. 32. (London: Harrods, Ltd.)

Coleoptera. (No. 87.) Pp. 145-310. (Den Haag: W. Junk.)

Edwards' Really Rigid Universal Clamp. (List B2.) (List 2.) Edwards' Rotary Blower and Vacuum Pump Type IV. (List G.2.) Pp. 2. (London: W. Edwards and Co.)

The Newton British-made Epidiascopes. Pp. 24. (London: Newton and Co.)

Galvanometers, Photographic Recording Apparatus, Galvanometer Accessories. (Section G. 33.) Pp. 47. (Delft: P. J. Kipp en Zonen.)