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CONTENTS.

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Early Mental Disorder.

IN continuation of our previous comments (NATURE, November 28) upon conditions of research in mental disorder, it may serve a useful purpose to describe, from a constructive point of view, some further practical aspects of the problem, and to show their bearing upon each other.

At the close of the War the Maudsley Hospital in London, like many others which had been put to army purposes, returned to civil use as a special institution under the London County Council for the treatment of early mental cases. At the same time, the pathological laboratory of the London Mental Hospitals was housed under the same roof. Thus was constituted an organisation for scientific investigation in vital relationship with one for observing and treating the earliest signs of insanity. From the first, no person admitted as an out-patient or to the wards of the Hospital was certified insane either before admission or during treatment by the hospital staff. Residence in the Hospital was a purely voluntary matter, and the divorce from legal procedure for compulsory detention was absolute. Patients seek advice and treatment in the same sense as they seek relief from purely physical symptoms at a general hospital; and, precisely as in a general hospital, admission to the wards may follow reference by a physician or attendance at the out-patient department of the Hospital.

Little imagination is needed to realise the differences between a voluntary mental hospital of this kind and other voluntary hospitals. There are peculiarities inseparable from responsibility for the welfare of persons who, from a medical if not a legal point of view, may not be strictly accountable for their actions. There are also the limitations inseparable from public control, to which general hospital physicians and surgeons are not subjected. But above all is a difference which even alienists themselves, trained for the most part in the shifts and inconveniences associated with sole care of hundreds of mental patients of all sorts and conditions, do not always appreciate. In general hospitals, except in comparatively rare cases, diagnosis is made relatively rapidly, and treatment, apart from mornings in the surgical theatres, and such measures as can be handed over to subordinates, takes actually little time. Fifty patients share the attentions of clinical clerks, houseman, assistant and chief, and the treatment of out-patients often entails further appointments to the staff. In mental disease it is recognised that if there is a physical cause, primary or contributory, it is obscure. Hence, even from a physical point of view, every patient in a hospital for the treatment of early mental cases is potentially in the position of the

rare, difficult cases of general hospital practice. Add the exhaustive and intimate personal investigation into history and behaviour indispensable to establish the past and present mental condition of every patient, and it is clear that to fulfil the first of its functions the special mental hospital should be staffed not less but more generously than any other kind of existing hospital, and by men of equal specialist competency, one with another, wholly responsible for their own cases. This is not an ideal but a necessity.

Treatment, however, is not the sole function of the voluntary mental hospital. Every person enabled to carry on his own, or any, avocation in society means a social saving of the work of two, and the importance of any improvement in medical efficiency here is obvious. But possibly the greatest opportunity in relation to the small voluntary hospital is for the observation of the early signs of disorder and the turning of the knowledge thus gained to scientific use. A passage in Lugaro's "Problems in Psychiatry" has special application in this connexion.

"In practice," he wrote, "it is not possible to limit one's attention to one single branch of a complicated subject, and all great pioneers of science have dived deep into two or more branches of knowledge with equal success and skill. There is a physics and a chemistry, but pure physicists and chemists do not exist. Anatomy can be separated from function, but the anatomist must be conversant with the latter. The physiologist does not understand his science without anatomy. But in no science do so many sciences dovetail into each other as in psychiatry. Therefore the alienist must—as much as the time at his disposal and his individual capacity permit—take an active part in work developing in neighbouring fields of research, cultivate other sciences and help them to progress, in order to further the progress of his own."

Every serious worker among the mentally disordered is in the position of such a pioneer. The foundations of his science have yet to be laid. They cannot be laid among the chronic insane; but only by the minute study of the developing disorder: otherwise as well seek the origin of species in the anatomy of a single type.

All these advantages are capable of being shared by the admission wards of the large mental hospitals, although the fact of legal certification goes very heavily against the establishment of relations in which freedom and candour predominate over fear and suspicion between patient and doctor. Setting aside the empty charge so commonly made against the institution of early treatment centres, that they attract the hysterical and neurotic patient—as though a surgeon might disdain to treat cut heads—it is frequently alleged that the admission wards of large asylums are now in reality such centres. There is every appearance of truth in this contention, excepting the essential appearance of similarity of aim and result. Certification is a legal, not a dividing, line. Little as we know of the real nature of such disturbances, we do know that the most maniacal behaviour is quite consistent with ultimate and even early recovery. Many early cases, and as many that are recoverable, reach the admission wards of asylums.[1] This fact alone links into an organic unity the principles of early treatment wherever it is carried out.

The characteristics of the small voluntary hospital are not exclusive. What is needed is that such centres as the Maudsley Hospital should be less special than they are. Large and important as their sphere might be, provided always that they were adequately equipped for their complex function, there must remain the social necessity for compulsory detention of some persons even in acute stages of disorder. Their treatment entails its own problems, and offers as profitable a field for investigation into fundamental problems as any. It would be a grave mistake to remove all responsibility for the solution of mental problems from asylum staffs.

Like so many other great social problems, the question of the advancement of our knowledge of mental disorder is fundamentally one of money. Without the clear recognition that the organisation of ordinary medical practice cannot appropriately be applied to mental disease, and that psychiatry cannot progress without adequate endowment, no considerable advance is possible.

Labour and Primitive Economics.

Primitive Labour. By L. H. Dudley Buxton. Pp. viii+272. (Methuen and Co., Ltd., 1924.) 7*s.* 6*d.* net.

UNDER the surface storms which have for some time been troubling the once calm waters of anthropology—as the contest concerning the origins of marriage, the differences of opinion about totemism, the fight between diffusionists and evolutionists—there has taken place a much more radical change in method, aim, and argument. More and more has the substance of serious anthropological work come to consist of sociological analysis of primitive culture. The nature of primitive organisation, the types and phases of economic activities, the relations between the economic and the religious aspect, or between magic and practical arts and pursuits, are now studied as empirical problems and not as pretexts for reconstruction and hypothesis. The new anthropology aims at the

[1] During 1924, 22,758 persons were admitted to County, District, and County Borough Mental Hospitals, and 6751 were discharged recovered. If transfers and readmissions are excluded from consideration, the proportion, per cent., of recoveries to admissions in 1924 was 34·3 per cent. The number of certified insane in London County Mental Hospitals in 1924 was 19,269. The figure was given inaccurately in NATURE, November 28, p. 775.

understanding and explanation of culture rather than at the establishment of "origins," "contacts," and "diffusions"; it moves exclusively in the realm of ascertained fact and avoids conjecture; it can yield results applicable in practice and not mere speculations of purely antiquarian interest.

Of all such positive subjects, primitive economics has been perhaps most neglected, in Great Britain at least; while within this subject the problem of primitive labour has scarcely been touched at all. It is a great privilege for a writer to be able to take up an entirely new question. His is naturally the duty of summarising all the preparatory and relevant work done, of formulating the problem, of making his original contribution, of setting the task for his successors. Unfortunately, it cannot be said that the author of the present work has fulfilled any of these tasks in a satisfactory manner. It would be impossible even to frame the problem on the basis of his contribution.

In order to do this it is important to have a clear definition of the concept with which we are dealing. What is *labour*? The reader of Mr. Buxton's book will find no definition, and the word is used loosely with a variety of meaning to cover "invention," "industries," "pursuits," and is usually identified in a cryptic manner with "arts of life," which, I take it, covers any form of activity whatever. (Ch. i.; also pp. 14, 63, 248, 250, 264-265 *et passim*.) But to identify labour with activity in general is, from the outset, to confuse the issue. For is it not in the harnessing of human energies, in the disciplining of purposeful and systematic activity, devoted to culturally valuable ends, that any real advance consists? It is only after we have distinguished labour from purely animal instinctive movement on the one hand, and from recreational and sportive activities on the other, that the problem emerges. Even in the satisfaction of his wants, such as search for food, provision for clothing and shelter, man may act instinctively on the animal pattern, or else reach his goal by culturally standardised types of behaviour. It is only the latter which I suggest should be regarded as forms of labour in the science of culture.

The anthropological problem, therefore, would be: What is the relation, at various stages of development, of the unregulated activities to those standardised by custom, and what part within the latter is occupied by work devoted to the production of concrete cultural values? For it is the achievement of something tangible and useful which must enter also into the definition of labour. In the first place it will be, of course, the satisfaction of man's primary wants: the search for food and its preparation; the procuring of raw materials for clothing, weapons, and direct objects of use. To this the lowest savage adds certain material goods which are not for consumption, but really belong to the primitive forms of capital—implements, arrangements for storing and preserving food, traps, hunting weapons, and so on. To define the savage, therefore, as Mr. Buxton does, by the fact that he "has no means of acquiring more wealth than he can carry about on his person or on the persons of his family" (p. 9), is incorrect even in regard to the most primitive man known, and would exclude from the inquiry all the most important facts about middle and higher savagery. Again, even amongst the lowest savages, there is work devoted to the production of what might be called luxuries—objects of art and monuments of culture—personal ornaments, paintings, and rude sculpture, stone memorials and graves, objects of cult and ritual.

We may, therefore, define labour as purposeful systematic activity standardised by tradition and devoted to the satisfaction of wants, the making of means of production, and the creation of objects of luxury, value, and renown.

If, however, labour is distinguished from other activities by its purpose, the question emerges: What is it that, in culture, drives man to strenuous, prolonged, and very often unpleasant effort? Here the problem of labour can be treated only against the background of the psychological problem of value. What are the effective incentives to effort? In what way are they related to instinctive drives and how far are they transformed by culture? It is obviously futile to discuss labour except as a part problem of economics. The early forms of labour are intimately correlated with the manner in which economic value came into existence. In fact, the inquiry has to burst the bounds even of the widest economic analysis and to consider how other motives, above all those of magical and religious character, have pushed man towards certain pursuits, established new values for him, and thus given him new forms of labour. The ingenious hypotheses of Eduard Hahn about the origin of domesticated animals and about the connexion between higher agriculture and religious cult; the views of Grosse about the influence of family life on economic pursuits; the recent contributions of Max Weber and Richard Thurnwald, form already a body of knowledge upon which any writer who treats of the problem of labour must take his stand. All this important research is unmentioned by the writer of the book under review.

From our definition of labour it also results that this type of activity, since it does not run on the lines of instinct and play, must involve a certain amount of resistance on the part of the organism. In other words, as we all know—and even the savage would agree with us—work is unpleasant. In primitive culture we find

indeed that man works very erratically, sometimes with the greatest efficiency, sometimes in a very unsatisfactory manner. A closer analysis shows that the efficient work is very often due to what might be called a palliative concomitant, some stimulant which carries man over the fatigue, tedium and monotony, over the need of recurring effort. An excellent study of this subject in one of its aspects has been given to us in Karl Bücher's "Arbeit und Rhythmus" (1899, 2nd ed.). No student of the problem should neglect this work, and had Mr. Buxton read it carefully and inspired himself with its methods he might have given us some data at least from the extremely rich inventory of the various concomitant stimuli, such as rhythm and music, drugs, work in company, emulation and example, importance of effective leadership and the use of rewards, material and moral.

The stimulating influence of work in company or of work under compulsion must be strictly kept apart from another and much bigger subject, that of the organisation of labour. Culture consists not only in the greater efficiency of effort, nor yet in the standardisation of this effort only, but also in the co-ordination of activities. The most primitive societies must have had a tradition of labour as well as a tradition of knowledge, belief, social organisation, and art.

Continuity in work transcends the limits of individual life, since not only the implement, the knowledge of material surroundings, but also the mode of working, the tricks of trade, and even the morals of hard and industrious labour must ever be engrained by the elder in the younger generation. This obviously implies some social organisation upon which the transmission of workmanship and education in work could have been based. This probably also led to the simplest forms of co-operation, those between the old and weak yet experienced on one hand, and the strong novices on the other. Since again transmission of workmanship must have been associated with kinship and marriage, the earliest forms of organised labour were to a great extent associated with the relation between husband and wife and parents and children.

The isolated household economy, however, was never the exclusive form of production even in the most primitive tribes. Prof. Karl Bücher, who develops an evolutionary scheme of human industries, would like to place at the beginning an even more primitive type of existence, that of isolated search for food. This is unquestionably a fictitious conception; even in simple search some order if not organisation is necessary. The roaming-grounds of every group are subject to the exclusive though collective rights of this group. Within this territory the very natural conditions such as the seasonal abundance of food, the advantages of systematic search, the technicalities of many proceedings in food-collecting, must have imposed a number of rules, dictated by knowledge and enforcing order and rudimentary forms of co-operation. The observations about food-collecting which I had opportunities of making among a number of Papuan and Melanesian tribes in New Guinea gave me the conviction that even among more primitive food-gatherers some organisation of labour must exist. The mere psychological factor which makes isolated search exceedingly tedious, and search in groups stimulating, refreshing, and more effective, would lead to the same conclusion. It is difficult to imagine collective work done in dead earnest, subject to natural conditions and guided therefore by knowledge and experience, which would be entirely unorganised.

There is, however, even a weightier reason for eliminating the concept of isolated search or of independent household economy. Culture stands and falls with the strength of tradition, with the quantity and quality of all that is transmitted from one generation to the other. A society cut up into independent families would, therefore, mean a tradition split into a number of extremely thin and precarious threads of cultural continuity. So that even in the lowest stages of development a society which would at least seasonally congregate, come into contact collectively, compare their practices and perhaps exchange material goods as well as ideas, would have a good cultural advantage over an atomised society. Moreover, a community which would be always ready to mobilise for defence or aggression, or in case of natural catastrophes, would always have a great advantage over its neighbours. This explains why we find in every savage community, described with sufficient accuracy and detail, periodic regular gatherings for religious, festive, or warlike purposes.

We are unfortunately not informed in what way the commissariat of such big gatherings is run. Yet it is clear that in a society like the Central Australians, who lead apparently a hand-to-mouth existence, and have to roam over big tracts of country in small bands in order to survive, some extraordinary economic feats must be performed if the hundreds of blacks who congregate for months for an Engwura or an Intichiuma ceremony have to be fed by those who are not busy in the ritual. There is here obviously a conundrum of the first order in primitive economic theory—not to speak of the practical difficulties to the blacks themselves—and yet our authorities who have given page after page of ceremonial detail have passed it over completely! So helpless is the first-hand observer in the absence of theoretical inspiration; as a field-worker, I may be allowed to say so. In any event, the

fact of big periodical gatherings among the most primitive tribes forces us to the conclusion that they have elaborate forms of economic organisation, more especially of organised labour. What is more, if they can organise on exceptional occasions, surely they must have some habits of organised work in their daily existence as well.

When we come to slightly higher stages, a great deal of collective and organised effort is required in such pursuits as communal hunting and fishing, any form of tropical agriculture, or the building of dwellings and canoes. In the case of such societies, we have at our disposal quite a respectable number of observations, and it would be possible to treat the subject not only tentatively so as to stimulate research, but also to advance certain positive conclusions. When a number of people work together at the clearing of the scrub, at the cutting down of a tree, or at the construction of some object, the question first arises—by what interest are they moved? Does every one receive some share, or even an equal share; or are they impelled by some *esprit de corps*, some unselfish motive of common good? The problem of incentive in communal labour leads therefore immediately into problems of ownership. Anthropology has perhaps discussed this problem more carefully than any other of primitive economics, but the relation between labour and prospective use and advantage still awaits to be competently treated, and more particularly to be freed from the ill-defined and misleading concept or word "Communism."

This is the place to attempt at least a tentative definition of what is understood by organised labour. In savage societies with a slightly higher culture, there are many tasks which transcend the forces of one individual; yet when several people co-operate, if there is not to be confusion, they must first of all be placed spatially and their respective contributions synchronised or placed into a sequence. In the simplest collective work, such as common clearing of bush, the pulling of a log, the planting of a garden or weeding, the people distribute themselves, and there are some means, either by personal arrangement or by customary signalling, of synchronising the pull of the log, of systematising the complete clearance of the bush, of ensuring an even distribution of the seed in the ground.

In more complex activities, however—imagine a canoe in rough weather, a fishing team at work, a fighting force manœuvring—there is a necessity not only of spatial and temporal co-ordination, but also a dove-tailing of the individual contributions to the common task. According to personal capacity, according to the position at that moment, according to social status, the various members of the organised team act each in the prescribed manner. There is among them, however, one whose task is not so much a special part of the common labour as the guidance of the whole. This is the leader. Leadership is necessary in certain enterprises, because of special knowledge, experience, and mental qualities; in others because of the need of one person to signal or indicate the sequence of events; in others again out of sheer deference to rank, status, and power. In primitive societies, moreover, there is one important element associated with control of work, that is the influence of magic. Magic indeed not only very often supplies the title to leadership, but seems to be one of the most important principles in the organisation of labour by supplying the stimulus, indicating the sequence, and commanding belief and subordination to the man in charge. We may, therefore, define the organisation of labour as the sum total of the factors which command the spatial and temporal placing of tasks; the distribution and dovetailing of functions, and, again, the integration of these functions by customary schemes, mutual agreement, and leadership.

The problems of organisation, therefore, would refer to the modes in which tasks are apportioned, to the nature of leadership, to the relation between technical and social rules, knowledge, and social prerogatives, finally to the study of magic as the controlling principle of labour. All this, however, would be futile if it were discussed without reference to the economic distribution of profits. For it is the inequality of labour, coupled with the inequality of gain, which forms, at the beginnings of civilisation, the foundations of progress. The best modern work in field anthropology establishes the importance of the economic factor in the foundation of political power, of rank, and of all forms of cultural eminence. The conditions as we know them from north-west America, from many African tribes, above all from Oceania, and more especially from Melanesia, reveal the accumulation of wealth as one of the strongest social incentives, the economic and ceremonial handling of valuables as one of the motives round which big social achievements crystallise, and the beginnings of a "leisured class" as the carrier of culture. The chief very often acts as a sort of tribal banker. All that Mr. Buxton has to say on this important subject is that "the chief's duties usually lie in other directions than those connected with arts of life" (p. 17), a statement succinct but not correct.

What has been said might perhaps be summarised in the statement that primitive labour has a technological aspect which leads to a disciplining and co-ordination of activities. This again implies from the earliest stages an organisation of labour which must be studied in its sociological context as well as with reference to the tribal economies. This, once more, leads to the psychological analysis of incentive, concomitant stimulus to

labour, value, and ownership. Mr. Buxton disregards the sociological, the economic, and the psychological problems. The technological aspect is treated only in a fragmentary descriptive manner. As a matter of fact, the second and third parts of the book, which are frankly descriptive—they consist to some extent of personal reminiscences told in a vivid and unassuming manner—are, within their limits, better perhaps than the more ambitious first part. That rapid impressions and anecdotal reminiscences as scattered throughout this volume have little anthropological value as field work, need scarcely be said. In the first part (pp. 1-72) we miss the formulation of the problem, even an approximate definition of terms and any consecutive argument. We remain under the impression that the book has been very rapidly written when we are told, for example, that "the house, then, will protect from the weather and provide a place wherein to live" (p. 60), or "clothing, therefore, may be considered at least in part as one of the arts of life" (p. 61)—and in such statements the book abounds. We feel that the art of omission has been neglected in writing it. To quote one more dictum: "Intimately connected with the arts of life, yet hardly forming one of them, may be grouped that type of craftsmanship which devotes itself to ornament and relaxation" (p. 63). How "relaxation" can be a form of craftsmanship or how craftsmanship is to be excluded from the "arts of life," passes my comprehension.

Disappointing also, in a book like the present, is the almost entire neglect of the most important works touching upon the subject. The names of Dargun, Ed. Hahn, Bücher, Schurtz, Cunow, Grosse, Laveleye, Lewinski, Thurnwald, and Max Weber are not mentioned. This is the less to be excused since there are in existence excellent brief resumés of the work done so far—to mention only "Die ethnologische Wirtschaftsforschung," by Pater W. Koppers, in *Anthropos*, 1915–16, and "Die Gestaltung der Wirtschaftsentwicklung von ihren Anfängen heraus," by R. Thurnwald, in "Erinnerungsgabe für Max Weber," Band i., 1923, both with excellent bibliographies.

The problem of labour, therefore, still awaits its theoretical launching. This is so much the more urgent since observations will not be forthcoming until the theory has erected a number of hypotheses, suggested a series of questions, and goaded the interest of field-ethnographers by a number of more or less extravagant assertions. It would be highly desirable that the subject of labour should be well under the control of theory and of empirical study, for it is one of practical importance in Colonial legislation and in the regulation of the manner by which native races are to work for or with the white man.

B. MALINOWSKI.

The Arts of Husbandry.

Actual Farming: its Processes and Practice. By W. J. Malden. Vol. 1. *The Farm: its Nature and Treatment.* Pp. 207. Vol. 2. *Croppings, Pastures and Weeds.* Pp. 295+11 plates. Vol. 3. *Live Stock, Labour and Marketing.* Pp. 240. (London: Ernest Benn, Ltd., 1925.) 50*s.* net.

THE task of writing a treatise covering the whole art of husbandry as it appears to those many sorts of farmers who practise it must necessarily be a formidable one. There is so very much to be said and so many points from which the same facts may be viewed, that the work may easily develop into an encyclopedia. From time to time courageous men have appeared who have endeavoured to capture and to set upon paper all that curious mass of information and tradition which, when seasoned with common sense and intuition, goes to make up a farmer's professional equipment. Such classics as "The Book of the Farm," or in a lesser way Fream's "Elements of Agriculture," are the result of such bold projects in the past, and it must be admitted that in so far as the written word has any influence at all upon the development of practical farming, they have proved their usefulness.

Mr. W. J. Malden, who is already well known as a writer on grassland farming and sheep and has an unusually wide personal experience of farming both in its practical and more definitely scientific aspects, has endeavoured to deal with the same subject in its more recent developments. His book is quite well-named, for its appeal is wholly to the working agriculturist and not at all to the man of science. Mr. Malden thinks as a farmer and feels as a farmer, and one can but regret that he does not write so well as some of those predecessors in agricultural literature from whose works he quotes. Many who read these three volumes will regret that the means of expression is not equal to the knowledge displayed in them.

The arrangement of so large a work is itself a matter of great difficulty, and in this particular the author has adopted a plan which should appeal to that body of his readers who may require his book as a work of reference. The whole is divided into three volumes, each with a sub-title which expresses its general purport. The first of these deals with the farm, its nature and treatment, the second with croppings, pastures and weeds, and the third with live stock, labour and marketing. The further subdivision into chapters is well done on lines which are familiar to students of agricultural literature. The first volume is probably the most valuable of the three, for some of the aspects of farming found in it are those which receive too little attention from contemporary writers.

Mr. Malden's view of the relation of the farmer to the rest of the community is one that is not uncommon among farmers, but is seldom adequately expressed. He says that "the farmer has every one as a critic," and that he has to carry on an extremely complex business and an unending war with the climate, in face of the freely expressed opinions of the mass of his uninstructed fellow-countrymen. Open criticism, even when it is ill-informed, matters very little when it is not accompanied by power of one sort or another. In this case of the farmer, the critics represent that urban majority which must influence the political views of any government to a very great degree. Farming and politics are widely removed from each other in most respects, but political neglect or misunderstanding can make the farmer's task very much more difficult than it need be.

The attitude of farmers towards change and so-called agricultural progress is very generally misunderstood, and Mr. Malden finds space to express a view which will gain support among those who have some knowledge of farming conditions, and of the ill-conceived and expensive reforms which are sometimes urged upon agriculturists. The history of agricultural development in Great Britain during the past fifty or sixty years shows that great progress has been made in the application of the sciences to the business of farming, and that the farmer of to-day is in a far better position to solve his problems of crop and animal husbandry than was his great-grandfather. Unfortunately, a closer study of the course of progress reveals the fact that this advance has been made at very great cost, and that a large number of individuals have been ruined in the process. So many well-meaning but unwise people, and so many interested rogues, have set out to advise farmers in the development of their businesses; so much incomplete discovery and unbalanced recommendation has been lavished upon agriculture, that the sturdy conservatism of the farmers might very well have become hardened to an incredulous contempt for all new ideas. That this has not happened is well shown by the present development of agricultural education and research, which depends upon the support of farmers all over the kingdom. Mr. Malden quotes from Wren Hoskyns to show that real progress finds a welcome on the farm as elsewhere, and that apparent lack of enterprise is often only wise caution on the part of the farmer. The beginning is worth quoting again:

"Ye ardent go-aheads! who expect every new argument to tell at once—every intellect to yield at first onset, every new plan to be tried by everybody—learn to wait: and you will find that there is much more chance of your notion being overtaken than overlooked, much more likelihood of your having to reclaim than to reassert a single hint that was ever good for anything."

CLEMENT HEIGHAM.

Optical Methods in Biology and Chemistry.

(1) *Handbuch der biologischen Arbeitsmethoden.* Herausgegeben von Prof. Dr. Emil Abderhalden. Lieferung 161. Abt. 2: *Physikalische Methoden*, Teil 1, Heft 5. *Photometrie, Tyndall-Photometrie, Zeitmessungen.* Von Paul Hirsch. *Colorimetrie.* Von Heinrich Kessler. Pp. 619-736+xvi. (Berlin und Wien: Urban und Schwarzenberg, 1925.) 5·70 gold marks.

(2) *Optische Messungen des Chemikers und des Mediziners.* Von Dr. Fritz Löwe. (Technische Fortschrittsberichte: Fortschritte der chemischen Technologie in Einzeldarstellungen, Band 6.) Pp. xi+166. (Dresden und Leipzig: Theodor Steinkopff, 1925.) 6 gold marks.

RAPID developments have taken place during recent years in the application of optical methods in various branches of science. For the efficient utilisation of such methods, the investigator or practitioner requires a knowledge of the functions and possibilities of the various instruments that are available for use in his particular sphere of work. To meet these requirements, modern textbooks professing to give a complete treatment of any subject usually contain a full account of suitable instruments and of the method of using them. As an alternative to the inclusion of elaborate instrumental details in a comprehensive treatise on any branch of science, the preparation of separate monographs dealing with the development of the instruments and their specialised applications has much to commend it. Revised editions of such monographs are more easily produced and more readily purchased, and the student or investigator can select those which deal with that branch of the subject in which he is most directly interested. The two books before us provide an example of each method.

(1) The first forms a small section of the second volume of a thirteen-volume treatise on methods and technique in biology, many parts of which have already been noticed in our columns. Two chapters are devoted to photometry and Tyndall photometry or the measurement of the scattering of light by extremely small particles held in suspension in the medium through which the light is passing. The theoretical treatment is adequate and the main types of instruments are well described; but many of the most recent developments are omitted and little information is given on the application of the instruments in particular cases. No attention is paid to the attempts which have been made to place photometry on a more accurate basis by the use of instruments which respond to light in a manner comparable with that of a normal

human eye. The appendix on spectrophotometry contains very little indication of the use of instruments which enable quantitative measurements of absorption to be made in the ultra-violet and the infra-red regions of the spectrum.

In making these criticisms we must, however, bear in mind that we are examining a small section of a large treatise, and it is possible that many of the items now omitted may find a place elsewhere in the completed work. Thus, in the chapter on Tyndall photometry, no mention is made of recent work on nephelometric methods in biochemistry; but the list of sections in course of preparation includes one on nephelometry, which is grouped with ultramicroscopy. The third chapter contains an instructive account of several types of stop-watches. Chronographs and microchronographs are not included, but reference is made in this connexion to another volume of the work.

The chapter on colorimetry deals with the simpler and more frequently applied part of the subject, namely, the determination of the comparative luminosity of the total light transmitted by a coloured body, as distinct from the calculation of the colour of the light. Here the chemist will find a considerable amount of information with regard to instruments and methods which permit him to use colour estimations in various branches of analytical work.

(2) The object of Dr. Löwe's book is to provide, in a readily accessible form and at a reasonable price, a comprehensive presentation of the advances that have been made since 1914 in optical instruments and their application in chemistry and medicine. The book admirably fulfils its purpose. The subjects dealt with are spectroscopy, refractometry, and interferometry. Developments in these regions have been particularly rapid during the period under review, and the author has had plenty of material with which to work. The selection he has made is good and the treatment is excellent.

Each section of the work contains an account of recent improvements in instruments and their employment in the routine examination of solids, liquids, and gases, and in special investigations, together with tables of constants for use in the interpretation of the results of observations, and a useful bibliography. These should prove of value to the worker in any branch of analytical chemistry. The author emphasises the advantages to be derived from a more extended use by chemists of the facilities which optical methods provide for making quantitative measurements. Such methods are undoubtedly neat and rapid, and this admirable survey should tend to popularise their use. In doing so, it will serve a very useful purpose.

Our Bookshelf.

Biologie der Flechten: Entwicklung und Begriff der Symbiose. Von Prof. Dr. Friedrich Tobler. Pp. viii + 266 + 1 Tafel. (Berlin: Gebrüder Borntraeger, 1925.) 13·50 gold marks.

THE original intention of the author was to write a complete account of the lichens, but in this he was forestalled by the publication of Miss Lorrain Smith's "Lichens," with the result that the present volume is confined to a survey of their biology. The historical and modern aspects of the subject are treated as a connected whole and discussed in the light of the most recent work. A full bibliography is given at the end of the book, with brief notes as to the contents of most of the papers.

The author regards the lichens as essentially a biologic rather than a systematic group, the keynotes to the whole volume being metabolism, symbiosis, and the relation of external conditions to the balance of the two symbionts. These views are brought out in discussions on such problems as the relative biologic and systematic significance of soredia and isidia—vegetative methods of multiplication, which are affected by external conditions but occur only in certain lichens, suggesting that their formation may be associated with particular structural types of cortex. The section on physiology includes a survey of the lichen acids, which are interesting as indications of the peculiar metabolism of lichens, and also useful for the identification of lichens, owing to their characteristic colour reactions with certain reagents.

The lichens are regarded as a synthetic group and one particularly favourable for the study of symbiosis. Illustrations are given of all stages from a loose association of fungus and alga to the complex types of symbiosis, where the relationship of the two symbionts is so intimate as to produce a peculiar and characteristic type of morphology and metabolism. This relationship is again closely bound up with external conditions—particularly light and moisture—extreme changes in which are liable to destroy the balance of the two symbionts.

The British Hydracarina. By Chas. D. Soar and W. Williamson. Vol. 1 (Ray Society Vol., No. 110). Pp. x + 216 + 20 plates. (London: British Museum (Natural History), 1925.) n.p.

ONCE more we are indebted to the Ray Society for an arachnid monograph. Instituted in 1844, Blackwall's classic work on spiders was one of the products of its youth. In the 'eighties it gave us Michael's Oribatidæ, to be followed at the beginning of the twentieth century by the same author's Tyroglyphidæ, and now we have the first instalment of the Hydracarina.

The present volume begins with a short historical section, for some reason only brought up to 1842, though later workers have some notice when classification is discussed. An interesting chapter on general characters and life-history follows, and makes it abundantly clear that there is here a large field for further research. The complications introduced by parasitism on the early instars of insects which presently leave the water are responsible for most of the gaps which still

exist in our knowledge of the habits of these curious creatures. The Koenike-Viets classification is adopted without comment, and three families are recognised—Halacaridæ, Limnocharidæ and Hygrobatidæ. Precedence is given to the Limnocharidæ, and about eighty species are dealt with in 126 pages of text, followed by twenty useful—if not sumptuous—plates.

Messrs. Soar and Williamson have begun their task well, and the monograph will be necessary to all interested in this rather isolated group. We confess to finding occasional obscurities of language. For example, "our observations on the hatching of *P. longipalpis* extended over seventeen days" (p. 24) appears from the context to mean that seventeen days was the incubation period; and what is the precise value of observations "stated to have been made by Piersig"? These, however, are small blemishes. We are grateful to the authors and to the Ray Society, which appears to be establishing a "corner" in Acarina. May we hope in due time for a reduction of the chaos which exists in the Gamasidæ and the Trombidiidæ? C. W.

An Introduction to Palæontology. By Dr. A. Morley Davies. Second impression. Pp. xiii + 414. (London: Thomas Murby and Co.; New York: D. Van Nostrand Co., 1925.)

WE welcome a second impression of the useful little introduction to the study of fossils by Dr. Morley Davies. It is, indeed, a most practical handbook both for the student of geology and the amateur collector, and is admirably designed to give an insight into the methods of palæontological science. It is not a systematic treatise on the various groups, but shows clearly how each is to be studied, and it provides a series of synoptical tables of classification which will suffice for those who are chiefly concerned with fossils as indicators of the age of rocks. There are also in the appendix synopses of the divisions of geological time and the stratigraphical distribution of fossils.

The second impression of the book differs little from the first, except that certain errors have been corrected. It still retains the birds curiously as an order of reptiles intercalated between the crocodiles and pterodactyls. There is also an oversight in describing insects in amber as preserved by the "antiseptic character" of this substance: they are never preserved—they have merely left cavities where they were originally embedded. The descriptions, though always concise and clear, are sometimes overburdened with technical terms which are liable to repel rather than attract the beginner and amateur. One, however, who has plodded through the book with actual specimens of the fossils referred to, will be amply equipped to use special treatises and proceed with independent research. A. S. W.

Department of Scientific and Industrial Research: Radio Research Board. Special Report No. 3: Variations of Apparent Bearings of Radio Transmitting Stations. Part 2: Observations on Fixed Stations, March 1922–April 1924. By Dr. R. L. Smith-Rose. Pp. viii + 107. (London: H.M. Stationery Office, 1925.) 4*s.* 6*d.* net.

THIS report discusses the progress of the investigation into the variations of the apparent bearings of radio transmitting stations from March 1922 to June 1923, when the observations on the longer wave-lengths ranging from 2000 to 9000 metres were discontinued. Observations, however, made at Lerwick, Shetland Islands, from July 1923 to April 1924 are included.

Experiments on the shorter wave-lengths are to be published in Part 3.

The results with the longer wave-lengths prove that when the waves travelled overland, distances ranging from 30 to 200 miles, abnormally large variations were recorded during night time. For distances less than 30 miles, the majority of the direction finder readings had an inaccuracy of about 2°. When the path between the transmitting and observing station is entirely oversea, the errors in the observed bearing were found to lie within the 2° limit for distances up to 100 miles. For most navigational purposes this accuracy suffices. It was found that, within the limits of the experiments, no appreciable effect on the results could be attributed either to the wave-length or to the use of damped or undamped waves.

The Elements of Internal-Combustion Engineering. By Telford Petrie. Pp. xi + 236. (London: Longmans, Green and Co., 1925.) 10*s.* 6*d.* net.

AMONG the available text-books on the theory of the internal combustion engine, there are few which present a good account of the subject within a moderate compass and can be recommended to a student in his undergraduate course. This book would appear to satisfy this requirement and is a worthy contribution to the subject. The first three chapters give a brief historical sketch and a descriptive account of the cycles employed in the various types of gas and oil engines now in use, including the Still engine and the Humphrey gas pump. The next five chapters contain a good account of the thermodynamics of the subject, including a chapter on variable specific heats so far as they affect the transformations in an actual engine, the whole of which is well arranged and clearly written.

In the remaining chapters, such matters as the formation of combustible mixtures and temperature effects are dealt with. In the former case the account contains much useful information relating to combustion which should prove of considerable interest to designers as well as to students; in the latter, however, the treatment is necessarily rather superficial, as the various subjects which are included in it could scarcely be dealt with satisfactorily in the space allotted to them. A chapter on the possibilities of development and a collection of good examples conclude the book. E. H. L.

Primer of Arithmetic for Middle Forms. By F. M. Marzials and N. K. Barber. Pp. xii + 262. (London: Oxford University Press, 1925.) 3*s.* 6*d.* net.

THIS book is intended to follow a preliminary course up to compound rules, practice, and unitary method. It has many excellent features which make it worthy of consideration by all teachers, but a serious defect is the neglect to train pupils in estimating for themselves the degree of accuracy which may be expected of their results; they are invariably given the number of significant figures required in the answer. It is regrettable that the absurd questions on finding the cost to the nearest penny of papering rooms have not been allowed to die a natural death.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Violent Spore-discharge in *Tilletia Tritici*.

Tilletia Tritici and *T. laevis* are fungi which cause the well-known stinking smut disease or bunt of wheat. An affected wheat grain becomes transformed into a sack filled with several million, closely packed, minute, brown chlamydospores which, in the mass, have the odour of decaying fish. These spores become powdery and, under natural conditions, are passively dispersed by wind and rain. In the artificial process of threshing, the smut-balls are broken open and much of the chlamydospore-powder becomes adherent to the outer surface of the sound wheat grains. When smutty grains are planted in the soil, the fungus attacks the wheat seedlings and once more gives rise to the smut disease. Farmers in Canada and other countries treat the seed-wheat with formalin or some other poisonous substance. This kills the chlamydospores and greatly reduces the incidence of the disease.

When a chlamydospore germinates on a wet substratum (Fig. 1, A), it gives rise to a short germ-tube or *basidium* (promycelium) which at its apex produces aerially a crown of from four to sixteen slender rod-shaped structures, called by Brefeld and others *primary conidia*. These conidia have been regarded by botanists in general as morphologically equivalent to the basidiospores of mushrooms and of rust fungi.[1]

The primary conidia, often while still on the basidium as illustrated by Brefeld,[2] conjugate in pairs, each pair forming an H-shaped structure. The work of Rawitscher [3] has shown that, during conjugation, a nucleus present in one of the two conidia passes via the bridging hypha into the other conidium, so that this becomes binucleate. The primary conidia readily become detached from the basidium-body which has borne them, but they are never discharged by that organ in a violent manner.

Each H-shaped pair of primary conidia, while still attached to the basidium-body, or after becoming detached, may put out a short sterigma at the end of which there is developed a sickle-shaped spore, called by Brefeld and others a *secondary conidium* (Fig. 1, A). Or, if malt-agar or other suitable nutrient medium be supplied, each H-shaped pair of primary conidia may put out a germ-tube which branches and rebranches for a long time and produces singly, at intervals along its hyphæ, many scores or hundreds of the sickle-shaped secondary conidia (Fig. 1, B). Each sickle-shaped conidium is produced aerially on a short conical sterigma to the end of which it is attached in an asymmetrical manner. As in the basidiospores of mushrooms and rust fungi, the axis of the basal part of the conidium is inclined to the axis of the sterigma at an angle of about 45°. Hitherto, no one seems to have suspected that the sickle-shaped secondary conidia are the basidiospores of the stinking smut fungus.

One of us (A.H.R.B.) was struck by the great resemblance of the sickle-shaped secondary conidia and their sterigmata to the basidiospores and sterigmata of the Hymenomycetes (mushrooms and toadstools),[4] Uredineæ (rust fungi),[5] and the three species of the recently described basidiomycetous yeast-genus Sporobolomyces ; [6] and it was therefore thought probable that these smut conidia, like the basidiospores just mentioned, are shot away from their sterigmata with the accompaniment of drop-excretion at the spore-hilum. The other author (T.C.V.) of the present communication undertook to test this supposition, with the result that, after overcoming the technical difficulties associated with (1) the germination of the chlamydospores in sterile 4 per cent. malt-agar and with (2) the development of the secondary conidia under conditions in which they could be watched for hours under the microscope, he made preparations which have enabled both of us to witness

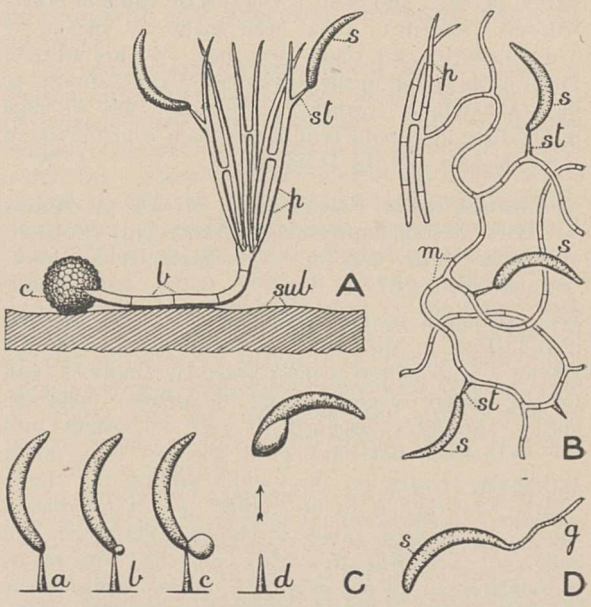

FIG 1.—Diagrams illustrating spore-production in *Tilletia Tritici*. A : a chlamydospore *c*, with its basidium *b* crowned by six primary conidia *p*, which have conjugated in pairs ; two of the pairs have produced short sterigmata *st* terminated by sickle-shaped secondary conidia *s* ; *sub*, a damp substratum. B : a pair of conjugated primary conidia *p* on malt-agar ; their germ-tube has developed into a branched mycelium *m*, which at intervals sends up into the air short sterigmata *st*, which bear sickle-shaped secondary conidia *s*. C : stages in the discharge of a single secondary conidium ; *a*, a full-grown spore on its sterigma ; *b*, the same with a drop of fluid just appearing at the spore-hilum ; *c*, the same, about 20 seconds later ; *d*, the same, one second after *c*, the spore and the drop have been violently shot from the sterigma. D : a discharged secondary conidium *s*, which has fallen on malt-agar and has germinated ; *g*, its germ-tube. Magnification : A and B, 300 ; C and D, 400.

the violent discharge of the secondary conidia, with the accompaniment of drop-excretion. Since 1883, the year in which Brefeld began to publish his classical researches on the smut fungi, many mycologists, phytopathologists, and general botanists have studied these organisms ; but, hitherto, the fact that a smut fungus should display violence in the discharge of its spores has not been observed and does not even seem to have been suspected by any one.

A sickle-shaped spore, under laboratory conditions, takes about an hour and fifteen minutes to develop from a tiny rudiment to full size and to mature. At the end of this time, if all goes well, a tiny drop of fluid begins to appear on the spore-hilum at the base of the spore just above the sterigma (Fig. 1, C). The drop grows visibly, protruding laterally, and, in about 20

[1] Cf. F. L. Stevens, "Plant Disease Fungi," New York, 1925, p. 213.
[2] O. Brefeld, "Untersuchungen über Pilze," Heft 5, 1883, Taf. 12, Figs. 26 and 27.
[3] F. Rawitscher, "Zur Sexualität der Brandpilze *Tilletia Tritici*," *Ber. d. Deutsch. Bot. Ges.*, Bd. 32, 1914, p. 310.
[4, 5] Cf. A. H. R. Buller, "Researches on Fungi," London, vol. 3, 1924, Fig. 204, p. 505.
[6] A. J. Kluyver und C. B. van Niel, "Über Spiegelbilder erzeugende Hefenarten und die neue Hefengattung Sporobolomyces," *Centralb. f. Bakteriologie*, Abt. 2, Bd. 63, 1924–1925, pp. 1-20, Taf. I and II.

seconds, attains a diameter equal to about one and one-half times the thickness of the spore. Then, suddenly, the spore and the drop are shot away from the sterigma to a distance of about one-half a millimetre. The sterigma left behind is apparently unchanged. Under suitable conditions, a thin spore-deposit of discharged spores gradually accumulates. On 4 per cent. malt-agar a spore begins to germinate within an hour of discharge from its sterigma (Fig. 1, D).

Sometimes abnormalities in spore-discharge may be observed. (1) A spore may grow to full size in the usual time, but there may be no drop-excretion at the hilum and no discharge. One spore remained seated on its sterigma unaltered for three days. (2) A spore may grow to full size and then, within an hour, may germinate at its apex. Such a spore never excretes a drop of fluid and is never violently discharged. (3) A spore may grow to full size and then, within an hour, a drop may be excreted at the spore-hilum; but the drop and spore are not discharged. Instead, the drop may run up the spore and then grow to an abnormally large size about the middle of the spore. The drop may dry up slowly and then the spore, while still seated on its sterigma, may germinate by sending out a germ-tube at its apex. The failure of the drop to be excreted and excessive drop-excretion, accompanied by failure of the spore to be discharged, as just described, have been observed by one of us as not infrequent abnormalities of the spore-discharge mechanism both in the Hymenomycetes and the Uredineæ.[7] Also in *Puccinia graminis* the same author has observed that a basidiospore, which has failed to be shot away, often germinates *in situ* at its apex.[8] Thus the abnormalities connected with the phenomenon of spore-discharge in the secondary conidia of our stinking smut fungus find their exact parallels in the abnormalities one may witness in a mushroom or in the fungus which causes the black stem rust disease of wheat.

Our discovery that the sickle-shaped spores or secondary conidia of Brefeld and others are violently shot away from their sterigmata, with accompanying drop-excretion at the spore-hilum, is of considerable theoretical importance; for it not only confirms with new and weighty evidence the correctness of the view generally held by botanists that the Tilletiaceæ belong to the great group of the Basidiomycetes, but it also allows us to draw the following new conclusions: (1) the so-called secondary conidia of *Tilletia Tritici* and of other species of Tilletia are in reality the true basidiospores; and (2) the sporidia or primary conidia of Brefeld and others are morphologically equivalent to sterigmata. Finally, it seems to us probable that further research will show that our new conception of the basidium in the genus Tilletia may be successfully applied to the basidia of the other genera of the Tilletiaceæ.

A. H. R. BULLER.
T. C. VANTERPOOL.

The University of Manitoba,
November 21.

Wireless Time Signals: Changes in the French Issues.

FOLLOWING a series of resolutions adopted at the meeting of the International Time Commission at Cambridge in July last, certain changes will be made in the issue of time signals from radio stations in France, commencing on January 1, 1926.

The present series of signals from the Eiffel Tower [FL], Lyons [Douai, YN] and Bordeaux [Lafayette, LY] will be withdrawn and will be replaced by the following series:

No.	G.M.T.	Signal.	Station.	W.L.	
1	8.0	International and Rhythmic Signals	FL	2,600	Spark
2	8.0	International and Rhythmic Signals	LY	19,000	CW
3	9.30	International	FL	2,600	Spark
4	20.0	International and Rhythmic Signals	LY	19,000	CW
5	22.45	Old Semi-automatic Signal .	FL	2,600	Spark
6, 7		Short-wave emissions — see below.			

This series will be put into operation in the first instance for a period of four months, after which it is contemplated that No. 3 may be withdrawn and No. 5 replaced by an issue of the International and Rhythmic Signal from FL, simultaneously with that from LY at 20^h. By that time it is expected that the issue on spark from FL will be replaced by an issue on modulated CW.

In the meantime the issues Nos. 3 and 5 will take the same form as hitherto, and for ordinary users the only service which is withdrawn is the issue of the Old Semi-automatic Series from FL at $10^h\ 45^m$.

The form taken by the issue No. 1 is the following:

[*a*] Preliminary signal.

[*b*] Times of issue of rhythmic signal of the *previous day* as determined by the *Bureau International de l'Heure*, Paris.[1]

[*c*] Commencing at $7^h\ 57^m\ 55^s$, the International Signal as hitherto, except that the three dashes which have constituted the Time Signal are to be replaced by six dots, commencing at the seconds 55·0, 56·0, 57·0, 58·0, 59·0, 60·0 and lasting each about 0·2 sec.

[*d*] Commencing at $8^h\ 1^m\ 0^s$, a new rhythmic issue of 306 signals, falling as follows:

$1^m\ 0^s$,	1st	dash	followed by	60 dots.
$2^m\ 0^s$,	62nd	,,	,,	,,
$3^m\ 0^s$,	123rd	,,	,,	,,
$4^m\ 0^s$,	184th	,,	,,	,,
$5^m\ 0^s$,	245th	,,	,,	,,
$6^m\ 0^s$,	306th	,,	,,	,,

The commencements of all these signals are to be evenly spaced; the commencements of the dashes are intended to fall precisely at the commencements of the seconds of mean time and they will be each about one-half second in duration; the dots will be about one-fifth of a second in duration.

Besides these issues upon the wave-lengths hitherto employed by FL and LY respectively, issues Nos. 6 and 7 will be made at 8^h and at 20^h simultaneously with the other issues, by the station FL on *short wave-lengths*, namely, 32 metres and 75 metres, on the same pattern as the issues Nos. 1, 2 and 4 above, during the probationary period of four months. After that, it is contemplated that one or other of these wave-lengths may be suppressed and the other retained permanently in addition to the series [1]-[5] above.

A period of probation of four months has been adopted in order to ascertain how far the new issues meet both general and scientific requirements.

Any comments which are the result of experience on the working of the new issues, or upon the abolition of the old issues, should be addressed either to *M. le Directeur, Bureau International de l'Heure*,

[7] A. H. R. Buller, "Researches on Fungi," vol. 2, 1922, pp. 18, 308-310; vol. 3, 1924, pp. 506-509.
[8] *Ibid.* vol. 3, Fig. 203, p. 503.

[1] An intimation received since this circular was prepared places [*b*] subsequent to [*d*], commencing at $8^h\ 6^m\ 5^s$ or $20^h\ 6^m\ 5^s$

Observatoire National, Paris, XIV^e, or to the undersigned.

They should arrive not later than the beginning of March.

R. A. SAMPSON,
President, International Time Commission.
Royal Observatory, Edinburgh,
December 10.

Experiment and Philosophy.

THIS letter is a dogmatic rejoinder to nobody in particular.

There is a wise Scots saying which warns us against showing half-done things to "bairns and fules." It ought to hang as a text by the bedside of every scientific researcher, with a note appended that "bairns" is to be glossed "non-scientific thinkers and the educated public." The Great Educated Public thirsts, very properly, for knowledge; but it loves best, if it can, to get the wine of learning all raw from the presses, dispensed by the vintners themselves, and to suck it up through the sweet straw of analogy. Of late years there has been a remarkable indulgence of this crude taste for "the last word in science"; and one immediate result has been that a good many metaphysically-minded folk have hastily engorged certain possibilities, perceived and put forth by men of science to be further tested by men of science, but forming draughts too heady and unmatured for the novice. Dazzling themselves with the tentative speculations of science, such pseudo-philosophers comfortably conclude—see them at it in any of the current reviews—that, after all, the scientific method can now be proved (with the aid of its own results!) to be merely argument in a circle.

So: all is well; the lamb of mysticism can now lie down with the lion of science, for the poor lion is exposed as nothing but a cud-chewing ruminant. Surely it is time that the lion gave a gentle roar or two, if only as a salutary reminder to the lamb who skips up bleating for more room than the lion is ready to concede?

The root of the trouble seems to lie in this: that non-scientific people are in such impetuous haste to "know" (as they are pleased to call the process of "being informed") that they will not understand the need to wait patiently for years—in large questions, for centuries—before suspicions now private to first-hand inquirers can be turned into public assertions. "Here's the latest," they seem to say; "let's have it; fling away what went before it and what went to make it." Yes; and fling away *this* latest, too, in a little while, so soon as real science shall have caught up with it and have made it a trifle dull and *démodé* because surer and better-balanced; and fling away, at the ghost of a permissive hint, whatever may any more obscure the glorious verities of untutored guessing. "How much better and finer it is (besides being much less trouble) to be able at last to ignore, as of old, the figments of science! (Of course, we don't mind using soap, we don't mind telephoning to our doctor to come quickly in his car to diagnose and cure our ailments, or to the surgeon to save our lives and minds—*these* scientific figments we tolerate, for we *like* them!)"

All this would not matter very much—the unlearned will perhaps know better in a few generations—if it were certain that it will not prejudice experimental science. But we buy a book purporting to teach the experimental man of science the inwardness of his business; we expect, perhaps, a helpful exposition of Whitehead's sane, lucid, and logical "Pan-physics," or else the elements of logical inference; but we get a confounding blend of two or three universes of discourse, an ambitious and premature synthesis of the only partially-analysed, which leads the working human reader into a barren and impotent finality.

The motto of this journal, Wordsworth's sentence, surely abides, nor can it be wrested from its meaning by crying (with the materialists of last century) that Nature includes all mind. No experimenter holds, in his inmost soul, the converse; namely, that mind includes all Nature, has indeed created it; nor will he admit, for generations still to come, that our real knowledge yet suffices to probe the vast theorems that our hurrying philosophers broadly accept as already settled. Of those lugubrious thinkers, those reactionaries whose claim once again is *Totam Asiam peragrare*, and who seek to cast three hundred years of patiently-won lore into the melting-pot, to gain the Indies out of the crucible: of these none are experimenters. They are like the jaded urban hero in the story, whose regeneration depends on his coming "close to the green and growing earth"; they have attenuated honest sense-facts by unremitting abstractions to the *n*th degree; they have lost the last touch with reality.

The working man of science at least has his feet well planted in the solid ground of observation; and if the soaring philosophers accuse him, on the contrary, of having his head too tightly embedded in that same ground, let him at all events show them that his protruding extremities nevertheless have not lost the power of vigorously kicking.

THOMAS HOBBES, Junior.

A pp' Group in the Arc Spectrum of Zinc.

ONE of us (R. A. S.) in a study of pp' groups in atomic spectra, which will be published in full later, has observed that in many two-valence-system spectra the frequency of the first pp' group is nearly a mean between the frequency of the first line of the principal series of singlets in the spectrum and the first line of the principal series of doublets of the once more ionised atom.

The rule holds for the pp' group in cadmium given by Ruark (*J.O.S.A.*, vol. 11, 1925, pp. 199) where we have

Cd I, $1S - 2P$	$\nu = 43691$
Cd I, $2p_1 - 2p_1'$	$\nu = 44088$
Cd II, $1s - 2p_1$	$\nu = 46618$

We were accordingly led to apply this rule to zinc where an exactly analogous group to that in cadmium was easily located.

The complete cadmium group as given by Ruark is:

λ.	Int.	ν.	Classification.
2329·27	10*R*	42918·6	$2p_2 - 2p_1'$
2306·61	5*R*	43340·3	$2p_1 - 2p_0'$
2267·46	5*R*	44088·6	$2p_1 - 2p_1'$
2239·86	5*R*	44631·7	$2p_0 - 2p_1'$

$\Delta p_1p_2 = 1170{\cdot}1$, $\Delta p_0p_1 = 543{\cdot}1$
$2p_1' = -2206{\cdot}6$ cm.$^{-1}$.

The group is anomalous in that only four lines appear instead of six lines as in a normal pp' multiplet, but the classification is fixed by the known Zeeman pattern of the line $2p_1 - 2p_0'$.

In zinc we find a similar group of four lines which we have classified as follows. The wave-lengths of Eder are used.

λ.	Int.	ν.	Classification.
2104·34	2	47505·7	$2p_2 - 2p_1'$
2096·88	2	47674·7	$2p_1 - 2p_0'$
2087·27	2	47894·0	$2p_1 - 2p_1'$
2079·10	2	48082·2	$2p_0 - 2p_1'$

$\Delta p_1p_2 = 388{\cdot}3$, $\Delta p_0p_1 = 188{\cdot}2$
$2p_1' = -4629$ cm.$^{-1}$.

This group obeys the rule stated in the first paragraph as follows :

Zn I, $1S - 2P$	$\nu = 46745{\cdot}8$
Zn I, $2p_1 - 2p_1'$	$\nu = 47894{\cdot}0$
Zn II, $1s - 2p_1$	$\nu = 49354{\cdot}7$

It also has within reasonable limits the separations of the known $2p$ levels of zinc which are :

$$\Delta p_1 p_2 = 388{\cdot}9,\ \Delta p_0 p_1 = 189{\cdot}8.$$

The Zeeman pattern of none of these lines is available so far as we can find.

We have been permitted to examine these lines on a spectrogram taken with a Hilger E 1 quartz spectrograph by Dr. R. V. Zumstein, National Research Fellow, at the University of Michigan. All four lines are sharp and like in appearance, although λ2087 appears to have a close diffuse companion barely resolved from it on the short wave-length side. There is a fifth line which might conceivably belong to the group, although its diffuse character would seem to exclude it. This line is

λ2070·11 Int. 1 ν48291·2

If this line were classified as $2p_1 - 2p_2'$ and the short wave-length companion of λ2087 classified as $2p_2 - 2p_2'$, we should then have a normal pp' triplet group. In view of the fact that λ2070 is diffuse and quite different in appearance from the first four lines, we hesitate to make this assignment. It may be said in favour of it that the diffuse companion to λ2087 mentioned above might be interpreted to mean that p_2' has a diffuse nature. We know, however, of no similar example of this sort.

RALPH A. SAWYER.
NORMAN C. BEESE.

Physical Laboratory,
University of Michigan,
Ann Arbor, Michigan,
November 6.

On a New Device for the Study of the Compton Effect.

ACCORDING to a recent tentative suggestion of W. R. Smythe, a study of the intensities of the Compton modified scattered X-ray spectrum lines might serve to prove whether the electrons effective in the scattering which produces the modified radiation are completely " free " or whether they are " bound " to atoms of the scattering substance. If " modified " scattering is produced by free electrons only, then the intensity of the modified line should be jointly proportional to the intensity of the incident radiation (number density of radiant corpuscles) and to the number of free electrons present. But this latter is itself at least roughly proportional to the intensity of the incident radiation, since it is safe to assume that most of these free electrons are rendered so by the photoelectric action of the incident X-radiation. Hence the intensity of the modified scattered line should vary roughly as the square of the incident intensity, or at least as some greater power than unity of the incident intensity.

Up to the present date, so far as I am aware, it has been necessary to study the Compton effect by very greatly prolonged X-ray exposures, or by ionisation chamber methods requiring extremely powerful X-ray tubes for the incident intensity, and very sensitive electrometer methods for detecting the presence of the lines. This is largely due to the fact that the original radiation must be scattered twice in succession, once to obtain the effect and once at an analysing crystal. The photographic exposures are frequently prolonged to 100 or 200 hours' duration and occupy a good portion of the life of an X-ray tube.

In order to investigate Smythe's suggestion, and for other purposes, I have constructed an X-ray tube of special design in which both scattering substance and analysing crystal are contained in a small metal box mounted on the end of the anti-cathode. The distance from the source of primary X-rays to the scattering material is so greatly reduced that the radiation available for the scattering is of the order of two thousand times more intense than that heretofore available. *It has been found possible to produce photographic spectrograms of the Compton effect with this apparatus in thirty seconds that would by previous methods have required a hundred hours' exposure.* Very moderate currents such as 5 ma. suffice for exciting the primary X-radiation. The possibilities of such an apparatus for high dispersion studies and many other purposes will be immediately evident to any one familiar with this field of work.

Preliminary studies with the new " target spectrometer " seem to show very little evidence for any intensification of the Compton modified lines greater than a strict proportionality to the incident intensity would require. It is too early, however, to decide this question with precision. If Smythe's tentative prediction is not eventually supported by experiment, then the theory that bound electrons are responsible for the observed " softening " of X-radiation scattered by light elements is strengthened.

Work is now in progress with the new apparatus which I hope will decide the above-mentioned question. A study of the fine structure of modified and unmodified lines by means of the new instrument is also under way. One of the novel features of the present target spectrometer is that it permits the study of radiation that has been scattered at an angle of almost exactly 180°. This angle offers several advantages in the study of the fine structure of the modified line.

JESSE W. M. DUMOND.
Norman Bridge Laboratory of Physics,
California Institute of Technology,
Pasadena, California,
October 28.

Genes and Linkage Groups in Genetics.

I WOULD like to ask Prof. MacBride to clear up one point in his review in NATURE for November 28, p. 776, for otherwise those who are not geneticists may be led astray.

Prof. MacBride writes of " the crude conception of the linear arrangement of the genes in the chromosome, and the idea of crossing-over." He is here, however, confusing two distinct points : (1) the linear arrangement of genes within linkage-groups, and the phenomena of partial linkage ; and (2) the identification of the linkage-groups with the chromosomes. Even if the latter were disproved, the evidence for the former would remain in its entirety, and it is with this alone that I wish here to deal.

Mendelian differences do occur ; some genetic bases for them exist (' genes ') ; genetic research, starting from Bateson's fundamental work on coupling and repulsion (' linkage ') has shown that they exist in groups, and that within each group they are in orderly arrangement ; and finally, Jennings has shown mathematically that a linear arrangement is the only one so far proposed which will fit the genetical results.

These seem to most biologists to be important facts ; and if Prof. MacBride will admit them, I should feel that there was a common basis for discussion. He does go on to discuss ' linkage,' but it is not clear to

me what exactly he intends. If there be any other explanation of the genetical linkage-results than what, following Morgan, I have given above, it is important that it should be fully and clearly set before us.

JULIAN S. HUXLEY.

King's College,
Strand, W.C.2.

THE confusion is in Prof. Huxley's mind and not in mine.

Of course, I recognise that there are such things as 'linkage groups' and that these must have some basis, but what that basis was I thought that I had made clear in my review. It is, I believe, an impairment of what for want of a better name may be called the 'developmental energy' of the organism which leads to an inhibition or slowing down of one or more of the independent processes of growth which make up its development.

The so-called 'genes,' 'unit factors,' or 'mutations' that are linked are so many symptoms or results of this weakening. According to its intensity, more or fewer of them may make their appearance, hence the variable character of the linking. The alleged 'orderly arrangement' of genes within each group is in my opinion a figment of the imagination to which, so far as I am aware, Dr. Bateson has never committed himself.

Jenning's 'proof' that the linear arrangement of the genes is the only one mathematically possible is, like so many examples of 'proofs' given by this school, a fine example of reasoning in a circle, for it assumes the breaking of the chromosome and the 'crossing over' of its pieces, which, as I have shown in the review, is a physical absurdity. I am confident that when the same physiological analysis is applied to the development of Drosophila which has been employed in the case of Vertebrata, its many mutations will be seen to be the multiform effects of a few simple causes, and I should like to remind Prof. Huxley that Johannsen, perhaps our foremost geneticist, has expressed a desire that the term 'unit-factor' should be proscribed, for the change to which we give this name is merely, he says, a "disturbance of the chromosomes." With this opinion I cordially agree.

E. W. MACBRIDE.

Moulting of Insects.

THE usual explanation of moulting, namely, that the chitinous integument, being elastic only to a limited extent, cannot keep pace with the increase in size of a growing insect and is therefore periodically shed, does not seem to have a very strong foundation. While experimenting upon the effect of starvation on insects, I have incidentally observed the following facts which strongly tell against such an explanation:

As is now well known, the usual length of the larval stage in *Tenebrio molitor* (the common mealworm) is 7-8 months, during which they moult 14-15 times. When the worms were intermittently starved, the larval period was extended to so many as 18 months, during which they moulted 30-31 times. The interesting point to be noted is that the size and weight before pupation of the 18 months' old larvæ (starved) and of the normally fed 7-8 months' old worms were the same. Since the ultimate size and weight remain the same, then, if moulting is simply to allow growth, there is absolutely no necessity for extra moults. Moreover, in one experiment, in which the worms were completely starved for 5 months and were actually losing weight and shrinking in size, the larvæ moulted 4 times, though, of course, this number was smaller than that in the normally fed individuals.

A similar state of things was observed in *Pieris brassicae*. In this species the larval stage extends over about 3 weeks in Great Britain (August). Starved caterpillars, which pupated about one month later than control individuals, moulted five times instead of four times, as is usual for this species and as was done by the normally fed individuals. The size and weight of both the starved and the control caterpillars just before pupation was almost the same.

Evidently, moulting cannot be solely and possibly is not mainly correlated with growth, because while growth does not exhibit itself unless there is a moult, the process of moulting can occur without being followed by growth. F. Balfour Browne, while rearing dragonflies, also observed that while some moults were followed by an increase in size, in the case of others the individual did not show any such increase (*Proc. Zool. Soc.*, 1909). That the number of moults is in proportion to the length of the larval life is better explained by considering that moulting is primarily connected with metabolism. Totally starved mealworms moult less frequently than normally fed individuals, because their metabolism is at a low ebb.

HEM SINGH PRUTHI.

Zoological Laboratory,
Cambridge,
December 2.

Rate of Growth of Fungus Rings.

IT is well known that on air-photographs of the chalk downland, fungus rings are often very clearly shown. Sometimes they form the most prominent objects on the photograph and their size is considerable. It has been noticed that they are best developed upon land which has not been under plough for a very long time: in fact they seem never to occur well developed on land which has been ploughed at some time during the last century or two and afterwards reverted to grass.

Before investigating this matter further on the air-photographs here, I should be grateful for information as to the rate of growth of these rings. Is it possible to tell the age of a ring from its diameter? I would gladly lend prints showing fungus rings to any one who is interested in this branch of study and might be able to supply reliable information on the subject.

O. G. S. CRAWFORD.

Ordnance Survey Office,
Southampton,
November 18

Einstein Shift and Doppler Shift.

MAY I ask whether the Einstein shift of spectral lines is supposed to be due to some change of frequency associated with an atomic occurrence while generating waves, or to direct influence of the gravitational potential on ether vibrations after they are generated.

For example, I suppose the observed shift in light from the companion of Sirius occurs in light primarily emitted, and not merely scattered, from that star. The light from a differentially moving dark satellite would exhibit to us a differential Doppler effect, but the satellite would presumably not affect the light borrowed from its primary with an Einstein shift, however concentratedly massive it might be.

I am not sure that this is correct: hence my question.

OLIVER LODGE.

December 8.

Evolution.[1]

By Sir OLIVER LODGE, F.R.S.

THE word "evolution" is often employed as an antithesis or opposition idea to creation; and it is quite possible that when Herbert Spencer was trying to extend ideas derived from Darwin as to the natural processes by which species had originated, and to apply them to the production of everything, that some idea of that kind was in his mind. He probably felt that he was exploding the popular idea of a sudden creation, a sudden production of things by a creative fiat, and substituting a long, slow, and gradual process, by which the simple evolved into the complex, and the potentialities latent in the atoms of matter became unfolded, developed, evolved; thus substituting or replacing a personal process, guided by something like will and intention, by an atomic and, so to speak, mechanical operation among the things themselves.

How mind and consciousness could come into such a scheme was scarcely known, though there were and had been guesses about that too; and the doctrines called "parallelism" and "epiphenomenalism" were sustained by different philosophic writers. Indeed, how life, even of the lower organisms, originated, was never answered; and though many attempts were made, all over the world and for centuries, at spontaneous generation (some of them in late years by Charlton Bastian at King's College, London), they never succeeded in producing life except by faulty experimentation. It was gradually established, and accepted by Huxley, that life only proceeded from antecedent life, so far as our experience went: that if all vital germs were excluded, no life, even of the lowest kind, appeared.

It was research on these lines which summoned the great Pasteur from chemistry to biology. It laid the foundation for his theory of disease, and it was the noble work of Lister to apply it with beneficent results to surgery. Thus and by all these channels was emphasised the doctrine of biogenesis: that life alone could produce life. Life produced itself; still, however, in its various forms, by a process of evolution, and by no act of special creation. The vital steps were gradual and could all be followed, once given the germ of life. The origin of life itself was left as an insoluble mystery, or rather as a mystery to be solved by science at some future date. It was thought, at any rate by some, that once life made its appearance in the scheme, the evolution of mind was only a further step in the process. Mind was apparently a stage ahead to which life might aspire, for life in the course of ages might blossom into mind.

The attempt thus to explain evolution as a gradual self-acting process was a legitimate one, and contained, as we now see, many of the elements of truth. It led to a materialistic philosophy, which for a time held the field, and attracted the attention and the enthusiasm of a multitude of workers. It was, however, not the whole truth: it was a working hypothesis. It went a certain distance with success, and only gradually were its weaknesses perceived. It was not so much wrong as incomplete. It sought to account for things it could not account for. But as an intermediate step it was helpful and stimulating, and invigorated the science of biology with a working hypothesis which has proved of great service. It served as a clue or guiding light among a multiplicity of phenomena which without it had seemed detached and disconnected; and it stimulated observation and experiment to a remarkable degree. It carried workers a long way, and it carried enthusiasts too far. It led to the exclusion of mind or purpose from the universe, and replaced it by mechanism. If a materialistic philosophy had worked, it would have been justified by results. But it was incomplete; and gradually its weaknesses and omissions became apparent; so that by this time, as a complete account of the universe, it is recognised as insufficient and faulty. The mistake—if it can be called a mistake—lay in the thoughts or contentions of those who put it forward as in opposition to the idea of creation, instead of regarding it as a method of creation.

The old idea of creation as a sudden achievement without intermediate steps, without any process that could be followed by the human mind, and without any extensive lapse of time, was seen to be erroneous. Yet, amid much crudity, most of us now perceive that it contains some elements of truth; just as the working hypothesis of mechanical evolution did. The time was not yet ripe for identifying and unifying the two. They seemed to be in the field as opposition theories, one against the other. They seemed to be mutually exclusive; so that if one were accepted, the other must be rejected.

Whether this opposition of the two views was seriously in the mind of the philosophers of that period may perhaps be questioned; in all probability it sometimes was. Among the rank and file it certainly was: many half-educated people leapt to the conclusion that the universe could be explained on mechanical principles and in terms of matter, and that in matter could be found the full potentiality of life and mind and everything that we have so far discovered or experienced in the universe. Whether or not that was the intention of the leaders may well be doubted. Huxley himself made it abundantly clear that in his view a materialistic philosophy had its limits, and that consciousness could not thus be accounted for. Nevertheless the two views, in the popular mind, were in opposition; and it led to alarm among the Churches at the doctrines of Darwinism and at the teachings of evolution generally. This feeling of antagonism between the two views, and the feeling of alarm and dislike of one of them, has survived in certain States of America, and has led to an attempt to suppress the disliked view by legal enactment.

However irrational this procedure may be, there is some excuse for it; and it is possible to regard their conscientious action with sympathy, even though the sympathy is mingled with amusement. Not in that way is truth really served. Freedom is the life-blood of science; and freedom is only consistent with the power of making mistakes and going wrong, as well as with the power of ascertaining truth and going right.

Crudities were not confined to one side of the controversy. Old doctrines of creation were crude; new doctrines of evolution were equally crude: and either

[1] From the Huxley Lecture delivered at Charing Cross Hospital on Thursday, December 3.

side could have their teeth set on edge by the other. Young and enthusiastic teachers, perceiving only one side of the problem, could rush into extremes; could not only uphold their own view, but also could pour scorn upon the other. Since the sectarian differences between religious bodies had led to the suppression of what may be called Biblical teaching in State schools, as the only alternative to strife and sectarian controversy,—since the freedom of the orthodox was limited, and they were prevented from teaching the young their own special and detailed creeds,—it became obnoxious to allow perfect freedom to the opposition side, which took no interest in sectarian controversy, but would gladly sweep away the whole of the doctrines associated in the popular mind with the mysteries of religion. Sectarian differences had limited freedom on one side; it seemed time to limit freedom on the other too; and that, I take it, is the explanation of what otherwise seems an irrational and foolish procedure.

There are, I know, a multitude of people in Great Britain who still feel the fundamental opposition between the two views, and some who in their heart sympathise with the action of those Southern States who have put the law in operation against one of them. There is always some justification for any human action which is well intentioned and sincere, however mistaken it may be. We are all of us constantly making mistakes: the proverb says that "it is human to err." It is part of our training to be able to make mistakes with perfectly good intentions, one of the mistakes being to think that we have an infallible guide when we have not. Infallibility has not been granted to man. We have to make our way among pitfalls and obstacles, to make progress slowly and with difficulty, and gradually to learn what is true by finding what is false; never learning the whole truth—for that we could not apprehend—but making our way towards the truth, in a blundering but persevering manner.

The very documents to which some of the ultra-orthodox pin their faith are full of misstatements and errors committed by humanity in the past; and however full they are of inspiration—as in many parts I am sure they are; much more, as I think, than some educated people are always inclined to admit—yet they are human documents, full likewise of the mistakes, misinterpretations, slips and errors appropriate to the human vehicles through which they have come. It is our business to try to sift the true from the false, the genuine from the mistaken, the misinterpretations of scribes, the faulty reports of occurrences, and thus to dig down to the underlying essence, which gives these documents their supreme value.

The book of inspiration, by which I mean the thoughts of the great thinkers and seers and saints and prophets of all time, is one avenue of truth: the book of Nature, explored by a multitude of energetic workers, that is to say, the book of science, is another. In so far as both are true, they cannot be in opposition. In so far as either is mistaken, opposition is inevitable; and although the virulence of the opposition is now greatly mitigated, and is not fierce and uncompromising, as it was even in the lifetime of some of us, some amount of opposition exists still. Indeed, in the minds of half-educated people its virulence is still manifest, and some fierceness of opposition still subsists to this day. It is so easy to take one side only of a controversy, to regard that as completely right, and the other as hopelessly and completely wrong. We find this attitude even in party politics. We find it more or less in the forensic activities of counsel in the law courts. It is understood, there, as a method of laying the case before the judge, to whom is left the impartiality of scrutinising the evidence for what it is worth, and coming to a judicial and balanced decision.

We ourselves, however, in our own minds and with our own responsibility, are both counsel and judge. There are moods in which we emphasise one side; there are moods in which we emphasise the other: but ultimately we try to hold a balance between them, and we doubtless hope that our ultimate convictions will be based on the evidence, and will lead to a true and impartial verdict.

My thesis is that there is no essential opposition between creation and evolution. One is the method of the other. They are not two processes, they are one—a gradual one which can be partially and reverently followed by the human mind. We have the right to study the methods so far as we can, the right to probe into the manner by which the manifold things around us are interrelated, and how they have come into their present form. We try to set forth the physical processes in detail, and for that special purpose to limit ourselves to the mechanical, the physical, the chemical, the calculable, and the directly observed, without the least trace of impiety, and without being reasonably accused of denying a great tract of country which is not on our beat, which we are not exploring, and which, though through lack of time and energy we perforce neglect, we do not (if we are wise) ever think of denying.

[Then followed an account of the process of cosmic evolution so far as modern science is able to formulate it, based upon the work of Eddington and Jeans. The question was then raised as to whether a linear process of evolution—a procedure in time with a beginning and an end—was likely to be the last word, or whether there was any way of overcoming the dissipation of energy and prospective stagnation.]

Now consider what happens when light of all kinds, ultra-violet light, X-rays, and all others, encounters a particle of dust, or, in other words, some atoms of matter, which have been driven to the confines of space by the pressure of light. What happens has been investigated in our laboratories, and is known as photo-electricity. An electron jumps out of the atom: the atom is ionised.

This ionisation of matter by light is becoming, or is likely to become, familiar in medicine. The photographic and chemical actions of light are constantly being studied, its action in polymerising sap in the leaves of trees and vegetation generally, the action of light on the skin also, and its familiar though remarkable effect on the nerve-supplied retina of the eye. How are these chemico-physical actions to be accounted for? Surely by the photo-electric property; that is, by the power of waves of the right frequency of vibration to eject an electron from an atom. An immense amount is now known about this process. Electrons are

revolving in fixed orbits inside the atom, as conceived by Prof. Bohr, and under the stimulus of radiation they jump from orbit to orbit as birds jump from perch to perch. An incoming wave can make them hop to a higher twig, or else fly away altogether.

This last process is called ionisation; for the atom, having lost an electric charge of one sign, is now charged with the opposite sign: it is an ion; it is no longer neutral and inert, it is active and chemically fierce; it is no longer satisfied, it seeks to combine with another. Chemical affinity is in full blast, and the molecular changes in protoplasm, in silver salts, and in the leaves of trees, occur. In the retina the nerves are bombarded by the ejected electrons, each striking with an energy appropriate to the frequency of the received vibrations, and thus give the different colour sensations through the extraordinary interpretative power of the mind through its organ the brain.

The destructive influence of this action on micro-organisms such as an anthrax bacilli, when they are exposed to ultra-violet light, is well known; and the health-giving power of these same ultra-violet rays—at present so sadly and wastefully and thoughtlessly obscured by the atmosphere of towns—is constantly receiving more and more expert attention.

Surely here we have a region of physics of great use in preventive medicine: a lavish supply of ultra-violet light is sent us by the sun; it only remains for us to enable this light to reach our bodies and our homes. We know how to generate such radiation in the laboratory also, and can use these rays for curative rather than for preventive purposes. A study of radiation—radiation of all kinds—has proved of late years intensely illuminating. Thereby that mysterious but fundamental entity, the quantum, has been detected; thereby the temperature, the constitution, the age, the speed, the history, of the various cosmic masses has been and is being elucidated; thereby the formation of wood, and the growth of vegetation on which animal life depends, has been explained; and now the sanitary and invigorating and beneficent work of sunlight on the human organism is being more and more appreciated, and more and more studied and applied by those who have the requisite training, who will watch for the dangers of excess, and regulate the appreciation of any kind of ray with patience and wisdom. I hope that a recognition of the electric and ionising power of such rays, which I urge as a reasonable explanation of their chemical and physiological activities, may be a hint in the right direction to those engaged in this work.

Reverting now to what I was beginning to deal with, namely, the hypothetical effect of stray or apparently waste radiation when it reaches the confines of space and encounters the supposed age-long accumulation of cosmic dust, which pictorially and for the present purpose we represent as more localised than it is at all likely to be; it may be said that the light, when it has travelled to those enormous distances, will be too feeble to do anything; but apparently it is not so. The jump of the electron is effected, not by the energy of the light, but by its frequency, its rapidity of vibration; and that is just the characteristic which it will retain unaltered, no matter how far it goes, or how weak it gets. Light of the critical frequency—which depends on the nature of the atom and the position of the electron in it—will be able to ionise it, however impoverished by wide-spreading the light is.

It is true that the number of electrons liberated depends on the intensity of the light, though the energy of each does not so depend. If the light is very weak, the number of ions formed will be few, but the area available is enormous. Nothing like such an area of matter exists in the visible cosmos. If only one or two ions a second were formed per square kilometre, the loss of matter from millions or even billions of suns could be compensated.

Now consider what happens when an atom is ionised. It has lost a negative charge: it has therefore become a positive ion. The negative charge has gone away, and will attach itself to some other atom, which thereby becomes a negative ion. Sooner or later the two may meet. They will not discharge into each other; that is not what happens; they will combine to form a molecule, a chemical compound. The process of chemistry has begun, under the influence of light.

We are evidently returning to the stage at which we begin the consideration of the course of evolution. Radiation gives up its own being, the energy takes the form of electrical separation. It then takes the form of chemical combination: aggregates of matter are formed. This aggregation may go on until the particles begin to feel the effect of the gravitative attraction of the far-distant cosmos. No longer will the particles be sustained and separated and driven away by light. They are now big enough to have effective weight; and slowly they will begin to make their way back; bringing with them in potential form the lost and radiated energy; and so begin once more the clash of atoms, the formation of nebulæ, the birth of stars, and ultimately of planets.

It may even be that fresh matter in the form of electrons and protons can be *generated* by radiation, apart from its photo-electric effect on already existing matter. To me it seems not unlikely. But that is going outside our laboratory knowledge: of that process of "beknotting" in the ether we have as yet no inkling. A knowledge of that may come, but not yet. Meanwhile we have something which, if not sufficient, seems at any rate a step towards reconstruction, rehabilitation, regeneration.

Some may feel this doctrine depressing, and ask: Is there then no progress, no increase of value, no real improvement, nothing but a universal level of uniformity, so that what is always has been and always will be, not only without change and decay, but also without rise and advance? That is not the deduction that we are entitled to make. For remember that we have been dealing with the physical universe only; we have not touched on the universe of mind, soul, spirit, or any of the emotions and faculties of man. We have been studying the course of physical evolution, and have imagined it as evolving in a cycle. I believe that is the essence of the physical universe, to follow a cycle, round and round:—The plant assimilating inorganic materials, elaborating them into food for animals, the animals returning them in the inorganic form, ready for the plant; energy taking the potential form, then the kinetic, then the potential again, and so on alternately for ever; water evaporated, rising as vapour, then falling as rain, getting back into the sea, and being

evaporated again. Everywhere we find a cyclical process in the material universe.

What about the mental universe? Surely there we find growth, development, increase of value, rise in status; the lower organisms becoming intelligent creatures, then developing into man. And what of man? If his death is the end of him, the value of his existence may be doubtful. But if, as I know, that is not the end of him, then there may be infinite progress in store. The cyclical machinery of the physical universe is employed to develop value in the mental and spiritual universe; just as the revolution of a fly-wheel may be the means of turning out a woven fabric of beauty and design. The fabric will age and turn to dust: so may a picture or a statue. But what about a poem or a piece of music? They have in them the seeds of immortality, and if great enough, will last so long as humanity endures. All things last for ever, if what we have been saying is true; but while the physical things last by a kind of evolution of cyclical change, the evolution of spiritual things has no necessary regress. They advance continually through higher and higher stages towards perfection. This, I take it, is the real meaning of evolution. This is why the physical universe exists. This is the real aim and purpose of the ultimate and infinite term "God."

Surveys of the Great Pyramids.[1]

By Sir W. M. FLINDERS PETRIE, F.R.S.

THERE seems a periodicity in the attention to the size of the Great Pyramid: the French survey 1799, Howard Vyse 1838, my survey 1881, and now Mr. Cole's survey in 1925, are at nearly equal intervals. The difficulty in measurement results from the Arab destruction of nearly the whole of the fine sloping blocks of casing, about 3 feet thick, thus leaving the inner core of masonry in steps, and further, the banking of the ruins up to 20 or 30 feet against the faces, which obstructs the base. The last remains of the lowest course of casing are only a short length in the middle of each side, and the purpose of this recent survey was to utilise more of these points of the original casing than had been seen before, such being more accessible since the removal of large quantities of the fragments, for making the road and building an hotel. In 1881 it was a risky affair to sink pits in loose rubbish 20 feet deep; I only escaped burial by a few seconds; seventeen shafts were sunk, but the casing edge was only found once on each side. In 1925 it was possible to uncover the casing over lengths of between 45 and 170 feet on different sides, and the use of such further material was very desirable in order to define the faces more precisely.

The 1925 survey was in two parts: (1) the prolongation of the alignment of the remaining portions of casing out to the corners by theodolite sighting, and (2) the survey of these produced corners by triangulation. The general order of accuracy that should be sought is indicated by the levels of the pavement, of which the mean error is only 0·21 inch; certainly it would be easier to achieve equality of length than of level. The method of setting a theodolite over an estimated edge of sloping casing, and then of telescopic estimation of such an edge at more than 100 feet away, is a risky process on the sand-blasted, pitted and chipped surfaces. The differences between 1881 and 1925 surveys depend on a third of an inch in such estimations. After that, the results depend on the 1925 triangulation for fixing the corner intersections by a chain of eight points joined by a traverse around the pyramid; this had a difference of 9·6″ = 2·7 inches if on the whole distance, which was distributed equally in the reduction. The 1881 survey included the whole pyramid in a single triangle, the discrepancies of which averaged 0·04 inch; these station marks can always be re-used, as they were drilled in the rock, and the co-ordinates were all published.

The results of the two surveys are, in inches of length of the side and angular orientation of face:

	1881.	1925.
N. side	9069·4 − 3′ 20″	9065·1 − 2′ 23″
E. side	9067·7 − 3 57	9073·0 − 5 30
S. side	9069·5 − 3 41	9070·5 − 1 57
W. side	9068·6 − 3 54	9069·2 − 2 30
Mean	9068·8 − 3′ 43″	9069·4 − 3′ 6″
Mean differences	0·7 12	2·3 1 12

There is a check on the estimated prolongation of the sides in 1925, as there is the 1881 estimate of the planes touching the core masonry. These were:

	1881.	Difference to Casing 1881.	Casing 1925.
N.	9002·3 − 4′ 35″	+1′ 15″	+2′ 7″
E.	8999·4 − 5 26	+1 29	− 4
S.	9001·7 − 5 23	+1 42	+3 26
W.	9002·5 − 5 39	+1 45	+3 9
Mean	9001·5 − 5′ 16″	+1′ 33″	+2′ 10″
Mean differences	1·0 20	10	1 8

As the planes of the core could be estimated within an inch of variation (= 23″) this is a useful check. It shows that the casing was adjusted 1′ or 2′ differently after the core was built. The divergence of the 1881 casing lines from the core have only 10″ irregularity; the 1925 results show 1′ 8″ of irregularity; as this latter is equal to 3 inches on the length of the side, the core is competent evidence in favour of the 1881 survey. It may also be observed that a building with mean error in level of 0·2 inch is more likely to have a lineal error of 0·7 inch found in 1881 than of 2·3 inch found in 1925.

On all grounds it seems highly desirable to settle more precisely the exactitude of the most accurate human work of such large size. Station marks are needed at the side of each end of the lines of casing observed, to be connected with the more accurate triangulation of the 1881 net, which has less than 0·1 inch probable error in stations. Offsets should be taken between the new stations to the estimated edge of the casing all along. These would show how exactly the straightness was maintained, on which depends all evidence for prolongation of the short lengths of remaining casing.

[1] "Determination of the Exact Size and Orientation of the Great Pyramid of Giza." By J. H. Cole. (Survey of Egypt, Paper No. 39; Government Press, Cairo.) 1925. 8vo. 9 pp. 1 pl. 10 P.T. (2s. 1d.).

The bases of some of the other pyramids are also known from my surveys. That of King Sneferu at Meydum immediately preceded the Great Pyramid, and was planned on a similar system of measures. Both have the proportion resulting from the height being the radius of a circle equal to the circuit of the base, the angles found being

By π theory . . .	51° 51′ 14″·3	
Khufu's pyramid . .	51 50 40	±1′ 5″
Sneferu's pyramid . .	51 52	±2′ ?

The dimensions found are:

Khufu's, height 7, circuit 44, ×40 cubits.
Sneferu's, ,, 7, ,, 44, ×25 cubits.

The modulus of design being thus 40 or 25 cubits shows the deliberate intention to embody the proportion of 7 : 22. The cubit required would be 20·61 or 20·66 respectively, and the best examples of early masonry elsewhere show a cubit between 20·62 and 20·65 inches. The mass of theories, which extend from good reason into a morass of impossibilities, would be too much to touch on here.

The accuracy of construction of the measured pyramids is, in inches:

Dynasty.	King.	Place.	Base.	m.d.	Azim.	m.d.
III	Sneferu	Meydum	5682·0	6·3	−24′ 25″	5′ 30″
IV	Khufu	Gizeh	9068·8	·7	− 3 43	12
IV	Khafra	,,	8474·9	1·5	− 5 26	33
IV	Menkaura	,,	4153·6	3·0	+14 3	1 50
XII	Senusert II.	Lahun	4168·5	1·9	− 2° 8′	2 30
?	?	S. Dahshur	7459·0	3·7	− 9′ 12″	4 3
			2064·6	1·1	−14 8	10 12

From these measures it seems that Menkaura and Senusert II. laid out 200 cubits as a base, and the South Dahshur pyramids are of 360 and 100 cubits on each side.

In the XIIth dynasty the passion for accuracy led to regarding that as the finest sacrifice in honour of the dead; the granite sarcophagi, which were never intended to be open to examination, or even seen, have mean errors from a straight line, and from true planes, of 1 in 15,000, or on one edge 1 in 23,000. No race ever seems to have appreciated so keenly the charm of perfection of work as did the magnificent men of the pyramid age.

Current Topics and Events.

IN a recent series of papers in the *Chemical News* (Oct. 30, Nov. 6, 13, 20 and 27) Messrs. Druce and Loring put forward claims that they have identified the elements of atomic number 75, 85, 87 and 93 by an X-ray examination of certain manganese salts. The element 75 is that recently isolated by Noddack and Tacke (rhenium), the others are in the radioactive region. An examination of the evidence on which these claims are based suggests that it is far from sufficient definitely to establish them. The element 75 is identified by two lines, 1·430 and 1·233, which are taken to be the α_1 and β_1 lines of its L spectrum; 85 by two lines, 1·086 and 0·895; 87 by a single line 1·040, and 93 by two lines, 0·895 and 0·693, the 0·895 line being the same as that used for the identification of the element 85. Of these six lines four, 1·430, 1·233, 1·040 and 0·895, are within error limit identical with the $K\alpha$ line of zinc and the three strongest lines (α_1, β_1, γ_1) of the mercury L spectrum. The authors quote a control experiment in which a six hours' exposure with a copper anticathode gave only the copper spectrum. This is rather surprising, as mercury is used to evacuate the tube and brass for the window of the tube and the slits of the spectrometer. Also, in a recent experiment made elsewhere and suggested by past experience, a two hours' exposure with a copper anticathode and apparatus similar to that used by the authors gave, in addition to the copper lines and the silver and bromine absorption bands, lines which were identified with the zinc $K\alpha$, the mercury $L\alpha_1$, $L\beta_1$, and $L\eta$ (?), and other lines at 0·950, 0·72 and 0·67. These are of doubtful origin but are possibly due to irregularities in the crystal oscillation or imperfections in the crystal. The authors in their papers give at least five lines which they observed and are unable to explain, although from the other six lines they identify four elements.

MR. HAROLD J. COOK, in a communication to *Science* for November 25, maintains that "good dependable evidence of human artifacts in the Pleistocene of America" has at last been found. The evidence in question comes from a point near the Colorado River, near the south-eastern end of the Staked Plains and near the little town of Colorado, Texas, on Lone Wolf Creek. The first work leading up to the discovery was done in the summer of 1924, when fossil animal bones were discovered by Mr. Nelson Vaughan. The site was visited by Mr. Cook, who checked the geology of the area in May 1925. In taking up a large block of material containing the articulated ribs and vertebræ of a fossil bison, of which the whole skeleton was discovered in association and splendidly preserved, the first artefact, a point, was found under the cervical vertebræ. A second point was found under the femur, and a third was found "in position with the body of this skeleton." These artefacts are large arrow heads or lance points, and are of unexpectedly fine workmanship, being more refined than modern types found in the area, and of distinct culture and design. It is suggested that the animal had been wounded and died on this spot, as the condition in which the remains were found appears to preclude the possibility of its having been water-borne or otherwise deposited. A number of other fossilised remains have been found, but in the season just past no further evidence of man has been brought to light. These fossils occur in valley gravels solidly cemented by calcareous deposits which rest between the present stream erosion and the old triassic walls of the former valley. Everything points to these deposits being entirely undisturbed. Similar bones and types were found in all places where fossils could be located, and included, besides the extinct bison—Elephas, Equus, and Camelus or Camelops, as well as others at present unidentified.

THE Linnean Society of New South Wales has just issued a history of its fifty years of activity since its foundation in 1874, for "The cultivation and study of the science of Natural History in all its branches,"

with illustrations of its various homes, and of its successive presidents. It has published forty-nine volumes of *Proceedings* during its career, and is a standing witness to its benefactor, the late Sir William Macleay (1820–1891), who sustained its early efforts and finally provided it with a permanent building and adequate endowment. It has never exceeded 200 members, so that the constant support of its first president has been of essential help to its maintenance. More than twenty thousand pounds were devised by its benefactor for the general use of the Society, the appointment of a bacteriologist and the Macleay fellows. It suffered a terrible misfortune in 1882, when the building in which it was housed was completely destroyed by fire, but by outside help its library was renewed, though all its possessions and official records for the first eight years of its existence were lost. The volume ends with an account of the eighteen Macleay fellows who have benefited by the ample foundation. Few societies can boast of the constant and generous support which this Society has enjoyed and made so effective.

PART 4 of volume 26 of the *Transactions of the Optical Society* is devoted to a description by Dr. W. H. Steavenson of the instruments and apparatus in the possession of Sir William Herschel at the time of his death in 1822, and now preserved by two of his grand-daughters in the old Observatory House at Slough. The collection includes one of the mirrors of the famous 40-foot telescope, one of the mirrors of the 20-foot instrument, a number of mirrors for smaller instruments, flat mirrors for Newtonian telescopes, a number of eyepieces and a complete 7-foot telescope. The apparatus has all been marked by Dr. Steavenson and the grand-daughters of Sir William, and a list is given of all the items with a short description of each. In the case of the mirrors, after cleaning with ether and lemon juice they have been examined as to their optical properties, and they show to what perfection the figuring of them had been brought by Herschel 130 years ago. The whole of the eyepieces are single lenses, the most powerful a double convex of 0·02 inch diameter and 0·01 inch thick. They substantiate Herschel's claim that he obtained powers between 1000 and 6000 on his 7-foot telescopes. Twelve photographs of instruments and observatory complete an interesting and valuable document.

WITH the commencement of our issues for the New Year we shall conduct and publish a column, to be continued weekly, under the title "Contemporary Birthdays." In this the dates of birth of various men of science resident in Great Britain, our Dominions, and in foreign countries will be recorded, and the essential details of the careers of some of them will be set forth, in so far as is possible under the limitations of space which NATURE must observe. The first of the series will appear on January 2.

A CURIOUS problem of the Arctic is noted in the *Geographical Journal* for December. In August 1924 Dr. Livingstone, of the Canadian Government ship *Arctic*, found on Pim Island in Smith Sound, about half a mile inland from the north-west end, part of a small leather case bearing the Royal Crown and the cipher V.R.I. in gold. The Director of the National Resources Intelligence Service of Canada suggests that this is part of a spectacle case dropped by an officer of the Nares expedition of 1875. The vessels of this expedition appear to have been the only British naval vessels to land parties on Pim Island during the reign of Queen Victoria. A drawback to this explanation is that Queen Victoria did not acquire the title of Imperatrix until 1876, the year of the expedition's return. Furthermore, it seems doubtful if any member of the Nares expedition had an opportunity of going so far from Payer Harbour, some few miles along the coast of Pim Island. The editor of the *Geographical Journal* would welcome information that could throw light on this problem, especially on two matters: evidence of the use of the cypher V.R.I. before 1876; and knowledge of any visit to the north-western extremity of Pim Island before 1924. An illustration shows the leather case. It has not been possible to trace any such gift to any member of the Nares expedition.

THE annual report of the Director of Research to the Council of the British Photographic Research Association shows that members of the research staff are continuing their investigations into the principles that underlie the practice of photography, and that during this year nine papers have been published in various scientific journals. In addition, various summaries of literature and more popular articles have been written, and various confidential investigations carried out for the members of the Association. The staff took a very active interest in the sixth International Congress of Photography held in Paris, and submitted to the Congress the only concrete proposals on the standardisation of plate-testing methods. It is to be hoped that the discussion of this subject at Paris will lead to more uniformity in the expressions of sensitivity and the other properties of photographic plates. The selenium density meter designed by the staff, and referred to in last year's report, has extended the possibility of work on experimental emulsions, and has been appreciated by many other laboratories.

REPORTS of committees appointed to award the Godard and Brocas prizes in the gift of the Société d'Anthropologie of Paris are published in the recent issue of the Society's bulletin (t. 5, sér. 7, fasc. 4-5-6). The Godard prize for 1924 is awarded to Dr. Maurice Neveux for a thesis entitled "Religion des noirs: Fétiches de la Côte d'Ivoire," which embodies observations made in 1909–1910 and 1914–1915, when the author was in charge of the medical services of that area. Two awards of the Brocas prize are made. The prize for 1922 is awarded to Dr. Fritz Sarasin, of Basle, for his work on the anthropology of the New Caledonians, and to Dr. E. Pittard, of the University of Geneva, for his book on the peoples of the Balkans. The prize for 1924 was divided between Dr. Antoine Delattre for a thesis on the comparative anatomy of the axis in mammals, M. Chaine, of Bordeaux, for his work on the digastric muscle, and M. Cipriano Lidio, of Florence, on the human patella.

THE brief account by Prof. R. R. Gates of his trip up the Amazon during the summer vacation of 1925, which is published in the *Quarterly Summary of the Royal Botanic Society*, Regent's Park, for October, is a timely reminder that improvements in communication are throwing open this interesting botanical region under much more favourable conditions than previously. The Botanic Garden of Rio de Janeiro has recently circulated particulars of a new biological station, attached to the forest reserve of Itatiaya, which is available for visit by biologists. It is situated in a region where tropical and alpine floras co-exist within a small area, with a range above sea-level from 800 to 3000 metres. A small library is attached to the laboratory at the station, for which the Director of the Botanic Garden solicits further publications from naturalists. The address of the new station is, Estaçao Biologica de Monte Serrat, Barão Homem de Mello, Estado do Rio, Brazil.

THE *Marine Observer* for December, issued by the Meteorological Office, Air Ministry, completes the second volume, the publication having been issued in monthly parts for two years (London: H.M. Stationery Office; 2*s*. net each part). The Marine Superintendent of the Meteorological Office is quite sanguine that it fills the place intended, and while it has already stimulated considerable interest from the Mercantile Marine, he appeals to those afloat to contribute articles, sketches, and photographs to add to the value, attractiveness, and utility of the journal. The publication takes the place of the *Monthly Pilot Charts* previously issued, and by preserving the copies intact, much information of value to the navigator is at hand, and, with the index to the separate volumes, there is easy access to the information. No. 24, for December, contains an article by Captain L. A. Brooke Smith, the Marine Superintendent, on "Developments in Wireless and Weather: An Aid to Navigation," and it is clearly shown how valuable the weather information will be to airships over the sea. Much value is attached to the weather registers kept for the Office by the captains and officers in the mercantile marine.

THE *Sitzungsberichte der Physikalischen-medizinischen Societät* at Erlangen is always worth reading. A recent issue (Band 54 und 55, 1922, 1923) contains a number of interesting papers by various authorities, among whom we are pleased to note Prof. Eilhard Wiedemann. Prof. Wiedemann, whose output of articles on the history of science is rivalled only by that of Prof. von Lippmann, here contributes a short study on the history of music among the Arabs. He gives translations of the appropriate sections of the encyclopædic *Mafātīḥ ul-'Ulūm* (Keys of the Sciences) and of Al-Akfānī's *Irshād al-Qāṣid* (The Right Guidance of the Seeker), and illustrates them with very interesting notes and explanations. Other articles of importance are (i.) On a method of estimating the melting-point of gelatin solutions, by Rudolf Reiger and Fritz Gernert, and (ii.) On the construction of the world according to Ibn al-Haitham, by Karl Kohl. A lighter note is struck by Alexander Gutbier in a popular lecture on "Die chemischen Elemente und der Weltenraum." On the medical side, Reinhold Wissmann gives a long account of his work upon war injuries to the eyeball. This occupies some 150 pages and deals with the subject in a masterly and exhaustive fashion.

WE sincerely share the regret, expressed by Dr. F. H. Gravely in the Report of the Madras Government Museum for 1924–25, "that limitations of staff make it impossible to continue, without neglecting other work of still greater urgency, the ethnological investigations so admirably begun years ago by Mr. Thurston." It is urgent enough that ancient customs rapidly disappearing under modern influences should be recorded without delay. On the other hand, one is glad to note that the University of Madras, by arrangement with the Fisheries Department, is establishing a Marine Biological Station on Krusadai Island in the Gulf of Manaar. Dr. Gravely is therefore preparing an introduction to the littoral fauna of the island.

THE Academy of Natural Sciences of Philadelphia, having managed for more than a century to perform admirable service under an act of incorporation and by-laws dating from 1817, but altered from time to time, at last found it necessary in 1924 to amend the charter and totally to revise the by-laws. The results are set forth in the Year-Book recently issued. Administration by council and curators has been abolished, a board of trustees created to manage the administrative and financial affairs of the academy, and a new council established to act in matters relating to the pursuits of the scientific staff. A new position of director of the museum has been created, and to it Mr. Witmer Stone has been appointed. The various sections of the Academy—geological, ornithological, etc.—have ceased to exist, but their place is taken by the Philadelphia Mineralogical Club, the Delaware Valley Ornithological Club, the American Entomological Society, and the newly formed Leidy Microscopical Club. Thus an easier opening is made for younger students.

ON Tuesday, December 15, the Priestley Club celebrated its jubilee by a dinner in the University of Leeds, to which a number of distinguished guests, representing various phases of activity, in pure and applied sciences, were invited. Sir J. C. Irvine, in proposing the toast of the Priestley Club, contrasted the conditions of experimental work in the days of Joseph Priestley with those which have been made possible by the development of institutions of the type of the newer universities in Great Britain. The advantages afforded by a general scientific society such as the Priestley Club in bringing together for the purpose of discussing scientific topics the various research workers in specialised provinces, were emphasised by Prof. A. Smithells, who pointed out the debt the present members of the Club owe to its founders, amongst whom were the late Sir T. E. Thorpe, Sir Arthur W. Rücker and Prof. L. C. Miall. Other guests included the Vice-Chancellor of the University of Leeds and the Rev. W. L. Schroeder, who

in succession to Priestley is the pastor of the Unitarian Chapel at Mill Hill, Leeds.

MESSRS. Casella and Co., of Parliament Street, London, have recently issued a price list of barometers. The list is well illustrated and a good description is given with each instrument, together with the price and any extra charge for the National Physical Laboratory certificate. Barometers of all descriptions are catalogued, standard instruments of the highest scientific principle as well as more ordinary mercurial barometers for observing stations and for use on board ship, for fishermen or lifeboat stations, and also a pit or miner's barometer. Aneroid barometers of various designs are shown, both large and small, for ordinary use, for mining and surveying, or for special use in aeroplanes. Barographs are listed, and these instruments, which are of great interest to the ordinary public, are of a reasonable price, the guarantee of the firm being of the highest order.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A deputy curator of the Public Libraries, Museum, and Art Gallery of the County Borough of Sunderland—Chairman of the Libraries, Museum, and Art Gallery Committee, Town Hall, Sunderland (January 4). A junior assistant (a botanist with good knowledge of chemistry, preferably biochemistry) at the laboratories of the British Cotton Industry Research Association—The Director, Shirley Institute, Didsbury, Manchester (January 13). An assistant at the Mount Stromlo Observatory, Australia—The High Commissioner for the Commonwealth of Australia, Australia House, Strand, W.C.2 (January 15—*extension of date*). The De Beers professorship of mechanical engineering in the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner of South Africa, Trafalgar Square, W.C.2 (February 1). A professor of social anthropology (who will be also the director of the school) and a senior lecturer in social anthropology at the School of African Life and Languages in the University of Cape Town—The Secretary, Office of the High Commissioner of South Africa, Trafalgar Square, W.C.2 (February 15). A pharmacist under the Government of Iraq—Crown Agents for the Colonies, 4 Millbank, S.W.1, quoting M/14126.

ERRATUM.—In NATURE of December 12, p. 861, five lines from end of first column, for 15^4 ergs *read* 10^{-4} ergs.

Our Astronomical Column.

COMETS.—The *Times* of December 16 contains the announcement of the discovery of a new comet in the constellation Reticulum by Mr. J. Ensor of the Pretoria General Hospital. It is stated that the comet is not visible to the naked eye, but that it has been observed at the Union Observatory, Johannesburg, and that its tail is 15′ long.

The position of the comet on December 14 was R.A. $3^h\ 38^m$, daily motion minus 12^m. S. Decl. 61°, daily motion 24′ S.

NAKED EYE SUNSPOTS.—The solar activity recently commented upon in these columns has continued. During the first half of December, two naked eye spot disturbances have been observed. The first of these was seen without a telescope only by persons of keen sight, but the second has been a distinct marking on the sun's disc when screened by fog or artificially with a dark glass. The former group was on the central meridian on December 10, when it was composed of two large composite spots. Although a new and apparently independent centre of activity, this group was not far distant from that of the naked eye group of November 8–20, which has not outlived the rotation.

The second group grew from some spots seen close to the sun's west limb on November 24 and 25, which, when brought again into view on the eastern limb on December 9, had become a long stream stretching 15° in longitude. The axis of the stream was inclined about 17° to the solar equator, the latitude of the leading spot being 21° N. and that of the follower 25° N. At the present phase of the sunspot cycle, spots in this latitude are usual, but groups so large as this present one are more commonly found between latitudes 10° and 15°. These are, of course, the zones most active near the maximum phase of the cycle. A very large group of spots appeared, however, in latitude 32° S. in February 1894, and one exactly on the sun's equator in May 1921 (see NATURE, vol. 107, p. 399).

Particulars of the recent spots are given in the table below. No considerable magnetic disturbances have been recorded as yet this month at Greenwich.

Date on Disc, 1925.	Central Meridian Passage (G.M.T.).	Latitude.	Maximum Area.
Dec. 4–16	Dec. 10·3	20° S.	1/900
Dec. 9–(22)	Dec. 16·0	23° N.	1/500

(Areas are corrected for foreshortening and express the proportion of the sun's hemisphere.)

TOTAL SOLAR ECLIPSE OF JUNE 29, 1927.—It is not too early to commence plans for the eclipse of June 29, 1927, total in Wales, England, and Norway. A large scale map of the track in Great Britain (10 miles to the inch) has been constructed by Mr. B. F. Bawtree (late of the Nautical Almanac Office), and is published in the B.A.A. Handbook for 1926. The central line runs from Criccieth (Carnarvonshire) to Hartlepool, passing through Colwyn Bay, Southport, Settle, and Richmond (Yorkshire). The north limit of totality runs just north of Beaumaris, Bangor, Lancaster, Durham, and just south of Sunderland. The south limit runs a little south of Denbigh, Liverpool, Accrington, Saltburn-on-Sea, and through Burnley.

It must be counted a fortunate circumstance that three of the observatories in the Nautical Almanac list (those of Bidston (Birkenhead), Stonyhurst College, and Durham) lie within the totality track. Stonyhurst specialises both in solar study and spectroscopy, and preparations for the eclipse are already in progress. The altitude of the sun is 13° on the east coast, and the duration of totality increases from 21·6 sec. on the west coast to 24·5 sec. at Hartlepool.

The conditions in Norway are far more favourable both as regards height of sun and length of totality, and those who propose to undertake important researches should certainly go there.

Research Items.

POTTERY FROM ANCON, PERU.—Dr. W. D. Strong has published a further instalment of his valuable studies of the collections of pottery from Peru which were made by Dr. Max Uhle, and are now in the Museum of the University of California. In No. 4 of Vol. 21 of the *Publications in American Archæology and Ethnology* of the University, he deals with the collections from Ancon, which do not, it is true, exhibit the same variety as the collections from some of the other sites previously described, but are nevertheless of considerable interest as exhibiting what is, in the main, a continuous local development, although outside influence is to be discerned. The earliest pottery found—early Ancon—came from shell mounds and is characteristically a one-colour ware, often unslipped, and with incised rectilinear and curvilinear designs. Dr. Uhle believed it similar to proto-Nazca, but probably it is rather an early widespread Peruvian type from which proto-Nazca developed. In the following period, middle Ancon I, the earliest from the necropolis, two types are found, one resembling early Ancon, the other consisting of polychrome foreign styles showing the influence of proto-Nazca, proto-Chimu, and Tiahuanacu. Middle Ancon II again shows two types, one local, the other a degraded Tiahuanacu of wide distribution. In late Ancon I a "black, red and white" ware, and late Ancon II, a black and white pottery, foreign influence apparently had little effect. Only in the upper layers is Inca pottery found; Dr. Uhle places the earliest period at approximately 100 B.C. It would seem that Ancon had already been abandoned at the time of the Spanish conquest.

GROWTH IN STATURE OF INFANTS.—A recent issue of the *Bulletin* of the *Société d'Anthropologie de Paris* (T. 5, Sér. 7, fasc. 4-5-6) contains two communications dealing with the modality of growth in stature in infants and the causes of its abnormalities by M. Variot and his assistant, M. Alfred Rusesco, of the Hospital of Notre Dame Perpétuel du Secours. M. Rusesco's results are based upon observations upon 602 infants. He finds that in the first twelve months there is usually a regular upward curve up to six months; but that after that age, in 82 per cent. of the cases, there are breaks in the regularity of the curve which are represented on the graph by horizontal lines—*paliers*—of which the first is the most serious. The duration of these breaks may vary from one week to six or eight weeks. A further analysis of the figures gives the following results:—Interruptions in regularity of curve of growth—infants above normal in weight, 29 per cent.; breast-fed infants, 75 per cent.; breast and artificial feeding combined, 76 per cent.; artificial feeding from birth, 84 per cent.; premature, 89 per cent.; infants below normal in weight, 100 per cent. These percentages bear no relation to absolute height, which may be quite normal, but represent only irregularities in rate of increase. It would appear, therefore, from an inspection of these figures, that there is a close connexion between nutrition and regularity in increase in stature. While food is regular, abundant, and well adapted to the needs of the organism, and nutrition is at the same time uninterrupted by morbidity, as, for example, by the anorexis of dentition, growth in stature is regular and continuous. M. Variot carries the matter further and shows, first, that the nutrition of the osseous system, which governs increase in stature, sometimes proceeds apart from nutrition of the organism generally, which regulates weight; and secondly, that on plotting various crises of the first year on the graphs, it appears that the *paliers* coincide with eruptions of the teeth.

AERIAL SURVEY OF A DELTA.—The difficulty of adequately surveying the channels and featureless swamps of the Mississippi delta and the need for the revision of the charts of that region suggested the possibilities of aerial survey. Previous experiments on the coast of New Jersey proved the value of these methods. A brief illustrated account of the survey, with notes of the cost, is contained in Special Publication No. 105 of the United States Coast and Geodetic Survey, by Mr. G. C. Mattison. The field work was done in 1921–22 with a seaplane, since the marshy condition prohibited the use of aeroplanes. The seaplane could not attain a higher altitude than 8000 ft., which was found to be a disadvantage. Since the use of aerial photographs was largely experimental, control by triangulation was arranged. The delta was divided into sections with natural features as boundaries, and over each compass flights were made. Flights were also made along the principal channels. The photographs had about 50 per cent. overlaps, and when the work was complete very few gaps between the strips were revealed. Results were fairly satisfactory, but left room for some improvements. At the same time, it is doubtful if ground of this nature could have been so well surveyed, and certainly not so quickly and cheaply, by any other method.

AMMONITES OF PORTUGUESE EAST AFRICA.—A collection of Upper Albian Ammonoidea belonging to the Transvaal Museum form the subject of a paper by Dr. L. F. Spath (*Ann. Transvaal Mus.*, 11, Pt. 3). The specimens, which are all from Catuane in Portuguese East Africa, include 33 ammonites and 69 heteromorphs. The fauna is of great interest, for it includes not only important and new forms of Inflaticeratidæ but also the majority of specimens belong to groups of "Crioceras" hitherto known mainly from Australia. The author briefly revises his former opinions based on a study of the Aptian ammonites from Zululand, Madagascar and Angola, recognising now that they came from beds of different and not the same dates. In strictly contemporaneous beds similar assemblages, if not identical species, are found. Ammonites are not only remarkably independent of facies, but are also of surprisingly world-wide distribution. In an appendix three ammonites from the Cenomanian of Maputoland are described.

ICE IN THE ATLANTIC.—The *Meteorological Magazine* for November contains an article by Lieut.-Comdr. Edward H. Smith, U.S. Coast Guard, on ice in the North Atlantic. It was off the tail of the Grand Banks that the giant passenger ship *Titanic* met with the appalling disaster on the night of April 14, 1912, through colliding with a low-lying iceberg. The Ice Patrol Service was established in consequence. The management of the service was accepted by the U.S., several nations sharing the expenses of the project, Great Britain contributing approximately 30 per cent. of the outlay. The Patrol has been operating for the past thirteen years and the U.S. Hydrographic Office co-operates with the Coast Guard in giving publicity to the ice information. The writer claims that there has not been a single life lost or a serious marine accident on the United States-Europe routes since the inception of the Ice Patrol. There are two ships detailed for ice patrol duty. The Patrol finds two general forms of ice, sea ice and land ice. The sea or field ice lasts from

February until May. Land ice consists of parts broken off from the ice sheets which cover certain land areas in the far north, and this constitutes a far greater menace to navigation than does sea ice. The iceberg season covers the period March 15–July 15. Records kept by the Patrol, 1913–1925, indicate a tendency towards uniformity in the drift of icebergs. The amount of ice drifting out of the north into the open Atlantic is subject to great annual variations. Based on past experience in association with correlation of other data, arrangements are now being made to begin a service of North Atlantic ice forecasts beginning with the season of 1926.

ROTATION OF BODIES DURING EARTHQUAKES.—During the St. Lawrence earthquake of February 28, 1925, many bodies were rotated on their bases, and these were examined by Mr. E. A. Hodgson (*Journ. R. Astr. Soc. of Canada*, vol. 19, 1925, pp. 169-178) in the hope that they might throw light on the position of the epicentre. This area is known to lie in an unsettled region between the St. Lawrence and Saguenay rivers and between their junction and Quebec. Though the main object of the inquiry was not attained, it was found that the rotation effects were confined, as a rule, to the region near the epicentre in which the vertical component of the motion was most marked. They depended greatly on the depth of the soil—the deeper the soil the greater the rotation for any given distance from the epicentre—on the slope of the ground and on the presence of tree roots near the monuments. As a rule, the rotations north of the St. Lawrence river were in the clockwise direction, and those on the south side in the counter-clockwise direction; but, while there were practically no exceptions to the rule on the north side, there were a considerable number on the south shore. The author concludes that this old earthquake problem (first considered by Mallet in 1846) is still unsolved.

THE EXCITATION OF HYDROGEN SPECTRA BY COLLISIONS WITH ELECTRONS.—Messrs. P. M. S. Blackett and J. Franck describe experiments in the *Zeitschrift für Physik* of October 20, showing that when very pure hydrogen is bombarded under suitable conditions by cathode rays, a spectrum is emitted which indicates that hydrogen molecules are split up in individual collisions into a normal and an excited atom, the latter afterwards emitting light. Precautions were taken to avoid the accumulation of free atoms in the tube, which included the coppering of the interior walls, cooling the tube with liquid air, and passing a rapid current of low-pressure hydrogen through it; the spectra are due neither to the excitation of neutral atoms by collision with electrons nor to excited molecules. The Doppler effect of the $H\alpha$ line in these experiments was compared with that obtained when many free atoms were present and the spectrum was due to their excitation; it was found to be much greater in the first case, the lines being broadened so that the fine structure observed in the second case became blurred This is explained as being due to the relative velocity of the two atoms of the dividing molecule. The authors consider it possible that the continuous hydrogen spectrum, reaching from the far ultra-violet to long wave-lengths, may be explained as due to the surplus energy available when the molecules are broken up by collision with electrons into two neutral atoms. The continuous spectrum referred to is not that connected with the series limit.

THE CONVECTION OF LIGHT BY MOVING MATTER.—In a recent communication (*Phil. Mag.*, Ser. 6, vol. 49, 1925, p. 579) and in an earlier one (*C.R.*, t. 175, 1922, p. 574) M. Charles L. R. E. Menges has pointed out an error in the usual deduction on Newtonian principles of the velocity of light in a moving medium, from which the conclusion has been generally and, according to M. Menges, wrongly drawn, that the older electromagnetic theory is contradicted by the results of the experiments of Fizeau and Zeeman on the velocity of light in moving media. If the refractive index of the moving medium be defined as the ratio that the velocity with which the light reaches the moving medium bears to the velocity of propagation of the light within the medium, then according to M. Menges it follows that the proper formulæ for the differences of phase in the experiments of Fizeau and Zeeman are those of Fresnel and H. A. Lorentz respectively, and that the usual incorrect results are due to the use of an incorrect expression for the refractive index, namely, that of the medium, when it is at rest, instead of that which belongs to the same medium when it is moving and when due allowance is made for the change of frequency of the incident light on account of the Döppler effect. Whilst it must be admitted that M. Menges appears to be right in his main contention that a proper choice of refractive index for the moving medium is essential, yet his own deduction is not entirely free from ambiguity, in so far as equation (11) in his earlier and more fundamental paper leads at once to the expression $\mu'_w = \mu + A(n' - n)$, where n and μ respectively denote the frequency and refractive index of the medium at rest, whilst n' and μ'_w denote the same quantities when the medium is moving. For A, which is a constant of integration, M. Menges puts $(\mu - 1)/n + d\mu/dn'$, as he says, in accordance with the assumption made by H. A. Lorentz that $d\mu/dn'$ does not vary from n to n'. It is not easy to see any sufficient reason for this identification of A, but if its validity be granted, the formulæ of Fresnel and H. A. Lorentz follow at once. Both of these formulæ have been deduced from the special theory of relativity by M. von Laue (*Ann. der Phys.*, F. 4, B. 62 (1920), p. 448); consequently, if the contention of M. Menges be correct, the experiments of Fizeau and Zeeman can no longer be regarded as deciding between the theory of relativity and the older electromagnetic theory.

NICKEL CATALYSTS.—The results of an X-ray investigation of nickel catalysts of different activity have been published by Clark, Asbury and Wick in the *Journal of the American Chemical Society* for November. The catalysts were prepared by reduction with carbon, ethyl alcohol, ethyl acetate, hydrogen and sodium hypophosphite, and they were examined in a spectrograph in powder form in an atmosphere of nitrogen. With the exception of the product obtained by the last method, which was colloidal, the space lattice and type were the same in all cases. No information was obtained concerning the surface of the catalysts. The results do not contradict the generally accepted theory that, above all, the condition of the surface determines the activity.

TOXIC PRINCIPLE OF INSECT POWDER.—In the *Scientific Papers of the Institute of Physical and Chemical Research*, Tokyo, for August 1925, R. Yamamoto gives the results of investigations on the insecticidal properties of insect powder. The insect powder was obtained from the dried flowers of *Chrysanthemum cinerariifolium*, and by extraction with suitable solvents and vacuum distillation a light brown syrup was obtained which was highly toxic to insects. This liquid, called pyrethron, when saponified yielded a liquid and two solid alcohols in addition to two acids, all of which were inactive towards insects. The formulæ for these substances and for pyrethron have been deduced.

The Instituto Oswaldo Cruz.

By Prof. T. D. A. COCKERELL.

FOR many years past I had been receiving the *Memorias do Instituto Oswaldo Cruz*, published at Rio de Janeiro, and sent with the utmost liberality to students and libraries in many countries. I had wondered at the variety and excellence of the papers, and the beautiful illustrations. I had seen some of the scientific results received as of fundamental importance, and incorporated in text-books. Accepting all this with due gratitude and appreciation, it was natural to feel puzzled to know how it all came about. Brazil is a great country, of enormous but largely undeveloped resources. Talk to any one who has been there, or who lived there, and the conversation is certain to drift toward a criticism of Brazilian politics and politicians. To be sure the same sort of thing happens in the United States, but we know something of the virtues of the northern continent and can weigh one thing against another. The foreigner approaching Brazil is sure to feel that "every prospect pleases," but more than likely to add that "only man is vile." I myself at one time could only suppose, in a vague manner, that the Instituto Oswaldo Cruz must have been founded and endowed by some multimillionaire, whose munificence had created an organisation essentially alien to the general spirit of the country. This supposition was entirely wrong.

Approaching Rio de Janeiro in the s.s. *Vestris*, and knowing that I should have only a day and a half in the city, it seemed prudent to send a wireless message to the Instituto, to make sure that I should not fail to see it. It is not always easy to get into South American scientific institutions; I found the magnificent museum at Rio closed, with no means of access; I was told that the Botanic Garden was closed; and the La Plata museum in Argentina was closed when I first visited that city. The museum at Lima was also closed during the few hours when it was possible for me to visit it. The Instituto Oswaldo Cruz is so much a working institution that I imagine it is rarely closed during daylight hours, but it is at Manguinhos, a suburb of Rio, and my wife and I were very grateful for the courtesy of the director in sending a car to take us out. Prof. Carlos Chagas, the director, took us over the building, and explained its history and the nature of the work. Oswaldo Cruz was not a man of wealth, but a practising physician in Brazil. Having studied in Paris, and come in contact with the keenest investigators of his time, he returned to Brazil full of scientific zeal. He was able, through his dominating and persuasive personality, to enlist the co-operation of his countrymen, with remarkable results. He was credited with having banished yellow fever from Brazil, or at least from the populous districts, utilising the results of modern work on the relation between mosquitoes and the fever. Through the work of the Instituto, smallpox has also essentially disappeared, the co-operation of the Government having been secured to make vaccination compulsory. It is evident to any one who gives attention to the subject that the whole problem of Brazilian progress and development is tied up with that of preventing disease. Cruz early perceived that this was the case, and went to work to demonstrate it and obtain public support for his efforts. The response was generous, and the fine building in Moorish style was erected at Manguinhos. Dr. Cruz was the first director, and when he died a favourite disciple, Dr. Chagas, was placed in charge. In a great public building in Rio are large and beautiful mural paintings illustrating the history of the country. Prominent among these is one of Dr. Cruz, represented as ministering to a group of people suffering from various diseases.

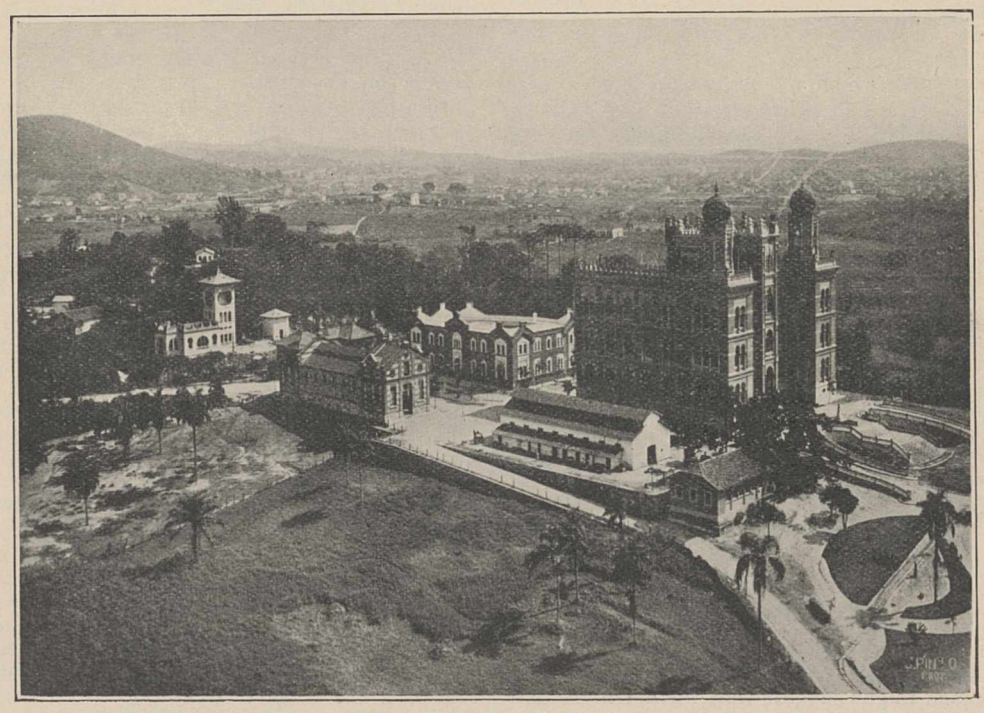

FIG. 1.—The Instituto Oswaldo Cruz.

The expenses of the Instituto are not derived from any Brazilian Rockefeller or Carnegie; the funds come about half from the Government and the other half from the sale of vaccines and serums which are made there. Thus the whole thing, from first to last, is to be regarded as a flower of Brazilian civilisation, one of the chief instrumentalities for Brazilian progress. As such, it should be known to the world and to the people of Brazil. As I, the foreigner, went over the building, enthusiastic at what I saw, a long-time resident of Rio also went the rounds, and confessed to us that until that day he never imagined what lay so close at hand. The latest number of the *Memorias* (vol. 17, part 2) was just being distributed, containing articles on ciliate Protozoa parasitic in guinea-pigs, a revision of the scorpions of Brazil, an account of worms parasitic in birds, and a statistical study of the incidence of disease due to parasitic worms among the children of Paraná. These papers are in Portuguese, but are accompanied by translations into English or French.

The work for which Dr. Chagas is especially well known is that on the disease called opilacao, caused by a trypanosome which is communicated by a large hemipterous bug, the *Triatoma megista*. The trypanosome was described by Dr. Chagas as *Trypanosoma cruzi* in 1909. The bugs frequent native houses, flying and attacking at night, as was graphically described to me by Dr. C. Spegazzini when I met him at La Plata. Dr. Chagas showed us the parasites in the fibres of the human heart and in the blood of a dog inoculated with injected human blood. Other species of Triatoma also carry the parasites. *Triatoma geniculata* gets its trypanosomes from the armadillo, *Dasypus novemcinctus*. The opilacao disease is not coincident with the distribution of Triatoma. Dr. E. Escomel of Arequipa, Peru, told me that *Triatoma infestans* was found between Arequipa and Mollendo, but harboured no trypanosomes. He had observed that it was attacked and killed by the spider *Lathrodectes mactans*, common in that region, as also in North America. *Triatoma sanguisuga* of the United States once enjoyed newspaper notoriety as the "kissing bug," but it appears to carry no trypanosomes. There can be little doubt that it would be capable of transmitting *Trypanosoma cruzi*, were it once infected.

The Instituto has a museum, and a library of 40,000 volumes, in uniform red binding. This is the largest medical library in South America. Behind the main building are smaller ones for physico-chemistry and mycology. The department of pathology was started in 1918 under the direction of Dr. Bowman C. Crowell, now of South Carolina. Dr. Crowell had specialised in tropical diseases in the Philippines, and was able to establish the work at Rio on a thoroughly scientific basis. Reports are now made on all autopsies in the Rio hospitals. Thus the progress and incidence of disease is watched with unceasing vigilance. There is of course a good collection of mosquitoes, including those concerned with malaria and yellow fever, the exact distribution of which is mapped. Mosquitoes are such fragile insects that in many collections, especially when much used, they soon become badly broken. At the Instituto this is avoided by placing them in small tubes, pinned on the cork. Thus they can be examined with a lens, without risk of damage. I regretted not to meet Dr. Adolph Lutz, so well known for his studies of blood-sucking Diptera. He was absent giving a course in parasitology in Venezuela, at the request of the Government of that country.

The museum contains a large collection of Batrachia and of poisonous snakes. Dr. Chagas said that Lachesis is the most dangerous form. Around the room are exhibits to illustrate all the important tropical diseases, some of which are little known to people of other regions. Fleas are important in this connexion: the collection of fleas is now being studied by Mr. Cezar Pinto, who has also described species of leeches. There is a small lecture theatre, and courses in bacteriology, proto-zoology, helminthology and entomology are given for graduate students of medicine. Even fresh-water Mollusca (Planorbis) have received critical attention, on account of the parasites they harbour.

Recent Researches on the Physiology of the Stomach.

THE large amount of work which has been carried out on the secretory processes and movements of the stomach might suggest that further investigations could add but little to our knowledge; such is, however, far from being the case. Recent advances made in this subject are due in the main to two quite different lines of approach; the improvement in surgical technique has produced more clear-cut results from animal experiments, and the application of these results to man has been facilitated by the discovery of methods of investigating the physiology of the stomach in human beings, whereby essential information, without which the true significance of animal experiments may be obscure, has been obtained.

As an illustration of the former method of advance, recent work by R. K. S. Lim, A. C. Ivy, and J. E. McCarthy may be cited (*Quart. Journ. Exper. Physiol.*, 1925, vol. 15, pp. 13 and 55). The authors, working with dogs, have developed a technique by means of which the entire stomach can be separated from the rest of the alimentary tract; the continuity of the latter is restored by an œsophageo-duodenal anastomosis, while the cut pyloric end of the stomach is made into a permanent fistula, the cardiac end being closed. The animals live well on a diet of ground meat, bread, milk and desiccated pancreas, with unlimited water, but raw meat is passed almost unchanged. Experiments were also performed on animals provided with different types of stomach pouches and fistulæ, following the original technique of Heidenhain and Pavlov and its various modifications.

Consideration may first be given to the arousal of gastric secretion by stimuli acting on the stomach itself; these are of two types, mechanical and chemical. The authors show unequivocably that mechanical stimulation by distension of the organ or a pouch thereof with a balloon causes a secretion of gastric juice, which occurs not only after severance of the vagus nerves, the main secretory and motor nerves of the stomach, but may be seen also in an isolated fundus pouch when the main stomach is distended, or in the stomach when a pyloric pouch is stimulated. There is a latent period of five to fifteen minutes after the beginning of the distension before secretion appears.

These observations are of great interest, not only because they confirm the opinions of some of the older physiologists, whose views have found little favour in modern teaching, but also because they suggest that certain observations on man, in which a mechanical stimulation has been suspected, are probably to be taken as really due to this cause. Many previous observations have shown that a flow of gastric juice can be obtained by the application of certain sub-

stances to the mucosa of the stomach; the authors have confirmed these results, showing that raw meat juice, β-alanine, and histamine stimulate, whereas undigested foods are without effect. The actual mechanism of stimulation is, however, not yet finally settled. The presence of extrinsic nervous connexions is unnecessary, but since a denervated pouch responds to the stimulation of the main stomach, one must assume that the effective stimulus is a chemical agent, carried by the circulating blood.

The authors have been unable to obtain unequivocal evidence of a hormone, such as postulated by Edkins, in the blood, and therefore incline to a view which advocates a common mechanism, as the basis of both mechanical and chemical stimulation. The stimuli produce an increased blood flow through the gastric glands resulting in an increased flow of gastric juice; in the case of mechanical distension, the motility of the stomach is involved in this effect. It is, however, possible that increased blood flow consequent on increased movements due to distension may be concerned only in the effects of mechanical stimulation, whilst the hormone mechanism may explain the results of chemical stimulation, more especially as Ivy reports, in a recent review of the subject, that a gastric pouch transplanted to a mammary gland secretes when gastrin (an extract of gastric mucous membrane) and histamine are applied to the surface of the main stomach, in which case an increased blood flow seems scarcely adequate as an explanation (v. *Journ. Amer. Med. Assoc.*, 1925, vol. 85, p. 877). It is to be noted, moreover, that in the case of the secretion of saliva, an increased blood flow through the salivary glands does not produce an increased secretion.

The gastric juice produced by local stimulation of the stomach is only part of that secreted in response to a meal. Before the food enters the stomach secretion occurs, produced reflexly by impulses set up by the sight and smell of the meal, together with those arising from its presence in the mouth itself. The arcs concerned in the latter reflex are situate in the brainstem, since the "psychic" secretion, as it is called, occurs in a decerebrate dog when given food. But Lim, Ivy, and McCarthy have added yet a further period to the secretion of gastric juice by showing that it is aroused by the application of digestion products such as peptone, amino-acids, and amines to the mucosa of the small intestine. If a meal were given to their dog with a pouch of the entire stomach, a secretion of gastric juice occurred about one to three hours later, depending in part on the time for digestion in the small intestine, in part on the time of appearance of the bile, which also acts as a stimulant. Hence gastric secretion can be divided into three phases, a cephalic (or "psychic"), a gastric, and an intestinal. It is only on an accurate knowledge of these processes that a rational therapy of gastro-intestinal tract disease can be based.

A certain amount of doubt has arisen as to the actual nature of the movements in the stomach, chiefly owing to the fact that different types have been described in man and animals; sometimes even different observers have found different appearances in the same species. E. D. McCrea, B. A. McSwiney, J. W. Morison, and J. S. B. Stopford (*Quart. Journ. Exper. Physiol.*, 1924, vol. 14, p. 397) have investigated the movements of the stomach in the rabbit, cat, dog, and man, both by means of the X-ray and also, in the animals, by direct inspection of the organ exposed under saline. Their observations clarify and correlate those of previous investigators. The fundus and part of the body of the organ remain almost quiescent during digestion, slowly contracting on the mass of food and forcing it into the more distal parts. In the latter two types of movements occur; in both there is a peristalsis of the remaining part of the body, but in one this is arrested at the pyloric antrum, whilst in the other the wave passes over it and reaches the pylorus; in the former case the peristaltic wave over the body is followed by contraction of the pyloric antrum and canal as a whole, in the same manner as the heart contracts in systole. The first type of movement is predominant in the stomach of the dog, rabbit, and man, the second in that of the cat; but occasionally the opposite type may occur, except that the second has not been observed in the dog's stomach. A transitional form is sometimes seen, namely, ripples running over a tonically-contracted pyloric antrum. The rhythms of the two parts of the stomach may be different. Movements can also be seen in the quiescent part of the fundus in man if the air-cap is displaced and its place taken by the barium sulphate meal. The authors conclude that the variations observed are due to differences in the type and consistence of the food, in the degree of tension in the muscular wall, and in the actual arrangement of the muscular fibres therein in the different species. The research system atises the somewhat confusing observations which have been previously made on this subject.

American Work on Tides.[1]

THE United States Coast and Geodetic Survey has done useful service in issuing the special publications referred to below. The manual prepared by Mr. Schureman was designed primarily for the tidal computers of the Survey, but the aim was to produce a convenient work of reference on the subject of the harmonic analysis and prediction of tides. It gives a résumé of the work of Kelvin, Darwin, and Harris. Part I. is devoted to the development of the tide-generating force, to the methods of analysis used by the Survey, and to a description of the U.S.A. tide-predicting machine. The method of analysis is worthy of comment. It makes use of several thousand stencils for the special summations required for the isolation of the constituents. The manual indicates, apparently for the first time, some of the more recent improvements in the method, and these are such as to diminish considerably the labour of calculation. In older methods only those constituents of which the speeds are exactly in the ratios 1 to 2, 3, 4, 6 and 8, were treated together until the final processes of the analysis were reached, but in this method constituents the speeds of which are approximately in these ratios are treated together in the earlier stages of the summations, and "secondary stencils" are then used to isolate the respective constituents.

Parts II. and III. are most useful to computers and research workers in other countries. Part II. contains tables of standard functions used in analysis and prediction, Harris's tables having been extended and others added. The astronomical arguments are now given from 1850 to 1999. Part III. consists of a noteworthy list of harmonic constants for nearly a thousand places scattered throughout the world. Hitherto research workers have had difficulty in obtaining lists of such constants, and no such comprehensive list has ever been published, though no doubt several manuscript lists have existed. The Survey has received constants from many sources,

[1] A Manual of the Harmonic Analysis and Prediction of Tides, by P. Schureman; Tides and Currents in New York Harbour, by H. A. Marmer; Tides and Currents in San Francisco Bay, by L. P. Disney and W. N. Overshiner; A Portable Automatic Tide Gauge, by G. T. Rude. Special Publications Nos. 98, 111, 115, 113. (Washington: Government Printing Office.) Prices 100, 30, 20, and 10 cents respectively.

and it must have been difficult at times to make sure that the constants were accurately given. The amplitudes for Gibraltar are ten times too great, but in general the constants appear to be trustworthy.

An immense amount of labour must have been expended in preparing these tables, and all concerned in the production of the manual deserve congratulation upon the efficient manner in which the work has been carried out.

Another activity of the Survey is shown by the two publications dealing with the tides and currents in New York Harbour and in San Francisco Bay. Altogether apart from their importance in navigation, tides and tidal currents enter as important factors into a number of problems connected with harbours and ports. These special publications are not devoted to the discussion of any involved mathematical theory of tides and currents, but are intended to present and discuss the results of observations in such a manner that they will be of interest and practical value to the mariner, the engineer, and the scientific worker. Mr. Marmer's introduction, however, is an admirable statement in simple language of the general characteristics of tides, and this is reprinted in the second publication.

The heights of various planes, such as mean sea level, mean tide level, mean high-water level, storm high-water level, and so on, from year to year are tabulated, explained, and discussed. Engineers must find this information exceedingly useful. Maps give the directions of current flow at intervals of time related to high-water time or to the time of high-water slack.

The importance of tidal currents is becoming increasingly recognised, and the Survey has taken the lead in preparing a separate annual volume of predictions of tidal currents. Hitherto, the current predictions for San Francisco Entrance refer only to the times of slack water for each day of the year, with suitable indications as to whether the current is about to turn from east to west, or vice versa. Beginning with the year 1926, however, the predictions will be considerably elaborated. For each day will be tabulated the time of slack water before flood, the time and velocity of each maximum flood, and corresponding times and velocities connected with the ebb. It will be noticed that fifty per cent. more information is given for the currents than for the elevations.

To meet the need for a portable tide gauge suitable for the use of hydrographic parties requiring tidal observations during a period of soundings, an instrument has been designed which appears to have reached almost the lowest practical limit of size. When encased, the instrument is almost a cube of 11 inches side, and it is supported on 3½-inch stock iron pipe which serves as a float-well at the same time. According to Commander Rude the apparatus will function for a week without attention. The gauge appears to be well suited to the purposes for which it is designed. A. T. DODSON.

Research in Textiles.

THE Fabrics Co-ordinating Research Committee was appointed in 1921, its members being representatives of the fighting services, the National Physical Laboratory, and the research associations for the textile industries. The duties of the Committee are the maintenance of co-ordination between research work on fabrics carried out by Government departments and others, and the direction of new investigations which appear necessary in the national interest and of civilian as well as of naval or military importance. The report recently issued [1] on the activities of the Committee during the past four years gives a lucid summary of progress in the scientific investigation of several problems of considerable national importance and of very diverse character.

The academic research worker will be interested to learn how frequently, in the solution of such problems, the application of laboratory results is limited by considerations apparently foreign to the subject, a striking illustration being afforded by the search for an antiseptic which will give protection to a fabric from the attacks of micro-organisms and, at the same time, have no deleterious effect upon it. This seemingly simple problem becomes very complex in practice, most antiseptic substances being excluded on account of some objectionable quality or an equally objectionable action on the properties of the fabric or the substances employed in dyeing or finishing this.

The Committee has initiated work on the deterioration of fabrics by the action of light, a problem of great urgency in connexion with aircraft, clothing and tentage, and a summary is given of recent work on the determination of the destructive band of the sun's spectrum (3900 Å.U. to 3100 Å.U.), the protective action of dyes having an absorption band covering this region, and the mechanism of deterioration. Much further work on the latter subject is required, for the causes are still obscure; but an interesting theory of the action of ozone in this connexion is outlined. This takes account of the oxygen adsorbed by the fibres and the possibility of this being ozonised by the direct action of sunlight, and is based upon a calculation by Lindeman that the ozonisation of the adsorbed air may be effected by light of wave-length 3200 Å.U.

Future progress depends largely upon the provision of more suitable sources of light for experimental purposes than sunlight or the mercury vapour lamp, and a more delicate means of measuring deterioration than the strength test. It is satisfactory to learn that research is being conducted on both these subjects.

An interesting appendix on the deterioration of fabrics by micro-organisms sketches the organisation of a large-scale attempt to collect systematically the organisms capable of causing the decay of fabrics. Specimens of the latter are being exposed, under the supervision of mycologists, at a number of stations in the British Empire, and arrangements are being made for the examination of the specimens after exposure. Again, the possibility of a more suitable test of deterioration than those now available requires further exploration.

A large section of the report is devoted to a comparison of fabric strength tests carried out on machines of different makes and capacities. From a technical point of view this is probably the most important section, for the results are of direct practical significance. They should, naturally, be read with great interest by all concerned with the mechanical testing of fabrics and the scientific investigation of the principles underlying the methods employed.

As a précis of the results of scientific research the report is highly commendable. A misleading statement has been noticed on p. 30, where it is stated, in a discussion of rate of loading, that, when textiles are broken, a larger percentage of the interlaced fibres are "disentangled and slip past one another without breakage." So far as the writer is aware, there is no evidence supporting this generalisation, which, for example, certainly does not apply to a fine yarn broken on the ballistic tester. F. SUMMERS.

[1] Department of Scientific and Industrial Research. First Report of the Fabrics Co-ordinating Research Committee. Pp. iv+70. (London: H.M. Stationery Office, 1925.) 1s. 9d. net.

University and Educational Intelligence.

BIRMINGHAM.—At a degree congregation held on December 18, the degree of D.Sc. was conferred on Douglas Heber Ingall for five published papers mainly on the relation between mechanical properties of metals and alloys and heat treatment and cold-work.

THE annual distribution of prizes was held at the Sir John Cass Technical Institute on Tuesday evening, December 15, when the prizes and certificates were distributed by Sir Thomas Kirke Rose, past president of the Institution of Mining and Metallurgy. The Chairman of the Governing Body, the Rev. J. F. Marr, in giving a summary of the work of the Institute for the past session, stated that real progress has been made in consolidating, strengthening and correlating the work of the science departments, in which more accommodation is much needed for advanced and research work. Twenty-seven students have been engaged in research work during the session and 11 investigations have been published, bringing the total number of papers issued from the Institute to 165. Following the distribution of awards, Sir Thomas Kirke Rose delivered an address on "Metallurgy and Minting," in the course of which he emphasised the effect the Institute has had in helping the industries of the neighbourhood and not least in its metallurgical work in aiding the Royal Mint. He dealt at some length with the still unsolved problems of minting which have so far baffled metallurgists, in order to bring out the fact that there are still worlds to conquer even in such an old-established industry as minting.

SALARIES of university professors in the United States increased rapidly after the War, so much so as to cause some temporary embarrassment to the administrators of the Carnegie Pension Fund. In the *Forum* for October, however, Dr. Frank Bohn asserts that college and university faculties are being deserted by their first-class members at a rate which calls for a drastic reform of the salary schedules. In a case which he cites as typical, a professor of psychology left the university where he was receiving 5000 dollars a year, and accepted an advertising position in New York in which he was able to earn five times as much. Dr. Bohn suggests that all major gifts to the universities, say those amounting to ten million dollars or more (which totalled during the past ten years no less than 1,435,500,000 dollars) should during the next ten years be devoted to the increase of salaries of university teachers. He holds that the starvation of the teaching profession is destroying the very foundations of higher education, and civilisation is in jeopardy of being submerged in "the noisy flood of ignorance and vulgar materialism." The universities are becoming less and less capable of fulfilling the hope of a generation ago that they would be the prophets, the priests, and the philosophers of democracy. Nor is "starvation" of their professors the only reason. They suffer primarily from elephantiasis, and the first step might well be a restriction of the number of students by imposing entrance tests which would be at least as severe as the general demands made of the Rhodes scholars. The group of professional schools should include only law, medicine, education, public administration, and the beaux arts. The number of students being thus reduced to, say, 1500, and the professors' salaries being raised to 20,000 dollars as a minimum, the universities' best teachers would no longer seek to escape on the first convenient opportunity, and the intellectual élite of the land would be drawn to them.

Societies and Academies.

LONDON.

Physical Society, November 13.—R. G. **Edwards** and B. **Worswick**: On the viscosity of ammonia gas. The viscosity of ammonia gas has been determined at three different temperatures by transpiring the gas through a capillary tube which had previously been calibrated with air. Sutherland's constant is found to be roughly 370, and the mean collisional area of the ammonia molecule $0{\cdot}633 \times 10^{-15}$ sq. cm.—T. G. **Hodgkinson**: Valve maintained tuning forks without condensers. The conductance of the valve grid decides the direction in which the electrode coils must be wound. It is also advantageous, particularly in the case of low frequency forks, to interpose transformers between the valve electrodes and the fork magnets.—C. **Chree**: The times of sudden commencements (S.C.'s) of magnetic storms: observation and theory. Dr. Bauer's early claim that S.C.'s are propagated from east to west or west to east, with velocities of from 100 to 200 kilometres per second, has been criticised adversely. Since then, Prof. S. Chapman and Fr. Rodés, of the Ebro Observatory, have propounded theories differing from one another and from Dr. Bauer's. Recently Dr. Bauer and Mr. W. J. Peters have concluded that the motion in longitude is much more rapid than according to Dr. Bauer's original estimate, and that it is really a case of propagation from the magnetic equator towards either magnetic pole. The Section of Terrestrial Magnetism and Electricity of the International Union of Geodesy and Geophysics has recently approved a scheme aiming at the construction and use of special instruments to find out whether S.C.'s have a finite rate of propagation. Suggestions are made as to the new apparatus and the stations most suitable for the investigation.

Royal Microscopical Society, November 18.—Sydney **Dickenson**: A simple method of isolating and handling individual spores and bacteria. The spores or bacteria are moved from place to place under continual observation in a local thickening of a water film. This water film is formed between a film of agar and a fine glass rod, which is moved in three dimensions by an apparatus designed for the purpose.

Royal Meteorological Society, November 18.—Sir Gilbert **Walker** and E. W. **Bliss**: On correlation coefficients: their calculation and use. An account is given of a new method of working out correlation coefficients. Calculations are shown (i.) of the likelihood that with a given coefficient r, the forecast and the actual departures will have the same sign, and (ii.) of the frequency with which, r being given, it will be possible to make a forecast with a 4 : 1 chance in its favour.—Catharine O. **Stevens**: Note on the variations in transparency of the atmosphere observed by means of a projected telescopic image of the sun. There is relation between the colours associated with a projected telescopic image of the sun in a darkened room and issues of weather. Meteorological conditions normal to clear weather with rising barometer yield a predominance of red, orange, and blue, to the exclusion of other colours. With steady barometer and cloudless sky, any pronounced departure from this colour-scheme is informative. Thus, if green is included, rain threatens; if purple or violet, electrical conditions are indicated; and in case all colour is whitened, a fall of barometric pressure is heralded.—N. L. **Silvester**: Notes on the behaviour of certain plants in relation to the weather. The analysis of 1300 observations upon pimpernel, daisy, chickweed, clover, dandelion, marigold, and gentian

to test the local forecast value of plants reputed in weather-lore gives a negative answer. Temperature of the soil surrounding the roots is a control factor in the movements of daisy and chickweed. Above the critical temperature in these two plants, and in the pimpernel, relative humidity becomes the dominant factor—a value of 80 per cent. approx. being the critical maximum in every case. Clover leaves respond to wind velocity. The closing movement commences when the velocity at 42 ft. above the surface exceeds 20 m.p.h. Plants responding to relative humidity can thus be used for prediction of rain only in so far as its incidence is preceded by the pre-requisite humidity increase.

Society of Public Analysts, December 2.—J. S. **Owens**: Measuring the smoke pollution of city air. The methods of measuring smoke pollution are based on: (*a*) Measurement of deposit from the air; and (*b*) measurement of suspended matter before it is deposited. The methods of the Advisory Committee on Air Pollution fall under the headings of: (1) Measurement of deposit by means of standard gauges; (2) measurement of suspended impurities by means of automatic filters, or records; and (3) measurement with the Owens' jet dust counter. The material trapped on dust records from 50 c.c. of air on an average winter's day in London weighs about 1/20,000 mgm., and consists of about 600,000 particles.—Oscar L. **Brady** and Gladys V. **Elsmie**: 2 : 4-Dinitrophenylhydrazine as a reagent for aldehydes and ketones. Aldehydes and ketones can be identified by the crystalline forms, colours and melting points of the dinitrophenylhyrazones which they yield with 2 : 4-dinitrophenylhydrazine. A solution of the hydrochloride is a suitable reagent for aldehydes and ketones soluble in water; it gives a filterable precipitate with 0·003 gm. of acetone or acetaldehyde.—Gunner **Jörgenson**: The determination of phosphoric acid as magnesium ammonium phosphate. The most trustworthy method of obtaining magnesium ammonium phosphate of the correct composition is to precipitate it from a nearly boiling solution (accuracy about 1 : 1000). This is the only sufficiently exact method for determining phosphoric acid in mineral phosphates and fertilisers. Precipitation of ammonium phosphomolybdate in the cold is less accurate (accuracy about 1 : 100). Precipitation of magnesium ammonium phosphate from a cold solution gives a precipitate much affected in composition by the conditions of precipitation.—C. H. **Thomson**: On the effect of blowing on the composition of certain fatty oils. The rise or fall in the composition, viscosity, and other constants of cottonseed, whale, sperm and shark oils are simultaneous at each stage of the process, but the rates of change are not the same. The changes produced by varying the conditions of "blowing" are not comparable, except that the viscosity and refractive index rise simultaneously. None of the oils after "blowing" yields ether-insoluble bromides.

CAMBRIDGE.

Philosophical Society, November 23.—R. C. **Punnett**: On a case of matriclinous inheritance in Antirrhinum.—J. B. S. **Haldane**: The change with age of a linkage between Mendelian factors in fowls.—M. S. **Pease**: A note on the inheritance of yellow fat in rabbits.—K. **Emeléus**: Notes on the electrical counter.

DUBLIN.

Royal Dublin Society, November 24.—K. C. **Bailey**: The radiations from radon promote interaction of ammonia with either carbon monoxide or carbon dioxide. In both cases ammonium cyanate and urea were formed. No ammonium cyanide was thus obtained from ammonia and carbon monoxide.—Paul A. **Murphy** and R. **McKay**: Methods for investigating the virus diseases of the potato, and some results obtained by their use. Most experiments on these diseases require two years to carry out, and necessitate keeping the plants free from insects during the first year. A method is now described whereby tubers may be infected with the mosaic diseases during the winter and the final results secured in June, the plants being grown in the open field. The method is more trustworthy than any previously used. It also separates the mosaics from leaf-roll. Methods more exact than those hitherto used are described for determining the rate of spread of the virus in a plant.—E. J. **Sheehy**: An examination of the errors introduced by the various approximate methods used for estimating the total quantities of milk and butter fat produced during a lactation.

MANCHESTER.

Literary and Philosophical Society, November 24.—Kenneth M. **Smith**: A study of the feeding methods of certain sucking insects in relation to the spread of "virus diseases" of the potato by such insects. "Mosaic" disease in potato is disseminated by insects, more particularly by those of the sucking type, such as aphides or leaf-hoppers. The whole process of infection of a healthy potato plant with mosaic disease would appear to be somewhat analogous to the infection of man with malaria by the mosquito. The insects have been studied with the sucking organ *in situ* in the tissue of the plant host. By this method it is possible to determine the exact part of the tissue tapped. Other points elucidated include the effect of the salivary secretions of the insect upon the health of the plant, the path followed by the beak through the tissue, *i.e.* an inter- or intra-cellular path, and the method of penetration of the cells, whether by pressure alone or by the solvent effect of the saliva upon the cell walls. Those insects which tap the phloem of the vascular bundles seem to act as carriers. Undue disorganisation of the surrounding tissue by the salivary secretions of the insect may tend to isolate the virus and thus prevent infection. This appears to be the case with certain insects the saliva of which is unusually toxic to the plant.

PARIS.

Academy of Sciences, November 16.—E. **Fichot**: The submarine relief of the Bay of Biscay. The supposed plateau in the Bay of Biscay does not exist. The outline is unchanged since the survey made in 1828.—Jean Baptiste **Senderens**: The preparation of the ether oxides of the fatty series. Details of the preparation of ethers from heptyl, cetyl, secondary amyl, and allyl alcohols, using sulphuric acid as catalyst.—Ernest **Laura**: An extended class of surfaces.—Georges **Bouligand**: Some points in the theory of harmonic functions.—A. **Guillet**: The chronostrobometer.—Alex. **Véronnet**: Equilibrium through the influence of radiation alone is impossible in the sun and in the stars. Internal equilibrium is isothermal and homogeneous.—Paul **Helbronner**: The geodesic junction of Corsica and continental France.—Mlle. A. **Serres**: A new magnetic state of the cobalt ion $Co^{\cdot\cdot}$.—A. **Portevin** and P. **Chevenard**: The influence of cold hardening and of tempering on the elastic properties of various metals and alloys.—A. **Petit**: Contribution to the study of the aluminium silicon

alloys.—Diaz de **Barros**: The nuclear numbers. The nuclear number is defined as a whole number equal to half the difference between the atomic weight of an element and its atomic number. Some properties of the numbers thus defined are given.—Raymond **Delaby**: The isomerisation of the vinyl-alkyl-carbinols $CH_2 : CH . CH(OH) . R$ into β-alkyl-allyl alcohols $CH_2(OH) . CH : CH . R$. The chain of reactions is as follows: addition of bromine, action of sodium formate, decomposition by heat of the diformin and saponification of the formic ester of the primary alcohol required. The operations are simple and yields fair (20 per cent.).—René **Bourret**: The Annamitic chain and the Bas-Laos plateaux to the west of Hué.—Eugène **Raguin**: The discovery of a fauna of Foraminifera, very probably Cretaceous, in the highly metamorphosed limestones of the Vallon du Pâquier near Grand-Motte (Savoy).—R. **Cerighelli**: The influence of the conditions of the medium on the germination of seeds in the absence of calcium. Whether the culture medium is sterile or not, the cotyledons immersed or not, or whether the water is present as liquid or vapour, it is proved that seeds cannot germinate properly in the absence of calcium. —V. **Lubimenko**: Chromatic adaptation in the marine algæ. Marine algæ are very poor in chlorophyll, the amounts found varying from 37 per cent. (green algæ) to 18 per cent. (red algæ) of the amount usual in higher plants. The red algæ adapt themselves to the light in two different ways: each species increases or diminishes the total quantity of pigment according to the depth. The proportion of phycoerythrine varies with the different species increasing with the depth below sea-level.— — **Eberhardt** and J. **Chevalier**: A new treatment of the diseases of the potato. The plants are sprayed with an emulsion of a thiohydrocarbon derived from resin by a simple process. The results of experimental cultures with eight kinds of potato are given. The treatment destroys parasites, arrests the development of fungi, and gives an increased weight of crop.—E. **Séguy**: The characters common to the Œstridæ and the Calliphorinæ.—Maurice **Piettre**: The preparation of the albumen of muscle or myoalbumen by the acetone method; its principal properties. Full details are given of the method adopted for the separation and purification of myoalbumen. Its properties are similar to those of serum albumen, lactalbumen, and ovalbumen, but is differentiated by coagulating at 45°-47° C., not as a fine sandy precipitate but in small flocks, and by its specific rotatory power, about half that of serum albumen.—Max **Aron**: The evolution of the genital glands of young tritons transplanted into adults of the same species. The idea of internal conditions limiting the development of the sexual cells.—Constantin **Gorini**: Gastrococcus.

SYDNEY.

Linnean Society of New South Wales, September 30. —R. J. **Tillyard**: A new fossil insect wing from Triassic beds near Deewhy, N.S.W. Description of a wing which, from a study of its venation, is placed in a new family in the order Protohemiptera.—J. R. **Malloch**: Notes on Australian Diptera. No. vii.—I. M. **Mackerras** and M. J. **Mackerras**: The Hæmatozoa of Australian marine Teleostei. The blood of 200 marine Teleostei taken in the vicinity of Sydney, N.S.W., was examined. Two new species of Trypanosoma and three of Hæmogregarina are described, thus bringing the Australian hæmatozoal fauna into line with that of other parts of the world. In addition, a new species of Trypanoplasma is described, this being apparently the first record of the occurrence of a member of this genus in the blood of a marine fish.—G. H. **Cunningham**: Gasteromycetes of Australasia. (iii.) The genera Bovista and Bovistella. Two species are allowed to remain in Bovista, six of those recorded in Cooke's Handbook being excluded from the genus. In Bovistella three species are retained and seven species are excluded on the ground that they possess the typical *Lycoperdon capillitium*.—R. **Greig-Smith**: The influence of certain colloids upon fermentation. Pt. ii. Yeasts and bacteria have their fermentative activities accelerated by the presence of certain mineral and other colloids such as talc, kieselguhr, silica, fuller's earth, charcoal and agar. The isolated enzymes are not influenced by the same colloids.

Royal Society of New South Wales, October 7.— R. H. **Cambage**: Acacia seedlings (Pt. xi.). The first half-dozen or so of the youngest leaves first assume a recumbent position, and may actually lie down on the ground before closing their leaflets at night. Tests were made to ascertain the strength exerted by these tender leaves when regaining their upright position in the morning, and it was found that with a weight of 0·227 gm. placed at 6 cm. from the base of a leaf 8 cm. long, the terminal point of the leaf in one case was carried upwards 6·5 cm.— H. R. **Seddon**, W. L. **Hindmarsh**, and H. R. **Carne**: Further observations on *Stachys arvensis*, "stagger weed," as a cause of staggers or shivers in sheep. As frequently happens with poisonous plants, it is not equally noxious at all stages, and its harmfulness depends to some extent upon the type of sheep which are fed upon it. Thus it has happened that certain feeding experiments have been entirely negative, whilst in others all animals have developed staggers. Green, succulent plants produce staggers, whereas yellowish, harsh plants are comparatively or entirely harmless. The staggers-producing principle seems to be most abundant in, if not confined to, the seed, and is contained in the ether-soluble fraction of the seed. When removed to other feed, sheep rapidly lose the staggers condition, certainly within a week. Young animals are much more susceptible than adult sheep.—F. R. **Morrison**: The fixed oil of the seeds of the Kurrajong (*Brachychiton populneum*, Syn. *Sterculia diversifolia*. G. Don). The oils obtained by extraction with ethyl ether and light petroleum ether respectively, were of a golden-yellow colour, and consisted of the triglycerides of palmitic, oleic, and linolic acids, together with smaller quantities of free palmitic, oleic, and linolic acids. The oil is thus of the semi-drying class.—M. B. **Welch**: Notes on the principal indigenous timbers of the natural order Saxifrageæ. There are about twenty genera in Australia, of which twelve are endemic and many are monotypic. Eight genera produce trees which reach a large size, and notably Ceratopetalum, Weinmannia, Geissois and Ackama are of commercial importance. The woods are diffuse—porous, the vessels bearing either scalariform or simple end perforations. The wood fibres show transition stages to fibre tracheids and even tracheids. The rays are normally heterogeneous and multiseriate.—R. K. **Newman**, V. M. **Trikojus**, and G. **Harker**: The use of phosphorus pentachloride in the preparation of glycerides. The preparation of a simple fatty substance, tributyrin—a compound of glycerol and butyric acid—is described. Two methods employed gave high yields. In one of these phosphorus pentachloride acts upon a mixture of glycerol and sodium butylate; in the other the tributyrin is prepared direct from glycerol and butyric acid, while special means are provided for the continuous removal of the water formed during the reaction. The pure tri-

butyrin prepared by either process has a much higher boiling point than that usually accepted, namely, 315·5° instead of 287° C. No matter what method was used, the same triglyceride was always formed, and there was no evidence of isomerism.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 11, No. 11, November).—Edward W. **Berry**: The age and affinities of the tertiary flora of western Canada. The flora seems to be mainly late Eocene and consists of hardwood assemblages of broad leaf types and coniferous trees resembling existing species in the Chinese uplands. The major element, of newer types, probably entered North America from Asia by land connexions in the Bering Sea region during the Upper Cretaceous or earlier Eocene.—S. **Loria**: The metastable $2p_3$-state of mercury atoms. A mixture of mercury vapour, thallium vapour, and nitrogen illuminated by light of wave-length 2537 Å.U. gives activated mercury atoms in the $2p_2$-state. On collision with nitrogen molecules, the main part of the activation energy may be retained in the $2p_3$-state of the mercury atom. The time for which the atom retains this energy depends on the surrounding gas, and can be measured, in this case, by the increase in intensity of the fluorescence spectrum of thallium.—H. D. **Smyth**: Some experiments on collisions of the second kind. Iodine vapour at a high temperature contains electrons with energies greater than that corresponding to the electron affinity of iodine (3·5 volts), due apparently to "collisions" in which an electron approaches a system of neutral iodine atom and electron; *i.e.* collisions of the second kind. Some evidence was also obtained with ozone that the critical increment of energy for decomposition is dissipated in a similar way.—Vladimir **Karapetoff**: General criterion for the circular locus of the current vector in A.C. circuits and machinery.—Edward V. **Huntington**: Postulates for reversible order on a closed line (separation of point-pairs).—Raymond **Dodge**: The hypothesis of inhibition by drainage. The hypothesis assumes that there is a definite amount of available neural energy in the nervous system which can be concentrated into specific neural paths and consequently drained from others. Using the knee-jerk and wink reflex in the human subject, it was found that the reflex action is unmodified by voluntary reaction to the stimulus. The hypothesis is therefore discarded pending new evidence.—George E. **Hale**: A test of the electromagnetic theory of the hydrogen vortices surrounding sunspots. There is no relationship between polarity and direction of whirl in 51 sunspots taken at random from three 11½-year cycles. It would appear that hydrogen vortices are hydrodynamical phenomena rather than electromagnetic (Störmer). Direction of whirl is determined, not by the sunspot vortices beneath them, but by the east and west deflexion, due to solar rotation, of currents flowing northward and southward towards centres of attraction above sunspots.—John W. **Gowen**: Recent evolution in milk secretion of Guernsey cattle. From the records of the Guernsey Advanced Registry animals, it appears that there has been considerable increase in average age-corrected milk yields, little change in butter-fat percentage, and continuous decrease in age of cows tested. The results are due to improved knowledge of feeding and care as well as to inheritance.—Calvin B. **Bridges**: (1) Elimination of chromosomes due to a mutant (Minute-*n*) in *Drosophila melanogaster*. (2) Haploidy in *Drosophila melanogaster*. Two individuals carrying haploid tissue were found; the tissue in each case was female.—Henry D. **Hooker**: Plant growth. Carbohydrate accumulation precedes the rest period of shoots and the formation of flower-buds, suggesting that it inhibits or retards leaf formation and thus carbohydrate manufacture. These facts are in accord with the idea that plant growth is a consecutive, reversible monomolecular reaction, and a mathematical formula is developed.

Official Publications Received.

Annals of the Cape Observatory. Vol. 8, Part 7: Occultations of Stars by the Moon, observed at the Royal Observatory, Cape of Good Hope, in the Years 1907 to 1922. Under the Direction of S. S. Hough. Pp. 32G. 6*s.* net. Vol. 8, Part 8: Determination of the Elements of the Moon's Orbit, the Parallactic Inequality and the Moon's Semidiameter, from Occultations of Stars by the Moon observed at the Royal Observatory, Cape of Good Hope, in the Years 1880 to 1922. By Dr. H. Spencer Jones. Pp. 47H. 4*s.* 6*d.* net. Vol. 13, Part 1: Proper Motions of Stars contained in the Cape Fundamental Catalogue of 1846 Stars for the Equinox 1900. Computed under the Direction of Dr. H. Spencer Jones. Pp. vi+150. 35*s.* net. (London: H.M. Stationery Office.)

Cape Astrographic Zones. Vol. 8: Catalogue of Rectangular Co-Ordinates and Diameters of Star-Images derived from Photographs taken at the Royal Observatory, Cape of Good Hope. Commenced under the Direction of Sir David Gill; Completed and Prepared for Press under the Supervision of S. S. Hough. Zone −48°. Pp. xliv+497. (London: H.M. Stationery Office.) 110*s.* net.

Observations of Stellar Parallax from Photographs taken and Measured at the Royal Observatory, Greenwich, in the Years 1913-1924. Under the Direction of Sir Frank Dyson. Pp. xix+134+8. (London: H.M. Stationery Office.) 24*s.* net.

Astronomical and Magnetical and Meteorological Observations made at the Royal Observatory, Greenwich, in the Year 1923. Under the Direction of Sir Frank Dyson. Pp. 8+Axx+A54+iv+B16+C2+Dix+D41+5+Exxii+E74+20. (London: H.M. Stationery Office.) 32*s.* 6*d.* net.

University College of Wales, Aberystwyth: Agricultural Department. Advisory Bulletin No. 1: Seeds Mixture Experiments in West and Central Wales, 1915-1925. Pp. 64. (Aberystwyth.) 6*d.*

British Museum (Natural History). Christmas Booklets. B93: The Rabbit. Pp. 2+1 plate. B99: The Stoat, or Ermine. Pp. 2+1 plate. B100: The Fox. Pp. 2+1 plate. C98: The Robin. Pp. 2+1 plate. (London: British Museum (Natural History).) 6*d.* each.

Scientific and Industrial Research Council of Alberta. Report No. 14 Analyses of Alberta Coal. By Edgar Stansfield, Robert T. Hollies, and William P. Campbell. Pp. 64. (Edmonton, Alba.: J. W. Jeffery.) 25 cents.

Proceedings of the Cambridge Philosophical Society. Vol. 22, Part 6, November. Pp. 817-978. (Cambridge: At the University Press.) 7*s.* 6*d.* net.

Transactions of the Royal Society of Edinburgh. Vol. 54, Part 2, No. 3: Size in relation to Internal Morphology. No. ii.: The Vascular System of Selaginella. By Claude W. Wardlaw. Pp. 281-308. 3*s.* 6*d.* Vol. 54, Part 2, No. 4: A Monograph on the General Morphology of the Myxinoid Fishes, based on a Study of Myxine. Part vi.: The Morphology of the Vascular System. By Prof. F. J. Cole. Pp. 309-342+5 plates. 6*s.* (Edinburgh: R. Grant and Son; London: Williams and Norgate, Ltd.)

Diary of Societies.

TUESDAY, DECEMBER 29.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir William Bragg: Old Trades and New Knowledge: (1) The Trade of the Sailor.

THURSDAY, DECEMBER 31.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir William Bragg: Old Trades and New Knowledge: (2) The Trade of the Smith.

FRIDAY, JANUARY 1.

PHOTOMICROGRAPHIC SOCIETY (at 4 Fetter Lane), at 7.—E. Cuzner: Stereo-Photomicrography.

JUNIOR INSTITUTION OF ENGINEERS (at 39 Victoria Street), at 7.30.—The Manufacture of Ordnance and the Rolling Mills and Crucible Melting Department at the River Don Works of Vickers, Ltd. (Cinematograph Lecture).

SATURDAY, JANUARY 2.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir William Bragg: Old Trades and New Knowledge: (3) The Trade of the Weaver.