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Social Ethics, or Present-Day Conflicts.

THE conflict between religion and science, which a few years ago seemed nearly extinct, has recently revived in another form, this time not so much on the theological as on the ethical side. Doubtless there is a kind of ignorant bibliolatry still surviving, which may be said to have a Theological bearing ; but apart from that there is a sort of conflict between the ideals of science and the ideals of religion—a conflict rather mingled with the emancipation of youth during the present century, and of some practical importance. The study of anthropology and of folk-lore has been pressed into the service ; there is a tendency in some quarters to regard social conventions and other traditions as akin to savage taboos, and to expect sensible people to ignore them. Psychology, too, has developed a scheme called behaviourism, which seems to urge a freer rein to natural instincts, and has become an element in the emancipation of youth.

The revolution in physics, that has led to the examination and rejection of many ancient ideas, is by no means confined to that science. Something of the same sort has been going on contemporaneously in ordinary life. Old customs are being examined to see if they have a rational basis, and when they run counter to instinctive desires are apt to be discarded and rebelled against on hasty and irrational grounds. Youth is complimented on its courage, its willingness to run risks and try anything regardless of consequences. Its courage is undeniable, but its wisdom may be questioned. Even the physical risks which youth is willing to run, in such directions as swimming and flying and breaking of records, may involve the enticing of others to destruction. In other ambitious enterprises, the apparently growing idea that a social taboo has no rational basis and can be ignored with impunity, is becoming a danger.

Even among serious thinkers there is a difference of opinion on these matters. Some hold that we are entering on an age of reason, which submits everything to reconsideration and must involve changes in practice ; while others have taught that an age of reason would mean the extinction of the human race, that animal instincts are necessary for its continuance, and that the struggle for existence and fierce competition are essential to its well-being and energetic development. It is argued that this competitive struggle has been all along essential to evolution, that the survival of the fittest can only thus be accomplished, and that

rivalry and strife must and ought to continue, even though humanity has now reached a superior stage. It is urged, on the other hand, that with the attainment of consciousness mankind might aim at gradually superseding competition by co-operation and mutual aid, that is to say, by instigating a course of conduct, on a large and even an international scale, such as has hitherto been confined mainly to family life. It has long been known that a family prospers not by competition and strife among its members, but by individual sacrifice and mutual aid; and one ideal is to extend this atmosphere of family life to neighbours and ultimately to all humanity, whereas the opposing ideal is that competition and rivalry must continue, lest mankind sinks into a contented apathy and loses the motive for individual exertion.

The doctrine of evolution has no clear say in this matter. There are those who hold that the same conflict which has brought us to what we are must continue unchecked or even intensified, now that we have become conscious of its benefits and have the power of directing its course. There are others who hold that though this method has been of great service in the past, it should now be taken in hand and controlled by conscious intelligence; that in fact it is one of those good things which has had its day and should now gradually cease to be.

Thus on the ethical side of effective religion, which might be defined as the practical outcome of beliefs, there is a conflict between the ideals of competitive struggle on one hand, and the ideals of the Sermon on the Mount on the other. These two ideals have long been in the field against each other, and it would be a great mistake to suppose that our present condition is the result of one or other alone. Both have, as a matter of fact, contributed to the result. Opinions may differ as to the proportion of success attributable to either, but it is surely certain that our hospitals and other numerous philanthropic efforts—the servers of the infirm and helpers of the weak—have been a conspicuous and effective element in the advance of the social organism. Civilised instincts have never been limited to the graspings of benefits and the accumulation of property. It has long been found that happiness does not lie that way. There is a deep-planted instinct to help those in distress, to run even irrational risks for the help of our fellows, and to enter on forlorn hopes without counting the cost. Evolution surely teaches that many lines of conduct, of which it may be difficult to give a rational account, have grown up as the result of experience, and have been formulated in a system of convention, and what may thoughtlessly be called 'taboo,' as the outcome of experiments which have been made by our ancestors,—never perhaps rationally formulated, and yet handed down from one generation to another as an inherited result of experience. We find some of these conventions unconsciously implanted in animal and even in plant life. Methods of propagation deleterious to the race are guarded against in the very structure of organisms, so that they are inhibited not by reason but by physical difficulty. It may be that some of those conventions which are now being uprooted and rebelled against may have a similar evolutionary significance, and be more beneficial than we find it easy to explain.

Whatever view we take, if our conduct is to be regulated by intelligence in accordance with scientific ideals, it is surely necessary that the whole of the facts should be considered, and that we should not proceed to reason on data which are imperfect and incomplete, so as to determine our behaviour in the light of half knowledge. When youth proceeds to flaunt experience, to overthrow conventions, and to demonstrate its courage by all manner of experiments, it is bound to be proceeding without full knowledge of the facts. It cannot but be in a state of considerable ignorance; and in its exuberance it may be throwing away many of the safeguards which the experience of the race has wisely, though often unconsciously, set up.

It is proverbially rash to draw up an indictment against a nation or a class, and the tendency of the age can scarcely be generalised. There is undoubtedly a claim for greater freedom, less supervision, less restrictions; and this when granted may be selfishly abused by individuals, not necessarily young, for mere personal gratification. The mere desire to have a good time is not a lofty ambition. On the other hand, a reconsideration of old customs might result in a genuine effort towards improved social conditions, which admittedly are as yet far from perfect. In spite of perturbing incidents, the spirit which helped us through the War, and through the minor episode of the strike, is still alive, and only latent until a call comes. A few feel the call insistent and ever present; many a youth is asking him or her self *quo vadis*, and is endeavouring to exert a wholesome guiding influence. Youth should not be either praised or rebuked indiscriminately. Incitements to adventure are popular, but they are dangerous and

unnecessary. Temptations are strong enough without pandering to them.

Meanwhile, those experimenters who ignore the ideals of religion, and claim to be following the ideals of science, must be warned that science at present speaks with a divided voice. Religion has always had some bearing upon conduct—sometimes good, sometimes bad; it is of long standing, in one form or other as old as the race; and in civilised countries it can scarcely be doubted that the influence of religion on the whole has been good. Science, on the other hand, is of recent growth, and until lately has not had much influence on conduct. If its ideals are to be followed they should clearly be based on complete knowledge, otherwise they may mislead. No one will claim that our scientific knowledge is complete. It would be rather rash to assume that our knowledge is anything like sufficiently complete to be a safe guide to conduct, or such as to justify the discarding of evolutionary experience and replacing it by a system based on half knowledge.

To make this point of view more definite: it is undeniable that a certain group of scientific men have claimed that the religious belief in a spiritual world is a dream, and the survival of the individual apart from his bodily organism an illusion. If this is true, then such beliefs cannot but have an influence upon conduct; and youth, already urged to such conduct by its instincts, will take advantage of those beliefs to justify its own tendencies and to rush unthinking to its fate.

On the other hand, there is a small though perhaps growing group of scientific men who hold that human life on this planet is but a small part of existence; that the organism is only a manifestation of something which has its roots in another order of being; that we are associated with matter only for a time; that we have to contend against the results of our animal ancestry while on this planet; and further, that individual personality and character, though grown and developed here, survive the change which we call death; that the consequences of our actions are perennial; that the spiritual world to which we really belong is a reality; and that these things are now becoming capable of demonstration. If this belief turns out to be true, then that also must have an influence on conduct; and even the possibility that it is true should not be ignored by those who are helping to determine the conduct of themselves and future generations. Any scientific system which ignores this aspect of things is based on one-sided knowledge, and as such is a dangerous guide. Religion has always taken these things into account, and it is excessively dangerous to ignore its sanctions and evolutionary traditions, the result of long experience on the part of those who must be considered the highest of the race.

The present-day conflict is no small matter. The two views are in the field against each other, and the outcome is in doubt. Knowledge comes but wisdom lingers; and during the conflict of opinion humanity does not stand still. Emancipated youth is claiming its privileges, and prides itself on living dangerously.

The literature of the present day is full of the signs of this conflict. It is exhibited in biological and psychological writings, and it is illustrated in its practical working by many novels. Perhaps the novels are the most important part of the literature, for they are widely disseminated and read, though doubtless many of the other books are read too. The art of the novelist is to make a study of contemporary life, to throw it into dramatic form, and to work out the actual consequences of the beliefs of the time.

There is one such novel, called "The Age of Reason," [1] to which I wish to direct the attention of scientific men; partly because it is very readable, but chiefly because the author seems to have a genius for absorbing information from many different types and for elaborating it in a popularly intelligible form, with only the exaggeration which is characteristic and inevitable in any dramatic representation. The author is Sir Philip Gibbs, of whom I have no personal knowledge, who made a great reputation as a war correspondent. He has been able to weld his study of the types into a tale, and without ostensibly acting as advocate or drawing any moral, has depicted with considerable skill the interactions of certain types, and the possible tragical outcome of the conflict. To enter into detail would probably be unsuited to these columns. Suffice it to say that among those types are a well-to-do West End parson with broad views, and an absurd wife; a biologist of assumed eminence fully satisfied with the materialistic outlook; two young women of different characters and training, each well meaning up to her own lights; and some young men who are earnest and well intentioned, though weak and rather at the mercy of their surroundings. There is also another clergyman, of the highest ideals, though with insufficient knowledge to be able to exert much influence, who nevertheless sacrifices himself

[1] "The Age of Reason": a Novel. By Sir Philip Gibbs. Pp. 288. (London: Hutchinson and Co., Ltd., n.d.) 7s. 6d. net.

heroically in the effort, but ultimately retreats to the safety of a religious order. All these and other incidental persons pursue their various ideals of life in the light of their knowledge and beliefs—such as they are—as so many in actual life are now doing. The working out of the theme by a man of genius can scarcely fail to be instructive, in spite of a few ugly episodes; and however much opinions may differ as to details, a serious attempt has evidently been made to grasp the situation and to depict the conflict now going on. No apology is needed, therefore, for bringing the book before the notice of the readers of NATURE.

OLIVER LODGE.

A Critical Period in the Development of the Plant World.

Palæontologia Sinica. Ser. A, vol. 2, fasc. 1: *Palæozoic Plants from Central Shansi.* By T. G. Halle. Pp. 317 + 64 plates. (Peking: Geological Survey of China, 1927.)

FROM a comparative study of floras of the past, the palæobotanist, especially if he is assisted by the enthusiasm of youth, expects to make some contribution towards a better understanding of the process of plant evolution. The fewer facts we possess, the easier it seems to fit them into a prearranged scheme; the larger the mass of material, the more difficult it becomes to interpret the conflicting testimony of many witnesses. Palæobotanical research has thrown much light on the relative antiquity of certain genera and families; but it may also be said that the longer one studies the records of the rocks the problem of evolution assumes a more baffling complexity. In order to visualise the march of plant-life over the unstable surface of the earth, it is necessary to work out, so far as possible, the distribution of plants both in space and in time. The recent publication of a volume by Prof. Halle of Stockholm on a collection of fossil plants from northern China affords an exceptionally good illustration of the bearing of palæobotanical research on problems of general biological interest. The memoir on the Palæozoic plants from Central Shansi, published as a volume of the "Palæontologia Sinica," is appropriately dedicated to the memory of Alfred Gabriel Nathorst, whose post at Stockholm—the Mecca of palæobotanists and one of the very few places where the science has been deemed worthy of the status of a separate department—is now very ably filled by the author.

Prof. Halle went to China in the autumn of 1916 to study, as palæontologists should, the plant-bearing strata in the field: after collecting material from many localities he was compelled, by a serious illness under very trying conditions, to abandon further work. An even more disastrous misfortune overtook him: the ship which was carrying the fossils to Sweden went down with all hands in a typhoon in September 1919. New collections of Palæozoic and Mesozoic plants made by Dr. Norin and by members of the Geological Survey of China were afterwards forwarded to Stockholm. The recently issued volume is devoted to the collections made by Dr. Norin in Central Shansi. The labour involved in their investigation must have been prodigious; there were 184 packing-cases, and, moreover, many of the plants were strange types. It is hoped to publish in a later volume an account of the material obtained by Mr. C. C. Wang in north-western Shansi. Prof. Halle has earned the gratitude of all students of extinct plants; and he may rest assured that all his fellow-workers rejoice that he has been entrusted with the exploration of one of the most promising fields of palæobotanical research—an undertaking demanding not only a wide knowledge of ancient floras, but also the ability to correlate taxonomic data with problems of primary importance to geologists and botanists.

The later Palæozoic vegetation of North America and Europe differed in many respects from the contemporary floras in the southern hemisphere and in India. In the latter part of the Carboniferous period and in the early stages of the Permian period, there were two fairly well-defined botanical provinces: a northern province reaching into the Arctic regions and extending as far south as the shores of the Tethys sea; a southern province represented by Gondwanaland. It has long been known that some members of the southern flora had wandered into the northern territory before the Triassic period was well advanced. The discovery of *Glossopteris* in Upper Permian beds in northern Russia in 1901, and later discoveries of Gondwanaland plants in Siberia, raised the question of possible routes of migration across the world-encircling Tethys sea. The inter-relation of the two provinces in the Permo-Carboniferous period is still vaguely defined, and the comparative lack of information on the late Palæozoic floras of China has been a serious gap in our knowledge.

The plant-bearing strata with which the memoir under consideration is concerned are classified by Dr. Norin as follows: At the base is the Yuehmenkou series consisting of sedimentary beds and seams of coal. The lower members of the series were assigned on the evidence of the fauna to

the uppermost part of the Lower Carboniferous system, and the upper portion was believed to be Permo-Carboniferous. Prof. Halle, on the evidence of the plants, regards the whole as Permo-Carboniferous in age. Then follows the Shihhotse series, a succession of delta deposits rich in plants: Dr. Norin assigns the series to the Permian period, and with this opinion Halle is in general agreement. Resting on the Shihhotse series is the Shihchienfeng series, a set of beds, without plant remains, but with layers of gypsum, deposited under more or less arid conditions.

After the formation of the Yuehmenkou and Shihhotse strata the physical environment changed; a well-drained region was converted into the marginal zone of a desert country. This change recalls a precisely similar shifting of the scenes in the northern hemisphere at the close of the Carboniferous period, when the humid forest belt across America and Europe was transformed into a semi-arid land inhabited by some of the hardier plants which remained as meagre representatives of the luxuriant vegetation of the Coal age. A comparison of the Permo-Carboniferous and early Triassic floras of the northern continents reveals a marked contrast in the nature and luxuriance of the vegetation. The floras which flourished during the closing stages of the Palæozoic era may be said to represent the last phase of a plant dynasty, which had gradually developed in vigour and in variety during the Devonian and Carboniferous periods and continued as a moribund vegetation into the Permian period.

The desert conditions which prevailed over a large continental area at the beginning of the Triassic period are reflected in the meagre vegetation which, in the later part of the period, was succeeded by a widely distributed and much richer flora. There are comparatively few clearly established connecting links between Triassic and Permo-Carboniferous floras: some types persisted, but the Triassic floras differ in many striking respects from those which preceded them; genera which may be described as modern suddenly become abundant and take the place of the familiar types of the Palæozoic era. We know very little about the world's vegetation at the period inaugurated by the Hercynian revolution, one of the revolutions which set a limit to the spread of the forests of the Coal age. In view of this apparent break in the orderly sequence of floras, it is of the greatest importance to seize opportunities of following the course of development of the plant world in an area such as that of northern China, where there is a conformable succession of fossiliferous strata at the upper limit of the Palæozoic system.

Another interesting question on which light may be expected from a fuller knowledge of the Far Eastern floras is the relation of them to contemporary floras in the northern and southern botanical provinces. Prof. Halle found that out of the 103 species described by him from northern Shansi, 70 are new and known only from China: the facies of the vegetation is similar to that of the northern Permo-Carboniferous province, and in the absence of *Glossopteris* and other genera it differs fundamentally from that of the Gondwanaland flora. The conclusions based on palæobotanical evidence may be briefly stated: many of the plants from the lower Yuehmenkou series are specifically identical with Stephanian (uppermost Carboniferous) forms from Europe, and may be regarded as Permo-Carboniferous in age. The upper portion of the series, which corresponds in age with the period of maximum coal production in northern China, is relatively poor in plants; the few species so far discovered range from Westphalian to Lower Permian. It would seem, therefore, that there is no palæobotanical reason for drawing a distinction in age between the lower and upper part of the Yuehmenkou series. Of the 58 species described from the lower Shihhotse series, only 15 occur in other countries, and these are Stephanian or Lower Permian types. Some suggest a Carboniferous age, while others agree more closely with Permian species. The boundary between late Carboniferous and early Permian forms is nowhere sharply marked.

Among the new species recorded from the Shihhotse series is *Gigantopteris Whitei*, one of several representatives of this remarkable fern, or possibly pteridosperm, which had previously been found in Lower Permian beds in Texas and in eastern Asia. Prof. Halle has added considerably to our knowledge of this genus, which had fronds reaching a breadth of 30 cm.: some of his species afford striking examples of the close correspondence between the flora of northern China and that of North America.

In some features the lower Shihhotse flora differs from European Stephanian floras: the widely distributed European genera *Callipteris* and *Walchia* are absent, and, on the other hand, the Shansi flora includes certain forms such as a species of *Cladophlebis*, some species of *Tæniopteris*, and a cycad, *Dioonites densinervis*, which clearly foreshadow Mesozoic types. There is a mixture of the ancient and more modern plant dynasties. Halle

regards the basal beds of the Shihhotse series as representing the beginning of the Permian period, though, as he points out, with undoubted Permian species are associated examples of genera which played a prominent part in Mesozoic floras. Of the upper Shihhotse series Halle says: "The most obvious evidence for a Permian age is to be found in the appearance of several forms of Mesozoic aspect, which seem to indicate the approach of the close of the Palæozoic era." The point is that the Shansi flora, probably a late Permian flora, exhibits rather a closer contact with the early Mesozoic floras than we find in contemporary floras in Europe and North America. In spite of this, Halle is disposed to think that the whole of the Shihhotse series may fall within the Lower Permian; he does not believe that even the uppermost beds "reach to anywhere near the Permian-Trias boundary."

The age of the Shihchienfang series is of special interest: the strata are conformable to those of the underlying Shihhotse series and indicate arid conditions. If the upper Shihhotse series, as Norin supposed, is Upper Permian, the overlying Shihchienfang series would be Triassic in age and equivalent to the Bunter sandstone of Europe. If, as Halle thinks probable, the upper Shihhotse beds are Lower Permian, the Shihchienfang should be correlated with gypsum-bearing Upper Permian of Europe: this correlation would afford an interesting parallel with the change from a humid to an arid climate at the close of the Carboniferous period in Europe and America.

Attention is directed without further comment to an important and valuable section in which the Chinese floras are compared with those of other parts of China and of Korea. Prof. Halle discusses at length the geographical range of the Shansi flora, which bears an intimate relationship with the northern or Arcto-Carboniferous floras of central and western Europe and North America. It is unfortunate that the rich material from American coalfields has not been more thoroughly investigated: making allowance for our relatively greater knowledge of European floras, the conclusion is that in the Shansi flora there are slightly more European than American species. On the other hand, "closely comparable but not identical species are found to a greater number in North America," and it cannot be said "that the relation to Europe is perceptibly closer than to North America."

Prof. Halle also discusses the relation of the Shansi flora to the contemporaneous floras of Angaraland. The Kusnezk flora of southern Siberia and north-western Mongolia extends as far north as lat. 71°-72° N., and it has been traced as far east as Vladivostok: its age is probably late Permian. Only one species is common to the Shansi and Kusnezk floras; the two are "almost entirely different." This is a surprising fact in view of the close relationship, both geographical and geological, between them. "There seems to remain a strong probability that China and the Siberian Angaraland belonged to regions markedly different in regard to vegetation and possibly climate at the close of the Palæozoic." It is suggested that the land of the Kusnezk flora may have been separated from that of the Shansi flora by a sea; in other words, there may have been two distinct phytogeographical regions in Asia outside the area of the *Glossopteris* or true Gondwanaland flora.

Whatever the explanation may be, it is clear that the facts recorded by Halle point to a greater range in variety of the northern floras than had previously been suspected. The discovery in Sumatra a few years ago of several species of plants that are widely distributed over the Arcto-Carboniferous province showed that the northern vegetation had penetrated far within Gondwanaland and had occupied territory which had always been considered the monopoly of the *Glossopteris* flora.

There is a close similarity between the Sumatran and the Shansi floras. It has long been known that certain members of the *Glossopteris* flora had reached Angaraland before the end of the Permian period, but it is only recently that evidence has been obtained of an equally great migration in the contrary direction. A controlling factor in the dispersal of plants has always been the nature of the geographical environment: as Halle says, "looking at the distribution of the late Palæozoic floras very broadly, it would seem that whereas the *Glossopteris* flora and, to some extent, the Angara flora with Gondwana elements are typically floras of the undisturbed continental areas, the Arcto-Carboniferous floras often have their greatest areas of uniform extension along the geosynclines."

The main purpose of this article is to direct attention to some of the many questions of general interest discussed by Prof. Halle. It must, however, be added that the greater part of the volume is occupied by admirable descriptions of the members of the Shansi flora, and there are many important floristic contributions. The author has produced a monumental work: the text is written in a clear and pleasant style which compares very favourably with that of many authors whose

mother-tongue is English; the illustrations are exceptionally good. It is a pleasure to be able whole-heartedly to congratulate both Prof. Halle and the editors of the "Palæontologia Sinica" on the service which they have rendered to palæobotany. A. C. SEWARD.

A Papuan Monograph.

The Kiwai Papuans of British New Guinea: a Nature-Born Instance of Rousseau's Ideal Community. By Prof. Gunnar Landtman. Pp. xxxix + 485 + 64 plates. (London: Macmillan and Co., 1927.) 30*s*. net.

THIS important volume constitutes a worthy successor to Dr. Landtman's previous publication on the folk-lore of the Kiwai Papuans, probably the most complete account in existence of the folk-lore of any primitive people. To collect the data for two such works is no mean test of physical and mental fortitude, as the writer of this notice knows from personal experience, having spent a few weeks in the Fly Estuary during the wet season some twenty years ago, when his visit was brought to an end by fever, which a medical colleague considered sufficiently serious to warrant his removal to Thursday Island in a pearling lugger. But he stayed long enough before being overcome to realise that the dominant qualities of the place were mud and mosquitoes. Dr. Landtman then showed decided pluck in enduring two years (1910–1912), including two rainy seasons, and he fully deserves the repute which these volumes should bring him on both sides of the Atlantic. How he came to Kiwai is explained by Dr. Haddon, who contributes a model ten-page introduction (*O si sic omnes*):

"Many years ago my friend, Dr. Gunnar Landtman, came to see me at Cambridge, and as soon as we had greeted one another he said, 'I will go anywhere in the world you like to send me.' . . . It did not take much consideration on my part to make a suggestion. . . . I was fully aware of the fragmentary nature of many of the results we had obtained [during the Cambridge Anthropological Expedition to Torres Straits], and it was evident that a detailed study of the adjacent regions of New Guinea was necessary before the affinities of the culture of the Torres Straits islanders could be satisfactorily discussed. . . . I explained the position to Dr. Landtman, and he decided to make that area his field of research."

The successful weathering of the difficulties of the estuary did not, however, mean the end of the author's troubles. On his way back to Helsingfors his steamer sank, and irreparable disaster was only averted by a diver's skill in recovering the trunk containing the field notes, the exact position of which in the hold Dr. Landtman was able to indicate.

The Kiwai are a heavily built, muscular group of Western Papuans, whose origin is obscure, and whose culture seems in part to be derived from some distance to the west, that is, from those tribes which in New Guinea are generally called Tugeri. In physique they certainly differ from the slighter men of Strachan Island and of the lower reaches of the Bensbach River, their western neighbours in British territory.

Besides investigating the Kiwai, Dr. Landtman examined so far as possible the habits and beliefs of the Mawatta on the mainland to the west, and of the Masingle, the bush people hitherto known in anthropological literature as Masingara. All these people are totemistic; in Kiwai each person has but one totem, the great majority being plants; at Mawatta everyone has one chief totem and many subsidiary totems, and here rather more than half are animals, as are all the Masingle totems, with one possible exception. This way of stating the facts is perhaps over simple, especially as regards Mawatta—where "each person has . . . in most cases an almost indefinite number of subsidiary totems"—for a classification shows that, as at Mabuiag in Torres Straits, where the totems are divided into two groups, one all land and the other all water animals, so here the two great groups are associated with land and sea respectively, even the winds concerned being those blowing from the land related to the land animals and plants, and those from the sea with water animals and plants. It may, in fact, be suggested that to speak of an almost indefinite number of subsidiary totems is an expression in white man's language of a basic division of living things into two great categories belonging to the land and water respectively, to one or other of which every man with the exception of "a small anomalous group" must himself belong as part of what a European would call "the scheme of Nature." Such arrangements, if the term be permitted, whereby the clans of a group share the world among them, are by no means uncommon, as, for example, among the Euahlayi of New South Wales, also described as having many subsidiary totems.

No clan is considered superior to another; indeed the Kiwai are purposeful egalitarians—"no want one man he go ahead, one man he come behind, better all man he go together"—and public affairs are settled by a council of old men, who seem to agree without difficulty. Their religious ideas

reflect this sociological attitude, for they have no generally accepted systematised beliefs concerning the gods or the other world. No public cult exists, and no prayers are made in communal fashion by a larger or smaller group of the population; nor is there a systematised cult of the dead, although it is recognised that something survives when the body rots. On the other hand, beings that are neither ghosts, nor in the ordinary sense of the word animals, abound, and almost everyone practises petty magic; the oldest men of each group, being considered to have most knowledge, are those who conduct the greater ceremonies and more systematised rites. In spite of this lack of religious ideas the Kiwai have a series of great pantomimic ceremonies; the *horiomu*, connected with the dead, during part of which such wonderfully decorated turtle-shell masks as those brought back by Dr. Haddon in 1889, and now in the British Museum, are worn; the *mimia*, in part a fire ceremony, whereby illness is kept away and the youths hardened; the *ga'era*, the occasion for the collection of a vast quantity of food from the gardens, with very much the same rivalry that occurs in the preparation of the *tabu* feast of the Melanesian-speaking peoples of the Central Division of the Territory; the *nigori*, which has for its purpose the killing of many turtle; and, most important of all, the *moguru* or life-giving ceremony.

This last is the most secret and fear-inspiring rite of the Kiwai people. Dr. Landtman had great difficulty in obtaining definite knowledge, and it was only by allowing his informants to come secretly, late at night, and whisper their information, that he was able gradually to piece together its outstanding features. The ceremony takes place inside the men's long-house, and persists with intervals for sometimes so long as two months. It is difficult to follow the whole series of ideas attached to the *moguru*, but clearly one of its two chief functions is to provide the 'medicine' which has the power to restore the languishing sago palms to full vigour. To produce this the Kiwai on this occasion (and on this occasion only) surrender themselves and their wives to promiscuous intercourse—only the closest blood relations avoiding each other—the chief ingredient in the 'medicine' being the sexual secretions, which, mixed with red paint, is smeared by every man on the trunk of a sago palm in his garden, the tree being requested to grow big and produce much food. Bananas and coconuts might also be anointed, as well as the people themselves, a small quantity taken with food being regarded as prophylactic against most physical ills. Connected with this part of the ceremony is the sexual instruction of the adolescents of both sexes.

The second principal event of the *moguru* is the *goro*, the ceremony of the captured wild boar, and this is more difficult to summarise. A wild boar is hunted, brought to bay, and instead of being killed is stunned and muzzled, its legs being tied together. It is painted, and ornamented with plumes of the cassowary and birds of Paradise, and laid on a litter with the legs bent beneath the body, with a bundle of arrows placed on each side. Covered with leaves so that no one shall see it, the litter is carried into the *darimo* (man-house) and deposited on a platform erected in front of the great central post, the head of the boar facing the eastern gable entrance. Beside the boar are placed bundles of arrows, clubs, beheading knives, and head-carriers. At this stage the boar is killed and its blood sprinkled on the human figures carved on the post and on the weapons surrounding it. One of the 'big fighting men' lies prostrate on top of the pig, his head pointing in the same direction; the 'new men,' that is, the initiates, now crawl on to the platform, passing astride over the prostrate man and the pig, each of them accompanied by his guardian, generally his maternal uncle, who when the boy's head is above that of the boar, puts 'medicine' into his mouth. In this part of the ceremony there seems to be room for considerable variation, but there is no doubt that the great object of the episode is preparation for war—it makes the men hot for blood so that they think about nothing but fighting—yet the pig also yields 'medicine' for the garden and for other purposes; its feet, after being dried and reddened, are buried in the sago plantation; the bones, stuck into the walls of the men's house, give protection from sickness, and so on. Naturally, women are rigorously excluded from this ceremony; but there is a notable exception—one very old woman is attached to every man-house, and with the old man who is the 'father' assists in all the rites.

It has only been possible to mention, and that briefly, some of the most striking facts recorded in this volume, but since this is the first adequate monograph on a Papuan people to be published, the reviewer may conclude by indicating a theoretical deduction of considerable interest, though only further investigation can show how far it is valid. The work of Prof. Malinowski on the Trobriand Islanders shows that to these Papuo-Melanesians the most essential part of a magical

process is the spell. As indicated by Dr. Landtman, magic plays a most important part in the life of the Kiwai, but there is nothing in his record to suggest that the spell is specially important; the power of the magic seems to depend preponderantly on the actual ingredients of the 'medicine,' which are often chosen on frank *similia similibus* principles. The question then arises whether this difference is merely, as it were, accidental between two peoples inhabiting areas tolerably far apart, or whether it may be taken as the expression of a psychic and ultimately ethnic difference between true (Western) Papuans and (Papuo-) Melanesians.

Our Bookshelf.

(1) *Stellarastronomie.* Von H. Kobold. (Sonderausgabe aus der Encyklopädie der mathematischen Wissenschaften.) Pp. iii + 239-372. (Leipzig und Berlin: B. G. Teubner, 1926.) 5·80 gold marks.

(2) *An Outline of Stellar Astronomy.* By Peter Doig. Pp. viii + 183. (London: The Draughtsman Publishing Co., Ltd., 1927.) 7*s.* 6*d.* net.

THESE two books with somewhat similar titles are to a marked degree supplementary one to the other. Prof. Kobold's volume is an extract, 134 pages in length, from the "Encyclopädie der mathematischen Wissenschaften." It was written in 1924 and has a few references introduced up to 1926. It is very complete in its historical work, giving, for example, an excellent account of all the important star catalogues and the early work on stellar motions and on the structure of the universe. It also gives good accounts of the more recent investigations up to 1924, but to a large extent it is affected by the common fault or quality of encyclopædias, it gives both sides of a discussion and rarely offers a decisive view on controversial points.

Mr. Doig's book is, on the other hand, an attempt to give an account of the present outlook on the constitution, dimensions, motions, and distribution in space of the stars and nebulæ. Even in the short bibliography appended to each of his chapters he rarely goes back so much as ten years. His book is much more popular in style and he is rightly more dogmatic in his general statements about the nature of the stars and the structure of the universe. Both books will serve as useful sources of reference to the present-day student of astronomy—Kobold for the past and Doig for the present.

Reading the two volumes together, one is struck at the rapid change of outlook in recent years in stellar astronomy—apart from astrophysics proper, which is changing so largely from year to year with the development of theoretical spectroscopy and atomic physics. Kobold's book, with its merely occasional references to the contribution of astrophysics to the problems of the structure of the universe, reflects a period of isolation between the two halves of astronomy, an isolation which has now vanished. With Doig the interest lies on the other side—the physical rather than the statistical—though he, too, has considerable interest in the statistical application of many physical observations. His own work along these lines, much of it published in the *Journal of the British Astronomical Association*, reappears quite properly in this book, set in the framework of the recent work of Eddington, Jeans, Russell, Seares, Shapley, and others, of which he gives an interesting account in his book.

Maps, their History, Characteristics and Uses: a Handbook for Teachers. By Sir Herbert George Fordham. Second edition. Pp. xii + 83 + 8 plates. (Cambridge: At the University Press, 1927.) 6*s.* net.

ALL who are interested in cartography and its history will welcome the issue of a second edition of Sir George Fordham's little book, which forms such an admirable introduction to the subject. It begins with a few pages on the elementary notions which lie behind the making and using of maps, and then we have an interesting page or two on terminology. How many people who commonly make use of atlases know who first used the term 'atlas,' and what a curious, far-fetched term it is? And how many remember that the word ousted its rivals 'theatrum' and 'speculum'?

After a concise and clear account of the history of map production, the author devotes a section of his book to art in cartography. This is a matter which deserves more study by cartographers than it sometimes receives. The use of colour in modern maps has led, in some instances, to a kind of carelessness in design; as if it were possible to smash one colour down upon another, and trust that all would come right in the final printing. It is sometimes forgotten that the use of five or six colours imposes upon the cartographer not less, but more, care in the design of the map than when dealing with a map in black and white.

The remarks on the graphic expression of the surface forms appear, on the whole, to be sound; it might have been mentioned that the Dutch surveyor who in 1729 first drew contours—in connexion with sea-bed soundings—was called Cruquius, and that Hutton used them in Great Britain in 1777, and that they were in use in military sketches in England probably so early as 1793. The author refers favourably to the Army "Manual of Map Reading and Field Sketching," edition 1914; but it is doubtful if the student could now obtain a copy. The latest manual of the kind was published in 1921, and is larger, more difficult, and more 'professorial' than its predecessor. In conclusion, we can heartily recommend this little book to all who use maps, especially to teachers of geography.

Romani Versions. By Sir Donald Macalister. (Gypsy Lore Society Monographs, No. 5.) Pp. 67. (London: Bernard Quaritch, Ltd., 1928. n.p.

SIR DONALD MACALISTER, like other noted scholars, has given some of his leisure hours to the making of translations from English poetry. But whereas

these have often been made in the long-cultivated tongues of Greece or Rome, the Principal of the University of Glasgow has chosen a less known medium, that strange Indian dialect which was brought to British shores some five or six centuries ago by wandering Gypsy tribes.

These versions are ingenious; often, so far as the non-Gypsy can judge, they attain beauty; certainly they testify to their author's knowledge of Romani. The poems are aptly chosen: "The Raggle-Taggle Gypsies," "The Princess and the Gypsies," "The Gypsy King," Scott's "The Lochmaben Harper," Kipling's "A Smuggler's Song," are suitable in their substance and spirit, and do not strain too much the limited, but genuine, Gypsy vocabulary. It is perhaps different with the polished artifice of 22 quatrains from FitzGerald's Omar, to which are added 22 translated with equal skill by Dr. J. Sampson.

Translation is not so difficult, perhaps, as it might at first sight seem. For while Romani has preserved something of the vocabulary and grammatical forms of its Indian original, its syntax is largely modelled on the language of its hosts. Also, as Dr. Sampson remarks in his introduction, even the real Gypsy songs collected in Greece by Paspati are imitations, both in metre and material, of popular Greek poetry.

Beyond the page or two of this introduction, the collection cannot, of course, claim to be of any scientific interest to the linguist or the student of folk-lore. But that was not the author's purpose. He made these versions to amuse himself; and without doubt they will bring as much pleasure and amusement to that band of Romani Rais whose delight in all things Gypsy is perhaps as intelligible as it is real.

"All I ask, the heaven above
And the road below me."

"Mangi muk o tem oprál
Ta o drom te java."

R. L. T.

Organic Chemistry for Advanced Students. By Prof. Julius B. Cohen. Fifth edition. Part 1: *Reactions.* Pp. vii+427. Part 2: *Structure.* Pp. vii+487. Part 3: *Synthesis.* Pp. vii+440. (London: Edward Arnold and Co., 1928.) 18*s.* net each vol.

THE fifth edition of this familiar work contains a good deal of new matter, but as the result of a judicious condensation of some of the less important sections, the complete work contains only 58 pages more than the fourth edition, which was published in 1923. No alterations have been made in the titles of the chapters. In Part 1, a revision of Chapters ii. and iii., on the nature of organic reactions and their dynamics, has afforded an opportunity of dealing with recent studies based on the electronic theory of chemical combination. In Part 2, a brief reference to the parachor theory has been incorporated in Chapter i., while Chapter v. has been amplified by the insertion of a short account of recent work on optically active derivatives of sulphur, boron, beryllium, zinc, and copper, and on the stereochemistry of metalammines. In Part 3, the account of the carbohydrates has been remodelled in accordance with new experimental data; we are glad to note, in passing, that the author has abandoned the term "monosaccharose" in favour of "monosaccharide." Part 3 includes, in addition, short accounts of recent advances in the chemistry of anthocyanins, terpenes, and sesquiterpenes; syntheses of glutathione, spermine, and thyroxine are other new features of this volume.

Altogether, the value of Prof. Cohen's book has been appreciably enhanced by the revision. It is well printed, the new sections having been reset in a particularly clear type. We suggest that the spacing of the formulæ in the synthesis of thyroxine (p. 178), and the unprefaced representation of glutathione at the stage of hydrogen acceptor (pp. 160 and 170), may prove somewhat confusing to the student at the first reading.

The Date of Easter and other Christian Festivals. By the Rev. David Ross Fotheringham. Pp. xv + 56. (London: Society for Promoting Christian Knowledge; New York and Toronto: The Macmillan Co., 1928.) Cloth, 2*s.* 6*d.* net; paper, 1*s.* 6*d.* net.

THIS book is largely taken up with a study of the evidence for the dates of the Nativity and Crucifixion. Much of this evidence is familiar to all, but some new points are introduced, including recent work on the moon's motion and the ancient calendar by the author's brother, Dr. J. K. Fotheringham, and by Mr. C. Schoch. The suggestion is made that the star of Bethlehem may be the planet Mars, rising heliacally. The author decides on December, 4 B.C. for the Nativity, and April 7, A.D. 30, for the Crucifixion. He then goes on to recommend the rule for determining Easter, that it should be April 9 if Sunday, or the first Sunday after this. This suggested rule is supported in the preface, which is written by Lord Desborough.

A. C. D. C.

The Annual Register: a Review of Public Events at Home and Abroad for the Year 1927. Edited by Dr. M. Epstein. Pp. xiv+318+168. (London: Longmans, Green and Co., Ltd., 1928.) 30*s.* net.

THIS valuable record of the year, with its impartial survey of the world's history, is again planned on the lines which have long been familiar. Half of Part I., which is a narrative under the headings of various States, is devoted to the history of Great Britain and half to other countries, including all in which events of importance occurred. Part II., in addition to a chronological list of events and an obituary with short biographies, has the usual survey of literature, science, art, finance, and law. Science receives fourteen pages, of which more than half is devoted to biology in its various aspects, and the remainder to the physical sciences. The public documents printed in full are the treaties with Iraq and the Hejaz, and the Italian Labour Charter.

Letters to the Editor.

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

The Nature of Clay, and its Significance in the Weathering Cycle.

THE characteristic constituent of the natural substance, clay, has been the subject of numerous investigations both by chemists and by pedologists. It is generally believed to be colloidal, and the residual product of the hydrolytic decomposition of mineral silicates. Whilst attempts have been made to study this complex by methods of acid extraction, the most promising line of advance has been the study of the finest fraction obtained in mechanical analysis—the so-called colloidal clay. Although this fraction, as isolated by some workers, may contain small proportions of unweathered material, we shall probably not err greatly in equating it with the weathering complex, particularly if a critical settling velocity of less than 10^{-4} cm./sec. has been used in its separation by means of sedimentation.

Considerations of space in the present communication preclude a full reference to recent work, but I would direct particular attention to an important investigation by W. O. Robinson and R. S. Holmes (*U.S. Dept. Agr. Bull.*, 1311, 1924). In this work, the authors report the composition of the colloidal clay from a number of North American soils. Perhaps their most important conclusion is that iron compounds, other than hydrated ferric oxide, are present as an essential part of the clay. Much of the confusion in the study of clay has arisen from regarding the clay complex as essentially an aluminium silicate or alumino-silicic acid, with hydrated ferric oxide present as an adventitious constituent. Robinson and Holmes examine the possibility that the clay complex is a mixture of an aluminium silicate of the kaolinite type ($Al_2O_3 . 2SiO_2 . 2H_2O$) and a ferric silicate of the nontronite type ($Fe_2O_3 . 2SiO_2 . 2H_2O$). Actually, only a minority of their clays fit this hypothesis. On one hand there are clays with excess of silica, and, on the other hand, clays with excess of sesquioxides—the latter clays being generally of a reddish or brownish colour.

The hypothesis examined by Robinson and Holmes could, however, only be verified by the examination of clays obtained from material which had originated directly from crystalline rocks and had, further, not been subjected to those leaching processes which cause a differentiation of the silica–sesquioxide complex. These changes result, in humid temperate climates, in the impoverishment of the surface in sesquioxides and the enrichment of a subsurface layer in these constituents. In extreme cases, in the so-called podsols, acid leaching gives rise to a bleached *A* horizon and a reddish brown, sometimes indurated, *B* horizon, which is relatively rich in sesquioxides. It is somewhat difficult to obtain material in which the silica–sesquioxide complex has not undergone some alteration, but I obtained, through the courtesy of Dr. Edward Greenly, three samples of clay from Anglesey which had originated from Mona Complex schists at a depth far below that at which the ordinary leaching processes operate. The clay fraction from a white clay gave a molecular ratio of silica to sesquioxides of 2·16; for a yellow clay the ratio was 2·09; and for a red clay 1·96. These figures are in fair agreement with the 2·0 ratio demanded by the kaolinite–nontronite hypothesis.

I have also examined a number of North Wales soils, derived from crystalline or consolidated rocks, in which it can be assumed that the clay is of primary origin. The average silica–sesquioxide ratio for the clay fraction of 17 such soils was 1·90, the individual ratios ranging from 1·51 to 2·22. Bearing in mind the tendency, under the conditions of North Wales, for sesquioxides to be leached down to lower levels, and also remembering that superficial erosion attacks the more siliceous *A* horizon, the fact that the ratio is less than 2·0 is in harmony with the hypothesis that the primary weathering product is a mixture of silicates of the kaolinite and nontronite type.

The figures of Robinson and Holmes and of other workers were then inspected in the light of what information was available as to their mode of origin, and it was evident that soils derived from crystalline rocks in humid temperate climates tend to give a weathering complex with a silica–sesquioxide ratio rather less than 2·0. It may be suggested that samples of such soils, collected without reference to considerations of profile, would probably be enriched in sesquioxides at the expense of eroded superficial horizons. I hope to elaborate this point in its significance for the regional study of soils in a further communication.

An investigation was also made of the clay fractions from a number of soils in which the parent material was alluvium or unconsolidated sediments. In these cases, the silica–sesquioxide ratio was always greater than 2·0, the average being actually 2·67 for 15 samples, with the individual ratios varying from 2·12 to 3·37. The published figures of other workers for the clay fractions from alluvial and unconsolidated deposits agree with these results. The more siliceous character of the clay fractions of such soils is not difficult to explain. One of the principal features of the hydrolytic decomposition of minerals is desilicification, and this is reflected in the appreciable content of silicic acid in river waters. Sea water, on the other hand, contains only traces of silicic acid. F. W. Clarke, in "Data of Geochemistry" (*U.S. Geol. Survey Bull.*, 770), places silica among the most important oceanic chemical sediments. The silica–sesquioxide ratio in the estimated contribution of rivers is of the order of 8·0. It is reasonable to suggest that the silicic acid present in river water undergoes precipitation together with estuarine and other littoral deposits, the clay complex of which is thereby enriched in silica relative to sesquioxides. Where these deposits again become exposed to atmospheric influences without intervening heat metamorphism, we obtain soils the clay fractions of which have a silica–sesquioxide greater than 2·0.

Summarising these results, I venture to put forward the view that the primary residual product of the chemical weathering of silicates is a mixture of kaolinite and nontronite, or of hydrated silicates having the same silica–sesquioxide ratio, namely, 2·0. Variations from this ratio may occur as a result of the differentiation consequent on soil profile development, leading in humid temperate climates to the production of a more siliceous *A* horizon and a less siliceous *B* horizon, and in humid tropical climates to the formation of laterite. Enrichment of the clay complex in silica takes place in estuarine and other littoral sediments owing to the concomitant precipitation of the silicic acid present in river waters.

The significance of the composition of the clay fraction has been recognised by many workers, notably by A. F. Joseph and his collaborators, who

have shown that clay properties are most strongly developed in the most siliceous clays. Hall and Russell, many years ago, attempted to correlate soil fertility with the composition of the clay fraction. It is evident, therefore, that students of the soil are likely to obtain results of the highest importance, both for the natural study of the soil and for the elucidation of problems of soil fertility, by giving attention to the composition of the clay fraction, particularly in its vertical variation in the soil profile.

G. W. ROBINSON.
University College of North Wales,
Bangor, May 21.

Insects and Potato Virus Diseases.

IT has long been a matter for conjecture as to what insect or insects are responsible in Great Britain for the dissemination of the 'virus' diseases affecting the potato plant. Experiments carried out by myself over a period of years show beyond doubt that, out of the normal insect potato fauna, one particular insect is a most efficient vehicle for the transmission of the serious disease known as 'leaf-roll.'

The insect in question is a small aphis, *Myzus persicæ* Sulz., and it attacks both the plant in the field and the sprouts of the tuber in the store. Under certain conditions I have been able to infect with fair regularity between ninety and one hundred per cent of the experimental plants with leaf-roll by means of this aphis. Further, I have proved, under glass-house conditions, that healthy potatoes, on the sprouts of which *Myzus persicæ* carrying the virus of leaf-roll has been feeding, will produce plants so badly 'rolled' within two months of the date of the first infection, as to give little or no crop. In the glass-house a number of known healthy potato tubers, with sprouts thus infected at the beginning of March, produced plants in an advanced stage of leaf-roll by the end of April.

It will thus be understood how it is possible for 'seed' potatoes, stored in a healthy condition, to give rise to a negligible crop in the ensuing season. Attempts to induce nine other species of insects which normally inhabit the potato plant to transmit the virus of leaf-roll under varying conditions have so far proved abortive. It is, however, unwise to deduce from these negative results that such insects are unable to transmit leaf-roll under any conditions. Suffice it to say that as yet they have not done so under conditions which gave positive results with *Myzus persicæ*.

As regards the disease known as 'mosaic,' the transmitting power of *Myzus persicæ* appears to be much less, and the percentage of experimental infections has been small. However, in experimenting with the virus of potato mosaic on another Solanaceous host, some curious facts relating to the behaviour of this virus have come to light. By infecting tobacco plants with the virus obtained from mosaic-affected 'Arran Victory' foliage by means of leaf mutilation inoculation, a very characteristic disease known as 'ringspot' is produced in the tobacco. The chief symptom of this is the formation of clearly defined whitish concentric rings, each having a central spot (Fig. 1).

On transferring this virus by needle inoculation back to healthy potatoes, a mosaic-like disease is produced in which the symptoms of the original mosaic are intensified and its infective nature very greatly increased. Its symptoms consist of a very characteristic and strongly marked mottling of the leaves, which later may become crinkled at the edges, accompanied by large numbers of small necrotic spots. It is, in fact, very similar to the potato virus disease known as 'crinkle,' with the exception that true crinkle is very much less infectious, so far as my experience goes. This altered virus can be passed by needle inoculation from potato to potato and from tobacco to tobacco or from one to the other with the utmost regularity, the symptoms developing in the former in eight to eleven days according to the temperature, and after a somewhat longer period in the latter.

It is now possible to induce the aphis *Myzus persicæ* to disseminate this virus to potatoes where

FIG. 1.—'Ringspot' on tobacco caused by inoculations with potato mosaic.

it would not do so before its passage through the tobacco, and successful transmissions have been performed in periods ranging from 14 to 24 days. This transformed or 'ringspot' mosaic in potato has not, however, adapted itself to dissemination by the aphis proportionately to its greatly increased infectivity to the plant, and aphis infection is still a matter of uncertainty. Inoculations into healthy tobacco plants with the juice of healthy potatoes or with viruses other than mosaic, have up to the present failed to produce ringspot, but when mosaic has been a component part of a virus complex ringspot has developed.

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The Excitation of the *D* Lines by the Green Sodium Band.

IN a recent paper (*Phys. Rev.*, May 1928) Prof. Wood and the present writer have discussed the conditions under which it is possible to excite the *D* line fluorescence in sodium vapour by light which is free from wave-lengths absorbed by the atom. A band in the green at 5200 A., 50 A. in width, was found to produce a maximum *D* line fluorescence when a foreign gas at a few millimetres pressure was mixed with the fluorescing vapour. The presence of a foreign gas seemed essential for the production of the *D* lines in this way, and the most obvious explanation seemed to be that the excited molecule collided with a foreign gas molecule and dissociated into one normal and one excited atom. But the dissociation potential as calculated by Pringsheim (*Zeit. f. Phys.*, **44**, 651; 1927) and Loomis (*Phys. Rev.*, **31**, 323; 1928) from

the analysis of the band spectra is much too high for this process to occur, as has been pointed out, and the alternative explanation was offered that the D lines were emitted when an atom was raised to the $2P$ levels on collision with an excited molecule. The molecule would then be left with but 0·3 volt energy, which would be distributed as part vibrational and part kinetic. The presence of a foreign gas would prevent rapid diffusion of the vapour to the cooler parts of the resonance tube, and allow the atomic and molecular densities to increase, thus increasing the probability of collision.

If this is the process occurring, it should be possible, then, to excite the atomic lines by the green molecular band in pure vapour of the proper vapour density. I have recently repeated these experiments, using an electrically heated resonance tube equipped with a thermocouple in order to obtain accurate temperature control, and have found that the green band does excite the D lines in pure vapour, but only in a narrow temperature range. The atomic lines appeared somewhat below 400°, rose to a sharp maximum at 410°, and disappeared again above 450°. The existence of a maximum intensity at 410° was very marked and could be determined within 5° or 10° very easily. Now, in the previous experiments no adequate temperature control was purposely employed, but it was found in the present work that the introduction of gas at a few millimetres pressure caused temperature changes of 10°-20°, the temperature rising on the introduction of the gas. Experiments showed this to be due entirely to the fact that the gas reduced the diffusion of the vapour to the cooler parts of the tube. The rapidly diffusing vapour, in the absence of gas, keeps the heated section at a lower temperature than it would attain if the diffusion were absent. Although the D lines were obtained in this way in the presence of gas, they were much less intense and appeared as before, only in a narrow temperature range.

An attempt was made to explain the phenomenon quantitatively. The intensity of the atomic lines formed in this way will be proportional to the number of collisions of excited molecules and atoms occurring per second, provided every excited atom so formed radiates. This, however, will not be the case, for a certain proportion of them is removed by collisions. Actually, the D line intensity will be measured by the number of excited atoms lost by radiation per second, and it is seen that collisions are operative both in increasing the number formed per second and in decreasing the number radiating per second, so that a balance between these factors may produce a maximum intensity at a definite temperature. Calculation showed, however, that for the D lines to be produced in this way, it is necessary to assume that the excited and normal molecules have diameters of the order of magnitude of 100×10^{-8}, or else to assume that the lifetime of excited molecules and atoms is 100 to 1000 times the accepted order of magnitude (10^{-8}).

In the course of the calculation it became necessary to know approximately the per cent dissociation of the molecule at 410°, the temperature at which the D line fluorescence was a maximum. To obtain this, the reaction isochore as modified by Fowler and Darwin (*Phil. Mag.*, **45**, 1; 1923) to include vibrationally and rotationally quantised systems was used, together with the constants of the green sodium band as given by Watson and Fredrickson (*Phys. Rev.*, **30**, 429; 1927). Assuming the vibrational levels to be fully excited at this temperature, which seems very probable, it turns out that the molecules are only 55 per cent dissociated at 410°, and that the per cent association increases with the temperature. This fact is pointed out for two reasons. One is that the per cent association has been generally considered to be small at this temperature, and this is not the case for molecules having a dissociation potential so high as 1 volt. The other is that it may be significant that the maximum intensity of the D lines, excited by the molecular band, should occur in a mixture of 50 per cent atoms and 50 per cent molecules.

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The Pulmonary Circulation of the Whale.

WHALES are remarkable not only for the time they remain under water, but also for the depth to which they descend. In my letter on the depth to which they descend (NATURE, Aug. 20, 1927, p. 263), I gave reasons for believing that the Greenland whale descends to the depth of a mile. The ability to reach that depth implies on the part of the whale the possession of certain attributes, namely:

1. It must be able to remain long enough under water to dive to that depth and make the return journey to the surface.

2. Its buoyancy must not depend on a compressible substance like air to such an extent that when it is at the end of its dive its negative buoyancy or tendency to sink is so great that its muscular powers are unable to cope with it.

3. Its natural orifices must be provided with valves to prevent the water entering the hollow viscera.

4. Its lungs and chest must be elastic and capable of contracting as the air in them is compressed and absorbed.

5. Its circulation must be so arranged that at times the venous blood can reach the aorta without having to pass through the lungs.

The Greenland whale appears to possess these attributes in a marked degree; when attacked it descends at the rate of seven or eight miles an hour, and after an interval of from a half to three-quarters of an hour reappears at the surface in an exhausted condition and is easily dispatched. It depends mainly on its blubber for its buoyancy, and only to a small extent on air, and as the former is incompressible it has a buoyant effect at all depths. Its blubber reaches a thickness of 22 in.; its great thickness is well shown in a photograph appearing in Cook's recent volume, "Pursuing the Whale."

As in other whales, the blow-holes of the Greenland whale are protected by valves which, in the undilated condition of the openings, prevent the entry of water without any effort on the animal's part. Knox, speaking of the blow-hole valves of a fin-whale, says: "The mechanism is admirable, and would sustain any pressure from above although the animal descended to thousands of fathoms." The blow-hole valves of the Greenland whale are described by Scoresby. In this whale even the small opening leading to the ear has its little valve.

The lungs and heart of the adult Greenland whale do not appear to have been examined, but they are doubtless at least as suitable for deep diving as those of other whales. Hunter, speaking of a fin-whale, says: "The lungs are extremely elastic in their substance, so much so as to squeeze out any air that may be thrown into them and become almost at once a solid mass, having a good deal the appearance, consistence, and feel of an ox's spleen."

As regards the existence of a channel through which the venous blood can reach the aorta, that is a patent condition of the ductus arteriosus. Murie, referring to a fin-whale, says: "The ductus-arteriosus existed as a thick rounded elastic cord. Its circum-

ference was 7 inches. Its canal was sufficiently closed to prevent the passage of blood by reason of the elasticity of its walls, but a probe the size of a quill could be pushed through the entire distance." Turner and Knox also found the vessel patent, although contracted in fin-whales.

In whales, owing to the peculiar lives they lead, the pulmonary circulation must often be carried on with considerable difficulty unless there is some arrangement against it. In the intervals between the respirations, the lungs, as Delage suggests, are probably used for hydrostatic purposes and the air in them is consequently often more or less compressed. When they descend to great depths, owing to the pressure of the water, their lungs must be in a very contracted state.

In view of these facts I venture to advance the following hypothesis concerning the heart of the Greenland and of other deep-diving whales: that in the intervals between the respirations when the air in the lungs is in a compressed state and at the times the animal is deep in the water and its chest greatly compressed, the venous blood reaches the aorta mainly via the ductus arteriosus instead of via the lungs as at other times; that the ductus is elastic and possibly contractile; and that it opens and allows the blood to pass as occasion requires.

R. W. GRAY.

Astrophysical Estimates of Ionisation Potentials of Iron, Yttrium, and Lanthanum.

THE work of Saha, Fowler, and Milne has shown how the intensities of ionised lines in stellar spectra are dependent upon temperature, pressure, ionisation, and excitation potentials. By studying the changes in intensity of a line from stars of one spectral class to another, astrophysical estimates have been made of the ionisation potentials of certain of the elements by several investigators.

In the case of a *Cepheid variable*, we have a star the luminosity of which changes slowly from maximum to minimum, then rises steeply to maximum again, with a regularity which is remarkable. During the same period the radial velocity goes through a cycle of changes as though the star were in a state of pulsation, expanding and then contracting, with consequent cyclic changes in the pressure and temperature of its outer portions giving rise to periodic variations in spectral classification.

Dr. F. C. Henroteau recently enlisted my interest in the variations in intensity of certain ionised lines, and in the course of an investigation of more than seventy spectrograms of η Aquilæ taken at the Dominion Observatory during the last few years, the behaviour of some twenty lines due to ionised atoms of scandium, titanium, iron, strontium, yttrium, barium, lanthanum has been studied. Microphotometer graphs of each spectrogram were made. An arc line insensitive to the periodic changes was selected closely adjacent to each of the spark lines under consideration and the ratio of the enhanced line to the arc line measured in each case. Plotting these ratios against phase (in η Aquilæ the period is 7·176382 days) the resulting curves exhibit general resemblance to one another but certain differences in position of maximum and spread of high values which must be attributed mainly to differences in ionisation potential. Taking the following known ionisation potentials:

At. No.	Element.	Ionisation Potential.
21	Sc	6·7 (Russell and Meggers)
22	Ti	6·5 (Kiess and Kiess)
38	Sr	5·67 (A. Fowler)
56	Ba	5·19 (A. Fowler)

as the basis, *the ionisation potentials of iron, yttrium, and lanthanum are estimated to be as follows:*

At. No.	Element.	Estimated I.P.
26	Fe	6·6 (5·5)
41	Y	6·6
57	La	4·9

In the case of iron, the alternative estimate (5·5 volts) is got by comparison with the graphs for strontium and barium, while the estimate 6·6 volts is the value relative to scandium and titanium. Spectroscopic values have been given as 5·9 and 8·15 by Sommerfeld, Gieseler, and Grotrian, while astrophysical estimates by Menzel are 7·5 and 13·0.

As regards yttrium, a spectroscopic determination has just been announced at the Washington meeting of the American Physical Society (April 20), by Meggers and Russell, agreeing with the above, 6·6 volts. This is of interest because the astrophysical estimates are certainly subject to large probable error.

For lanthanum I am unaware of any previous determination, and in confirmation of this and the other estimates, further study of the behaviour of sensitive lines in the spectra of Cepheid variables will be carried out. I am indebted to the Director of the Dominion Observatory for permission to utilise data taken from spectrograms belonging to that institution.

A. VIBERT DOUGLAS.

McGill University,
April 25.

Active Nitrogen.

IN some recent experiments it has been possible to show that metastable molecules of nitrogen are present in active nitrogen. A preliminary report of these experiments has been made by one of us (J. K.) before the April meeting of the American Physical Society. The absence of a spectroscopic transition from the first or A electronic level of the molecule to the normal level has been reported by Miss Sponer, who also suggested that this level may be a metastable one. Also the transition from the normal level of the molecule to the A level has not been observed in absorption. The long life of active nitrogen cannot, however, be explained on the hypothesis that active nitrogen is a metastable molecule. Its long life and its behaviour in the presence of catalysts suggests with certainty that active nitrogen is atomic and that metastable molecules are formed under the influence of the recombination of nitrogen atoms to molecules.

In order to account for the excitation of the first positive bands of nitrogen in the afterglow with abnormal intensity distribution, we assume that in addition to metastable molecules, metastable atoms of nitrogen are formed during the recombination of atoms to molecules. These metastable atoms excite the metastable molecules to the upper level of the first positive bands by collisions of the second kind. The lowest three terms of atomic nitrogen are predicted by the Hund theory to be ^4S, ^2D, and ^2P, where the ^4S term is a normal one and the ^2D and ^{2}P terms are metastable. The difference $^2D - {}^4S$ is found from Hopfield's data on the ionisation limits of N I to be 2·37 volts. The difference $^2P - {}^4S$ has been extrapolated from the spectrum of O II and found to be 3·56 volts. Collisions between nitrogen atoms in the ^2P state and metastable nitrogen molecules yield, as the most probable result, nitrogen molecules in the 11th vibrational state of the B electronic level. This is the upper level of the strongest afterglow bands. We make use here of the principle of resonance that has been so successful in collisions of the second kind.

Other experiments show that more than one active

entity is involved in the excitation of the first positive bands in the afterglow. This was done by destroying the visible afterglow by heating, and then showing that the 'dark modification' of active nitrogen could still excite the *D* lines of sodium. The NO bands, requiring about 6 volts for their excitation, are also quenched by heating. This seems to show that the metastable molecules are quenched by heating and the metastable atoms are undisturbed. Willey showed that when a mild electric discharge was passed through active nitrogen and the visible glow destroyed, the remaining gas was still active and was capable of exciting chemical reactions in which the energy was about 45,000 cal. This, it is seen, is in agreement with the present experiments.

The absence of absorption in active nitrogen between 3000 A. and 6500 A. has been reported by several observers. On the hypotheses presented here, the absorption, if present, should be either in the far ultra-violet or in the far red. The far ultra-violet corresponds to atomic absorption and the far red to the absorption of first positive bands, from the low *A* vibrational states in which most of the metastable molecules are likely to be.

A detailed account of this work will be presented later.

JOSEPH KAPLAN.
(National Research Fellow in Physics.)
GÜNTHER CARIO.
(Fellow of the International Education Board.)
Palmer Physical Laboratory,
Princeton, N.J.

Square Roots and the Decimal System.

IN NATURE of Mar. 3 is an obituary notice of the late Alexander Siemens. The last two sentences of this obituary suggest that possibly there is a misprint or a misunderstanding.

These sentences referred to are as follows:

"There was one thing said at this meeting which the writer never saw contradicted, and that was that without the decimal system it would not be possible to extract square roots. It is quite easy, however, to turn the square root of any number or fraction into a continued fraction and then find its value to any required degree of accuracy as a vulgar fraction."

I am sure Mr. Siemens never advocated the adoption of the decimal system in arithmetic or anything else but weights and measures. Any other application of the decimal system would be quite equal to the American Congressman that tried to get a bill through Congress enacting that π should be proclaimed by law to be 3·000.

C. E. W. DODWELL.
46 Coburg Road,
Halifax, N.S.,
May 4.

I HAVE read Mr. Dodwell's remarks with interest. It will be noticed that I did not say that it was my friend Mr. Siemens that made the statement, but merely that it was said at the meeting. My recollection is that he asked a rhetorical question somewhat as follows: "How were the square roots of numbers such as 6 to be found if we had no decimal system?" I am certain that I was only prevented from speaking on this question by my desire not to help the opponents of the decimal system. I did not attribute it to Siemens in my obituary notice, because I looked up the account of the meeting in the *Journal of the Institution of Electrical Engineers* and found that it had been deleted, probably by the person who said it.

A well-known method of extracting square roots without using decimals is that first given in English in the "Arithmetic" of James Thomson, the father of Lord Kelvin, which was published in 1819. It is interesting to remember that by 1880, when Lord Kelvin and his brother James edited it, it had run through seventy-one editions. Using this method, we get

$$\sqrt{6} = 2 + \sqrt{6} - 2 = 2 + \frac{2}{\sqrt{6}+2}$$

$$= 2 + \frac{1}{2 + 1/(\sqrt{6}+2)} = 2 + \frac{1}{2 + \frac{1}{4 + \ldots}}.$$

The 2 and the 4 repeating. Thus we get as convergents to $\sqrt{6}$,

$$2, \frac{5}{2}, \frac{22}{9}, \frac{49}{20}, \frac{218}{89}, \frac{485}{198}, \ldots$$

The last convergent equals 2·449495 approximately, and the true value is 2·449490 approximately. The successive convergents are alternatively less and greater than the true value. In this connexion something may be said in favour of vulgar fractions. The method is still set in school examination papers.

A. R.

New Regularities in the Band Spectrum of Helium.

THE letter (NATURE, May 19) of Messrs. Takamine, Dieke, and Suga, reporting certain results in connexion with the analysis of the band spectrum of helium, was of peculiar interest to me, in view of the fact that I was proposing shortly to incorporate many of them in Part V. of a series of papers dealing with this subject. Mr. A. Harvey, working in collaboration with me, has measured and interpreted a number of new bands, chiefly in the less refrangible region, and, so far as can be gathered from the letter in question, has arrived at substantially similar conclusions. There appears to be at least one important difference of interpretation, but discussion of this had better await detailed publication. Meanwhile it may avoid confusion to remark that in all probability the band $3X \longrightarrow 2P$ ('ortho-He') of Takamine, Dieke, and Suga, is that near λ5885 already described in Part IV. (*Proc. Roy. Soc.*, A, **118**, p. 157), whilst one designated $4Z \longrightarrow 2P$ by Dr. Jevons and myself in a paper at present awaiting publication is actually the next series member to their $3Z \longrightarrow 2P$. It is remarkable, and fortunate, that the same symbols *X* and *Z* have been respectively chosen in both cases for the new levels. The latter was employed in our case because of the large and unusual Zeeman effect exhibited by the lines of this band.

The effective electronic quantum numbers of these new levels will be of interest to theoretical workers and are as follows, those of several known atomic and molecular levels being included for comparison:

	S.	*P.*	*D.*	*X.*	*Z.*
ortho He	1·689	1·937	2·997	—	—
par He	1·850	2·009	2·998	—	—
ortho He_2	1·788	1·928	3·013	2·958	2·935
par He_2	1·853	1·964	3·015	2·972	2·952

It will be noted that the pHe$_2$ values are throughout higher than the corresponding oHe$_2$ values, and it is significant that the atomic parhelium and orthohelium quantum numbers differ consistently from one another

in the same sense. We have here, probably for the first time, quite unambiguous evidence for the existence of molecular electronic levels which are additional to the ordinary atomic system of levels. Such additional levels constitute an important feature of Hund's recent theoretical work on band spectra. Briefly expressed, his view is that whereas in atoms the term type is determined by the total orbital angular momentum (l) of the outer electrons, in molecules it is determined by the component (i_l) of this parallel to the line of nuclei. Thus in atoms we have only one S sequence ($l=0$) of a given multiplicity, but in molecules more than one may exist, corresponding to $i_l=0$ ($l=0, 1, 2 \ldots$). The characteristics of the X level, for example, strongly suggest that it is related to the S level in some such way as this.

W. E. CURTIS.

Armstrong College,
Newcastle-upon-Tyne.

The Sligo Artefacts.

FOR some years past, in my researches upon the Norfolk coast, I have made a close study of the alleged hurling of large flints against each other during storms, and as, after much observation, I have not seen such collisions take place, I am unable to believe in their occurrence in the area I have investigated. So far as my knowledge extends, the capability of waves in picking up stones is limited to comparatively small specimens. These, when they fall, may strike others lying upon the beach, but such impacts, especially as they occur in water—a medium which definitely lessens the force of the blow—cannot remove, in ordinary circumstances, flakes of large dimensions (see *Science Progress*, No. 87, Jan. 1928). It is known that stones of considerable size are sometimes thrown by the action of the sea on to promenades, but these stones are apparently being rolled towards the shore, and by the uprush of the water when it meets a more or less vertical sea-wall, are carried on to the promenade. There cannot, of course, be any doubt that bulky masses of flint are propelled up the beach, sometimes aided by the buoying effect of attached seaweed, and I have witnessed such movements while storms were in progress upon the east coast. But the travel of the flints is very gradual, as it is only certain waves which are capable of moving them, and the extent of each stage of advance is generally small.

I am not familiar with the capabilities of the Atlantic in moving blocks of limestone upon the Sligo coast, but, for the reasons mentioned above, I would regard it as improbable that masses of this rock of the size described by Profs. Jones and Boswell in NATURE of June 2 could ever have been hurled to their present position by wave action. I can, however, imagine that such blocks could by slow degrees be transported by the sea to where they are now found. Actual observation during storms is what is needed for the elucidation of this question, and until this is carried out erroneous views regarding it may be prevalent.

Since Mr. Burchell's last letter to NATURE he has again visited Sligo and found *in situ* in ancient deposits, two more artefacts. One of these, made of quartzite, is a remarkable specimen, which is, I imagine, sure to be enthusiastically received by those who, like myself, by reason of the evidence already to hand, believe in the greater antiquity of man in Ireland. The other specimens, found previously by Mr. Burchell *in situ* in boulder clay, are, in my opinion, clearly of human origin, and of very great importance.

J. REID MOIR.

One House,
Ipswich.

A Voracious Pike.

THE photograph here reproduced (Fig. 1) shows the attitude of two pike as they were washed ashore dead in the lake here a few days ago. The smaller fish, weighing 7½ lb., had bitten off a good deal more than he could chew of the larger—8 lb. I suppose the two fishes met head on, so that neither could discern the size of the other. The smaller fish, seeing something that seemed edible before him, went for it and paid full penalty for its voracity. Several years ago the late Mr. Malloch, of Perth, sent me a photograph of two pike that had been washed ashore in Loch Tay in precisely the same posture as ours. If I remember aright, they weighed 8 or 9 lb. apiece.

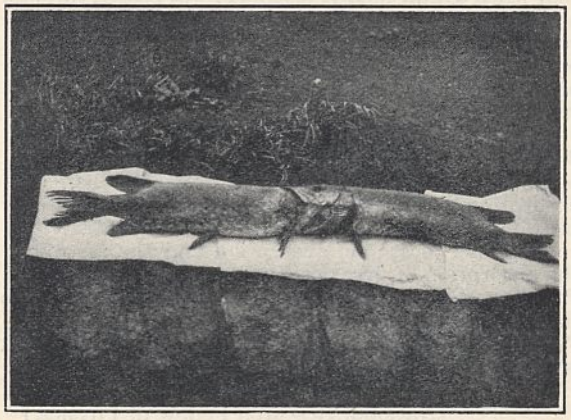

FIG. 1.

HERBERT MAXWELL.

Monreith, Whauphill,
Wigtonshire.

Woods and Wireless.

IN a letter in NATURE of April 7, Dr. Rolf makes some very interesting comments on the subject of absorption of wireless waves by trees, and refers to a paper in which I directed attention to this phenomenon. It is quite clear, as Dr. Rolf points out, that the capacity effect of the tree ought to be taken into account as well as its conductivity effect. It appears to me, however, to be a little doubtful whether such a simple modification of Sommerfeld's theory as Dr. Rolf proposes, is all that is required. The constants of conductivity and S.I.C. employed by Sommerfeld are for an isotropic medium, whereas used in connexion with trees they refer only to the vertical axis. Again, if we increase the conductivity of the tree we clearly increase the energy absorbed, and therefore the attenuation will be greater, whereas by Dr. Rolf's method, an increase of the conductivity leads to the opposite conclusion.

Dr. Rolf seeks to explain by the capacity effect of trees the curious phenomenon of negative damping (which, by the way, was first discovered not by myself but by Messrs. Ratcliffe and Barnett), but I am inclined to doubt whether this is the cause in the case of the curve obtained for Daventry, since this region is one of comparatively few trees, and further, the departure of the attenuation from its ideal value (assuming a bare surface) has been found to be small. The explanation, however, should not be abandoned without further investigation.

R. H. BARFIELD.

Radio Research Station,
Datchet, Windsor,
May 16.

Coal-mining Explosives.

THE dangers due to the presence of inflammable gas and dust in the working atmosphere have led to the development of a special class of explosives for use in coal mines. In general these are detonating explosives, to which have been added 'cooling salts' (for example, sodium chloride) or into which have been introduced a 'cooling agent' (ammonium nitrate), the object of which is to reduce either the amount or the temperature of the flame the explosive gives on detonation. An increased margin of safety in the presence of firedamp has been secured by these means. A rather serious drawback has been that the efficiency of the explosive has, naturally, been decreased, and as a result detonation has been made less certain; that is, the possibility of misfires has been increased. A limit is thus set, beyond it is not advisable to proceed. In the opinion of some observers, this limit has already been passed.

None of the present coal-mining explosives is a true safety explosive, and all are capable of igniting mixtures of firedamp and air in certain circumstances. On the other hand, many explosives, the use of which would rightly be considered dangerous in coal-mining work, may be fired under carefully controlled conditions in the presence of an inflammable firedamp–air mixture without causing ignition. It would appear that it is the conditions under which the explosive is fired that are of prime importance in deciding whether an ignition of firedamp or coal dust can take place or not, and the comparative immunity of the coal mines of Great Britain from ignitions due to the use of explosives is stated to be quite as much to the credit of the shot-firer for the care taken by him in carrying out his duties, as to that of the manufacturers of the explosives used.

As a basis for the researches on coal-mining explosives which are being carried out at the Safety in Mines Research Station at Buxton, it is therefore considered that the rational lines on which to proceed are to concentrate on the effects of methods used underground in firing explosives, in order to help the shot-firer to use them safely, rather than on the effects of the materials of which explosives are made in the hope of producing an inherently safe explosive. An outline of the methods used and of some of the results already obtained has been given recently by Dr. W. Payman.[1]

One of the difficulties of these researches is due to the fact that it is not possible to devise a single test which will give satisfactory information of the behaviour of an explosive under all the very varied conditions met with in mining operations. The main feature of the present official test, as recently modified by the Explosives in Mines Research Committee, consists of firing the explosive from a steel cannon, untamped, into an explosive mixture of firedamp and air. This gives a measure of the relative safeties of different explosives under one set of conditions, but though many of the explosives on the present 'Permitted List' have been fired under the conditions of the official test and 30 to 40 ounces have been used without causing ignition, yet some of these explosives have caused ignition of firedamp underground with so small a charge as 4 ounces.

A method of test sometimes used to supplement the official test in Great Britain and other countries is to measure photographically the amount of flame given out by an explosive on detonation. This method, on which great reliance is often placed, is of no real value taken alone, as is shown by the photographs reproduced in Fig. 1. Two explosives were used for these photographs, and those at (*a*) show the amount of flame produced on firing the explosive as in the official test. In the official test, Explosive A is more dangerous than Explosive B, although it gives less flame. For photographs (*b*) the experiment was repeated, except that the detonator was placed at the back of the charge instead of at the front. Though this makes no apparent change in the safety of either explosive in the official test, it will be seen that it results in much more flame being sent out by the explosive.

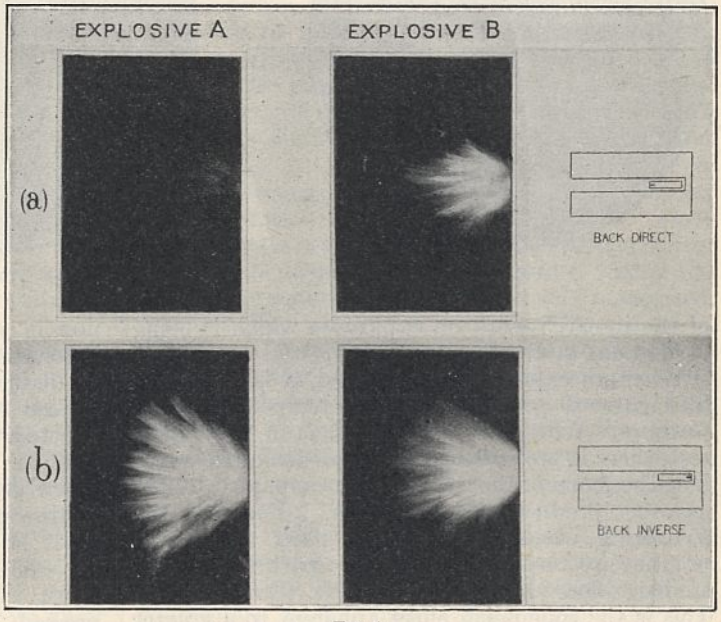

FIG. 1.

It is evident from these photographs that the modern coal-mining explosive, or 'permitted' explosive, as it is called, is by no means a flameless explosive. If we are to learn anything about the mechanism of ignition of a firedamp–air mixture

[1] "The Problem of the Safe Use of Coal-mining Explosives." W. Payman. Midland Institute of Mining Engineers, General Meeting, Leeds, April 17, 1928.

by an explosive, it will be necessary to find the answer to two questions. The first is not why do explosives cause the ignition of a gas mixture, but why do not these large, apparently hot, flames produced by ' permitted ' explosives during official test always ignite firedamp–air mixtures when they are fired into them ? Secondly, when ignition does result—for example when the charge is increased —is the flame then the cause, or if not, what is ? The attempts to answer these questions are regarded by Dr. Payman as the most important part of the research work on explosives which is being carried out at Buxton.

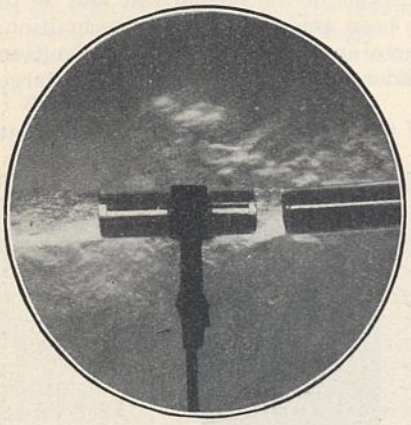

FIG. 2.

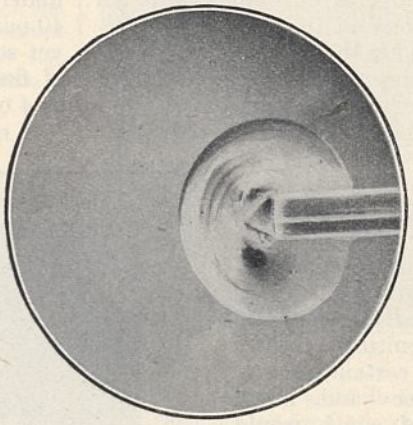

FIG. 3.

When an explosive is detonated, it is converted into gaseous products at high temperature and pressure. When fired untamped, as in the official test, there is projected from the mouth of the shot-hole the flame of the explosive accompanied by the gaseous products of explosion. Further, the shattering effect which makes itself evident in practice by breaking down the coal must have a similar effect on the air outside the shot-hole. This is the concussion effect apparent to a greater or less degree by its effects on the ear whenever a shot is fired. Since it is known that nearly all flames will cause the ignition of an inflammable gas mixture, it is convenient to consider the flame as the chief potential source of ignition of firedamp when explosives are fired. The effects of the hot gases and shock and pressure waves can then be considered separately, not only with regard to the possibilities of their causing or aiding ignition, but also with regard to the likelihood that they may lessen or remove entirely the igniting power of the flame.

A method has been developed at Buxton, based on an old German optical device, which enables photographs to be obtained of the invisible detonation gases and waves sent out by an explosive in addition to photographs of the visible flame. This method depends essentially on the refraction of a beam of light at the edges of the detonation gases and at the surface of the shock wave. The method has been used to give both ' snapshots ' and moving film records, the former using the spark produced on the almost instantaneous discharge of a Leyden jar, the latter using a powerful arc lamp to give the beam of light.[2] The utility of the method may be appreciated from Fig. 2, which shows a photograph of a normally invisible stream of compressed air passing through a glass tube.

In order to obtain a photograph of a shock—or concussion—wave independently of any flame or products of detonation, such a wave was produced by bursting a small celluloid disc by means of compressed air, the record reproduced in Fig. 3 being obtained. The front of the shock wave, which is approximately spherical, is shown as a circle, the wave resembling somewhat a soap-bubble blown from the end of a tube.

The next photograph (Fig. 4) shows the wave and the gaseous products of detonation when a No. 6 fulminate detonator is fired in an iron tube open at both ends. Here again we see the approximately spherical shock-wave, but now it is closely followed by the gases evolved on detonation. The shock-wave marks the boundary of disturbance, and the air outside this at the instant the photograph was taken is quite unaffected. The air which was formerly enclosed within the space defined by the spherical shock-wave has now been compressed into the space between the shock-wave front and the front of the gaseous products of detonation.

FIG. 4.

Moving film records have enabled the speed of the shock-wave to be determined, and have also given the relative position of flame, waves, and gases as they travel away from the shot-hole.

In addition to the purely scientific examination of the formation and spread of explosive gases, flames, and waves away from an explosive, these photographic methods are being linked up with experiments designed to examine the ignition process under actual conditions of mining practice.

[2] A full description of the method is given in " The Pressure Wave Sent Out by an Explosive," Part 1, by W. Payman and H. Robinson. Part 2 by W. Payman and W. Shepherd. *Safety in Mines Research Board Papers*, No. 18 and No. 29.

The Sun's Outer Atmosphere.[1]

By Prof. E. A. MILNE, F.R.S.

ASTRONOMERS are accustomed to divide the outer regions of the sun into four parts: (1) the photospheric layers, (2) the reversing layer, (3) the chromosphere, (4) the corona. In this address I wish to deal particularly with the chromosphere, but before doing so I should like to dwell a little on certain aspects of this fourfold division. Meteorologists make a similar subdivision of the earth's atmosphere. We have the troposphere, the stratosphere, the conducting layers, the auroral layers, and so on. But meteorologists have at least one advantage over solar physicists—meteorologists know where the earth's atmosphere begins. It may leave off very indefinitely, but it certainly begins quite definitely—it begins at the solid and liquid crust of the earth. It is sharply bounded below. But on the sun, and indeed on any star, no such sharp base exists. Whether the sun is wholly gaseous, or whether with Dr. Jeans we suppose it to be ultimately in a liquid state in the far interior, we are at least certain that owing to the high surface temperature and the positive temperature gradient implied by the outflow of heat, the entire outer layers, down to a depth much greater than the furthest depth we can see, are in the gaseous state. We therefore have no datum line for the base of the solar atmosphere.

It is true that, as seen in the sky, the sun has a sharp edge. But we have to remember that at the sun's distance one second of arc corresponds to 700 km., and that a line of sight passing one second of arc inside the sun's limb traverses 64,000 km. of the solar sphere. Thus the sharpness is to some extent illusory. We can, however, assert that above the level corresponding to the 'sharp edge' the gases are practically transparent as regards their continuous spectrum, whilst below this level they are practically opaque. If we knew the intrinsic opacity (per unit mass) of the solar material, we could calculate the pressure at which the transition from practical transparency to practical opacity takes place, for a line of sight nearly tangent to the sun. Assuming that general opacity arises from the ejection of photo electrons, the various unknowns may be estimated. We find that the opacity of a column of given length varies as the square of the pressure, and hence falls off rapidly outwards. It appears that practical transparency along a tangential line of sight occurs at a pressure of about 10^{-6} atmospheres. When we view the sun's surface normally, at the centre of the sun's disc, we see to a deeper level. Calculation shows that all but one per cent. of the light originates at depths where the pressure does not exceed 10^{-3} atmospheres. This change of pressure, 10^{-6} atmospheres to 10^{-3} atmospheres, appears to take place in a range of depth of some 50 km. These limits serve to define the 'photospheric layers'—the layers within which originates the light of the continuous spectrum sent to us by the sun.

[1] Discourse delivered at the Royal Institution on Friday, Mar. 9.

Superimposed on the sun's continuous spectrum is an absorption line spectrum. Some of these lines show in their fine structure reversals, but we may ignore these and state that for the undisturbed solar disc we have, broadly speaking, a spectrum composed entirely of absorption lines. We are not compelled to assume that the layers producing these lines are entirely exterior to the photospheric layers. Theory shows that, provided the temperature decreases outwards, an absorption spectrum will be shown if the gas has a general coefficient of absorption and superimposed on this certain selective absorption coefficients associated with particular wave-lengths. Thus if the general coefficient of absorption remained definitely constant at all levels up to the sun's boundary, we should still have a Fraunhofer spectrum. Actually, if we accept the photoelectric origin of the general absorption, the general absorption coefficient per unit mass decreases with the pressure, and thus as we pass outwards the general absorption coefficient becomes practically zero whilst the selective absorption coefficients are still large. There is therefore a region effectively transparent except in the lines themselves. Nevertheless, within the photospheric range of pressures already mentioned, selective line absorption will also be occurring. The term 'reversing layer' is used to denote in a general way those layers which contribute to the Fraunhofer spectrum, but we now see that there is no precise delimitation between the reversing layer and the photospheric layers. The two shade into one another. The photospheric layers are also giving rise to line absorption, though this absorption will be weak; in other words, the residual intensities of the lines produced in this region will not be much below the intensity of the continuous background. The upper reversing layer, transparent except in the lines, will give rise to stronger lines, that is, lines with smaller residual intensities.

As evidence for this we have that the stellar sequence of spectra indicates a pressure of the order of 10^{-4} atmospheres for the layer in which absorption lines of excited atoms originate, but a pressure of the order of 10^{-7} atmospheres for the layer in which absorption lines of normal atoms originate. The former pressure lies inside our photospheric range of pressure, the latter pressure lies outside it.

In the upper reversing layer a new feature begins to present itself—the selective effect of radiation pressure near a wave-length of selective absorption. Now it must be supposed that selective absorption is occurring to some extent at all depths throughout the sun; in the far interior, the X-ray levels of the atoms will be giving rise to selective absorption. We may, therefore, pause for a moment to inquire how it is that selective radiation pressure only arises on the fringe of the sun. The pressure of radiation at any particular wave-length is

proportional to two factors. One is the net outward stream of radiation—the difference between the inward and outward streams; the other is the selective absorption coefficient in that wave-length—the degree of obstruction offered. But the selective absorption has itself an influence on the net stream. Where the selective obstruction is high, neither an inward nor an outward beam can go very far without being absorbed, and consequently the average distance (from a given atom) from which either an inward or outward beam originates is very small. When the state is one of 'local thermodynamic equilibrium,' as can be shown to hold provided the density is not too low, this has the effect of making the inward and outward beams very nearly equal at a wave-length of strong selective absorption. They originate from

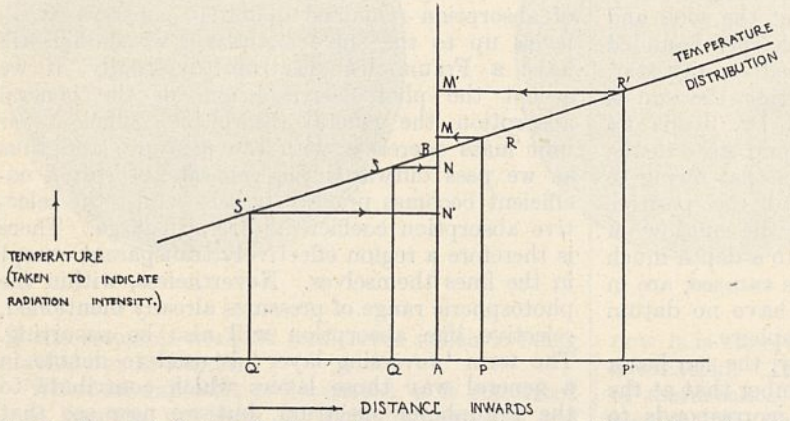

FIG. 1.—Diagram to illustrate the absence of selective radiation pressure in local thermodynamic equilibrium in interior. AM and AN represent the outward and inward fluxes at A in ν-radiation, AM′ and AN′ the outward and inward fluxes at A in ν'-radiation, where $k_\nu > k_{\nu'}$ (k=absorption coefficient). These fluxes originate at the mean positions P, Q, P′, Q′ respectively, where AP < AP′ because $k_\nu > k_{\nu'}$. The following relations hold:

i. Large absorption coefficient k_ν.
Net flux at A $\propto$ AM − AN = MN $\propto$ PQ $\propto 1/k_\nu$.

ii. Small absorption coefficient $k_{\nu'}$.
Net flux at A $\propto$ AM′ − AN′ = M′N′ $\propto$ P′Q′ $\propto 1/k_{\nu'}$.

Hence ($k_\nu \times$ net flux in ν-radiation) = ($k\nu' \times$ net flux in ν'-radiation), or radiation pressure due to ν-radiation = radiation pressure due to ν'-radiation.
Thus no selective effect in the interior.

places so close to one another, both in space and in temperature, that they are only slightly unequal. They accordingly very nearly cut one another out. Thus in the product (selective absorption coefficient) × (net stream) the effect of the large selective absorption coefficient is neutralised by the small net stream, and we get no appreciable effect of selective radiation pressure; the radiation pressure is the same at a wave-length of selective absorption as at a wave-length where there is no selective absorption.

Let us now see what happens near the boundary of the star, assuming local thermodynamic equilibrium holds up to the boundary. Near the outer confines of the star the inward stream is small, and there is little to neutralise the outward stream. The net stream is almost equal to the outward stream, and a big selective absorption coefficient will give rise to a big selective radiation pressure.

We can look at the matter at a slightly different angle. At the outside of the star, the big selective absorption coefficient, combined with such outward stream as exists, gives rise to a big selective radiation pressure, even though the big selective coefficient has itself cut down the outward stream to a value below the photospheric value. As we go inwards, an inward stream is generated by the back radiation from the atoms traversed, and this soon nearly balances the outward stream, giving a small net stream in the interior.

At all depths selective absorption cuts down the intensity of each stream. The difference between the interior and the surface is that in the interior the two streams are cut down to nearly the same amount and balance one another, whilst at the surface the outward stream, though cut down, is unbalanced.

The consequence of this is that in the upper reversing layer the gases are pushed outwards by selective radiation pressure, and so the layer is less compressed than the lower reversing layer and photospheric layer beneath. It is not easy to make an exact calculation, but it appears roughly that for calcium atoms the pressure decreases from 10^{-5} atmospheres to some very small pressure in a range of about 100 km. This estimate is not to be pressed—it may perhaps be an under-estimate. But we shall not go far wrong in attributing a thickness of the order of some hundreds of kilometres to the upper reversing layer.

In this region, in a steady state, the atoms are maintained in equilibrium under gravity, the gradient of gas pressure and selective radiation pressure. As we go outwards selective radiation pressure steadily increases in importance. The question arises, what happens at the upper boundary of this layer? Actually, it cannot have a definite upper boundary, but we will suppose we are endeavouring to trace the pressure upwards by the same principles as govern the equilibrium of the earth's atmosphere, selective radiation pressure only being added. Two possibilities arise: either selective radiation pressure, though increasing, remains steadily less than gravity, or it attains a value greater than gravity. It may do the former for some kinds of atoms, the latter for other kinds of atoms. In the former case nothing particular happens; the atoms of this particular kind simply thin out moderately rapidly. In the latter case, we arrive at a contradiction. When radiation pressure exceeds gravity, equilibrium is no longer possible unless the gradient of gas pressure becomes reversed. As it is difficult to see how the gas pressure could ever begin to decrease again once it began to increase—and it must ultimately

decrease because the sun's atmosphere is finite—we reject this possibility. But if equilibrium is no longer possible, since we have assumed equilibrium all the time, something must be wrong with our assumptions. We could only now keep the atoms in equilibrium if we assumed some kind of hypothetical net which caged the atoms down. Let us suppose that the atoms are, in fact, kept in equilibrium by a net of this kind, and that then the net is suddenly removed. What will happen?

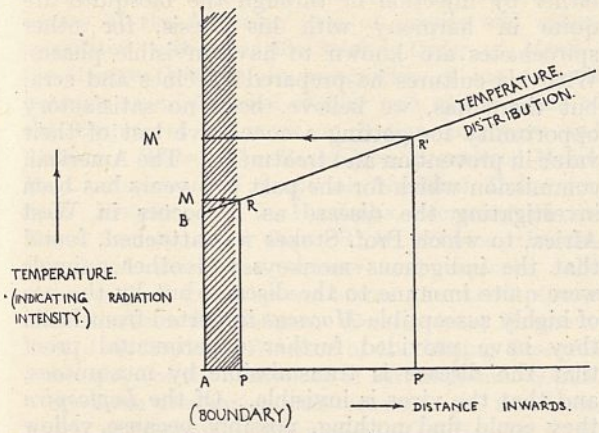

FIG. 2.—Diagram to illustrate existence of selective radiation pressure at boundary (chromosphere absent). AM and AN represent the emergent fluxes at the boundary in ν and ν'-radiation ($k_\nu > k_{\nu'}$). They originate at depths P and P' respectively, and so correspond to temperatures PR and P'R'. Since k_ν is large, P is practically at A, and the emergent flux in ν-radiation corresponds closely to the boundary temperature AB. The following relations hold:

i. Large absorption coefficient k_ν.
Net flux $\propto AM = AB + BM = AB + c/k_\nu$.

ii. Small absorption coefficient $k_{\nu'}$.
Net flux $\propto AM' = AB + BM' = AB + c/k_{\nu'}$.

ν – Radiation pressure $\propto k_\nu AM = k_\nu AB + c$.

ν' – Radiation pressure $\propto k_{\nu'} AM' = k_{\nu'} AB + c$.

Hence $k_\nu > k_{\nu'}$ implies ν-radiation pressure $> \nu'$-radiation pressure.

The atoms, being acted on by a radiation pressure exceeding gravity, will be ejected from the layers below. An outer atmosphere will come into being. But the ejection of atoms will not proceed indefinitely. As this new outer atmosphere becomes thicker and thicker its back radiation will begin to be appreciable; it must be constantly returning to the layers below some fraction of the radiation incident on it. The back radiation will exert a downward pressure, which will go on increasing with increasing thickness of the outer atmosphere until finally its back pressure is equal to the pressure exerted by our hypothetical net. After that no more atoms will be ejected, and the outer atmosphere will be permanent, and will exist in a state of equilibrium.

In the case of the sun we identify this outer atmosphere with the chromosphere, observed at times of total solar eclipse and spectroscopically at other times. About a century ago, Canning called a New World into existence to redress the balance of the Old. For millions of years the sun has been calling a new atmosphere into existence to redress the balance of the old.

(To be continued.)

Obituary.

DR. CHARLES H. GILBERT.

IN the passing of Dr. Charles Gilbert, America has lost one of her most trusted fishery authorities and a zoologist of wide reputation. He had retired from his professorial duties at Stanford University, California, some three years ago, and was devoting his whole energies to the working out of salmon problems on the Pacific coast, and specially in Alaska, where the most productive salmon fisheries of the world now exist, when a sharp attack of bronchitis terminated his career.

A native of the State of Illinois, Dr. Gilbert early came under the spell of that famous ichthyologist, David Starr Jordan, and in a short time was his most prominent pupil and then his associate in various expeditions. Ere long, papers were appearing on the fishes of southern California and the Pacific Islands over their joint names. When the Stanford University was created in 1891, Jordan became the principal and Gilbert the professor of zoology. At the age of sixty-five he retired, after occupying the chair for thirty-four years. His published work during this long period, as shown in Dr. Bashford Dean's "Bibliography of Fishes," was almost exclusively on systematic ichthyology. He described many new species—in one paper 32, and in another 25—in a search of American waters. He studied the fishes of Panama when de Lesseps was engaged upon his unsuccessful effort to construct the canal, and he also wrote on the fishes of the inhospitable Galapagos Islands, and of Hawaii and Japan.

It was in 1880 that Dr. Gilbert first became associated with the U.S. Fisheries Commission, and from that time forward much of his work had practical application to fishery problems on the Pacific Coast. The interests of the salmon began to claim him from the year 1912, and it may be said without much fear of contradiction that his best and most useful work was carried on in the elucidation of the great runs of salmon in British Columbia and Alaska, and that in this branch of investigation he became the leading authority. Salmon research in Scotland had already revealed not only the importance of marking fish, but also the great value of salmon scale study, and Gilbert was the first in America to appreciate the insight into the life history of fishes which this branch of study can yield.

The runs of salmon in the famous Fraser River, which since the days of the Hudson's Bay Company had been regarded as inexhaustible, had begun to decline in a rather alarming manner, and a great fall of rock into the Hell's Gate cañon during the making of the Canadian Northern Railroad had blocked the river and wiped out the 'big run' which occurred every fourth year. The extensive

canning industry became seriously alarmed. Gilbert came to the aid of British Columbia and produced a series of admirable papers on the life history of the most valuable species (*Oncorhynchus nerka*), the Sockeye, and laid the foundation for the scientific study of the other species found in the rivers of the coast.

Since the salmon interests of the State of Washington and of British Columbia were inextricably linked in any scheme of regulative treatment, it was clear that only by the creation of a joint body representing both the United States and Canada could satisfactory results be attained. Dr. Gilbert was one of those who actively urged the calling of a conference for the consideration of this proposal, and in the spring of 1925 a representative body assembled at Seattle. From this there sprang into being the International Pacific Salmon Investigation Federation under the chairmanship of Mr. Henry O'Malley, the U.S. Commissioner of Fisheries. One of the important lines of investigation decided upon was the migrations of salmon to Alaska and an estimate of the spawning stocks necessary for the maintenance of the fisheries, and this work was naturally put into Dr. Gilbert's hands. The biological work generally is in charge of Dr. Willis Rich, of the U.S. Bureau of Fisheries, a worker who has repeatedly collaborated with Dr. Gilbert in recent years.

The Federation has suffered a great loss in the death of one of its most thorough and trustworthy investigators. W. L. C.

DR. HIDEYO NOGUCHI.

WE much regret to see the announcement that Dr. Noguchi died at Accra on May 21, of yellow fever contracted in the course of his investigation of the cause and mode of transmission of that disease. Our readers will recall that Prof. Adrian Stokes died in the same way in September last, and some of them may remember the death of that brilliant young man, Walter Myers, when he went to Para on the same errand so long ago as 1901.

During the last ten years Dr. Noguchi has been extensively engaged on the parasitology of yellow fever as it occurred in Central and South America, working in conjunction with the sanitary campaign by which the International Health Board have very nearly succeeded in eradicating the disease in those parts. In Ecuador in 1918 he found a spirochæte which could be grown in pure culture and with which a disease resembling yellow fever could be produced in guinea-pigs and some other animals. The organism had been seen in the kidney of a fatal case some years before by Stimson, but his account was published briefly in an official report, and no particular importance was attached to it. Noguchi produced cumulative evidence that his *Leptospira icteroides* was distinct from other similar organisms and etiologically related to yellow fever, which was very strong if not entirely conclusive: a convenient summary by him will be found in the *Lancet* (1922, vol. i. p. 1185). The well-established facts that the disease can be transmitted by an ultramicroscopic agent either by injection or through the mosquito are quite in harmony with his thesis, for other spirochætes are known to have invisible phases. With his cultures he prepared vaccines and sera, but there has, we believe, been no satisfactory opportunity for getting a conclusive test of their value in prevention and treatment. The American commission which for the past two years has been investigating the disease as it occurs in West Africa, to which Prof. Stokes was attached, found that the indigenous monkeys and other animals were quite immune to the disease, but by the use of highly susceptible *Macacus* imported from India they have provided further experimental proof that the disease is transmissible by mosquitoes, and that the virus is invisible. Of the *Leptospira* they could find nothing, possibly because yellow fever in Africa is not the same thing as yellow fever in the Americas. It was doubtless this discrepancy which led Dr. Noguchi to Accra last November with such unhappy results.

Dr. Noguchi was born in Japan in 1876, and educated at Tokyo University and the Institute for Infectious Diseases. He went to the United States in 1901 as lecturer on pathology in the University of Pennsylvania, and afterwards worked at the Carnegie Institution. Since 1914 he has been one of the most distinguished members of the staff of the Rockefeller Institute. Apart from yellow fever, he will be remembered for his pioneer work on the cultivation of spirochætes outside the body and their specific differentiation, for his demonstration of the *Spirochæta pallida* in the brain which gave the final proof that general paralysis was syphilitic, and for his work on vaccine virus. The successive volumes of the *Journal of Experimental Medicine* are good enough evidence of his fertile brain and clever hands. Lately he has been working out the cause of oroya fever in Peru, which seems to be due to a minute parasite inside the red blood corpuscles.

WE regret to announce the following deaths:

Mr. A. R. Bennett, a well-known telephone engineer who was responsible for many inventions connected with the telephone in its early days, on May 24, aged seventy-eight years.

Dr. William F. M. Goss, past president of the American Society of Mechanical Engineers and formerly professor of railway engineering and dean of the college of engineering at the University of Illinois, on Mar. 23, aged sixty-eight years.

Dr. John Horne, F.R.S., formerly assistant director in Scotland of the Geological Survey, on May 29, aged eighty years.

Prof. C. W. Howard, director of the Government Bureau for the Improvement of Sericulture in Kwongtung Province, who had recently been appointed head of the Department of Biology at Wheaton College, Illinois, and was an entomologist of wide experience in the United States, South Africa, and China, on Mar. 1, aged forty-six years.

Prof. Otto Nordenskjöld, an honorary corresponding member of the Royal Geographical Society, leader of the Swedish Antarctic expedition of 1902–3, on June 2, aged fifty-eight years.

News and Views.

THE King's Birthday honours list includes the names of the following men of science and others associated with scientific work: *Order of Merit*—Sir George Grierson, in recognition of his eminent position as an Oriental scholar and of the value to the Empire of his work on Indian languages and dialects. *Baron*—The Right Hon. Sir Alfred Mond, Bart., chairman of Imperial Chemical Industries, Ltd. *Knights*—Dr. J. H. Jeans, secretary of the Royal Society; and Capt. G. H. Wilkins, the distinguished Australian aviator and explorer, who recently flew an aeroplane across the Arctic Ocean from Alaska to Spitsbergen. *Companion of Honour*—Prof. J. S. Haldane, Director of the Mining Research Laboratory of the University of Birmingham. *G.B.E.*—Sir John Dewrance, past president of the Institution of Mechanical Engineers. *C.B.E.*—Dr. C. H. Lander, Director of Fuel Research, Department of Scientific and Industrial Research; and Mr. H. E. Wimperis, Director of Scientific Research, Air Ministry. *O.B.E.*—Prof. A. V. Bernard, professor of hygiene and preventive medicine in the University of Malta, and Medical Officer of Health, Malta; Mr. R. S. Cooke, Inspector-General, Ministry of Auqaf, and Honorary Director of Antiquities, Iraq; Mr. E. R. Sawer, Director of the Department of Agriculture, Palestine; Dr. W. S. Tucker, Director of Acoustics at the Air Defence Experimental Establishment, War Office; and Mr. R. McK. Wood, principal scientific officer, Royal Aircraft Establishment, Farnborough. *M.B.E.*—Mr. W. R. Black, assistant principal, Ministry of Agriculture and Fisheries; Dr. J. F. Corson, assistant bacteriologist, Medical and Sanitary Department, Tanganyika Territory; and Mr. G. Maclean, Sleeping Sickness Officer, Medical and Sanitary Department, Tanganyika Territory.

THE Institution of Civil Engineers has had the good fortune to be served by a succession of secretaries of outstanding ability, the name of one of whom, James Forrest, is commemorated by the James Forrest Lecture, while the name of his predecessor was given to the Manby Premium. Charles Manby (1804-1884) was the son of Aaron Manby, and helped his father construct the first iron steamer to go to sea, and also worked under him at the Paris Gas Works and the Charenton Ironworks. Establishing himself in London as a civil engineer, in 1839 he became secretary to the Institution, in the duties of which James Forrest (1825–1917) assisted him. On retirement in 1856, Manby was presented with a sum of money "as a token of personal esteem and in recognition of the valuable services" he had rendered to the members individually and collectively. During the early 'fifties, Forrest had been assistant secretary to the Society of Arts, but on Manby's retirement he returned to the Institution of Civil Engineers and continued to hold that important post until 1896. During his tenure of office the names on the roll had risen from between 800 and 900 to 6900, inclusive of the student class, while the annual income had grown from £3000 to more than £20,000. Various marks of respect were shown Forrest. His portrait was presented to the Institution in 1890, an endowment fund for the James Forrest Lecture was raised in 1891, while Forrest himself, after retirement, established in 1897 the James Forrest medal, to be awarded annually to the writer of the best student's paper. On retirement, Forrest was succeeded by Dr. Tudsbery, who in turn has been succeeded by Dr. Jeffcott.

ON the eve of his elevation to the peerage, Sir Alfred Mond was able to announce to the first ordinary general meeting of the shareholders of Imperial Chemical Industries, Ltd., that the profits for the year had exceeded the estimate by half a million pounds, a result he attributed to the improvement of trade consequent upon a less disturbed labour position, the uniformly good relations prevailing between the management and employees in the various firms absorbed in the merger, the continually increasing demand for heavy chemicals in the artificial silk industry, in agriculture, etc., to the increased capacity of the combine to be adventurous in research and in applying its results, and to the negotiating power which its capital resources conferred upon it. Referring to negotiations with chemical interests in other countries, Sir Alfred said the merger has laid it down as a cardinal point of policy that it must regard itself as the guardian of the national safety in the way of production of chemical products, and many of its research activities are based upon the need for carrying that policy into effect. It expects shortly to put into operation a plant to manufacture methanol, an important raw material of the dye industry for which Great Britain is at present dependent on foreign sources of supply, and the Billingham factory hopes to make the production of petrol from coal a commercial proposition. Impetus has been given to the researches into this chemical engineering problem by the import duty on oil fuel. The tradition of the associated firms of the essential necessity of research and its continuous application has been strengthened by the formation of a consultative research council representative of the academic and industrial world.

THE Commission for Synoptic Weather Information met in London during the week May 29–June 2, under the presidency of Lieut.-Col. E. Gold, Assistant Director of the Meteorological Office, Air Ministry. The Commission deals with the international exchange of the meteorological reports on which weather forecasts are based. It specifies the codes in which the reports shall be abbreviated and the time-table according to which the different radio services shall transmit the reports. Representatives from the meteorological services of Denmark, Holland, Belgium, France, Germany, Norway, Sweden, Finland, Russia, Poland, Czecho-Slovakia, Iceland, Portugal, Spain, and Great Britain attended the meeting, as well as the Director of the Meteorological Service of Canada and the Chief of the United States Weather Bureau. The meeting in London was preceded by a meeting in Paris of a sub-commission appointed to formulate proposals in

regard to the collection and distribution of meteorological reports from the ocean. This sub-commission met under the presidency of General Delcambre, the Director of the National Meteorological Office of France. The British representative at the meeting at Paris was Commdr. L. A. Brooke-Smith, superintendent of the Marine Division of the Meteorological Office, Air Ministry. During the meeting in London the delegates were entertained by H.M. Government to luncheon, at which Sir Philip Sassoon, the Under-Secretary of State for Air, presided. They also paid a visit to the aerodrome at Croydon, when they inspected the meteorological service which provides for the requirements of aviation between London and the Continent.

BY permission of the Air Ministry, a special meeting of the Royal Meteorological Society was held at the Croydon Aerodrome on Thursday afternoon, May 31. About two hundred fellows and their friends were present, including representatives from the International Commission for Synoptic Weather Information who were attending a conference at the Air Ministry. After a brief address of welcome by Sir Richard Gregory, president of the Society, supported by Dr. G. C. Simpson, Director of the Meteorological Office, a lecture on the "Development of Meteorological Services for Aviation" was given by Capt. F. Entwistle, Superintendent, Aviation Services Division, Meteorological Office. Capt. Entwistle explained the organisation by which pilots are not only informed of the weather conditions over the route they are flying at the time of the commencement of the flight, but also of the changes likely to occur and the prevailing conditions at neighbouring stations, so that an alternative route can be taken in the event of bad conditions on the normal route. Tea was provided at the Aerodrome Hotel, and afterwards guides conducted parties to the various points of interest in the aerodrome. These included the recently opened booking and waiting rooms, customs' offices, emigration department, control tower, etc. A popular feature of the afternoon was the opportunity provided by Imperial Airways, Ltd., to make short flights at a reduced charge in commodious air liners specially detailed for this purpose. About one-third of the company took advantage of this opportunity to make an ascent.

THE last news from General Nobile in the *Italia* was received on the morning of May 25, when the airship was approaching Spitsbergen on the way back from the Pole in bad weather. Various relief measures have been taken in the hope that the explorers have reached land in safety. The *Citta di Milano*, the *Italia's* base ship, made a cruise from King's Bay to Amsterdam Island, where heavy pack-ice forced her to return. The *Times* reports that Norway has sent Lieut. L. Holm with an aeroplane by sea to Spitsbergen, where Capt. R. Larsen will probably join him. The Store Norske Spitsbergen Coal Co. has arranged to put at the disposal of the search a team of sledge dogs with experienced dog-drivers. They will be sent overland from Advent Bay. The Italian and Swedish Governments also propose to send aeroplanes, and the Soviet Government has dispatched an ice-breaker from Archangel to the Barents Sea. The most probable place for the airmen to be found is the northern coast of Spitsbergen. There they may have found a few Norwegian trappers wintering. Sea communication with the north coast is not yet open, and the explorers, in want of sledge equipment, may have decided against an overland journey to King's Bay or Advent Bay. On the other hand, if the *Italia*, by want of fuel, or by damage to the envelope, was forced down on the drifting ice, there is less hope of the explorers having been able to reach safety. But the lack of news for some weeks need not be taken to imply disaster to all on board. The *Italia* may even have been carried as far as Novaya Zemlya.

THE Samuel Augustine Courtauld Institute of Biochemistry will be opened at the Middlesex Hospital on June 14 by H.R.H. Prince Arthur of Connaught. At the ceremony, Sir Archibald E. Garrod will give an address on "The Place of Biochemistry in Medicine." The Institute, which is part of the scheme for the new Middlesex Hospital, was made possible by the generosity of Mr. S. A. Courtauld. It occupies a site at the back of the present Hospital and is six stories high, with a basement and sub-basement, connected to the main building by underground passages and a bridge across Union Street. Below ground is the boiler-house, designed to meet the needs of the whole of the new Hospital; on the ground floor is a well-designed restaurant for students of the Medical School; the upper five floors are given over entirely to biochemical work, and consist of four large fully equipped laboratories, one for students, another for clinical routine work, and two for research. There is also a series of small rooms for special purposes, such as the incubator room, the dark room, large-scale preparation room, library, office, and private room. Besides these, on the top floor there is some space that has not yet been allotted, and two large well-ventilated animal houses. The whole Institute is fully equipped with the most up-to-date apparatus, and everything has been done to ensure that the best possible means are at the disposal of the professor and his staff for the furtherance of biochemical research.

AT the thirty-seventh annual general meeting of the Institution of Mining and Metallurgy, held at Burlington House, Piccadilly, on May 17, Mr. R. E. Palmer, president of the Institution, occupied the chair. In the course of the proceedings, the Hon. Peter Larkin, High Commissioner for Canada, presented to the Institution on behalf of Canadian friends and admirers of the late Dr. Willet G. Miller, Provincial Geologist for Ontario, a replica of the portrait of Dr. Miller which is now hanging in the Ontario Parliament Buildings. The president received it on behalf of the Institution. Dr. Miller was the recipient of the Gold Medal of the Institution in 1915, "in recognition of his eminence as an economic geologist, and of the important part played in mining by economic geology." Mr. Palmer then presented the Gold Medal of the Institution to the Right Hon. Sir

Alfred Mond, "in recognition of his scientific and industrial services in the development of the mineral resources and metallurgical industries of the British Empire." Sir Alfred Mond acknowledged this award of the highest honour the Institution can confer in a speech of considerable interest, in which he reviewed the advances made in the mining and metallurgical industries more particularly from the Empire point of view. Mr. Palmer delivered his presidential address, having for its subject "The Institution—its Objects, Aims, and Value, not only to the Members, but to the Profession and Mining Industry as a whole," after which he inducted the new president, Prof. S. J. Truscott, into the chair.

THE coming congress of the International Astronomical Union at Leyden on July 5–12 offers every prospect of being an important and interesting meeting. Between two and three hundred delegates, representing more than twenty countries, so far removed as Japan and Mexico, will meet to discuss programmes of work which either require international co-operation or are best forwarded by general agreement in many details. For the first time since the War, representatives of the Central Powers and of Russia will be present; this year they come as visitors, but it is to be hoped that at the next conference their countries may have seen their way to enable them to come as full members. The main work of the Union lies in the meetings of some twenty-seven standing committees devoted to special lines of astronomical work. Resolutions adopted by the various committees will, after any financial implications have been examined, be placed before a general assembly of the Union at the close of the meeting. A visit to the Zuider Zee reclamation works is among the functions on the lighter side of the programme of the Union. The president is Prof. W. de Sitter, Director of the Leyden Observatory, and the local secretary is Dr. Hins, of the Observatory staff.

THE effects of recent electricity legislation in Great Britain on the status and salaries of the engineers employed in the electricity supply industry is producing new difficulties which will have to be overcome if the community is to benefit. According to the Act, if a station fails to generate electricity at a price less than that at which it can be supplied to it by the Central Board, it is liable to lose its status as a generating station and be converted into a distributing station. Now the price which a station charges for electricity depends on the salaries and wages of the engineers it employs. If these are too low, it may be flourishing at the expense of other stations which pay their workmen higher wages. It seems necessary that some special legislative machinery be employed which will adjust salaries and wages, and so prevent strikes. It looks as if the electricity supply industry has become, or is on the point of becoming, the most vital industry in Great Britain. As the machines for producing the electric energy needed for electric lighting and industrial purposes are being concentrated in a few very large stations, the whole system will be very vulnerable to labour disturbances and a very brief stoppage would inflict most serious loss on the country. Formerly, railway transport could claim to be the most vital industry, but the general strike which happened a few years ago proved that road motor transport, its formidable competitor, could greatly mitigate the damage that would otherwise have fallen on the public. The objection to legislative machinery to prevent strikes and lockouts is that there are always some employers and trade unions who will ignore the proper channels for ventilating grievances.

SIR ERNEST RUTHERFORD, Cambridge, and M. Jean Perrin, professor of physical chemistry at the Sorbonne, have been elected associates of the Royal Academy of Belgium.

SIR WILLIAM J. POPE has been elected Prime Warden of the Goldsmiths' Company in succession to Sir John Mullens. Other fellows of the Royal Society who have been Prime Wardens of the Company are Mr. George Matthey, Sir Frederick Bramwell, Sir Frederick Abel, Sir J. Wolfe Barry, Mr. C. T. Heycock, and Sir Dugald Clerk.

MR. E. A. REEVES, map curator and instructor in practical astronomy and surveying to the Royal Geographical Society, has been awarded the Society's Victoria Medal. Mr. Reeves was president of Section E (Geography) at the Newcastle meeting in 1916 of the British Association, and is a distinguished cartographer. The Victoria Medal is given occasionally for purely scientific attainments, the last award being in 1927, to Sir Charles Close.

MR. H. RICHARDSON, Principal of the Bradford Technical College, has been made Officier d'Académie by the French Government. Mr. Richardson, who was formerly a Beyer fellow of the University of Manchester, was, before he received his present appointment, director of university studies in the College of Technology, Manchester, and secretary of the Board of the Faculty of Technology in the University. He has been closely concerned with the development of technical education in the textile industry. The French order 'Palmes Universitaires,' designed "to honour eminent talent and to reward services rendered to education," comprises two grades, Officier d'Académie and Officier de l'Instruction Publique. It is the former decoration which Mr. Richardson has received.

AN earthquake of moderate intensity was recorded at Kew Observatory on June 1, at 13 hr. 24 min. 51 sec. G.M.T. The epicentre is estimated to have been 5770 miles away, but the records are too small to give any indication of the direction.

THE Royal Danish Research Ship *Dana* is to leave Copenhagen about June 8 on a two years' world cruise under the command of Dr. Johannes Schmidt. We understand that both physical and biological work will be undertaken, and as regards the latter, it is expected to include much more pelagic than bottom work. All the oceans of the world will be visited, but special attention will be given to the western part of the Pacific Ocean.

OWING to numerous requests on the part of archæologists, Mr. Reid Moir will make an exhibit in London, during June and July, of specimens

illustrative of all the phases of prehistoric man as revealed in recent years in East Anglia. The exhibition, which, through the kindness of the Society of Antiquaries, is being held in its rooms in Burlington House, will open on Monday, June 18, and close on Saturday, July 7. There will be no charge for admission. The specimens will be on exhibit from 10 A.M. to 6 P.M. daily, with the following exceptions: Tuesday, June 19 and 26, 10 A.M. to 1 P.M.; Saturday, June 23 and 30, and July 7, 10 A.M. to mid-day. The exhibit will be explained by geological sections, and each group of specimens will be carefully labelled.

THE Advisory Committee recently appointed by the president of the Scottish Board of Health—the Right Hon. Sir John Gilmour, Bart., Secretary of State for Scotland—held its first meeting on Friday, June 1, at the offices of the Board, 121A Princes Street, Edinburgh, under the chairmanship of Sir John Findlay, Bart. Sir John Gilmour, who received the members of the Committee, referred to the difficulty and complexity of the problems on which the Committee has been called upon to advise, and gave an assurance that any practical proposals put forward for reducing the pollution of rivers would receive sympathetic consideration. The Committee considered the general scope of the terms of reference given to it, and resolved to carry out, as a preliminary measure, an investigation of the extent, nature, and effect of pollution on the River Tweed and its tributaries and of the administration of the Rivers Pollution Prevention Acts in that area. Evidence is to be invited on behalf of the various interests concerned.

A REMARKABLY cheap geological map of Europe has been made available by the Oxford University Press. It is not new, but is a re-issue of the map, well known to older geologists, that was prepared by Topley and Goodchild for Sir Joseph Prestwich. The size is 22 in. × 16 in., and as the map is durably mounted on linen to fold, it should, at the modest price of half-a-crown, appeal to students all over the world. Although more detail may have been presented in later and more expensive maps, the Oxford map has the very real advantage of clearly displaying the major structural features by means of a simple but effective system of colouring. Despite its age there is no reason to regard it as out-of-date, for within the limited scope of its small scale it still remains a trustworthy guide to the salient features of a continent which, in the west and south, is too complicated for detailed representation on a map of any reasonable scale. Thus, even apart from the low price, it may be confidently recommended as a most useful adjunct to the study of the geology of Europe.

THE List of Second-hand Scientific Instruments (No. 92) which has recently been issued by Messrs. C. Baker, 244 High Holborn, W.C.1, is larger than usual, for the customary January list was held over. The catalogue, which contains nearly sixty pages of matter, contains a big selection of apparatus, mainly optical in character. More than a third relates to microscopes and accessories, and the short electrical section contains instruments which were the property of the late Sir David Salamons. Photographic apparatus is now brought together in a separate catalogue, so it does not appear in the general list. Intending purchasers of microscopes or fittings, and surveying and electrical instruments, should certainly see Messrs. Baker's List No. 92.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A head of the mechanical and civil engineering department of the Technical College, Sunderland—The Chief Education Officer, Education Offices, Sunderland (June 12). An assistant librarian at Birkbeck College—The Secretary, Birkbeck College, Breams Buildings, Fetter Lane, E.C.4 (June 12). Three forest officers, on probation, under H.M. Forestry Commissioners—The Secretary, Forestry Commission, 22 Grosvenor Gardens, S.W.1 (June 14). A professor of electrical engineering under the Egyptian Ministry of Education—The Director, Egyptian Education Office, 39 Victoria Street, S.W.1 (June 14). A lecturer for production engineering at the County Technical College, Wednesbury—The Director of Education, County Education Offices, Stafford (June 16). A junior technical officer in an Admiralty Experimental Establishment—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (June 16). A temporary assistant lecturer in the training department (women) of the University College of South Wales and Monmouthshire, with special qualifications in biology and nature study—The Registrar, University College, Cardiff (June 19). An assistant in the library of Bedford College for Women—The Secretary, Bedford College for Women, Regent's Park, N.W.1 (June 20). Professors of civil engineering, mechanical engineering, and electrical engineering, at the College of Engineering, Guindy, Madras—The Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1 (June 23). An assistant lecturer in physics at the University College of Wales, Aberystwyth—The Secretary, University College of Wales, Aberystwyth (June 24). A lecturer in textile physics in the department of textile industries of the University of Leeds—The Registrar, The University, Leeds (June 25). A temporary reader in organic chemistry in the University of Dacca, East Bengal—The Registrar, University of Dacca, East Bengal (June 26). Two lecturers at the Municipal Technical College, Swansea, with qualifications in two of the following subjects—chemistry, botany, and pharmacy—The Director of Education, Education Office, Dynevor Place, Swansea (June 28). A research student in the department of medical entomology of the London School of Hygiene and Tropical Medicine—The Secretary, London School of Hygiene and Tropical Medicine, 23 Endsleigh Gardens, W.C.1 (July 7). An assistant in field husbandry at the Massey Agricultural College, New Zealand—The High Commissioner for New Zealand, 415 Strand, W.C.2. A lecture assistant and laboratory steward in the chemistry department of the Royal Technical College, Salford—The Secretary for Education, Education Office, Salford. A lecturer in geography, botany, and zoology at the Bedford Training College—The Principal, Training College, 14 The Crescent, Bedford.

Research Items.

BEISAN.—Some additional particulars of the cult objects found in the temples of Tell el-Hosn at Beisan by the expedition of the Museum of Pennsylvania to Beth-shan, are given in an account of the excavations by Mr. Alan Rowe, Field Director, which appears in the *Museum Journal* (Philadelphia) for the last quarter of 1927. Two new Canaanitish temples were discovered, bringing the total up to six, a door jamb showing a portrait of Rameses-Wesr-Khepesh, the actual builder of the temple of Dagon of 1 Chronicles x. 10, and the blackened trunk of a palm tree, proving that the date, now entirely absent from Beisan, flourished there 3400 years ago. It is known also to have been plentiful in Byzantine and early Arabic times. In the inner sanctuary of the southern temple of Thothmes III. was found the shoulder blade of a young bull, part of the animal sacrifice which was offered in the adjoining room. In this room were the altar of sacrifice, the channels for the blood, and the hole containing the remains of the wooden post to which the victim was attached. At the south end of the altar were two horns of a bull that had been slaughtered upon it, and to the west, a collar bone of a bull with a sacrificial dagger of bronze and wood. The bull was about three years old, recalling the bullock of three years offered by Hannah in Shiloh. A hole near by with small pieces of wood and a semi-circular piece of plaster, suggested that here was a pole on which the carcase was suspended for dressing, as shown in the papyrus of Anhai. A heavy bronze pendant showing a lion seizing a bull (?) was probably an amulet which hung on the neck of the victim. In the southern corridor were found hundreds of cigar-shaped clay objects, 3½ inches in length, which were doubtless votive offerings representing rolls of bread or cakes for the Queen of Heaven. Of two round objects of clay, one showed a seal impression containing the Egyptian word *imenyt*, 'daily offering,' which is here compared with 'shewbread' of Israelitish usage.

LIVER IN PERNICIOUS ANÆMIA. — Pernicious anæmia is a disease characterised by progressive blood destruction and usually terminating fatally within three or four years whatever the treatment. In 1925, Whipple and Robscheit-Robbins observed that in the treatment of experimental hæmorrhagic anæmias in dogs, a diet rich in liver exerted a remarkable regenerating effect. A little later, Minot and Murphy applied this observation to the treatment of pernicious anæmia in man, and announced last year that they had treated 125 cases of this disease, with success in practically all the cases. A number of reports by other observers has now appeared which fully substantiate the curative effect of liver treatment in pernicious anæmia (*Lancet*, April 28). The liver must be given raw, or very lightly cooked, 200 grams, or thereabouts, daily, and the diet has to be continued for weeks or months. Some individuals fail to tolerate the diet, and it needs careful regulation. Certain liver extracts may be substituted for the liver itself. The beneficial effect of the treatment is seen both in the general improvement in the patient and in the regeneration of the blood.

THE BIRDS OF CHINA.—In spite of the troubles in which its country has been plunged, the Peking Society of Natural History has been able to issue a new part of Volume I. of its *Bulletin*, containing a second and final instalment of a tentative list of Chinese birds by Messrs. Wilder, Gee, and Moffett. The part shows evidence of difficulties in production: it bears no date (the copy before us arrived at NATURE office on April 10), but the many errata might have been much reduced by careful proof-reading. The present part deals with the Passeres, and has followed modern precedent in splitting many of the older genera. The number of species in the completed list is 1028, or, if sub-species be added, 1468 forms. The list is intended to be a real guide to Chinese birds, for all the information is repeated in Chinese and the genuine colloquial names of species, as well as Chinese translations of the English names, have been inserted.

COPEPODS AND HYDROGEN ION CONCENTRATION.—Mr. A. G. Lowndes, in a paper entitled "Freshwater Copepoda and Hydrogen Ion Concentration" (*Annals and Magazine of Natural History*, Ser. 10, vol. i, April) embodies the results of several years' continual observations undertaken in order to find out the connexion (if any) between the distribution of freshwater copepods and the hydrogen ion concentration of the water in which they lived. The method was very simple, the *p*H of various pieces of water being taken directly in the field and the copepods collected being carefully identified in the laboratory. The localities studied, besides many in England, include the Island of Skye and Spitsbergen, and a large number of genera and species is recorded. The *p*H varies from 3·0 to 9·8, and although no species occurs through the whole range, yet all those studied are capable of living within a very wide margin. Thus a variety of *Cyclops longvidus* can live between *p*H 3·0 and 7·2. This copepod, selected for special observation and reared from egg to adult under the widest possible variation of hydrogen ion concentration, showed that provided calcium and magnesium salts were not present in too great a quantity, a high value of *p*H is not injurious. It bred freely, and there was no alteration in structure so far as direct measurements could show. Individuals taken from ponds with low and high *p*H showed no more variation than those taken from the same pond. It is shown from these observations and experiments that the hydrogen ion concentration can have no direct influence on *Cyclops longvidus*, and its influence on other species is probably small.

THE SHELL OF TORTOISES.—It has been shown that plates of bone, superficial to the true bony skeleton, occur in the carapace and plastron of certain tortoises, and Oliver P. Hay has suggested that these represent the relics of a primitive superficial armour, which still remains almost complete in the leather-back turtle, *Dermochelys*. In a second contribution on the subject (*Proc. U.S. Nat. Mus.*, vol. 73, art. 3) Hay describes these epithecal bones in another specimen of the South American "matamata," *Chelys*. He considers that primitively the horny scutes upon the surface of a tortoise's armour coincided with epithecal ossicles, but that in the highly developed thecophorous turtles the coincidence no longer exists. This leads him to suppose that, contrary to the usual view, the horny shields had primarily no relation to the costal plates, but were intimately related to a more superficial series, the epithecal plates. As a result of the ultimate suppression of the latter in the course of ages, the horny shields were brought into contact with the more deeply lodged thecal bones. The shields themselves do not grow at their edges merely, but a new layer of horn is laid down upon the whole inner face.

FLOWERING PLANTS OF THE PANAMA CANAL ZONE.—The Smithsonian Institution of Washington, D.C., has just published a handbook on the flowering plants

of the Panama Canal Zone. It is the work of Paul C. Standley, of the National Herbarium, and is the result of co-operation of the Smithsonian Institution, the U.S. Department of Agriculture, and the Canal Zone Authorities. The handbook is on the popular plan and will be found useful to lumbermen, horticulturists, and casual visitors. Since many of the plants of the Canal Zone are common to all Central America and the West Indies, the usefulness of the book is correspondingly increased. Besides a brief description of each plant, the author discusses its history, gives all the vernacular names so that the plant can be readily identified locally, and a résumé of its uses.

COLOUR VARIETIES OF RICE.—A study of colour inheritance in rice has been made by Messrs. Mitra, Gupta, and Ganguli (*Memoirs Dept. Agric. India*, Bot. Series, vol. 15, No. 4) in Assam. The amount of natural crossing is found to be so low as 0·5 per cent, perhaps owing to the heavy rains and morning dew preventing the aerial transference of pollen. The colours of different parts of the rice plant are inherited independently, although there may also be correlation of colour in these parts, which include the leaf-sheath, pulvinus, ligule, auricle, internodes, outer and inner glume, stigma, and kernel. The pigmented cell sap may give red, yellow, brown, purple, and black colours, but they usually disappear from the mature plant except in the spikelet. Purple is dominant over green or white, red over white, green or yellow over brown, and black over green or yellow, and dominance may also be incomplete. Purple, pink, brown, yellow, red, and black colours appear in a series of shades determined by independent colour factors. When coloured and non-coloured factors were crossed, a Mendelian 3 : 1 ratio generally resulted, but in more complicated cases 9 : 7, 9 : 3 : 4, 9 : 6 : 1, etc. Thus the pulvinus is white or purple, and when certain forms with white-green pulvinus were crossed together, the F_1 was light purple (intermediate), while the F_2 gave a ratio of 9 purple : 7 green. In one case white × white stigma gave 15 white : 1 purple stigma in F_2. A detailed study of the colour inheritance in various organs is useful in delimiting the many varieties of cultivated rice.

NEW CALIFORNIAN MIOCENE MOLLUSCA.—New species of mollusca, and one *Serpula*, from the Vaqueros and Temblor formations of the Californian Miocene are described by L. W. Wiedey (*Trans. San Diego Soc. Nat. Hist.*, vol. 5), no attempt, however, being made at present to monograph the faunas as a whole. The material has been collected from widely scattered localities in the State south of the San Francisco Bay region. A historical view of the two formations precedes the systematic description of 34 new species (including the *Serpula*) illustrated on 13 very good plates. The faunas of both present warm-water aspects in their assemblages of genera. While the preceding Upper Oligocene fauna was predominantly of cool-water nature, an invasion of many truly tropical genera took place during the Vaqueros, which was succeeded by somewhat cooler conditions during the Temblor formation, when a warm temperature type is indicated as having prevailed.

THE LUNAR PERIODICITY OF EARTHQUAKES.—During the year 1927 the seismographs at the Hawaiian Volcano Observatory recorded 1149 local earthquakes (*Volcano Letter*, No. 170, Mar. 29). Among them, the regular recurrence of times of increased seismic activity was too noticeable to be set aside as accidental. These epochs of greater activity occur at intervals of about two weeks and near the times of the first and last quarter phases of the moon. According to Perrey's first law, similar epochs coincide nearly with the times of new and full moon, but it should be remembered that Perrey's law relates to ordinary earthquakes, while most of the Hawaiian tremors are of volcanic origin.

EXPLORATION IN NOVAYA ZEMLYA.—The exploration of Novaya Zemlya, in spite of a Norwegian expedition a few years ago, was far from complete when in 1921 the Russian Institute for the Exploration of the North begun a series of systematically planned expeditions. The work has continued year by year up to the present, under the direction of Dr. R. Samoilovitch, who gives a summary with map in *Arktis* (Heft 1/2; 1928). The most important part of the work lay on the survey and geological examination of the east coasts, particularly of the northern island, which were previously imperfectly known. A great deal of oceanographical work was also done, including an examination of the fauna of the shore waters and the currents of Kara Strait. Favourable ice conditions in 1927 allowed a cruise to Franz Josef Land and back, on which many oceanographical stations were made. When the results are available, they should fill some of the gaps in the knowledge of the Barents Sea.

COAL-SEAMS OF NORTHUMBERLAND AND DURHAM.—During the past few years, Dr. Wm. Hopkins has been collecting evidence bearing on the correlation of the coal-seams of the north-east coalfield of England, and his results and conclusions, now published (with a very full discussion) in the *Trans. Inst. Min. Eng.* (vol. 74, pp. 221-241; 1927; and vol. 75, pp. 49-59; 1928), constitute an important contribution to our knowledge of a field which until recently has been unduly neglected. Dr. Hopkins has modified the hitherto accepted correlations of some of the more important seams, and the scheme which he advocates is illustrated by two plates of vertical sections. The sources of evidence collected from pit to pit include the thickness, lithological characters, and sequence of the beds intervening between the seams, and in particular the characters of the fossil bands associated with the seams. Some of the mussel bands can be used to confirm or modify the tentative conclusions based on other lines of evidence, and the 'ostracod band' above the Harvey seam, comprising a unique assemblage of mussels, annelids, and ostracods, affords a particularly valuable datum plane, since it can be traced over the greater part of the field, and is everywhere stamped with a succession of characters not simulated in any way by the other fossil bands of the area. Dr. Hopkins has brought into order a confused mass of data, and has established a general framework which itself suggests new problems for future investigations.

RYDBERG TERM TABLES.—Rydberg's tables of $N/(m+a)^2$, which have been invaluable in the analysis of the series spectra of neutral atoms, contained several errors as they appeared in the standard "Seriengesetze der Linienspektren" (Paschen-Götze). They have been reprinted in a corrected form in the April number of the *Journal of the Optical Society of America*, together with the four-, nine-, and sixteen-fold numbers appropriate to the spectra of singly, doubly, and trebly ionised atoms respectively. The computing has been done partly by Prof. Paschen himself, and partly by Messrs. C. J. Humphreys, J. E. Mack, and R. A. Sawyer. The last-mentioned author, who was recently associated with Prof. Paschen in the analysis of the first spark spectrum of aluminium (Al II), has translated a short article by the latter describing the method of use of the tables.

OIL AND GAS AT BELL SPRINGS, WYOMING.—The enterprise of the American people in continuing their detailed search for oil in the Rocky Mountain region, despite the excessive over-production of this commodity which that country, hence the world at large, is experiencing, is in many respects remarkable. It is attested periodically by the appearance of appropriate bulletins of the United States' Geological Survey, of which No. 796—D, the work of Messrs. C. E. Dobbin, H. W. Hoots, and C. H. Dane, is the latest example. Perusal of this account of the Bell Springs region does not encourage the belief in any ultimate discovery of a second Salt Creek, the one really big oilfield which this State, incidentally the whole Rocky Mountain region of the United States, has produced. On the contrary, save for the striking of dry gas at the top of the Cloverly formation (Cretaceous) on what is known as the Separation Flats structure, little of economic interest seems to have eventuated from some eight years of exploration. Technically this dry gas, in really large quantities, presents some interesting problems, both to the geologist and to the engineer. In this case, the first yield was at the rate of 11,000,000 cubic feet per day, which was afterwards increased by drilling 30 feet deeper to 15,000,000 cubic feet, at a pressure of 860 lb. per square inch. Ordinarily, it might have been presumed with reason that further drilling would reveal the presence of some petroleum, but, instead, the well in question went to water, and all attempts to shut it off by plugging back to the gas zone, failed. The moral seems to be that in this Rocky Mountain region large quantities of *dry* gas (in itself entirely a commercial proposition providing it occurs in accessible areas and can be economically fed to centres of civilisation, as in Alberta, Canada) tend to be indicative of the absence of petroleum in any magnitude. The literature is full of similar examples from this region, and the chief problem raised is that of the genesis of the gas: how it comes about that such enormous quantities of dry gas are formed without the accompanying achievement of mineral oil. Alternatively, if petroleum was formed initially, what has become of it ?

STANDARDISATION OF SILVER NITRATE SOLUTIONS FOR USE WITH SEA WATER.—For more than twenty-five years standard sea water obtainable only from the Hydrographic Laboratories of Copenhagen has been used for the standardisation of silver nitrate solutions used in oceanic investigations. Several criticisms of this standard have appeared recently, and in the *Journal of the American Chemical Society* for March, T. G. Thomson describes experiments from which he concludes that the use of pure sodium chloride solutions and ordinary standard apparatus gives equally accurate results. Two solutions of silver nitrate were estimated, with both pure sodium chloride solutions and standard sea water from the Hydrographic Laboratories. The results obtained with each standard closely agreed within the limits of experimental error. The empirical formula $Cl_w = 0.008 + 0.99980\ Cl_v - 0.001228\ Cl^2_v$ was derived for the conversion of the chloride per litre at 20° C. to the chlorine per kilogram; Cl_w represents grams of chlorine per kilogram and Cl_v grams per litre.

COAL CARBONISATION TESTS.—In accordance with the established scheme of the Department of Scientific and Industrial Research, a test has been carried out on another type of plant for carbonising coal at low temperatures (Department of Scientific and Industrial Research. Report of Test by the Director of Fuel Research on the Crozier Retort installed by Mineral Oils Extraction, Limited, at Wembley. (London: H.M. Stationery Office, 1928. 9*d*. net.). This retort was designed primarily for the treatment of shale. It is a vertical retort of elongated cross-section externally heated, but having as a special feature cross flues at five levels, whereby the heating gases are carried through the body of the charge. The retort is operated intermittently, but might conceivably be worked continuously. Owing to the elaborate internal construction, it cannot be used with coking material and the actual test was made on a Scotch splint coal with scarcely any tendency to fusion. The yields (per ton) were: coke 15·4 cwt., gas of low calorific value 23·9 therms, tar 16·4 gal., crude spirit 0·8 gal., ammonium sulphate 9·1 lb. From the results given, it is clear that the plant has a limited field of service so far as coal is concerned, and from the account given of the test, it seems as though there is room for considerable perfection in details of design.

THE QUANTUM YIELD IN THE PHOTOCHEMICAL DECOMPOSITION OF NITROGEN DIOXIDE.—From the pressure changes which occur when nitrogen dioxide is exposed to the radiation from a mercury vapour lamp, Norrish concluded that to a certain extent nitric oxide and oxygen are produced by photochemical decomposition of the dioxide. In the *Journal of the American Chemical Society* for March, R. G. Dickinson and W. P. Baxter describe experiments which confirm this view and afford measurements of the quantum yield of the reaction with monochromatic radiation. The conditions were arranged so that the pressures of the reaction products were sufficiently low (less than 0·1 mm.) for their rate of recombination to be very slow. The reaction could thus be considered simply as a decomposition rather than a photochemical equilibrium. After exposure, the nitrogen peroxide was frozen out with liquid air and the pressure of the residual gas measured by means of a quartz fibre gauge. The yield was found to be largely independent of the pressures of NO_2 and N_2O_4, but was greatly influenced by the wave-length of the radiation. It is assumed that the first step in the reaction is the absorption of a quantum by a molecule of NO_2, which then reacts with an unactivated molecule: $NO_2 + h\nu \longrightarrow NO'_2$; $NO'_2 + NO_2 = 2NO + O_2$. In the absence of degradation to heat or other loss of energy, the yield should be unity. The most effective wave-length used was 3660 A., which gave a yield of 0·77.

THEORY OF THE AUTOGYRO.—An autogyro obtains remarkably high lift forces from a system of freely rotating blades, and it is important to develop a theory which will explain the behaviour of an autogyro and will provide a method of estimating the effect of changes in the fundamental parameters of the system. In R. and M. 1111, Aeronautical Research Committee (London: H.M. Stationery Office, 1928. 1*s*. 6*d*. net) Mr. H. Glauert develops a theory depending on the assumptions that the angles of incidence of the blade elements are small, that the interference flow is similar to that caused by an ordinary aerofoil, and that only first order harmonics of periodic terms need be retained in the equations. An alternative method of analysis by considering the energy losses of an autogyro is developed in an appendix to the main report. The maximum lift coefficient of an autogyro, using the disc area as fundamental area and the forward speed as fundamental speed, lies between 0·5 and 0·6 in general, and the best lift-drag ratio is of the order of 6 or 8 at most. Moreover, since it is necessary to maintain a sufficient ratio of tip speed to forward speed, the stalling speed of an autogyro must rise with the maximum speed of level flight, and so the principal merit of the autogyro system, the low landing speed, would disappear in the case of high speed aircraft.

The Cracking of Lead Cable Sheathing.

A PAPER on the important practical subject of "The Deterioration of Lead Cable Sheathing," by Messrs. S. Beckinsale and H. Waterhouse, read at the spring meeting of the Institute of Metals, represents work done in the Research Department, Woolwich, for the British Non-Ferrous Metals Research Association. The authors have examined a large number of lead cable sheaths which have failed in service by inter-crystalline cracking, and it was found in all cases that the material which had failed was lead of a high degree of chemical purity. It has been suggested that this type of cracking may have resulted from overheating during the extrusion of the sheath. It is shown, however, in the present paper that for lead of the composition generally used, working can be done from room temperature up to within a few degrees of the melting point without leading to cracking, and the only difference observed in the lead rolled at different temperatures was that the grain size tended to increase as the temperature was raised. It was not found possible to reproduce any cracking corresponding with that observed in service by variations of the working temperature.

It has been observed previously that the structure of the same cable sheath varies very appreciably so far as the size of the crystals is concerned. This point has been taken up with considerable care by the present authors, and they have shown that there is no probability that appreciable grain growth has occurred during service. They have also failed to find any reason to believe that there is a relationship between the frequency of the cracking and the crystal size. This type of cracking has also been attributed to allotropic changes in the lead, but careful work, both pyrometric and mechanical, has failed to reveal any evidence of such allotropic change, and it is considered that the possibility of such things being in any way responsible for the cracking must be dismissed.

Cracking is well known to occur in brass which is subjected to the simultaneous effect of stress and corrosive action. Similar cracking in lead has been obtained under the combined action of tensile stress and corrosion with solutions of acetic acid or lead acetate. It is not believed, however, that such corrosive attack can have any important bearing on the present subject, since it was observed that the cracking in service commenced on the inner surface of the sheath and spread outwards, and that it was not until the cracks had reached the exterior surface that the slightest evidence of local corrosion of the inner surface could be detected. It was shown, however, that while silver, copper, bismuth, and nickel all diminished the resistance of lead to corrosion in soluble acetates, arsenic, cadmium, and particularly tin and antimony, all rendered lead more resistant. There are cases on record where acetic or some other organic acid appears to have played an important part in the failure by corrosion of lead sheet and cable sheathing which had been in contact with oak, though pitch pine and deal appear to be without action. Creosote, if free from acetic acid, also has no influence in the production of inter-crystalline cracking.

The failure of the sheathing occurs generally in situations subject to vibration, or where the metal is subject to changes of length due to fluctuations of temperature, and the view that the cracking is due to 'fatigue' is one for which there is considerable support. Fatigue tests have been carried out which indicate a range of stress at the fatigue limit of approximately only 0·18 ton per square inch, and cracks were found in the fatigue test pieces which bear a striking relationship to those in the cable sheathing which had failed.

Since the cracking in service was thus in all probability due to fatigue, experiments were carried out with lead alloys in which the fatigue limit was higher. Even very small amounts of metals, such as bismuth and silver, which are regarded as undesirable impurities in certain respects, have a beneficial effect in raising the fatigue limit. The most satisfactory method of doing this, however, is to use the binary or ternary alloys of lead containing tin, antimony, or cadmium; 0·5 per cent of cadmium increases the fatigue limit to more than three times that of pure lead, while similar increases can be obtained by using ternary alloys containing cadmium and either tin or antimony. These ternary alloys have not only a high fatigue limit, but they also have a permanence of composition during melting and a resistance to oxidation at raised temperatures which are superior to those of the binary alloys, while in addition they possess good corrosion-resisting properties. F. C. T.

University Statistics,[1] 1926–27.

SINCE the acceptance by Oxford and Cambridge of annual parliamentary grants and the consequent inclusion of these two universities in the University Grants Committee's returns, these statistics have presented a fairly comprehensive survey of university work in Great Britain. For five years now the returns have comprised all universities and, with few exceptions, all university colleges in Great Britain, and it seems a pity that they are not supplemented by others, in identical form, for the excepted institutions.

The total number of full-time students of both sexes in 1926–27 was 42,354. The proportion of women to men has risen during the past five years from 14 : 36 to 15 : 35. In England as a whole women formed, in 1926–27, 28·3 per cent of the total number; in Wales, 39·3 per cent; in Scotland, 34 per cent; in London institutions, 35·7 per cent. Since the War the large body of students aided under the government scheme for the higher education of ex-service men has obscured the situation in regard to student enrolments. As this large body has gradually passed out of the universities the total number of men students has continuously fallen until 1925–26, when only 17 of the ex-service scholarship holders remained. Now for the first time the actual tendencies of student enrolments to increase are exhibited in the returns, which show an increase of 748 (men 658, women 90) over the number of full-time students in the preceding year. If from the figures shown in the returns for preceding years the number of ex-service scholarship holders are deducted, the decreases shown in 1925–26 and 1924–25 are converted into increases of 58 and 360 respectively, and the decrease in 1923–24 is reduced to 113. Similarly, the increase in the proportion of women is converted to a slight decrease.

[1] Returns from Universities and University Colleges in receipt of Treasury Grant, 1926–27. (London: H.M. Stationery Office, 1928.) Pp. 24. 3s. net.

Since 1922–23 a very remarkable change has taken place in what may be called the balance of university studies—the distribution of full-time students among the main subject groups. Between 1913–14 and 1922–1923 the returns (in which, as already stated, Oxford and Cambridge were not included) showed a fall of more than five per cent in the percentage of the total represented by students in the arts group (including theology, fine art, law, music, commerce, economics, and education), whilst the percentage represented by the medical group rose by more than three, and the percentage of the other three groups, pure science, technology, and agriculture, rose very slightly. Since 1922–23, on the other hand, the returns, including now Oxford and Cambridge, show a rise in the percentage of the arts group from 40·8 to 51·7, whilst the number of students in that group has risen by above 3500, despite a fall of more than 2000 in the grand total of students. The position of the pure science and agriculture groups has remained fairly steady, but for the medical and technology groups both percentages and actual numbers have markedly decreased, namely, from 11,866 (26·6 per cent) and 5567 (12·5) to 8415 (19·9) and 3970 (9·4) respectively. The greatest changes were in Scotland, where the percentage of the medical group fell from 35·2 to 22·7, while the percentage of the arts group rose from 38·9 to 56·1.

This extraordinary rise in favour of the arts group of subjects is attributed by the University Grants Committee to the attraction exercised, during a period of bad trade and restricted opportunities in other professions, by the improved prospects offered by the profession of teaching. This explanation is supported to some extent by statistics of teachers in grant-aided secondary schools in England and Wales. Between 1922 and 1927 their total number increased by 676, while the number of those of them who were university graduates increased by more than two thousand,—from 11,937 to 14,019—the increases year by year being 241, 419, 552, and 870. Clearly the teaching profession has been absorbing a largely increasing proportion of the universities' output of graduates. The falling off in the number of the technological students is, the Committee considers, due to the continuance of serious depression in many industries.

A similar rise in favour of the arts group of subjects and decline in number of students of technology are disclosed by recent statistics of university education in Prussia. The years 1924 to 1927 have seen in Prussia a steady decline in the student enrolments of the Technischen Hochschulen from 8603 to 7936, whilst most of the subjects grouped under the heading of arts show an increase, which is most noticeable under modern languages. Of interest in this connexion are the following extracts from the United States Bureau of Education's biennial survey of higher education, 1924–26: "Immediately after the War . . . the idea gained ground that educational institutions should emphasize training to very specific objectives. The two-year period under review gives many indications that there has been a decided reaction . . . a returning faith, if not in the disciplinary value of the so-called cultural subjects, at any rate in their practical value and in the habits of application developed by the exertion required to master them."

A new table, introduced for the first time last year, classifies research and other advanced students under the branches of study in which they were engaged. Under certain branches of science it gives the following numbers of full-time advanced students: chemistry 511, engineering 141, physics 132, botany 83, geology 52, mathematics 47, zoology 43, metallurgy 42, agriculture 35, physiology 33. Commenting on the dominant position of chemistry, the Committee suggests that the other sciences, and especially the biological sciences other than medicine, have been far too much neglected by advanced students at the universities. It observes also in regard to chemistry that the immediate demand is more for men who have combined a study of this subject with such other subjects as engineering, agriculture, bio-chemistry, and botany than for men whose special knowledge is confined to the ordinary branches of pure chemistry.

Annual Visitation of the Royal Observatory, Greenwich.

THE visitation of the Royal Observatory, Greenwich, took place on Saturday, June 2, and was attended, as usual, by a large gathering of astronomers and their friends. The Astronomer Royal presented his report for the year ended on May 10 last.

The usual observations of sun, moon, planets, and stars were made with the transit circle. The moon's longitude was 6·2″ in advance of that given by Brown's tables. The residual has been diminishing by 0·2″ per annum since the new tables were introduced in 1923. The latitude is systematically south of the tables by ¾″. It will be remembered that Brown removed the constant term of 1″ which Hansen had applied to the latitude, but the observations show that some such term is needed. The catalogue of 11,000 stars between declination 32° and 64° is making good progress, and should be finished in 1930. The stars selected as comparison stars for Eros in 1931 are also being observed; they are so closely packed that it is difficult to get sufficient observations of each of them.

A re-discussion of the declinations of stars near the pole shows that there is no evidence of secular change of latitude since the erection of the transit circle in 1851. The observations would scarcely permit of a greater change than 0·1″ per century. The observations with the Cookson floating zenith telescope have been discussed both for latitude variation and aberration. The aberration constant for the seven years 1919–26 is 20·447″; that for the previous seven years was 20·442″; the corresponding values of the solar parallax are 8·814″ and 8·816″. The parallaxes of 39 stars were determined from photographs with the Thompson equatorial, bringing the total up to date to 369 stars.

Spectroscopic observations of the 'colour-temperature' of early-type stars have been continued with the 30-inch reflector; the spectroscope has been modified by the substitution of a mirror for the lens; this enables the investigation to be carried farther towards the red end of the spectrum, which previously was in bad focus. The micro-photometer has also been modified to permit shorter sections of the spectrum to be measured, thus avoiding regions of absorption. The 30-inch reflector was also used for the photography of comets Grigg-Skjellerup and Pons-Winnecke. The latter was photographed when very near the earth, its angular motion being nearly equal to that of the moon. Its nucleus at that time was quite small and stellar, permitting accurate measures to be made.

The astrographic equatorial is being used for

determining proper motions in the Greenwich zone, by re-photographing fields taken twenty-five to thirty years ago. The zone from declination 73° to 77° has been under observation during the year. Special attention has been paid to stars measurable as double stars on the plates; Dr. Groot published a paper on these stars in the *Mon. Not. R.A.S.* for last November.

The egress of Mercury at the transit of last November was observed both visually and photographically. Three consecutive transits of Mercury (those of 1914, 1924, and 1927) have been well observed at Greenwich; the first of the present century, that of 1907, was also seen by glimpses, but the contacts could not be observed.

The mean area of spots on the sun in 1927 was practically the same as in 1926. The first four months of 1928 show no appreciable change. The indications at present point to a flat maximum like that of 1907 and lower than that of 1917. The curve for the last four cycles supports the result obtained from magnetic polarities of spots, that the complete cycle comprises two eleven-year periods. An interesting album was exhibited showing photographic traces of the more remarkable magnetic storms in juxtaposition with photographs of the sun's disc at the time; in most cases there was a large sunspot near the central meridian, or a region that had been active not long before. The subject is under further investigation.

The Astronomer Royal refers with satisfaction in his report to the successful results obtained at Giggleswick in the solar eclipse of June 29. One investigation that failed at that time, the comparison of the calcium doublet in the infra-red with the *H* and *K* lines, was afterwards carried out at Greenwich with a larger dispersion. The line at 8542 A. was found to be somewhat more intense than *K*. Preparations are being made for observing the eclipse of 1929, total in the Malay peninsula; Dr. Jackson and Mr. Melotte are going, and will make further investigation of the gravitational bending of light.

Magnetic observations are now made at Abinger. The results for the last three years are:

	Decl. W.	Hor. Force.	Vert. Force.	Dip.
1925	13° 22·7′	0·18597	0·42946	66° 35·1′
1926	13 10·4	0.18581	0·42947	66 36·3
1927	12 58·4	0·18575	0·42932	66 36·2

The result for 1925 is the mean of the ten months February–November. The greatest daily movement of the air was 1003 miles on Feb. 11. Interesting traces of the sudden variations in temperature, direction of wind, and barometric pressure on this day, due to the passage of a 'line-squall,' were exhibited. The rainfall for 1927 was 27·78 inches, being 3·54 above the average. There were 82 entirely sunless days, the total bright sunshine being 27·4 per cent. of the possible amount.

The time service is now based on weekly observations with a small reversible transit instrument; it is found that the results of this differ in the mean by 0·09 sec. from those with the transit-circle. The Shortt clocks are so reliable that their rate can be trusted for a week. With reference to the distribution of Greenwich time from the broadcasting station at Rugby, the Astronomer Royal notes that the distribution of time by galvanic signals was suggested by Airy in his report for 1849 and carried out on a small scale in 1852. Note is made of the indebtedness of the time department to the enthusiasm, care, and patience of Mr. Bowyer.

A. C. D. CROMMELIN.

University and Educational Intelligence.

CAMBRIDGE.—Dr. A. E. Barclay, Christ's College, has been appointed lecturer in medical radiology and electrology. Mr. W. N. C. van Grutten, King's College, has been appointed an assistant secretary to the Appointments Board.

Prof. G. H. Hardy gave the Rouse Ball lecture on June 6 on the subject "Mathematical Proof."

The chair of astrophysics was partially endowed by an anonymous donor in 1913, and it is reported that this donor has now paid over £12,000 to the University, a sum greater than the money originally offered to the University.

LONDON.—The title of reader in physics in the University has been conferred on Miss M. O. Saltmarsh as from May 17 last, in respect of the post held by her at Bedford College. Dr. Saltmarsh studied at Girton College, Cambridge, and for two periods was engaged on research work in physics at the Cavendish Laboratory. Since 1910 she has been respectively demonstrator, assistant lecturer, and lecturer at Bedford College. She was granted leave of absence by the College Council to give visiting lectures to the department of physics at Vassar College, Poughkeepsie, N.Y., U.S.A., in 1920–21. Her recent published work has been on spectrum analysis.

Applications are invited for the Graham Scholarship in pathology, value £300 per annum, and tenable in the first instance for two years, founded to enable "a young man to continue his pathological researches and at the same time to secure his services to the school of advanced medical studies connected with University College Hospital as a teacher under the direction of the professor of pathology." Applications must reach the Academic Registrar, University of London, South Kensington, S.W.7, by June 26.

The following post-graduate studentships are being offered by the Council of Bedford College for Women: Amy Lady Tate research scholarship, value £125 for two years, and an anonymous research studentship, value £100 for one year. Candidates must be graduates of Bedford College in the faculty of arts or science. Applications must reach the Secretary of the College, Regent's Park, N.W.1, by June 27.

THE Research Prize awarded by the Scientific Club of Winnipeg for the best research work done in the University of Manitoba during a period of three years by a recent graduate, has been divided between Leonard B. Clark and Charles F. Goodeve, whose work was carried on in the Departments of Zoology and Chemistry respectively.

THE Streatfeild Research Scholarship in medicine and surgery, the annual value of which will probably be £250 and the tenure three years, will shortly be awarded. Applications, which should state the nature of the proposed research, the place where it will be carried out, and the status of the applicant, should be sent to the Registrar, Royal College of Physicians, Pall Mall East, S.W.1, by, at latest, June 29.

VACATION courses in glass-blowing and instrument-making have been arranged for by the Society for the Advancement of the Training of Instrument Makers (Vereeniging tot Bevordering van de Opleiding tot Instrumentmaker), for the latter half of August, in the Physical (Cryogenic) Laboratory of the University, Leyden, Holland, particulars of which are obtainable from Dr. C. A. Crommelin of that laboratory.

Calendar of Customs and Festivals.

(Addenda to May) May 29.

RESTORATION OR ROYAL OAK DAY.—Established by Act of Parliament and first celebrated in 1665 as a day of general thanksgiving for the restoration of Charles II. to the throne. It was, and still is, marked in popular observance by the wearing of an oak leaf, which at one time used to be gilded, associating the day with the story of the king's escape from the Parliamentarians by hiding in an oak. The alternative name "Oak Apple Day" was justified by the requirement in some localities that the sprig of oak should bear galls, and at Northampton, when the corporation went in procession to All Souls' Church, the charity boys and girls each wore a gilt oak apple on a sprig of oak, for which gilded potatoes were substituted if no oak apples were obtainable.

The simple form of celebration by wearing an oak leaf has been supplemented in various localities by other observances, which, it is most probable, must be regarded as transferences derived from the May Day celebrations. In Derbyshire, for example, oak boughs were hung over the doors of houses; at Basingstoke, and in the neighbouring towns, bands of men gathered oak sprigs which they hung on knockers, latches, and other parts of the doors of houses, a service for which they expected gifts of beer, etc. Garlands were sometimes hung on the doors of houses. At Durham, May 29 was one of three days on which the Dean and Chapter caused twenty shillings in copper to be scrambled for, a custom known as 'push penny,' which antedated the Restoration and went back to monastic times. The choir sang anthems from the large tower, also a May Day custom.

In Devonshire, at Starcross, the connexion with May Day was indicated by the children's custom of carrying about May babies in boxes which resembled coffins; and at Tiverton a procession included an 'Oliver'—a character dressed in black with hands and face smeared with soot, and his body bound with a strong cord, who capered ridiculously and was pelted with dirt and stones by the crowd—and a throne of oak boughs on which a child was seated.

RIDING THE MARCHES.—In Scotland, a custom analogous to that of 'beating the bounds' in England, was observed in certain districts at the end of May. At Hawick it took place on the last Friday in the month, when the standard of the town was carried by a cornet followed by the magistrates and burgesses round the boundaries, and formal demonstration of their legal rites was made. An ancient song celebrating the border contests with the English was sung by the cornet from the roof of an old tenement belonging to the town. At Inveresk this custom of riding the marches was observed once in fifty years, when a company armed with spears and including a minstrel and a fully armed champion paraded the boundaries.

June 11.

ST. BARNABAS.—On this feast it appears to have been the custom to decorate some churches with garlands of roses and woodruff. Entries to this effect appear in the accounts of St. Mary-at-Hill, London. For 1512 the entry runs: "Rec'd of the gadryng of the Maydyns on St. Barnabas Day vjs viijd."

A miraculous walnut tree which grew beside the holy thorn in the churchyard of Glastonbury Abbey never budded before St. Barnabas Day, but on that day shot forth its leaves. Cuttings from this tree were much in request at a high price, even after the Reformation, King James I. being among those who obtained them.

St. Barnabas Day was proverbially the longest day and shortest night, as indeed it would be under the Old Style, and storms were believed to be prevalent on this day.

At the parish of Hesket, in Cumberland, the Court of Inglewood Forest was held annually on St. Barnabas day in the open air. The suitors assembled on the highway side at a place marked by an ancient thorn, paid their annual dues to the lord of the forest and selected juries from among the twenty manors forming part of the demesne. Cumberland being one of the counties in England in which evidences of Norse influence are especially notable, it is not surprising to find here a survival of the Scandinavian institution of the open air communal assembly, the *thing*, and that it should be associated with a tree traditionally held in regard. The ash was also especially reverenced by the northern nations. In their legendary beliefs it was the ash tree Yggdrasi which supported the earth. There is ample evidence of the sacred tree in British folklore. In Irish belief there were five trees, situated in different parts of the country, which were looked upon with veneration as having magical properties. Of these one was a yew, one an oak, and two were ashes. The fall of these five magical trees was held to signify the triumph of Christianity over paganism. Down to historical times each tribe in Ireland possessed a sacred tree—which in some sort symbolised the existence of the clan, for if it were hewn down by an enemy it signified the overthrow of the clan. An oak tree near Oswestry, known as Mile Oak, was popularly associated with St. Oswald and was held inviolable. Many place names indicate a derivation from an association with a thorn, an ash, or an oak. Among the Celtic peoples, the hazel was specially venerated.

Tree worship was prevalent in early times among all Aryan-speaking peoples. The sacred fig-tree of Romulus in the Forum at Rome was worshipped down to the time of the Empire, and on the Palatine Hill was a cornel tree which was esteemed one of the most sacred objects of the city. At Benevento was a sacred walnut tree which was especially noted in the popular imagination as a meeting-place of witches.

June 15.

ST. VITUS DAY.—This day seems to have been connected with rain in the same way as St. Swithin. If it rained on this day, according to a popular proverb, it would rain for thirty days. Offerings were made to St. Vitus on this day as a protection against disease, and in particular against the disease with which the saint's name is associated. The reason for this association is not known. The saint, who was a native of Sicily and was martyred about A.D. 303, in an entirely legendary account which confuses two different persons, is said to have cured a son of Diocletian of possession—historically an impossibility—also Diocletian had no son.

ST. VOUGAS or VIE (sixth century), venerated especially at Treguenec in Brittany, an Irish bishop who, like many other Irish saints, sailed on a stone across the sea. A rock off the coast of Brittany is traditionally known as 'the Ship,' and it is supposed to be that which served St. Vie. He is associated with a sacred grove. When a church dedicated to him was built on the spot where his relics had been revered, a wood was cut down. His relics at Treguenec were visited by pilgrims who sought relief from fever. In Ireland, in Carn parish, Co. Wexford, are a church and well dedicated to St. Vauk or Vaak.

Societies and Academies.

LONDON.

Physical Society, May 11.—**E. G. Richardson**: The amplitude of sound waves in resonators. After a consideration of the relations between the 'pipe' and the 'Helmholtz resonator,' graphs of the variation of amplitude, obtained by means of a hot-wire anemometer traversed through various types of resonator, are reproduced. By means of a calibrated manometer of the vibrating membrane type, some direct values of the impedance of orifices are obtained. Traverses across an orifice through which the air is vibrating in simple harmonic form are obtained with the hot wire: these show a tendency for the air to vibrate with greater amplitude in annuli remote from the centre of the orifice.—**R. E. Clay**: The focus of a gas-filled X-ray tube. Pinhole photographs of the focus obtained with various radii of curvature of the cathode and various distances from the anticathode are discussed; it is concluded that with the tubes of the type considered, a radius of about 2 cm. and a distance of 3 or 4 cm. are the best conditions.

Royal Statistical Society, May 15.—**D. Caradog Jones**: The cost of living of a sample of middle-class budgets. The budgets were divided into three groups, representing, respectively, families living in London, in large towns with a population exceeding 50,000, and in smaller towns and country places. For families of about the same type, the budgets revealed a higher level of expenditure in the small towns than in the large towns. This seems to be due in part to the higher cost of living experienced rather than to the higher standard of living enjoyed there. On an average, out of a total family expenditure of between £400 and £500 a year, in round numbers 40 per cent is spent on housekeeping and service, 20 per cent on rent, rates, fuel and light, 10 per cent on clothing, 10 per cent also on holidays, clubs, and recreation, 5 per cent on insurance. In general, the proportion of the total income spent on the necessaries of life, such as food and house-room, tends to fall as the income rises. In the normal middle-class family, nearly 40 per cent of the total food bill represented expenditure on meat, fish, bacon, etc. The dairy products, milk, butter, eggs and cheese, came next in order of importance, costing about two-thirds as much as the first group. Bread, including cakes and biscuits, and also fruit and vegetables, each accounted for roughly half as much as the dairy group. There was then a drop to 5 per cent for jam and sugar, and for tea, coffee, cocoa, etc. When this group of middle-class families is compared with the Sumner Committee group of working-class families, it is found that the middle class spend relatively more on meat, milk, and fruit, while the working class spend more on bread, tea, and sugar.

PARIS.

Academy of Sciences, May 7.—**G. Bigourdan**: The various methods used for the calculation of pendulum corrections. It is usual to employ one master pendulum and several subsidiary pendulums. The most exact method implies a continuous comparison of all the pendulums in order to eliminate any temporary irregularity in any one of them. Other methods in use are adversely criticised.—**Pierre Termier** and **Eugène Maury**: New geological observations in eastern Corsica: phenomena of crushing and lamination: mylonites and tectonic breccia—**Georges Claude**: Obtaining energy from the sea. In connexion with this project, a 50-watt turbine has been made, which, working between 15° and 35° C. gives power of 40 kilowatts.—**Louis Roy**: The intrinsic equations of elastic surfaces with three parameters.—**C. Sauvageau**: The question of *Tilopteris Mertensii*. Observations tending to prove that this alga multiplies by simple budding. There is no alternation of generations.—**Maurice Caullery** was elected a member of the Section of Anatomy in succession to the late F. Henneguy.—**V. Hlavatý**: The second fundamental form II.: generalisation of the theorem of Enneper.—**Miécislas Biernacki**: The lines of Julia of integral functions.—**D. V. Jonesco**: Some theorems of existence of the integrals of systems of differential equations.—**Vladimir Bernstein**: Concerning a formula of F. and R. Nevanlinna relative to the meromorph functions in a sector.—**Serge Bernstein**: Functions regularly monotone.—**R. Gosse**: The equations $s = f(x, y, z, p, q)$ which admit an invariant for one single system of characteristics.—**W. Gontcharoff**: Series of zeros of successive differentials.—**J. Herbrand**: The theory of the demonstration.—**D. Riabouchinsky**: Some remarks on functions of current.—**D. Gernez**: The rapid construction on the map of lines for utilising radiogoniometric bearings taken from a vessel.—**Léopold Infeld**: Maxwell's equations in the theory common to gravitation and electricity.—**R. Darbord**: The absolute measurement of coefficients of influence.—**E. Pierret**: A new method of maintaining oscillations in a triode valve. Description of a method of obtaining stable waves of wave-length between 14 cm. and 18 cm.—**M. Fallot**: The magnetic susceptibility and second supposed isoelectric point of gelatine. Determinations of the magnetic susceptibility of gelatine as a function of the hydrogen ion concentration showed only one minimum value, at $p\mathrm{H} = 4{\cdot}7$. The refractive index and dispersion of these gelatine solutions were found to be independent of the hydrogen ion concentration.—**G. Bruhat** and **M. Pauthenier**: Remarks on the theory of electrostriction and its experimental control.—**L. Décombe**: Electrified spherical films, the photo-electric effect and the X-ray fluorescence spectrum.—**Marcel Cau**: Double refraction and dichroism of thin films of iron obtained by distillation. The films were produced on plates of glass placed over an iron wire heated electrically in a vacuum. The films, which were grey by transmitted light and presented a polished appearance, showed double refraction accompanied by dichroism. The effect is produced by the magnetic field of the current used for the distillation.—**Marc de Hemptinne**: The photolysis of benzaldehyde. A study of the absorption spectrum suggests that benzaldehyde should be decomposed under the influence of rays of wave-length less than 2500 A., and benzene and carbon monoxide should be the products of decomposition. Experiments are described confirming these predictions.—**Aubert, Dumanois, and Pignot**: The effects of antidetonants in the vapour phase. Experiments showing that antidetonants acting in the gaseous phase increased the time of combustion.—**C. F. Muttelet**: Study of the acidity of fruit juice and of jams.—**Mme. Ramart-Lucas**: The comparative stability of isomers according to their absorption spectra.—**A. Wahl** and **Lobeck**: A new reaction of the disulphisatides.—**J. A. Le Bel**: Stalactites. A description of some peculiarities of some stalactites found in a cave at Les Eyzies (Dordogne).—**F. Dienert**: The circulation of subterranean waters in alluvium. Examples of the use of dyes for following the circulation of underground water.—**J. Viret**: The Oligocene fauna of Coderet, near Branssat (Allier).—**E. Leblond**: The formation of accessory vacuoles in *Closterium lunula*.—**R. Dieuzeide**: The transformation and disappearance of certain denticles of the skin of *Centrophorus*

granulosus.—**A. Lacassagne**: The action of the *K*-rays of aluminium on some micro-organisms. Details of the effects of varying time exposures to the rays on cultures of pyocyanic bacillus, prodigiosus, staphylococcus and entero-coccus.—**F. Holmeck**: Attempt at the interpretation from the energy point of view of the action of the *K*-rays of aluminium on micro-organisms.

CAPE TOWN.

Royal Society of South Africa, April 18.—**Th. Schrire**: On some new species of bacteria isolated from *Xenopus Lœvis*. Three new organisms have been isolated from a mould-like growth on a frog (*Xenopus Lœvis*). The disease could not be reproduced by inoculation with various methods, but a mixed infection with all three organisms is highly pathogenic to frogs.—**J. F. V. Phillips**: *Curtisia Faginea* Ait. ('Assegaai'): An ecological study. This tree is important sylviculturally and economically. It is best developed in the Knysna forests, although it ranges from the Cape Peninsula to the forests of Gazaland. It is very rarely a dominant, and still more occurs in pure communities. It is most at home in the medium moist forest at Knysna. In pole and later stages the species is definitely semi-light-demanding. The plant flowers regularly, fruits fairly regularly and heavily. The fruits are of moderate fertility; the greater number aggregate at the base of the parent. The rate of growth in girth is slow.—**S. Schonland**: Materials for a revision of Crassulaceæ (The South African species of the genus *Crassula* L. emend. Schonl.). A wider view than usual is taken of specific limits, but no less than 219 species of *Crassula* are recognised in South Africa.—**H. G. Fourcade**: A new method of aerial surveying: note on the determination of the verticals of a plate pair.—**A. V. Duthie**: On a terrestrial Isœtes, *I. stellenbossiensis*, A. Duthie, from the Stellenbosch Flats. This is the third species of Isœtes to be described from the Union of South Africa. It occurs in shallow depressions, which are damp in the winter but dry during the summer months, and has been found growing beside xerophytic plants.—**Margaret R. Levyns**: Veld-burning experiments at Ida's Valley, Stellenbosch. The type of vegetation covering the area is that known as 'rhenosterveld,' which is not a stable type of plant community. Burning leads to rapid increase of the rhenoster bush and certain other plants, and also induces vigorous growth among the petaloid monocotyledons and some other plants, this vigour being of a temporary nature. Clearing the ground of bush does not favour the spread of the rhenoster bush. In this case vigorous growth is more apparent among the grasses than among the petaloid monocotyledons.

GENEVA.

Society of Physics and Natural History, April 19.—**S. C. Guha**: The microcrescometer, normal type and universal type. Study of the growth of the coleoptilum of oats. The author presents two different forms of an instrument designed to measure the growth of plants, multiplying the movements up to 5000 and 20,000 times, by means of a lever which causes an angular displacement of a mirror. He gives the first results of his observations on the daily growth of the coleoptilum of oats, showing a maximum between 10 A.M. and noon.

May 3.—**Gr. Gutzeit**: A rapid method of qualitative analysis. The author has attempted to generalise the use of spot reactions, carried out on filter paper or on a porcelain plate with depressions, with the aid of various specific organic reagents. Characteristic reactions for 23 metals and 17 acid groups are given.—**P. Rossier and G. Tiercy**: The auxiliary chronometer *Nm* of the Observatory of Geneva and the rating of chronometers submitted to examination. This Nardin chronometer has been regulated for mean time and compared with the Riefler sidereal time pendulum. The comparisons have been made by two different methods of measurement; the maximum difference in the two cases has been 0·02 sec.—**P. Balavoine**: The tannin content of wine is influenced by the climatic conditions at the time of vinification. This fact has been proved by comparing products obtained simultaneously and working on a similar portion in the eastern Pyrenees and at Geneva. All the other characteristics remain similar; the proportions of tannin are respectively 0·17 and 0·02. Other experiments lead to the same conclusion.—**B. P. G. Hochreutiner**: A new Cyrtandropsis in the Hawaiian islands. The observed facts lead to the conclusion that the Cyrtandropsis are formed from different species of the genus *Cyrtandra*, which have afterwards evolved in a convergent manner.

Official Publications Received.

BRITISH.

Canada North of Fifty-six Degrees: the Land of Long Summer Days. By E. M. Kindle. (*The Canadian Naturalist*, Vol. 42, No. 3, March.) Pp. iv+53-86+20 plates. (Ottawa: The Ottawa Field-Naturalists' Club.) 50 cents.

Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1122 (AE. 295): Lift and Drag of Three Model Aeroplanes. Comparative Tests in Atmospheric and Variable Density Wind Tunnels at the same Reynolds Number. By H. C. H. Townend. (T. 2462, revd.) Pp. 6+6 plates. 6*d*. net. No. 1123 (AE. 296): Wind Tunnel Tests with High Tip Speed Airscrews. The Characteristics of Bi-Convex No. 2 Aerofoil Section at High Speeds. By Dr. G. P. Douglas and W. G. A. Perring. (T. 2533.) Pp. 10+5 plates. 9*d*. net. (London: H.M. Stationery Office.)

The Welsh Journal of Agriculture: the Journal of the Welsh Agricultural Education Conference. Vol. 4. Pp. 431. (Cardiff: University of Wales Press Board.) 2*s*. 6*d*.; cloth, 4*s*.

Schedule and Programme of the British Aquarists' Association Third Annual Exhibition, July 24th to July 28th (inclusive), 1928, at Trinity Hall, Great Portland Street, London, W.1. Pp. 28. (London.) 3*d*.

South Western Naturalists' Union. Annual Report and Proceedings, to 31st December 1927. Pp. 44. (Bristol.)

The Journal of the Quekett Microscopical Club. Edited by W. S. Warton. Ser. 2, Vol. 16, No. 94, May. Pp. 48. (London: Williams and Norgate, Ltd.) 3*s*. 6*d*. net.

Catalogue of Indian Insects. Part 13: Cicindelidae. By Mercia Heynes-Wood and Cedric Dover. Pp. v+138. (Calcutta: Government of India Central Publication Branch.) 2.8 rupees; 4*s*. 6*d*.

Falmouth Observatory. Meteorological Notes and Tables for the Year 1927. By Joshua Bath Phillips. Pp. 8. (Falmouth.)

Transactions of the Royal Society of Edinburgh. Vol. 55, Part 3, No. 32: On the Feeding Mechanism of the Fairy Shrimp, *Chirocephalus diaphanus* Prevost. By Prof. H. Graham Cannon. Pp. 807-822. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 2*s*.

Industrial Safety Congress organised jointly by the Home Office and the National "Safety First" Association, and held in Caxton Hall, Westminster, and at the Home Office Industrial Museum, Westminster, London, March 20th, 1928. Report of Proceedings. Pp. 59. (London: H.M. Stationery Office.) 9*d*. net.

Transactions of the Optical Society. Vol. 29, No. 3. Pp. 101-148. (London.) 10*s*.

Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1124 (Ae. 297): Wind Tunnel Tests with High Tip Speed Airscrews. The Characteristics of a Conventional Airscrew Section, Aerofoil R. and M. 322, No. 3, at High Speeds. By Dr. G. P. Douglas and W. G. A. Perring. (T. 2530.) Pp. 14+6 plates. 9*d*. net. No. 1125 (Ae. 298): An Analysis of some Causes of Discrepancy between the Calculated Failing Load of the Structure of an Aircraft and the Load at which Failure occurs on Strength Test. By H. B. Howard and K. T. Spencer. (D. 184, revd.) Pp. 9+5 plates. 6*d*. net. (London: H.M. Stationery Office.)

FOREIGN.

United States Department of Agriculture. Technical Bulletin No. 60: Ineffectiveness of Internal Medication of Poultry for the Control of External Parasites. By D. C. Parman and W. S. Abbott, and J. J. Culver and W. M. Davidson. Pp. 24. (Washington, D.C.: Government Printing Office.) 5 cents.

Department of the Interior: Bureau of Education. Bulletin, 1927, No. 40: Statistics of Universities, Colleges and Professional Schools, 1925-26. Pp. 167. (Washington, D.C.: Government Printing Office.) 25 cents.

Instituts scientifiques de Buitenzorg : 's Lands Plantentuin. Treubia : Recueil de travaux zoologiques, hydrobiologiques et océanographiques. Vol. 9, Supplément, Janvier : Monographie der Indo-Australischen Scoliiden (Hym. Acul.) mit zoogeographischen Betrachtungen. Von Dr. J. G. Betrem. Pp. iv+388+5 Tafeln. (Buitenzorg.)

Report on Norwegian Fishery and Marine Investigations. Vol. 3, No. 9 : The Rearing of Lobster Larvae at Flødevigen. By Alf Dannevig. Pp. 15. (Bergen : A.-S. John Griegs Boktrykkeri.)

Department of Commerce : Bureau of Standards. Scientific Papers of the Bureau of Standards, No. 572 : Cause and Removal of certain Heterogeneities in Glass. By L. W. Tilton, A. N. Finn and A. Q. Tool. Pp. 719-736. (Washington, D.C. : Government Printing Office.) 10 cents.

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 37 : Experimental Study on the Effects of Low Barometric Pressures and Oxygen Deprivation upon the Efficiency of Mental and Physical Work. By Kwan-ichi Tanaka. Pp. 127-231. (Tôkyô : Kôseikai Publishing House.) 1.55 yen.

United States Department of Agriculture. Technical Bulletin No. 59 : The European Corn Borer and its Controlling Factors in Europe. By W. R. Thompson and H. L. Parker. Pp. 63. (Washington, D.C. : Government Printing Office.) 10 cents.

Department of the Interior : Bureau of Education. Bulletin, 1928, No. 3 : College and University Extension Helps in Adult Education. By L. R. Alderman. Pp. iv+35. (Washington, D.C. : Government Printing Office.) 10 cents.

Japanese Journal of Geology and Geography. Transactions and Abstracts. Vol. 5, No. 4. Pp. ii+133-224+17-22+7+plates 13-23. (Tokyo : National Research Council of Japan.)

CATALOGUES.

Auswahl neuerer Bücher. Pp. 24. (Berlin und Bonn a. Rh. : Ferd. Dummlers Verlag.)

Catalogue of Scientific Books and Publications of Learned Societies. (No. 309.) Pp. 78. (Cambridge : W. Heffer and Sons, Ltd.)

Diary of Societies.

FRIDAY, JUNE 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.—W. H. Wright : Photography of the Planets in Light of Different Wave-lengths (George Darwin Lecture).—S. R. Pike : Note on the Separation of Gases in Prominences.—N. Goryatscheff : The Definitive Elements of the Orbit of Comet 1925 *c* (Orkisz).

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 5.—At 6.15 (Annual General Meeting).—M. Hine : Report on a Case of Neurofibromatosis of the Eyelid, and of a Case in which a Glass Ball burst in the Socket.—F. Ridley : Lysozyme-antibacterial Body present in Great Concentration in Tears, and Especially its Relation to the Human Eye.

PHYSICAL SOCIETY (at Imperial College of Science), at 5.—L. F. Richardson and others : Contact Potential in the Dolezalek Electrometer connected Idiostatically.—G. P. Barnard : Some Experiments on the Light-Sensitivity of Commercial Selenium Cells.—Dr. J. R. I. Hepburn : The Vapour Pressure of Water over Sulphuric Acid–Water Mixtures at 25° C. and its Measurement by an Improved Dew-point Apparatus.—Demonstration :—A simple Practical Application of the Properties of Selenium Cells, G. P. Barnard.

MALACOLOGICAL SOCIETY (at Linnean Society), at 6.—Prof. A. E. Boycott : The Habitats of *Clausilia biplicata* Montg.—R. Winckworth : Remarks on Limpets and Description of New Species of *Acmæa*.

GEOLOGISTS' ASSOCIATION (in Architectural Theatre, University College), at 7.30.—Dr. T. Robertson and T. N. George : The Carboniferous Limestone of the North Crop of the South Wales Coalfield.—Dr. R. L. Sherlock : The Alleged Pliocene of Buckinghamshire and Hertfordshire.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. G. P. Thomson : The Waves of an Electron.

SATURDAY, JUNE 9.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (North-Eastern District), at 10.30 A.M. (at Municipal Buildings, West Hartlepool).—At 5 (at Grand Hotel, West Hartlepool).—F. Durkin : Municipal Work at West Hartlepool.—J. H. Miers : Municipal Work at Hartlepool.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Yorkshire District) (at Town Hall, Wakefield), at 2.—L. Ives : Municipal Work in Wakefield.

BIOCHEMICAL SOCIETY (at Rothamsted Experimental Station, Harpenden).—E. Boyland and S. F. Cook : The Blood Pigment of Ascidians.—R. R. Morrison, P. R. Peacock, and S. Wright : The Action of X-radiation on Vitamin D in Irradiated Ergosterol.—L. R. Bishop : A Study of the Proteins in Barley.—P. H. H. Gray : Production of Indigotin from Indol by Soil Bacteria.—G. V. Jacks : The Formation of Humus.

TUESDAY, JUNE 12.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. C. Bolton : The Interpretation of Gastric Symptoms (3).

QUEKETT MICROSCOPICAL CLUB, at 7.30.—Prof. J. S. Huxley : Some Problems of Animal Growth.

WEDNESDAY, JUNE 13.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Prof. G. B. Barbour : A Re-excavated Cretaceous Valley on the Mongolian Border.—S. I. Tomkeieff : The Volcanic Complex of Calton Hill (Derbyshire) : a Petrological Study.—Dr. S. H. Haughton : A Brief Account, illustrated by lantern slides, of the Arrangements in Progress for the Forthcoming XVth Session of the International Geological Congress, to be held in South Africa in July and August 1929.

ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY (Annual General Meeting) (at Northampton Polytechnic Institute), at 8.15.

THURSDAY, JUNE 14.

ROYAL SOCIETY, at 4.30.—Prof. A. V. Hill : (*a*) Myothermic Apparatus ; (*b*) The Rôle of Oxidation in Maintaining the Dynamic Equilibrium of the Muscle Cell ; (*c*) The Absolute Value of the Isometric Heat Coefficient Ti/H in a Muscle Twitch and the Effect of Stimulation and Fatigue ; (*d*) The Absence of Delayed Anaerobic Heat in a Series of Muscle Twitches ; (*e*) The Recovery Heat-Production in Oxygen after a Series of Muscle Twitches.—Prof. A. V. Hill and W. Hartree : The Anaerobic Delayed Heat-Production after a Tetanus.—C. H. Best and Ruth Partridge : The Equation of Motion of a Runner Exerting a Maximal Effort.—*To be read in title only* :—C. A. Seyler : The Dictyoxylon Cortex of Lycopodiales as a Constituent of Coal.—B. Sahni : On Clepsydropsis Australis, a Zygopterid Tree Fern with a Tempskya-like False Stem from the Carboniferous Rocks of Australia.—W. O. James : Experimental Researches on Vegetable Assimilation and Respiration. XIX.—A. W. Greenwood : Studies on the Relation of Gonadic Structure to Plumage Characterisation in the Domestic Fowl. IV.—Prof. T. P. Hilditch : Relationships between Chemical Composition of Vegetable Seed Fats and their Botanical Origin.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—Prof. G. H. Hardy : A Formula of Ramanujan.—E. L. Ince : Simultaneous Linear Partial Differential Equations of the Second Order.—K. Knopp : Über Reihen mit positiven Gliedern.—Echo D. Pepper : On Density Distribution in Stellar Space.—E. G. C. Poole : Dirichlet's Principle for a Flat Ring.—T. G. Room : Notes on some Geometrical Configurations : (I.)-(VIII.).—W. E. Sumpner : Fractional Integration.—C. T. Preece : Theorems stated by Ramanujan (III.).—Prof. G. N. Watson : Theorems stated by Ramanujan (IV.).

OPTICAL SOCIETY (at Imperial College of Science), at 7.30.—Instr. Capt. T. Y. Baker : The Errors of a Reflecting Prism.—W. D. Wright : A Trichromatic Colorimeter with Spectral Primaries.—T. Smith : (*a*) The Theory of Aplanatic Surfaces ; (*b*) The Primordial Coefficients of Asymmetrical Lenses ; (*c*) Note on the Use of Lenses in Series for Sight Testing.—Demonstration :—Slides illustrating Studies in Diffraction, the late F. W. Shurlock.

SATURDAY, JUNE 16.

ROYAL SOCIETY OF MEDICINE (Therapeutics Section) (at Pharmacological Laboratory, Oxford).—Annual General Meeting and Laboratory Meeting.

MINING INSTITUTE OF SCOTLAND (at Dunfermline).

PUBLIC LECTURES.

MONDAY, JUNE 11.

KING'S COLLEGE, at 5.30.—Prof. E. L. Stevenson : The Expansion of Geographical Knowledge in the Early Renaissance as illustrated by Contemporary Maps (1) : The Geography of the pre-Columbian Period.

WEDNESDAY, JUNE 13.

KING'S COLLEGE, at 5.30.—Prof. E. L. Stevenson : The Expansion of Geographical Knowledge in the Early Renaissance as illustrated by Contemporary Maps (2) : Christopher Columbus and the Beginnings of Trans-Oceanic Discovery.

THURSDAY, JUNE 14.

INSTITUTE OF PATHOLOGY AND RESEARCH (St. Mary's Hospital), at 5.—Dr. P. Fildes : Principles of the Treatment of Tetanus with Antitoxin.

FRIDAY, JUNE 15.

KING'S COLLEGE, at 5.30.—Prof. A. Wildon Carr : Some Problems in Metaphysics (1) : The Nature of Human Freedom.

CONGRESS.

JUNE 6 TO 9.

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES (at Rochester).

Friday, June 8.

Geological Section.

At 10.30 A.M.—
H. H. Milner : Geology from the Air (Presidential Address).
At 11.30 A.M.—
Dr. S. W. Wooldridge : The Geomorphology of the North Downs.
At 12.30—
H. G. Dines : The Bapchild Palæolithic Site.

Zoological Section.

At 11 A.M.—
Prof. E. W. MacBride : The Conditions for Progressive Evolution (Presidential Address).
At 12 NOON—
H. H. S. Bovingdon : The Reflections of a Biologist on Food and Efficiency.

Saturday, June 9.

Regional Survey Section.

At 11 A.M.—
C. C. Fagg : The History of the Regional Survey Movement (Presidential Address).
At 12 NOON—
G. E. Hutchings : A Regional Survey of the Lower Medway Valley.