THURSDAY, DECEMBER 7, 1911.

HEALING BY TOUCH.

The King's Evil. By Dr. Raymond Crawfurd. Pp. 187. (Oxford: The Clarendon Press, 1911.) Price 8*s.* 6*d.* net.

THE history of the king's evil and the royal touch, whether as a picture in detail of a certain stream of a very ancient tradition, or as a particular instance of something more than a tradition or symbol, of a mystic interpretation of man's relation to the unseen powers which encompass him, is a deeply interesting study. We are far from imputing it as a fault to Dr. Raymond Crawfurd if, in his scholarly decision to keep to his own part of a great subject, and to do thoroughly what he undertook, he has averted his eye from the ancient sources of the mystery, or even neglected the facts and fables which linked up the modern and the ancient modes of miraculous healing. Still, has not Dr. Crawfurd almost dissembled these sources of the far past and the ancient myth? He remarks, for instance, that the gods "have transmitted the gift" (of healing) to mortal man—especially to conspicuous individuals such as kings; to Pyrrhus, for example, or Vespasian. And a few sentences farther on (p. 10) he says that, with the spread of Christianity, the priest "usurped" for a while the prerogative of healing. This seems scarcely the right colour to put upon the past. Samuel looked upon Saul as the usurper of intercessory functions. And the gift of healing was not so much a "transmission" from gods to men as that in this function the priest-king originally was the organ rather than the agent of the supernatural; originally the potency was not so much a delegation as a continuity.

The laying on of hands, as practised for disease in England and France, and as still practised in the institution of Holy Orders, passed by insensible gradations from gods and godlings to heroes and men. Any kindred touch might convey its influence, even the touch of a relic of the operative personage. From this point of view, in Greece, χεὶρ and δύναμις were equivalent. And in various times and circumstances the manual act might pass a stream of virtue from healer to patient, or might be a manumission, or a protective gesture, or merely a symbol. Clearly, in the idea of the royal touch, it stood for more than a symbol.

The "soothing-handed" (ἠπιόχειροι) Chiron, Eileithyiæ, Apollo, Hygieia, poured forth their virtue to Asclepius, Serapis, the mother of God (χεὶρ τῆς Παναγίας), Cosmas and Damian, and onward, until we take up the modern part of the story with Dr. Crawfurd, from Robert the Pious (996–1031 A.D.). If in view of the inclination of the readers of NATURE towards evolution I have ventured to knit up a few of these ancient links, from the beginning of his own story Dr. Crawfurd is an indispensable guide. From the first we feel we are in good hands; the scrupulous references to authorities, the exploration of the sources, many of which the author has either brought to light or has set in their proper light, the first glance at the scholarly translations from the Latin, or at the excellent bibliography, and, above all, the sound criticism not unspiced with humour, give the reader a sense of completeness and sureness. The subject of the royal touch had not been adequately treated; Dr. Crawfurd has been fortunate in his subject, and has produced an exhaustive and probably a final study of it.

Magic touch in ancient times was valid not for a few but for all or any diseases and for parturition. In the Middle Ages, however, it had become restricted to jaundice—the *morbus regius*—and to bubos. For the jaundice the touch soon fell out of use; the bubos were chiefly of the scrofulous kind, but Dr. Crawfurd supposes that not a few ambulant cases of bubonic plague (*lues inguinaria*) were included in the crowd. At a later date probably syphilis came in, a disease not mentioned, I think, by the author, though as he has forgotten an index—the only defect in his scholarly apparatus—I cannot be sure of this. In one of the Continental galleries I remember a picture, of the early sixteenth century, commemorating a cure by a miracle-working saint, in which the patient exhibited in his own person a fine specimen of syphilitic ulceration and of the painter's veracity.

If we regard the laying on of hands as an ancient prerogative, one deriving from the larger function of "Binding and Loosing," we attach less importance to the defects of the records of its appearance in modern times; we guess that this mystery never died out; that the lack of records is due to their destruction, or to silence on matters of familiar custom. Still, Dr. Crawfurd is as precise as sources will allow, and it is not without interest to note that, if in France the definite history of the touch begins with Robert the Pious, yet the legends of the times of Clovis suggest in this respect also the continuity of Gallo-Roman ritual. With Clovis, as with later kings of England and France, with Queen Anne for instance, the assumption of this prerogative may have been to prove that he too was hedged about with divinity. England, in her comparative isolation from the Roman tradition, records no royal touch before Edward the Confessor.

If it was not until much later times that the kings became specialists in scrofula the previous vagueness depended largely on that of contemporary diagnosis. And here we come to matter of interest to our faith-healers of to-day; to the partnership of physician and priest or king—priest or king as the touch was, generally speaking, conducted under an imposing courtly and religious ceremony. Dr. Crawfurd carefully reproduces the Offices as modified from time to time, and he tells us that the enthusiasm of the sick was thus exalted to an amazing passion. Moreover, the king's physicians took a prominent part, not only in protecting him from crowds of sufferers of a non-descript kind, or of kinds not amenable to the royal touch, but actively in securing this blessing for the cases in which their skill had failed, and for persons in whom they were interested. Passing over earlier and cruder ages, we may descend in time to so great

a man as Wiseman, the really distinguished, sagacious, and learned sergeant surgeon to Charles the Second, who said of his master's potency, with probably more than a courtier's sincerity, that "he cureth more in any one year than all the Chirurgions of London have done in an age." This testimony is the more remarkable as Wiseman was not himself officially concerned with the ceremony. In one passage, indeed, Wiseman attributes a relapse to the loss of the angel from the neck of the patient. Like Alexander of Tralles, good doctor as for his time he was, he still clung to amulets and such magic. We read then with no surprise the devout appreciations of such men as Fuller and Collier. Shortly before Wiseman, we have the curious story, one better known to medical men, of the arraignment of one Leverett, at the instance of William Clowes the Younger, surgeon to Charles the First, before the College of Physicians for his imposture, which this august body had no difficulty in proving by convincing evidence of facts, in pretending to vie with the king in the power of curing the evil, even by methods still more magical. We do not find, however, that the College did the fairest thing in its power; it might have put the King and Leverett severally to trial on the same patient or patients. But, as Clowes aptly remarked, Leverett was not even a seventh son of a seventh son; he proved to be only the fourth. He was a hollow rogue.

Still, the sceptic had crept near the ears of his world, even at an early date; not always knowing himself to be a sceptic. John of Gaddesden (under Edward the First) assigned to the royal touch a place midway between the polypharmacy of the physician and the craft of the surgeon—"a delicate provision," says Dr. Crawfurd, "for the contingency of the king's therapeutical impotence." As this passage is almost the only original suggestion in his "Rosa Anglica," we may guess that John, like the many persons who do not know that they are humorists, was naïvely unaware of his own scepticism. It is a happy biographical trait of Henry of Navarre that, at Ivry, on cutting down a man with his sabre, he exclaimed, "Je te touche, que Dieu te guérisse." But perhaps this says less for Henry's scepticism than Dr. Crawfurd thinks, characteristic of him as the story is. Even in the sixteenth century the stronger the creed the safer to jest with it; the Church has always tolerated the jester, while handing over the wrangler to the secular arm.

The first great sceptic, to whose robust disdain of this item of his divinity the discredit of the touch is due, was William the Third. His sturdiness did him the more honour as such a proof of his dynastic authenticity would have been convenient. This testimony had more weight with Anne; though it would have gone hard with her heirship had it depended on her cure of Samuel Johnson. The gold touch-piece she bestowed upon her eminent patient is, we are told, in the British Museum. It is hard to believe that such great modern surgeons as Alibert and Dupuytren presented sufferers from the evil to Charles the Tenth; perhaps they were the last medical authorities to be so complaisant; though the later Stuarts amused themselves, and others, by clinging to this last rag of their divinity until their dissolution.

I hope my readers will agree with me that I have taken no improper liberty with them in dwelling at this length upon so able and entertaining a volume.

CLIFFORD ALLBUTT.

GROUP-THEORY.

Theory of Groups of Finite Order. By Prof. W. Burnside, F.R.S. Second edition. Pp. xxiv+512. (Cambridge: University Press, 1911.) Price 15*s.* net.

IN the new edition of Prof. Burnside's standard work important changes have been made by rearrangement of old material, and by addition of new. The main feature, for which many English readers will be very grateful, is the addition of several chapters on groups of linear substitutions. Among the most important of all contributions to group-theory must be reckoned the memoirs of Frobenius in the Berlin *Sitzungsberichte*; unfortunately they are not very accessible to English students, and are by no means easy to read; hence, Prof. Burnside's connected, and in many ways independent, discussion of this part of the theory is very welcome. In particular, there is a chapter on characteristics, and another on various special applications; it may be noticed, as showing the power and value of the characteristic-theory, that the theorem "every group whose order contains only two distinct primes is soluble," appears as a corollary.

At present, the theory of groups is in a very interesting state for various independent reasons. Several great mathematical theories are intimately associated with group-theory, or at least with some aspect of it; thus, there is the theory of algebraic equations, the division of period and argument in elliptic functions, and the immense field of elliptic modular functions—to mention these alone. But, besides this, the theory of groups, which so long seemed a rather arid appendix to the theory of permutations and combinations, has changed its aspect into a definite, independent, and fascinating branch of analysis, as peculiar and baffling as the theory of numbers, if not more so. It has now been approached and studied under four, at least, of its Protean aspects; as defined, in the abstract, by a multiplication-table, or, equivalently, by a set of formal equations like $a^2=b^2=(ab)^2=1$; as a set of permutations; as a set of linear substitutions; and as a set of geometrical operations. Each of these methods has suggested intrinsic properties of groups, and we have now a considerable set of distinctive epithets, such as "self-conjugate," "Abelian," "metabelian," "soluble," and so on, each of which marks a definite advance in classification. But some of the most obvious problems seem as far from solution as ever; for instance, it seems probable that no group of odd order, except a cyclical one, can be simple, but the proof has still to be found.

There is, therefore, abundant field for research, and the more varied the interests and attainments of those who undertake it the better, because some new symbolism, or some new association with geometry, or the like, may lead to the discovery of new properties

of groups. Oddly enough, on the other hand, group-theory assumes less preliminary knowledge than anything else except arithmetic, so that beginners, in a sense, start level, and have equal chances for a prize. Many of Prof. Burnside's examples, and, in particular, the notes at the end of the volume, are intended to suggest various lines of research.

It has already been observed that some of the matter of the first edition has been rearranged. The general effect has been to put more of the abstract theory in the earlier chapters; this will probably commend itself to experts, but will not make the book easier for beginners. They will probably find it convenient to pick and choose, and pay special attention to examples; they might begin by reading chaps. i.–v., vii.–ix., xviii.–xx., passing lightly over the more difficult parts; they must, in any case, become quite familiar with transformation, conjugate and self-conjugate operations and sub-groups, and the meaning of Hölder's symbol G/H. The great landmarks in the less advanced part of the theory are the properties of composition-series and their allies, together with Sylow's theorem and its consequences; these, at any rate, must be fully mastered before trying to advance.

The English student of group-theory is now fortunate in having at his disposal three excellent text-books in his own language: Mr. Hilton's "Finite Groups," which is a capital introduction to the subject, with plenty of easy examples; the present volume; and Prof. Dickson's "Linear Groups," which is particularly valuable for its completeness of detail, and its analysis of Galois fields. Our younger mathematicians are now fairly free from the shackles of ancient tradition, and we may confidently hope that some of them will add to our knowledge of this fascinating theory.

G. B. M.

A GUIDE-BOOK FOR INDIA.

A Handbook for Travellers in India, Burma, and Ceylon, including the Provinces of Bengal, Bombay, Madras, the United Provinces of Agra and Lucknow, the Panjab, Eastern Bengal and Assam, the North-West Frontier Province, Baluchistan, and the Central Provinces, and the Native States of Rajputana, Central India, Kashmir, Hyderabad, Mysore, &c. Eighth edition, with 80 maps and plans. Pp. cxvi+530. (London: J. Murray; Calcutta: Thacker, Spink, and Co., 1911.) Price 20*s.* net.

THE handbook to India, Burma, and Ceylon issued by Mr. John Murray, which now appears in its eighth edition, has reached its present form after a long series of revisions. It was first published between 1859 and 1883 in four volumes, and was the work of a well-known Oriental scholar, the late Captain E. B. Eastwick, who collected the material during several journeys to India. When we remember that in the period immediately following the Mutiny of 1857 communications throughout the Empire were imperfect, and that the present vast library of Indian books of reference, such as the imperial and provincial gazetteers, the census, archæological, and other departmental reports were not available for reference, Captain Eastwick's work was, in its way, admirable. Since the book appeared in its original form it has been subjected to constant revision by competent scholars, and has now been practically rewritten by Mr. H. C. Fanshawe, late secretary to the Government of the Panjab, and author of an excellent account of the imperial city of Delhi. The arrangement has been recast in accordance with the most recent railway developments, and the accounts of the most important places have been revised in the light of modern research.

The handbook in its present form thus furnishes a compendium of the most trustworthy information regarding the topography, races, antiquities, and modern history of the Empire. As might have been expected, there are in some places signs that the new material has been imperfectly assimilated with the old, and some errors, misprints, and omissions have escaped the attention of the latest editor. Thus, Sir Colin Campbell's force at the final relief of Lucknow, which consisted of seventeen battalions of infantry, twenty-nine squadrons of cavalry, and 134 guns, certainly aggregated more than 2000 men; the venerable error that the River Gumti, really the Gomati, "rich in cows," means "serpentine," should not have been repeated; the sportsman might have been warned that rifles carrying the army cartridges are rigidly excluded, and he should have been advised to supplement his Express rifle by a smaller bore, high-velocity weapon.

These, however, are trifling matters, and the introductory chapter which gives advice on expenses, clothing, food, sanitation, and camping represents the accumulated experience of many competent authorities, while the accounts of the great cities, their architecture and industries, the campaigns and battles, leave little to be desired. The maps and plans are numerous, and, as a rule, excellent. The present edition, while it will be indispensable to the tourist, will find a wider circle of readers among officers on Indian service and their friends at home who are interested in the country and its people. For ordinary people it will be a useful substitute for a collection of the more bulky books of reference, such as the imperial and provincial gazetteers and the departmental reports, which must be consulted by all serious students of the Indian Empire, its races, and their history.

ENGINEERING GEOLOGY.

Geology for Engineers. By Lieut.-Colonel R. F. Sorsbie, R.E. Pp. xxvii+423. (London: C. Griffin and Co., Ltd., 1911.) Price 10*s.* 6*d.* net.

ONE important engineering lesson from this book is the danger of working with unknown materials and of using unfamiliar terms. The book is a compilation, mainly from second-hand sources of information, half of which are out of date. The author has seldom discovered the recent original authorities. The work consists of two parts; the first 238 pages

summarise the rudiments of general geology; the special subject of the book is confined to the second section of 160 pages.

The first part is unduly long, and is so inaccurate and out of date that engineering students will be well advised to learn the elements of geology from a more trustworthy text-book. The author's petrological knowledge may be illustrated by the following examples. "Peridotite.—A name used for a basalt or dolerite rich in olivine, chiefly noticeable on their [*sic*] alteration into serpentine" (p. 111). Clay (p. 114) is said to have "very nearly the same composition as the mineral felspar." The Silurian greywackes are included on p. 281 in the crystalline schists. Oolite is described as composed of "egg-like granules." The definition of agglomerate omits the essential character of the size of the fragments. In the author's definition of conglomerate, puddingstone is based on the rounded form of the pebbles instead of on the induration of the rock. The trap-rocks are retained in reliance on authors who, in this respect, were conservative when they wrote in 1885. The table of rock characters on pp. 203 to 206 is useless and misleading.

The section on palæontology is better, as it is briefer; it is equally inaccurate. The author says that the Cœlenterata are characterised by "a distinct body-cavity," and he refers to Favosites, which he includes in the Hexacoralla, as having septa "in sixes." On an authority of 1889 he states (p. 153) that the Radiolaria "are rarely found fossil."

In the chapters on stratigraphy are included various tables of foreign formations. Those for Australia, New Zealand, and South Africa are quoted from Prestwich's "Geology" of 1886. They are only of historic value. The value of the information on British stratigraphy may be judged from the statement (p. 180) that the Calciferous sandstones are overlain by the Carboniferous limestone in the north of Scotland.

It may be claimed that the book should be judged by its second part, which is, however, no better than the first. It contains much useful information, but most of the authorities quoted are out of date, and inadequate knowledge of geology and geography has led the author into many mistakes. He assures us (pp 239–40) that in open and barren plains

"the construction of railways influences the rainful [*sic*] to a very great extent. Instead of continuous drought all along the Pacific railroad, rain now falls in refreshing abundance."

The authority quoted for this extinct belief is Humber's "Water Supply of Cities and Towns," published in 1876. This book is the author's most oft-quoted source of information on matters connected with rainfall. The rate of deep-sea sedimentation is adopted, at second hand, from "the late Mr. Tylor" (p. 383), though a later authority on this question is elsewhere referred to (p. 23) as "Mr. Murray." The author often refers to himself as the authority for his statements, and amongst other criteria of doubtful geological value, which he advances as a result of his own observations, is that "snakes are common on light soils."

AN EASTERN HORSE-BOOK.

The Faras-Nāma-e Rangīn; or, the Book of the Horse. By "Rangīn." Translated from the Urdu by Lieut.-Colonel D. C. Phillott. Pp. xx+83. (London: Bernard Quaritch, 1911.) Price 10*s.* 6*d.* net.

THE author of this treatise, who wrote under the *nom de plume* of "Rangīn," was, it appears, from the translator's introduction, one Sa'adat Yar Khan, whose birthplace was Delhi. After serving for some time in the cavalry of one or more of the native princes, he eventually became a recluse, during which period of his life he appears to have written the present and other works. He died in October, 1835. In the East the "Fars-Nāma" rapidly attained popularity, as is attested by the fact of its having passed through several editions; but we fear that the same good fortune is unlikely to attend the translation. Indeed, it is difficult to see to what class of readers it is likely to appeal in this country, although it is suggested by the translator that it may prove of service to officers of native cavalry in India. Personally, we should have thought a good English work on the management and disease of horses would have suited their purpose far better, except perhaps as regards native ideas of the "points" of a horse.

In the introduction, Colonel Phillott, after referring to the important part played by the horse in the history of civilisation in India, observes that no treatise on the subject would be complete without mention of the legends and myths connected with its origin. These differ markedly according as to whether they are derived from Moslem or Hindu sources, although, as is so often the case in similar matters in India, some of these show evident signs of a mixed origin. As "Rangīn" was a Moslem, he naturally wrote from the point of view of his own creed, and the translator has accordingly considered it desirable to give an account of the Hindu belief on this subject. As bearing on the origin of the classical myth of Pegasus, it is interesting to note that "according to Hindu legends, the horse was created a flying animal, one that could fly and run, and no man or God could snare it. Indra wanted horses for his chariots, and requested the sage Salihotra to deprive the horses of their wings. Accordingly Salihotra, by his *yoga* or supernatural power, derived by his austerities, accomplished Indra's wish." Deprived of their power of making long journeys in the air in search of medicinal herbs, the horses asked Salihotra to write a book on their diseases, which he did, and in time the Sanskrit name of the writer came to mean, first veterinary science, and then a horse. To this day native cavalry regiments have their *salotris*.

In connection with native horses, Colonel Phillott mentions that

"Indian countrybreds will eat and thrive on food that would probably kill English horses. In the Persian Gulf and elsewhere locusts, fish, and dates are regarded as legitimate food for horses and cattle; in Tibet the *tanghans* [horses] are given pig's blood and raw liver; and in the cold regions of Central Asia meat is regarded as a necessity for horses."

The actual text of the work must be passed over with the bare remark that "Rangîn" appears to have acquired a considerable knowledge of equine anatomy, both normal and pathological.

R. L.

ANIMAL PSYCHOLOGY.

La Nouvelle Psychologie Animale. By G. Bohn. Pp. ii+200. (Paris: F. Alcan, 1911.) Price 2.50 francs.

Clever Hans (the Horse of Mr. Van Osten): a Contribution to Experimental Animal and Human Psychology. By Oskar Pfungst. With an introduction by Prof. C. Stumpf. Translated from the German by Carl L. Hahn. With a prefatory note by J. R. Angell. Pp. vii+274. (New York: H. Holt and Co., 1911.) Price 1.50 dollars net.

DR. BOHN'S book is, as he himself states in his preface, the sequel and complement of an earlier work, "La Naissance de l'Intelligence," already reviewed in the pages of this journal. Its aim is to present a concise account of the development of psychism in the comparatively high forms of life represented by the class of anthropods and vertebrates respectively. The vital activities of the lower organisms are not neglected, however, and in the opening pages of the book one finds an excellent summary of the forms of explanation in terms of physical chemistry which Prof. Loeb has made famous under the names "tropisms" and "differential sensibility."

Dr. Bohn is Loeb's most distinguished follower, and he has defined the above-mentioned terms and indicated exactly to what forms of behaviour they are applicable with a brilliance even superior to that of the master himself. There is little doubt that the terms have been used with great laxity by many writers, particularly by those psychologists who are inclined to reject Prof. Loeb's views, and Dr. Bohn has done a real service to science in rendering them precise. Moreover, no one unhampered by preconceived theories will find fault, on the score of method, with Dr. Bohn for endeavouring to apply the law of parsimony as rigidly as possible, and only appealing to psychical factors after all the possibilities of physical and chemical explanation have been exhausted. Yet the result may not be entirely convincing, for although the observation of lowly forms of life encourages a mechanical system of explanation which the man of science is then stimulated to develop with ever-increasing complexity until it seems to give an approximately accurate account of even the higher forms of conscious behaviour of highly developed organisms, an investigator starting from the other end of the scale and acquiring an intimate knowledge of the nature and significance of consciousness in the life of man and the higher animals is likely to come to a very different conclusion as to the nature of, say, even protozoan activity. It seems, indeed, inevitable that there should be at least two widely diverging schools of thought in animal psychology, out of the conflict of the views of which truth will ultimately emerge, and that both are therefore necessary to the science.

Dr. Bohn passes on to a clear statement of the meaning and sphere of influence of "associative memory," and after a full discussion of the principal instincts of "articulated" animals, in which he shows that the word "instinct" explains nothing, and that the so-called instincts are aggregates of diverse activities which are far from exhibiting the exact adjustment to one another and to the environment with which they have been hitherto credited, he describes the principal experimental methods employed in the investigation of the psychical activity of the vertebrates, together with the more important results of these investigations. The little book is crammed with the most valuable material, set out in the most concise and attractive style, and one is glad to note that it has been crowned by the Academy of Moral and Political Sciences. No psychologist should omit to read it and re-read it.

"Clever Hans" was a Russian trotting horse, who took German music-hall audiences by storm by his remarkable power of working simple arithmetical sums, and answering other questions requiring a similar kind of reasoning ability. The owner, an elementary-school master, had taken him when young and taught him the rules of arithmetic according to the ordinary approved methods, and was himself convinced of his *bona fides*. An unofficially appointed Commission of psychological experts eventually proved conclusively, by experiments with the animal, that no true reasoning processes were performed, but that the horse, who tapped out its answers with its right foreleg, judged, by minimal muscular movements unconsciously performed by the questioner, when it had to stop. The questioner in asking the question was found to bend slightly forward, and then unconsciously straighten himself when the correct number of taps had been given. A slouch hat improved the "scores" by magnifying the amplitude of the movements, and when the questioner himself did not know the answer the horse was quite unable to give it. For further details of this most entrancing story, the reader is referred to the book itself.

WILLIAM BROWN.

OUR BOOK SHELF.

Vine-growing in England. By H. M. Tod. Pp. x+113. (London: Chatto and Windus, 1911.) Price 1s. net.

THE vision of the British householder sitting under his own vine seems capable of being realised from the perusal of Mr. Tod's interesting little treatise on vine-growing in England. The author examines the historical evidence connected with the vine in England and points out conclusively that its culture was once widespread not only in the country but also in and around London. Its decline no doubt was largely brought about by the dissolution of the monasteries, and it is also suggested that the enclosure of the land rendered many situations unsuitable for vineyards. The practical details for successful viticulture given in this book are admirable, and the author speaks with authority gained from a wide experience of vine growing in England, Europe, and South Africa.

Anyone anxious to start vines either in the open or against walls will find in the book before us almost every detail set out and every question answered. The site for the vineyard and the nature of the soil are

naturally of prime importance. The ground should slope both eastwards and southwards, and should be sheltered from south-west winds. The land should not be rich, but it must be well drained, and a point of interest in this connection is that vines can be grown for profit on poor land which is not suitable for corn.

Five years must elapse before the vines may be allowed to begin to bear, and the crops at first must be small, so that anyone who intends to lay down a vineyard will have to be prepared to wait for his profits. During the five years of waiting and after the vines will require much careful attention.

At the end of the book there is a chapter on wine, but it is a matter for regret that nothing of a practical nature is said about wine-making in England, though it is true that allusion is made to good wines which have been produced in this country, nor of the possibilities of profit of a wine industry. A list of the best vines for growing in England is given, with short accounts of the grapes and of the purposes for which they are most suitable.

Further Researches into Induced Cell-reproduction and Cancer. Consisting of papers by H. C. Ross, J. W. Cropper, and E. H. Ross. (The McFadden Researches.) Pp. 63. (London: John Murray, 1911.) Price 3*s*. 6*d*. net.

In this little book Mr. H. C. Ross gives a number of papers by his colleagues and himself on the lines already laid down in the larger book which appeared earlier in the year. Much enthusiastic work is indicated, but it is difficult to realise that the booklet is intended as a serious contribution to science. The same criticisms that were levelled at the earlier production can be urged with equal or even greater cogency against this recent production, and it is really very difficult to avoid the conviction that the collaborators are gaily prancing about on dangerous ground the nature of which they very imperfectly comprehend. Thus the description of centrosomes and the familiar structure of erythrocytes is possibly a correct portrayal of appearances seen, but the conclusions as to the inducement of division in them are absolutely unconvincing. That there may be disruption is probable enough under the conditions employed, but the case for a true division in the sense in which this is ordinarily understood does not appear to have been made out in the examples they describe. There is, furthermore, an absence of anything like a cautious and critical attitude towards the surprising results alleged to have been obtained, and this of itself is enough to arouse scepticism in the mind of anyone who has had any experience of the pitfalls that lie in the path of all scientific investigation, and these pitfalls are especially numerous in the field of cytology.

The Adventures of Jack Rabbit. By Richard Kearton. With eight autochromes and numerous photographs direct from nature by Richard and Grace Kearton. Pp. xii+248. (London: Cassell and Co., Ltd., 1911.) Price 6*s*.

Although animal autobiographies do not appeal to ourselves, Mr. Kearton's attempt to describe the life and experiences of a wild rabbit will probably prove acceptable to a number of juvenile readers, especially during the Christmas holiday season; and if its perusal results in even a few of such readers taking seriously to nature-study the writer will doubtless have succeeded in his aim.

The feature of the work in which adults will be interested is formed by the illustrations, many of which, we think, are even above Mr. Kearton's high average; among these special attention may be directed to the eight "autochromes," by which we presume are meant colour-photographs. These are absolutely superb, whether they take the form of a clump of bluebells or a mass of blue speedwell, or whether they depict animals. Among those of the latter type, we are more particularly pleased with the portrait of a young fieldfare, and the picture of a thrush's nest and eggs amid their surroundings. It is, however, noteworthy in the case of the latter that the nest, eggs, and supporting stems are much more conspicuous than they would be in nature; this, we presume, being one of the unavoidable defects of colour-photography. The illustrations alone are quite sufficient to sell the book.

As regards the text, it may be remarked that it is unnecessary to refer to the thrush as the "song-thrush," a prefix, in this and other cases, being required only for species other than the typical one. It would also be better to call such animals as the water-rat and the field-mouse by their vernacular names instead of alluding to them as "voles." R. L.

The Natural History and Antiquities of Selborne. By Gilbert White. With illustrations in colour by G. E. Collins. Pp. viii+475. (London: Macmillan and Co., Ltd., 1911.) Price 10*s*. 6*d*. net.

Several years ago Mr. E. A. Martin, in "A Bibliography of Gilbert White," gave the results of an inquiry as to the number of editions which had been published of the famous "Natural History of Selborne." It appeared that up to the end of 1895 no fewer than seventy-three separate editions of the work had been issued since the original handsome quarto was published in 1789; and this number is now probably well above one hundred. There is apparently a constant demand for copies of Gilbert White's classic, and it is satisfactory that this should be so, for no more inspiring work on natural history has ever been written.

As good wine needs no bush, so White's "Selborne" requires no explanatory notes, and is best left to speak for itself. The present edition is free from editorial interference, its distinguishing characteristic being the twenty-four coloured plates representing outdoor life and scenes in and near Selborne. In the selection of subjects and their treatment the artist has shown sympathetic feeling and execution which are as rare as they are welcome. The result is a beautiful edition of a work which should be in every library. The text is ever fresh, and it would be difficult to produce more delightful illustrations to it than those painted by Mr. Collins.

A Primer of Astronomy. By Sir Robert Ball, F.R.S. Pp. viii+228+11 plates. (Cambridge University Press, 1911.) Price 1*s*. 6*d*. net.

The first edition of this book was published in 1900, and there was a reprint in 1906. To the present issue two large charts of the northern and southern celestial hemispheres have been added, and also a chapter of forty-two pages, entitled "Celestial Objects." By means of these additions, the reader will be able easily to find his way about the heavens and identify objects and scenes of particular interest. It is a little to be regretted that the text has apparently been unaltered with the view of bringing it up to date; for though the fundamental facts relating to the solar and stellar systems remain much as they were when the book was written, a few statements, such as that, for instance, referring to Halley's comet as "due again about 1910," are—to say the least—anachronistic. We hope that the demand for the book will be great enough to justify the publication of a revised edition at no distant date.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Weather of 1911.

WITH reference to Sir Edward Fry's letter in NATURE of November 16, the following figures may be of interest.

We have some eighteen records of the temperature up to a height of 15 kilometres or more over the British Isles during the period of the hot weather, distributed over seven days. Excluding the records for Scotland in September, where the weather was not hot, the following departures from the mean are found :—

At 2·5	kilometres	a	temperature	of +5·5° C.
5·0	,,	,,	,,	+2·5°
7·5	,,	,,	,,	normal
10·0	,,	,,	,,	normal
12·5	,,	,,	,,	−7·0°
15·0	,,	,,	,,	−5·0°

These figures show that the heat was confined to the lower strata. With anticyclonic weather, such as prevailed during the summer, it is usual to find a negative departure from the mean temperature above 12 km.; but the greatest departure from the mean is generally found at about 7·5 km., where, as a rule, we get +5° C. The +5° C. at 2·5 and the normal value at 7·5 are very unusual, but they are shown more or less in every record.

I agree with Dr. Shaw in thinking that the surface conditions are imposed upon us by the conditions that prevail above. From the total and partial correlation coefficients that I have obtained it seems to me that the pressure in the layers of air just under the isothermal, which may be taken as the pressure at 9 km., is the dominant factor in the distribution of pressure and temperature in the whole region of the atmosphere that has been explored, with the exception of the temperature near the ground, which in temperate latitudes is certainly more dependent upon the direction of the wind than upon anything else.

I do not altogether agree with Dr. Shaw in thinking that the changes of temperature at 9 km. are in any way due to changes in the direction of the wind at that height. It seems to me more likely that they are produced by rising or falling air, and that the vertical motion, and therefore the temperature, is the direct result of the variations of pressure.

Unfortunately, it is only on rare occasions that we can ascertain the rate and direction of the wind at great heights; but there is sufficient information to show us whether the temperature at any given height up to 15 or 20 km. is dependent upon the direction and rate of drift of the atmosphere as a whole, for the direction and distance of the falling place of the balloon supply the requisite information about the general drift on any particular occasion.

I hope shortly to tabulate the results of some 200 ascents, and ascertain what the connection, if any, may be.

Pyrton Hill, December 2. W. H. DINES.

The Interaction between Passing Ships.

THE statement made in NATURE of November 30, in the article on "The Interaction between Passing Ships," to the effect that no experiments have been made to test this interference in shallow water except those recently carried out at Teddington, needs some little qualification. A somewhat extensive set of experiments to test this, among other points, was carried out some two months ago at University College, Dundee. Screw-propelled models of various sizes, at distances apart up to 200 yards, were used in these experiments, the depth of water varying from 1·6 times the draught of the vessels to 12 times the draught. The results were of such apparent interest that they were communicated to the Admiralty, who arranged for the Teddington tests, of a more restricted nature, to be carried out on larger accurate scale models of the *Hawke* and *Olympic*. The results of the Dundee experiments have been for some weeks in the hands of one of the scientific societies, and it is hoped that they may soon be made public. A. H. GIBSON.

Engineering Department, University College, Dundee, December 2.

December Meteor-showers.

THE following meteor-showers become due during the period December 8–31 :—

Epoch December 7, 17h. (G.M.T.), second order of magnitude. Principal maximum, December 8, 8h. 15m.; secondary maximum, December 8, 3h. 40m.

Epoch December 7, 22h. 30m., approximately sixth order of magnitude. Principal maximum, December 8, 1h. 30m.; secondary maximum, December 9, 1h. 40m.

Epoch December 13, 17h. 30m., approximately sixth order of magnitude. Principal maximum, December 12, 1h.; secondary maxima, December 11, 15h. 30m., and December 13, 11h.

Epoch December 13, 13h. 30m., thirteenth order of magnitude. Principal maximum, December 14, 22h. 5m.; secondary maxima, December 13, 21h. 5m., and December 16, 17h. 30m.

Epoch December 18, 2h. 30m., thirty-fifth order of magnitude. Principal maximum, December 18, 19h. 50m.; secondary maximum, December 19, 7h. 40m.

Epoch December 19, 10h., approximately fifteenth order of magnitude. Principal maximum, December 19, 13h. 50m.; secondary maximum, December 19, 17h. 15m.

Epoch December 22, 1h., fourth order of magnitude. Principal maximum, December 23, 0h. 40m.; secondary maximum, December 22, 21h. 30m.

Epoch December 23, 2h. 30m., ninth order of magnitude. Principal maximum, December 24, 6h. 30m.; secondary maximum, December 24, 18h. 15m.

Epoch December 25, 15h. 30m., approximately twentieth order of magnitude. Principal maximum, December 27, 13h. 50m.; secondary maximum, December 26, 15h.

Epoch December 30, 0h. 30m., approximately eighteenth order of magnitude. Principal maximum, December 31, 15h.; secondary maxima, December 31, 11h. 30m. and 16h. 15m.

There are reasons for believing that the total mass of a meteoric maximum may be considerably greater than is generally supposed. Such a mass of matter, in being brought to rest, must give rise to currents in the upper strata of the atmosphere, these currents very probably constituting what may be known as atmospheric depressions, inasmuch as a column of air if thus set in motion will weigh less than when undisturbed.

In December meteor-showers are more evenly distributed over the month than was the case in November; still, there are periods of special meteoric activity. The first of these, in intensity as well as in time, occurs on December 8; the second period, as regards intensity, is spread over the days December 22–24; while the third period, which is comparatively weak, falls between December 16 and 21. Shooting stars may be numerous on the night of December 31. JOHN R. HENRY.

Dublin, December 4.

The Inheritance of Mental Characters.

To Dr. Archdall Reid it is an "astounding thing" that I should imagine that Prof. Pearson could possibly agree with the interpretation I ventured to put upon his statement which Dr. Reid condemns as "void of all content" and "quite nonsensical." Dr. Reid evidently feels that my quotation from his attack upon Prof. Pearson was not quite fair, in that I omitted part of the context which he regards as essential. I apologise for an entirely unintentional and unforeseen cause of offence. As he has himself rectified this omission, I may, I presume, take it that all is *en évidence*

requisite to substantiate his wholesale and unqualified condemnation. May I follow Dr. Reid's example, and quote the whole of his quotation from Prof. Pearson?—"The sameness [in the appearance of moral and intellectual faculties as well as of physical characters][1] surely involves something additional. It involves a like heritage from parents. The degree of resemblance between children and parents for the physical characters in man may be applied to the degree of resemblance between children and parents for psychical characters. We inherit our parents' tempers, our parents' consciousness, shyness and ability, even as we inherit their stature, forearm, and span." This is the whole of the statement condemned.

I gather that Dr. Reid thinks as I do, that individuals vary in their capacity for developing various mental characters such as temper, skill in mathematics, music, and the various uses of language, and that such capacities may be, and very frequently are, inherited. Physical characters, different from "eye-colour or hair texture," but such as the capacity for a high or low degree of development of the muscles, bones, or internal organs, and including "stature, fore-arm, and span" to a considerable extent, also vary, and are very frequently inherited. Such characters, mental or physical, depend upon both inborn capacity and environment for development. Both capacity for development and environment vary, but only the capacity for development is inherited. Therefore I see nothing in Prof. Pearson's statement which in any way warrants Dr. Reid in saying that it is "utterly without significance, utterly void of all content," and "is so vague as to be quite nonsensical."

It is quite evident that Dr. Reid believes that Prof. Pearson holds that something beyond a capacity for development, which varies in individuals, is inherited. But there is nothing in the statement which implies anything of the kind, so it appears that Dr. Reid has issued an unqualified condemnation of something, with which he does not disagree, that Prof. Pearson has said, because he does not agree with what he believes Prof. Pearson thinks but has not said.

Now I know that there are people who claim the peculiar power of knowing what others think without using any of the usual physical means of communication. I, unfortunately, have no such power, and I take it that there are many who, like myself, are in a less fortunate position than the members of Dr. Reid's audience, in whose minds, he tells us, no misapprehension as to his meaning arose. The unfortunate persons who have no means, beyond reading what has been written, of knowing what Prof. Pearson and Dr. Reid think, are liable to be seriously misled by what Dr. Reid wrote in his paper. In his anxiety to emphasise the great capacity possessed by man for making acquirements, Dr. Reid runs perilously near to ignoring the facts that this general capacity is made up of many capacities, that all these capacities are variable, and that the variations are heritable. Is he so annoyed with Prof. Pearson for laying what he considers undue stress upon the heritable part of mental characters, that his criticism has gone beyond what he actually means? This is suggested by the manner in which he treats some of the physical characters in his paper. "Heads, hearts, lungs, livers, and the like are inborn and invariably present in parents and offspring." Certainly, but the capacity for development varies in different individuals and is heritable. For instance, the heart of one individual will react to frequently repeated and violent exercise by increased muscular development, while in another it will give way and dilate under precisely similar conditions. So also with mental characters. No environment will make some men mathematicians, while others will become great mathematicians in a comparatively unfavourable environment. Much the same may be said of temper and similar characters.

After all, it is surely the heritable part—the variations in capacities for making acquirements in various directions—that really matters from the eugenic point of view.

Dr. Reid fears that "Prof. Pearson will pray ardently to be delivered from his friends." Unfortunately I have not the slightest claim to the friendship of Prof. Pearson. I neither fear nor hope with regard to his feelings as to what I have written about his statement. Even should he publish a repudiation of my interpretation in every detail, my position would be precisely what it is now—one of protest against a wholesale, unqualified, and one might almost say violent condemnation without any very evident reason, a condemnation likely to cause misunderstandings in a subject in which I am particularly interested. Such methods in controversy can serve no useful purpose.

Glasgow, December 2. CHARLES WALKER.

[1] Inserted to make the meaning of the context clear.

On the Occurrence of Brown Cannel Coal ("Kerosene Shale") with *Reinschia australis* in the Falkland Islands.

AMONGST an interesting exchange series of fossils sent to the National Museum, Melbourne, by the honorary curator of the Falkland Islands Museum, there is a specimen of "kerosene shale," which, on account of its deep brown colour, resinous lustre, and eminent conchoidal fracture, at once reminded me of the oil-bearing rock of Hartley, New South Wales. Upon slicing this specimen and comparing the structure with a slide of the Hartley rock in our museum cabinet it was evident that they were practically identical. The Falkland Islands specimen is formed, like that of the New South Wales rock, almost entirely of the small (?) thallophyte described by MM. Renault and Bertrand under the name of *Reinschia australis*, and believed by them to be nearly related to the Hydrodictyaceæ or Volvocineæ. The deep yellow coloured sacs are of the same dimensions in both examples. The specific gravities of the Falkland Islands and the New South Wales rocks were found to be approximately equal, being in both cases slightly more than 1. Prof. Liversidge gives that of the Hartley, New South Wales, specimen as 1·052. As Liversidge points out, this rock is scarcely a shale, since the shaly structure in hand-specimens is absent, but would be more aptly termed a "Cannel coal," or, as suggested by the Rev. W. B. Clarke, "brown cannel."

The Falkland Islands specimen was found near Hill Cove, West Falkland, and I have since been kindly furnished with further information as to its occurring a fair distance up several river valleys; so that this fact, together with its tolerably fresh appearance and only slightly water-worn surface, does not support the idea that it may be drifted from a great distance. There is considerable probability that deposits of this "kerosene shale" will eventually be found *in situ*, since the fact of a typical Glossopteris flora occurring in East Falkland has already been proved by J. Halle, the geologist to the Swedish Magellanic Expedition (*Geol. Mag.*, 1908, p. 265). To quote that author's own words:—"Fossils, principally leaves of Glossopteris, occur in many places, and it is evident that the whole southern part of East Falkland south of Wickham Heights belongs to the Gondwana system." Not only does the fossil flora correspond in this remarkable way with other areas of Gondwanaland, but amongst the brachiopods in the above collection several of the Spirifers bear a close resemblance to New South Wales species. FREDERICK CHAPMAN.

National Museum, Melbourne.

Optical Projection of Figures in Full Relief.

AT the recent Glasgow Exhibition an optical illusion was exhibited which showed very distinctly and daintily living human figures in full relief, standing upon a desk, on a scale of about 8 inches = 6 feet.

The production has caused much debate in private circles, and I write in the hope that someone may be able to inform me how it was produced.

I may say that the images were shown in ordinary electric light, and no optical apparatus of any description was visible.

Behind the figures the wall, which was at a distance of about 8 inches, was covered by what seemed an ordinary flowered tapestry.

The writer saw the same thing about seven years ago on the stage in Paris, and then, as now, the explanation eluded him and many of his friends. CURIOUS.

THE NEW BELL-PETTIGREW MUSEUM OF NATURAL HISTORY IN THE UNIVERSITY OF ST. ANDREWS.

THE comparatively few specimens of natural history in the olden time were stored in the Library of the University or in other rooms, and though Dr. McVicar, the first lecturer on the subject of natural history, commenced a new collection, about 1826, in the old dining hall of the United College, the results were small. It was not until 1838, the date of the foundation of the Literary and Philosophical Society, that Sir David Brewster pressed forward the formation of a museum for the University; indeed, this was one of the main aims of the society. Under the fostering care of the distinguished principal just mentioned, active progress was made, and by and by the Government provided a hall and adjoining rooms, with the necessary cases for the collections. The specimens have gradually accumulated since that date, and to such a degree after 1882 that the crowded condition of the shelves renders the museum at present mainly a store for the preservation rather than the exhibition of its contents. The need for extension was felt as early as 1884, when the architect of the Board of Works made plans for the extension of the museum on the present site—plans which met with the approval of everyone in the University. These included an aquarium and a marine laboratory on the ground floor, laboratories and class-rooms over them, whilst another large hall and accessory rooms formed an extension of the present museum to Butts Wynd, these filling up the north-western corner of the quadrangle. Unfortunately, though sympathetic, Mr. Gladstone's Government could not afford the funds, and ever since the condition has been clamant. It is true the University might have provided the funds, for it has built large additions in the shape of new class-rooms and a physical laboratory, and appropriated 5000*l.* of the Carnegie grant for endowing the chemical research laboratory, the munificent gift of Prof. Purdie. The department of zoology, however, had to wait. Thus it happened that, after the death of Prof. Pettigrew, his widow resolved to erect a memorial to him in the form of the spacious new museum at the Bute Medical Buildings, a site which in itself is full of reminiscences of the long-continued efforts of the deceased professor and a colleague—supported by the late Lord Bute and the medical graduates of the University—for securing two *anni medici* at St. Andrews, the other three years being intended for Dundee. Moreover, as he was a former custodian of the old museum, the gift of this memorial of Prof. Pettigrew is peculiarly appropriate.

Accordingly, plans of the new museum were prepared by Messrs. James Gillespie and Scott, architects, St. Andrews (to whom this article owes its illustrations), and the negotiations between Mrs. Pettigrew and the University Court were energetically carried out by my colleague, Prof. Musgrove, who, indeed, superintended the operations from first to last. Now the entire structure has been completed and furnished with electric light, and the cases (jointly provided by Mrs. Pettigrew and the University) have been erected in the great hall, where the celebration banquet was held last September. These cases are of the most modern type, viz. of iron, each wall-case carrying a door composed of a single sheet of plate-glass 9 feet by 5 feet, larger sheets of glass occurring in the central cases on the floor.

FIG. 1.—Front (West) of the New Bell-Pettigrew Museum.

The museum (Fig. 1) faces the west, close to the line of trees skirting the long walk of St. Mary's College, and is appended to the Bute Medical Buildings, from which access is gained by a fireproof door on each flat. Externally it has the botanic garden on three sides, and, when the approaches are widened, public access from Queen's Terrace and West Burn Lane will be facilitated; yet as regards position it is perhaps less in the current of visitors than the old museum in the United College.

The building (Fig. 1) is in the style of the English Renaissance, thus agreeing with the Bute Medical Buildings to which it is attached, and which were erected by Lord Bute, the same architects having prepared the plans. The main door faces the west and Queen's Gardens, and there are two stories. At each end of the roof is an open stonework canopy, the monogram of Prof. Pettigrew and his widow being engraved beneath.

The sunk floor contains long passages and spaces for storage and ventilation, and gives access to pipes and wires. The ground floor (Fig. 2) covers an area of about 130 feet by 75 feet, the entrance, already noted, being at the north-west corner, and leading to a vestibule, shut off by swinging and partially glazed doors, and a hall 65 feet long by 17 feet broad, with a spacious bow-window in the centre commanding views of the ancient halls of St. Mary's College and the principal's house, as well as the fine new Carnegie Library. At the eastern end of the hall are blank spaces which indicate where doors will in future open into a large lecture-theatre (not yet built). The ethnological collections will probably be placed in this hall. A stair leads from the north-western end of the hall to the upper floor, and in the spaces of the projecting tower are sinks and lavatories. The west front is devoted to teaching and administration, and is

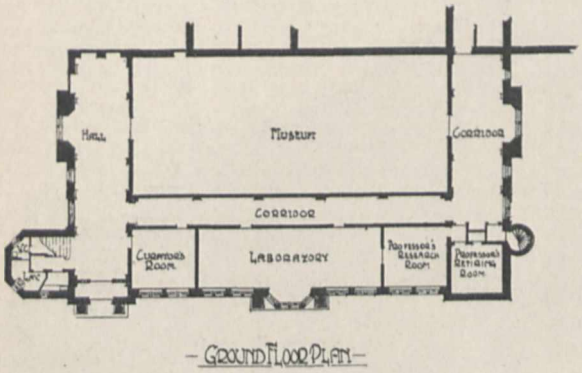


FIG. 2.—For scale see Fig. 3.

separated by a long corridor from the main hall of the museum. It contains from north to south a curator's room, a class-room for practical zoology, 62 feet by 17 feet, a research-room, and a professor's room, near which is a turret-stair leading to the upper floor and to the roof. A corridor about 50 feet long and 17 feet broad extends along the southern face, with a spacious bow-window as in the north corridor; and as the botanical department adjoins and communicates with its eastern end, it is probable that this area will be devoted to the botanical collections.

The main hall of the museum on this floor is 90 feet long by 40 feet broad, and it passes upward to the roof, so that large skeletons, such as those of cetaceans, may be suspended in mid-air, rings and hooks being fixed to the beams, whilst a belt of wood below the cornice gives facilities for hanging pictures. The roof is doubly glazed, the inner layer being formed of muranese glass for diffusing the light, which is northern throughout, except at the lateral windows of the corridors. The floor is handsomely paved with marble mosaic, a special gift of Mrs. Pettigrew. This large hall will probably suffice for the mammals and birds, and, it may be, for the reptiles.

The upper floor (Fig. 3) has the same general area as the ground floor; but, since the great hall goes to the roof, only the western, northern, and southern galleries are available for cases. The spacious western gallery is about 122 feet long by 28 feet broad, and the inner borders of both it and the adjoining galleries are flanked by a series of Roman Doric columns, the effect of which is agreeable from all points of view. The entire upper floor is fireproof, being composed of iron and concrete with solid interlocked maple blocks. The north and south galleries are each about 70 feet long by 17 feet wide, a large bow-window occurring in the centre of each.

The extensive series of spirit preparations of the marine invertebrates (chiefly British), the collection of fishes and their eggs and early stages, will find space on the main part of this floor and along the northern corridor, but wall-cases are still required. Table-cases now in the old museum will occupy much of the floor. The southern corridor, which communicates by a door with the Bute Medical Buildings and is on a level with the department of geology, will probably contain the larger part of the geological and mineralogical specimens.

The munificence of Mrs. Pettigrew has thus solved the long-continued problem of museum accommodation, while at the same time it has produced a lasting memorial to a valued colleague, whose early researches on the muscular fibres and nerves of the mammalian heart, of the muscular fibres of the stomach and of the bladder, and whose ingenious ex-

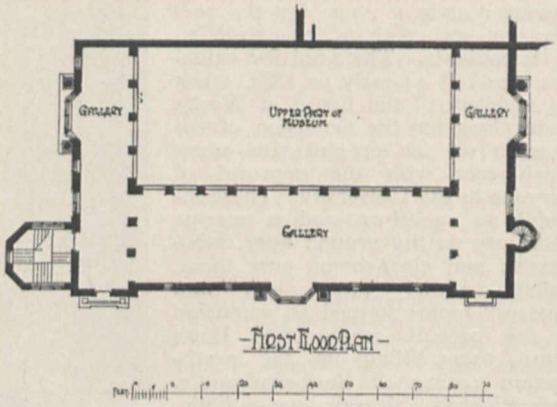


FIG. 3.

periments on flight and animal locomotion are worthy of all praise. Indeed, as regards flight, it needed but a modern petrol engine to have raised Prof. Pettigrew's marvellous apparatus in the air, instead of flapping along the ground under the weight of a heavy steam-engine. W. C. M.

THE PRESERVATION OF THE AFRICAN FAUNA AND ITS RELATION TO TROPICAL DISEASES.[1]

WHEN educated opinion in Europe, especially in England, could take stock of the ravages of British and Boer hunters who were exterminating the wonderful mammalian fauna of South Africa, a movement set in in the opposite direction for pleading with the British, German, French, and Belgian Governments to discourage or prohibit the destruction of wild life in their African territories. This desire to preserve the fascinating aspects of wild nature began to take a more acute shape in the last decade of the nineteenth century, and various African administrators, who were naturalists as well as sportsmen, induced their Governments to allow them to proclaim certain areas in Africa to be game reserves in which more or less complete protection was afforded to beasts, birds, and reptiles. The British

1 "Further Correspondence Relating to the Preservation of Wild Animals in Africa." [Cd. 5775.] (H.M. Stationery Office.) Price 8½*d*.

Foreign Office took up the matter in the early 'nineties, and through Sir Clement Hill and others made arrangements with European nations for the institution of game regulations throughout Africa which might check the devastating raids of sportsmen. The movement was accentuated by a revelation of the wonders of the equatorial East African fauna, which really rivalled those of Cape Colony and Natal in the days of Roualeyn Gordon Cumming.

European opinion in Africa became sharply divided into two classes. There were the officials and some of the missionaries who, backed by the men of science of Europe, thought quite as much of the natural wonders of these African States, and regarded them as being an asset of equal importance with the profits which might be derived by the opening up of the country under the energy of European planters or capitalists. To some of us the lion, the elephant, the giraffe, the eland, kudu, sable antelope, and oryx were quite as important subjects of the new protectorates, and as deserving of reasonable protection, as the human inhabitants, and from an æsthetic point of view this argument was reasonable. On the other hand, the European immigrants and most of the natives clamoured for the right to destroy the wild game when and as they pleased. The Europeans, indeed, were seized by a kind of lust for blood which distracted them a good deal from the coffee, cotton, sugar cane, rubber, and tobacco planting which should have occupied most of their energies. They could not let an elephant or a buffalo, a rhinoceros or a giraffe, live within thirty miles of their station. The natives, forbidden to kill one another any longer, and unable to fight with the European, wished to devote their warlike enterprise to the destruction of big game, especially as the products of the chase were so marketable.

On the whole, the wishes of the official element, supported by the home Governments, prevailed. Game reserves were instituted, and to a great extent made valid by the application of laws. Highly-priced licences checked indiscriminate shooting on the part of Europeans, while the natives were seldom able to obtain arms of precision necessary to the rapid slaughter of game. So it was hoped in time a balance might be struck, and all the European possessions in Africa be studded with beautiful Government parks and paradises, in which would be preserved from extinction the wonderful fauna and the interesting flora of the most backward of the continents. In East Africa it seemed as if this policy of game preservation was a good one, even from a commercial point of view. The marvellous natural zoological gardens which it produced along the track of the Uganda railway brought every winter hundreds of well-to-do tourists, who spent much money in the country and amongst the natives. Then also it was thought that the African elephant might after all be harnessed to our industries, or allowed to breed as a provider of ivory; we might domesticate the eland and the bush-buck, and even do for the African buffalo what the European colonists of tropical Asia did for that of India several thousand years ago.

But at this stage—about three years ago—a new factor entered into the consideration of the problem. It was suspected that in many parts of Africa the existence of big game was actually prejudicial, and even dangerous, to the coexistence of the human race, black, white, or yellow. It seemed as though other creatures than man and monkeys must act as reservoirs of micro-organisms, especially trypanosomes, provocative of disease. Consequently, so long as they coexisted with man, the various species of tsetse-fly, of tick, and flea, would, even if infected human beings were isolated, have always the means of renewing their supplies of disease germs. In this way, epidemics of disease might be constantly renewed amongst man in Africa and his domestic animals. Certain game reserves, such as the elephant marsh in the southern part of Nyasaland, became peculiarly obnoxious to the European settlers round about. They stated that the herds of buffalo and other game that had increased and multiplied within this reserve were sources from which the tsetse-fly obtained at once its livelihood and its means of doing harm.

As regards the question of the relations between the tsetse-fly and the big game, it has been pointed out in a very authoritative manner by Sir Alfred Sharpe and other deservedly recognised authorities in the field that there are numerous districts in Africa almost entirely without big game which, nevertheless, swarm with tsetse-fly to such an extent that they are practically uninhabitable by man. In other words, that the existence of buffaloes, kudus, elands, zebras, &c., is *not* necessary to the perpetuation of the tsetse-fly, which apparently finds some other creature than these large mammals to supply it with the blood nutriment it requires or desires. Consequently, this argument does not hold as a justification for the extirpation of big game. Moreover, in many parts of West Africa where disease-conveying species of tsetse (Glossina) exist, there is very little big game. But within the last twelve months or so it has been proved conclusively by the biologists at work in Uganda that the large antelopes of that country are the hosts of dangerous trypanosomes, amongst others, of the trypanosome which causes sleeping sickness; and that if this terrible malady is to be extirpated from the Uganda Protectorate, practically all the larger antelopes must go; or at any rate, that their extirpation must be carried out rigorously in those well-wooded regions close to water inhabited by the dangerous *Glossina palpalis*.

Such discoveries, of course, have given great encouragement to that party among us specially represented by pioneers and colonists on the spot, eager for the unlimited destruction of wild life. There is, indeed, need for a wise administration of the law in this respect, and for the Colonial Office to obtain and to act on the most careful scientific advice. The same people that wish no check to be put on their blood-lust in regard to the destruction of rhinoceroses, of giraffes, of buffaloes and elephants, are equally eager to shoot all striking or beautiful birds, especially the various forms of white heron (egret) and crane—notably the crowned crane. Now it has been shown that certain forms of heron, especially the white ones, live almost entirely on insects and ticks, pursuing them by the waterside and attaching themselves to herds of domestic cattle or wild game, whom they relieve of their parasites and of the infesting flies. Similarly, crowned cranes, besides being very beautiful, are in every way the friend of man. They live chiefly on grasshoppers and locusts, they eat nothing that is of any value to man, and they are constantly at work destroying his enemies. In many regions of Africa the giraffe, the oryx, the elephant, rhinoceros, zebra, &c., are not in a position to be harbourers of trypanosomes, or if they are, these regions are entirely free from tsetse-flies.

The whole question is so important to the world in general, both for the extirpation of disease and the preservation of beauty and interest in fauna and flora, that it would be well to hold a Brussels Conference once in five years to discuss these questions, in regard to the destruction of harmful insects and the preservation or destruction of birds and beasts.

H. H. JOHNSTON.

CONCERNING CRUSTACEANS.[1]

THIS is a good instance of a sound type of book, one in which the specialist seeks to interest accessible outsiders in the particular class of animals to which he has devoted himself. It sometimes happens, indeed, that the specialist, forgetful that there was a time when even he knew nothing of his "ology," writes what no one outside the cult can pretend to enjoy or even to understand; or, having got narrowed down to a particular side of his subject, writes without perspective or any picturesqueness. But although Dr. Calman is one of the leading lights on crustaceans, and has by his researches made "carcinology" (we are instinctively sure that he hates the word) his lasting debtor, he condescends to write so that any fellow can understand, and he takes a broad view of his delightful subject. We say "delightful subject," not to depreciate the success which Dr. Calman has achieved in writing so interestingly about crustaceans, but because it must be admitted that there is considerable inequality in the literary value of the various classes of animals. Every zoologist for his own group, but there is no denying that crustaceans have more "points" about them than brachiopods, and more "habits" than crinoids.

FIG. 1.—A Spider-crab, *Maia squinado*, dressed in fragments of weeds. British (reduced). From "The Life of Crustacea."

Dr. Calman knows so much about crustaceans that he imbues even familiar themes with new interest. Thus the second introductory chapter, which gives an account of the lobster, as so many teachers of zoology do year after year, is enlivened by fresh touches. We read, for instance, of the prawn that was induced to put iron filings into its ears, with the result that its locomotion was seriously disturbed whenever a strong electro-magnet was brought into its vicinity. We are told, apropos of colour, that living lobsters are occasionally found of a brilliant red colour—ready boiled as it were. An account of the lobster's habits of food-testing, quoted from Dr. H. C. Williamson, strikes us as a fine piece of natural history. It seems, by the way, an unnecessary condescension to the laity to go on speaking of the gizzard as a stomach—a term which, as the author knows so well, is doubly misleading.

Helped by the excellent illustrations, the reader may, with a little care, get from the third chapter a grip of the somewhat intricate classification of the fairy-shrimps, water-fleas, carp-lice, barnacles, opossum-shrimps, wood-lice, sand-hoppers, prawns, squillas, lobsters, crabs, &c., that are all included under the title Crustacea. In the next chapter, which deals with life-histories, the author is careful to point out that while the occurrence of a nauplius larva in the life-history of, let us say, a branchiopod, a copepod, an ostracod, a barnacle, and a penæid prawn is strongly suggestive of the evolution-idea, there is no reason to entertain the idea that there ever was an ancestral type like a nauplius, or that any ancestors of the shore-crab resembled, even remotely, the zoëa stage with which the life-history of the individual now begins.

A great part of the book is devoted to a consideration of crustaceans in relation to their habitats, a mode of treatment which lays emphasis on adaptations. We are taken first to the sea-shore, where the "shifts for a living" are so numerous and varied. We read of symmetrical hermit-crabs in water-logged bamboo-stems; of crabs that masked themselves with seaweeds, and when placed in an aquarium among sponges picked off the weeds and put on sponge; of Prof. Garstang's observations on the breathing of Corystes when buried in the sand, of the ocypods that make a buzzing or hissing sound with their stridulating organ, perhaps, as Dr. Alcock suggested, to warn intruders that the burrow is already occupied; of the extraordinary protective resemblance of Huenia; of the bewildering variety of colour and colour pattern in Hippolyte; and so on through a wealth of fascinating illustrations. We are taken next to the deep sea, and the adaptations of long, stilt-like legs, of highly developed tactile organs, and the like are discussed. The discussion of luminescence is commendably cautious. Of a recently described case of certain deep-sea prawns which have photophores

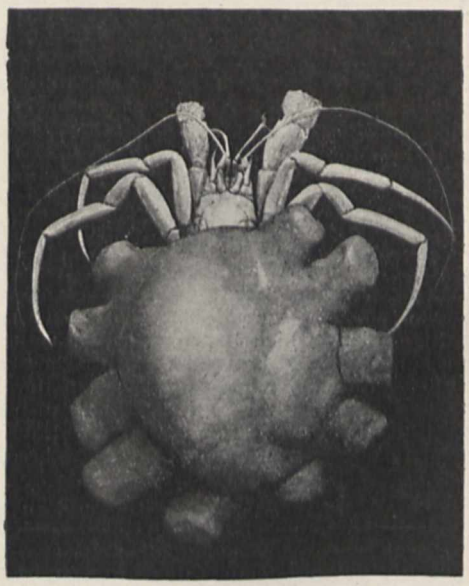


FIG. 2.—A Deep-sea Hermit-crab, *Parapagurus pilosimanus*, sheltered by a colony of Epizoanthus. From deep water off the west of Ireland (slightly reduced). From "The Life of Crustacea."

[1] "The Life of Crustacea." By Dr. W. T. Calman. Pp. xvi+289. (London: Methuen and Co. Ltd., 1911.) Price 6s.

placed so as to illuminate the interior of the gill cavities, Dr. Calman well says: "What function they can discharge in this position seems beyond conjecture." It is very interesting also to read of *Platycuma holti*, which seems to feed on the deep-sea ooze, that it has a coiled food-canal, a very rare condition in Crustacea. Another kind of interest attaches to the occurrence of some old-fashioned types, such as the Eryonidea, in the great abysses. In an equally instructive manner the author deals with the crustaceans of the surface of the sea, of the fresh waters, and of the dry land.

A chapter on crustaceans as parasites and messmates is full of quaint things; we read of a little crab, *Hapalocarcinus marsupialis*, in which the female allows herself to be imprisoned within a cage or "gall" of living coral; of *Melia tesselata*, which carries a sea-anemone in each claw and uses it as a living weapon; and of the extraordinary life-histories of some of the parasitic forms. The contact of crustaceans with human life is illustrated by the palatable lobsters and crabs, shrimps and prawns, by the part which minute forms play in the economy of the sea, by the unique case of the species of Cyclops which is the intermediate host of the guinea-worm, and by borers like the gribble. A short account of Crustacea in the past completes the book, apart from useful appendices on collecting and on literature.

In every respect Dr. Calman's book is a success; it is as instructive as it is interesting, as careful as it is picturesque. It is an admirable introduction not merely to Crustacea but to natural history. In connection with a second edition, we venture to suggest that the author should consider the advisability of adding another twenty pages with tables helping the student to identify the commoner British forms. This seems all the more feasible when we notice the numerous excellent illustrations of British forms with which the book is already provided. But in the meantime we offer the author our congratulations.

THE NUTRITIONAL VALUE OF INDIVIDUAL PROTEINS.

NOW that the composition of the various foodstuffs is becoming better known, physiologists can apply themselves with renewed vigour and greater success to the problem of the part which each plays in nutrition. In this relationship most interest attaches to the proteins, and it is with this important class of substances that Dr. Osborne and Dr. Mendel have commenced what promises to be a most valuable series of researches.[1] It has long been known that gelatin is an insufficient food, and this fits in with the absence of certain molecular groupings (tyrosine and tryptophane) from its composition. More recent experiments have shown that other "imperfect" proteins—for instance, the zein of maize—are also imperfect from the nutritional point of view. There are, however, great difficulties in carrying out investigations on the effect of administering the necessary nitrogen in the shape of a single protein. In order to eliminate individual differences in animals, the experiments must be numerous; but perhaps the greatest drawback of all is the fact that a monotonous diet in itself produces distaste for food, so that the experiment is usually brought to an end by the animals refusing to take what is offered them after a comparatively short period of time.

In the present experiments rats were selected as the object of attack; they can be utilised in large numbers, and, being small animals, a comparatively limited supply of the purified protein will last a long time. Whether the results obtained are applicable in all details to other animals, man included, one feels a little chary in deciding, the proverbial association of mice and men being hardly sufficient grounds for supposing that men and rats are exactly similar in metabolic habits. The rat's span of life is much shorter than that of the larger animals, its first year corresponding roughly to the first thirty years of a man's life.

The two American physiologists mentioned have, however, been remarkably successful in avoiding the bad effects of a monotonous diet; but whether this was due to luck or to certain precautions they took is not quite clear from their publication. Whichever explanation is the correct one, they succeeded in keeping their animals alive for many months. They record numerous experiments in which casein formed the sole nitrogenous constituent of the dietary, and the animals exhibited no sign of ill-health or loss of weight. One animal lived for nearly a year on a diet in which the only protein given was the glutenin of wheat.

The authors direct attention to a most important point which is frequently neglected in such experiments. The metabolism of a growing animal is a different story from that of the adult. This is recognised empirically by practical physicians; it is recognised in the discussion which has taken place in the daily Press and elsewhere on the nutritive value of the different kinds of bread. But the reason for such a belief is still in the region of the unknown. We have no certain knowledge of what are the food constituents, no doubt present in quite small quantities, which are of special value in stimulating growth in young animals. Drs. Osborne and Mendel quite clearly see the problem, but so far they have not solved it. Casein, the protein selected for their most numerous experiments, is the principal protein of milk, the most important of the foods taken by the young; and yet they found that this dietary, given to young rats, maintained their weight, but led to little or no growth.

If we believe the exaggerated statements in the advertisements of foods consisting of this protein freed more or less completely from the other constituents of milk, we should be led to think them extremely valuable substitutes for the untreated article. Practical experience has shown that this is not the case, and the careful experiments which have prompted these remarks have the most important practical outcome in showing the danger of tampering with this essential article in the dietary of infants. Any attempt to "purify" it by removing constituents which are quite as important as the protein, and may be, from the health and growth point of view, even more important, is fraught with peril to the public.

W. D. H.

[1] "Feeding Experiments with Isolated Food Substances." By T. B. Osborne and Lafayette B. Mendel, with the cooperation of Edna L. Ferry. Pp. 53. (Published by the Carnegie Institution of Washington, 1911.)

ANNIVERSARY MEETING OF THE ROYAL SOCIETY.

THE anniversary meeting of the Royal Society was held on November 30, when the report of the council was read and Sir Archibald Geikie delivered his presidential address. In the evening the anniversary dinner was given in the Hotel Metropole, and the speakers included Lord Justice Buckley, who proposed the toast of the Royal Society, Lord Alverstone (Lord Chief Justice), the Lord Mayor, and Dr. A. W. Ward (president of the British Academy).

In response to an appeal from the council for funds for the construction of additional buildings for ad-

ministrative and other purposes, that are required to meet the rapid extension of the work of the National Physical Laboratory, and for alterations needed to enable the testing work now carried on at Kew to be removed to Bushy, the Treasury has signified "that in addition to the sum of 5000*l.* inserted in the Estimates for the current year, My Lords will be prepared to ask Parliament to vote two further instalments of the same amount in 1912–13 and 1913–14, on the understanding that the whole scheme will be completed with this assistance." Plans for the buildings have accordingly been prepared, and their erection will be proceeded with at an early date.

At the request of the council, the Admiralty placed the services of H.M.S. *Encounter* at the disposal of the observers sent out by the Joint Permanent Eclipse Committee to observe the solar eclipse of April 28, 1911, and Captain Colomb and his officers and men rendered very efficient assistance to the work. The weather conditions were not very favourable, and two minutes of the 217 seconds of totality were lost. Under these adverse conditions one fairly good photograph was secured by the 3-foot coronograph with the Abney 4-inch lens of 33 inches focal length. With the short focus prismatic camera the whole hydrogen series from H_α to H_2 was secured at the beginning of the second "flash," and, although not adding much to previous knowledge, this is the first time H_α has been photographed at an eclipse.

Satisfaction was expressed by the council at the consent of Sir Joseph Larmor to be nominated for the office of senior secretary of the society for another year in view of the detailed preparations for the celebration of the society's 250th anniversary next year. A minute of the council states that "it is desirable that the secretaries be not so re-elected as to hold office for a period exceeding ten successive years," and under this rule Sir Joseph Larmor would in the ordinary course have retired on November 30. The council expressed the opinion, however, that on account of the celebration next year it would be detrimental to lose the advantage of the senior secretary's long experience and intimate knowledge of the work of the society, while at the same time the task of his successor would be made unduly onerous. This opinion was confirmed by the re-election of Sir Joseph Larmor as secretary at the anniversary meeting on November 30.

After referring to the losses by death which the society had suffered during the past year, the president directed attention to some points in the council's report not mentioned above and to the scientific work of the medallists. Subjoined are some extracts from the address :—

Presidential Address.

In my address last year I adverted to the history of seismological observation in this country and to the part taken in the development of this branch of observational science by our associate, Dr. Milne. I expressed the hope that means might be found to place his important service on a more permanent footing, with an enlarged staff and more generous financial aid. Though no important advance has yet been made towards the realisation of this hope, the subject has not been lost sight of, and at least one useful step has been taken in the more complete equipment of Eskdalemuir Observatory as a seismological station. There are now installed there the complete Galitzin apparatus and the twin Milne apparatus, which record photographically, and also the Wiechert and the Omori instruments, the observations of which are recorded on smoked paper. To Prof. Schuster we are indebted for his generosity in presenting the Galitzin apparatus. The various instruments, when completely put into working order, will supply valuable material for a comparison of results, and will provide an important addition to the network of seismological stations in this country. The addition of this seismological work to the other duties of the superintendent of the Eskdalemuir Observatory has shown that an increase of the staff under his supervision is imperatively required. The Gassiot Committee, after a full consideration of the subject, has recommended that a grant in aid for a limited period should be made by the Royal Society, and the council, approving of the proposal, has granted a sum of 450*l.* for the purpose of supplying an additional observer for two years, after which some other more permanent arrangement must be provided. In the meantime, the council has been gratified by the gift of 200*l.* from Mr. Matthew Gray for the purpose of assisting the progress of seismology at Eskdalemuir.

Fellows are aware that for many years past the society has been conducting researches into the cause and prophylactic treatment of tropical diseases, and that these researches are still in progress. Much information has been collected; and it is satisfactory to know that, since steps have been taken to remove the native population from the fly-belts, the areas affected by one of the most terrible of these maladies, sleeping sickness, have been considerably restricted. But much remains to be accomplished before the knowledge of the subject can be made as complete as it should be. As will be seen from the report of the council, the investigation is now about to be extended far beyond the bounds originally contemplated. It has been plausibly suggested that sleeping sickness may be transmitted from other sources than infected human beings, and the question arises whether the wild animals of tropical Africa may possibly supply the trypanosomes of that disease. Accordingly, at the request of the Colonial Office, the Royal Society has organised and despatched a new commission, under the directorship of Sir David Bruce, for the purpose of studying on the spot what may be the relation of the native fauna of Nyasaland and other parts of Africa to the spread of human trypanosomiasis, and what trypanosome diseases may affect the domestic animals of that region. The composition of the staff has been carefully considered with a view to secure adequate attention to each of the various branches of investigation that are embraced in the wide inquiry which is projected. It is interesting to know that Lady Bruce, who has all along been one of the most efficient observers in Africa, again accompanies her husband on this fresh expedition. I may add that she is not the only lady engaged under our auspices in Africa; Miss Robertson, who has had considerable experience in the study of trypanosomes, has volunteered her services in Uganda, and is now at the Mpumu laboratory tracking the development and transmission of the organisms to which trypanosomiasis is due.

The "Catalogue of Scientific Literature for the Nineteenth Century," on which the committee of the Royal Society has now been engaged for more than fifty years, is speedily approaching completion. The material for the final part (1883–1900) of the general catalogue, which is classified under authors' names, has been collected and sorted, and is nearly ready to pass through the press. Of the subject-indexes of scientific papers for the nineteenth century, two volumes, pure mathematics and mechanics, have been published; and the index for physics, in two volumes, is well under way. While the committee does not claim perfection in detail for the classification of the subject-matter of those sciences, and while it is aware that the arrangement of so great a mass of material which must be condensed into small space will always be liable to technical criticism in details, it nevertheless believes that no person who in future shall set about a general investigation or an historical survey in any department of one of these sciences can afford to neglect consultation of this index. It was felt to be worth while by so great a man as Thomas Young, a hundred years ago, to devote a large amount of time to the compilation of a classified index of the literature of natural philosophy up to that date, when the achievement was just within the range of private enterprise. The immense volume of the scientific literature of the last century could have been digested only by some corporate organisation; and the whole scientific world has signified in advance its obligation to the committee of the society and to the generous benefactors who have assisted the society in the work when its own funds had been depleted by undertaking the continuation

of the same work in the twentieth century as the "International Catalogue of Scientific Literature."

Having gone to so much trouble and expense in the preparation of the materials for these subject-indexes, the society is naturally desirous to see that the results become accessible to the scientific public, for whose use the volumes are intended. All the funds which the Royal Society can possibly devote to this work are necessary for its completion; thus there can be no question of free exchange, as was the case with the earlier volumes, however much the Royal Society might desire it. But, as the fellows are already aware, the Cambridge University Press has consented to undertake the entire risk of printing and publication, and has agreed to sell the volumes at a very moderate price. We are informed that the volumes of the index already issued have, for some reason, not yet attracted the attention among universities and public libraries that was confidently anticipated. I have therefore thought it desirable to bring this matter to notice to-day.

On July 15 of next year the Royal Society will have lived for exactly two centuries and a half. Looking back upon this long career, and considering the friendly relations which the society has for generations maintained with the men of science in all quarters of the globe, the president and council have thought that the occasion will be one which ought not to be passed over in silence, but which deserves to be marked in some worthy way. They have accordingly decided to invite the chief universities, academies, scientific societies, and other institutions in this country, in our colonial dominions, and abroad, to send delegates hither to join with us in celebrating our 250th birthday. The invitations will be issued next month, so as to allow ample time for the selection and the arrangements of the delegates and for our own preparations here. Our patron, his Majesty the King, has been pleased to signify his appreciation of the importance of our proposed celebration. Though the details of the function have not yet been settled, it is thought that the first reception and welcoming of our guests should be held in our own rooms, which, with their portraits and other memorials of our past, will doubtless be of interest to the visitors. For the banquet, at which the fellows and their guests will dine together, we hope to enjoy the use of a large hall specially lent to us for the occasion. Considering the early association of the Royal Society with Gresham College and the City, we trust that some opportunity will be afforded to us of renewing that intercourse, and thus of allowing our delegates to partake of the well-known hospitality of London. There will doubtless be a good deal of private hospitality. Of course, every facility will be arranged for our guests to see public buildings, museums, libraries, and other objects of interest. At the end of the function in London, the delegates may not improbably be invited to visit the Universities of Oxford and Cambridge.

As a permanent memento of the occasion, the council has decided to reproduce in facsimile the pages of the charter-book, containing the signatures of the fellows from that of the founder, Charles II., down to the present day. This interesting volume is now in course of preparation at the Oxford University Press. It has also been arranged to issue a new edition of the society's "Record," in great part rewritten, closely revised, and brought up to date. This volume is also in progress.

MEDALLISTS, 1911.

The Copley Medal.

The Copley medal is this year awarded to Sir George Howard Darwin, for his long series of researches on tidal theory, including its bearing on the physical constitution of the earth and on problems of evolution in the planetary system.

As regards the actual oceanic tides, he has perfected the method of harmonic analysis initiated by Lord Kelvin, and has greatly promoted its practical application by the invention of simplified methods of ascertaining the tidal constants of a port from the observations and of framing tide-tables. In another series of researches the tides of a solid planet of slightly viscous material are investigated, including the consequent secular changes in the motion of the planet and of the tide-generating satellite. He traced from this point of view the past history of the earth and moon, and was led to the now celebrated hypothesis that the latter body originated by fission from its primary when in a molten state.

He has further studied in great detail the classical problem as to the possible figures of equilibrium of a rotating mass of liquid and their respective stabilities, which has engaged in succession the attention of Maclaurin, Jacobi, Kelvin, and Poincaré. The difficult theory of a binary system composed of two liquid masses revolving in relative equilibrium, now known as Roche's problem, has been greatly developed and extended by him. Such investigations have, of course, an important bearing on the theory of the evolution of the earth-moon system already referred to.

The above is a mere summary of the main lines of Sir George Darwin's activity. There are, in addition, a number of highly important memoirs on more or less cognate subjects. For example, in dealing with the question as to the degree of rigidity of the earth as it now exists, he has treated it from various points of view; he has considered the theory of the long-period tides, and the stresses produced in the interior by the weight of continents and mountain chains. Mention should also be made of remarkable papers on the history of meteoric swarms, and (in the domain of the more classical astronomy) on periodic orbits.

Royal Medals.

The assent of his Majesty the King has been signified to the following awards of the two Royal medals:—

The Royal medal on the physical side was assigned to Prof. George Chrystal, of Edinburgh University, on account of his contributions to mathematical and physical science, especially, of late years, to the study of seiches on lakes. Conspicuous in his early years as one of Clerk Maxwell's principal lieutenants, it is to him that we owe the experimental proof of the extreme precision of Ohm's law of electric conduction (Brit. Assoc. Report, 1876). His memoir on the differential telephone (Trans. Roy. Soc. Edin., 1880) was a notable early extension of the theory and practice of Maxwell's principles as regards inductances, now become more familiar when power transmission, as well as telephonic intercourse, proceeds by use of alternating currents. His duties as a teacher of mathematics led to the "Treatise on Algebra," which, besides being a book of original vein, was the earliest systematic exposition in our language of the more rigorous methods demanded in recent times in algebraic analysis. But this purely mental discipline, and its continuation in various memoirs on abstract mathematics, could not wholly occupy a mind trained originally in the school of physical science. Of late years Prof. Chrystal had been engaged with great success in a most interesting subject of research, in the theory and the observation of the free persisting oscillations of level in lakes, first observed and analysed by Forel on the Lake of Geneva.

At the moment when the council was adjudicating this medal it was unaware that the illustrious mathematician at Edinburgh was then lying on his death-bed. He had been in failing health for some time, but the latest news was more favourable. The end came, however, before he could learn that a Royal medal had been assigned to him. In these circumstances it was felt that the award should not be cancelled, but that the medal should be transmitted to his family as a visible token of the admiration with which the Royal Society regards his life-work. On appealing for the sanction of the Royal donor of the medal, his Majesty was pleased to approve of our proposal, and to add an expression of his condolence: "The King trusts that you will be so good as to convey to the family the assurance of his Majesty's sincere sympathy in the terrible loss that they have sustained, through which so distinguished a career has been brought to a close." Those who had personal acquaintance with Prof. Chrystal mourn the extinction of a life full of charm and brightness.

The Royal medal on the biological side has been awarded to William Maddock Bayliss, F.R.S. During the last twenty-five years the part taken by Dr. Bayliss in the advancement of physiology has perhaps been unequalled by any other physiologist in this country. His work has ranged over a wide field. In his earlier papers dealing with the electrical phenomena associated with the excita-

tory state in glands and contractile tissues, he brought forward results which were, at the time, entirely novel, and have formed the basis of all subsequent investigations. His paper with Starling on the electrical phenomena of the mammalian heart was the first to give the correct form of the normal variation, as confirmed by later investigations with the string galvanometer.

Another subject which has engaged his attention at intervals during the whole of his career has been the question of the innervation of the blood-vessels. A third group of researches is represented by those on the innervation, intrinsic and extrinsic, of the intestines. A fourth group of papers deals with the mechanism of the pancreatic secretion. These researches, which by themselves would be sufficient to justify the award of the Royal medal, were also carried out in partnership with his colleague, Prof. Starling. The discovery of secretin afforded for the first time a convenient and easy method of obtaining pancreatic juice in large quantities. The investigation of the properties of pancreatic juice and of the activation of its chief proteolytic ferment by another ferment, enterokinase, secreted by the intestinal mucous membrane, has led Bayliss to a further series of researches on the mode of action of enzymes and on the closely related questions with regard to the nature of colloidal solutions. The value of this work has been universally recognised.

Davy Medal.

The Davy medal is this year assigned to Prof. Henry Edward Armstrong, F.R.S., on account of his researches in organic and in general chemistry.

For many years he has been engaged, partly alone and partly in collaboration with many of his students and others, in the investigation of a number of important problems in organic chemistry. His series of memoirs on the terpenes, on the chemical and physical relationships which obtain among the isomerides of the naphthalene and the benzene series, and on physiological chemistry, have established a strong claim for recognition.

In addition to his direct scientific work, he has taken an active part in the discussion and criticism of current theories, and has put forward views on chemical change and on other subjects which have suggested fruitful lines of inquiry. Gifted with a scientific imagination, interested in the work of others, exceptionally well informed as to recent progress, not only in chemistry, but also in cognate sciences, he has had a stimulating effect on his fellow chemists, and has done much to bring together for their mutual benefit the workers in different fields.

Hughes Medal.

The Hughes medal has been assigned to Charles Thomson Rees Wilson, F.R.S., in recognition of the value of his contributions to our knowledge of the nuclei produced in dust-free gases, and of his investigations upon the nature and properties of ions in gases. Following up the well-known work of Aitken on dust nuclei, Mr. Wilson devised a special apparatus for producing a sudden cooling of a gas saturated with water vapour. After completely freeing the gas from dust particles he found that water was condensed on a few nuclei after an expansion of volume greater than 1·25, and that a dense cloud was formed when it exceeded 1·38. This work was in progress at the time of the discovery of X-rays. He immediately tried the effect of passing this radiation through the gas in the expansion chamber, and found that a dense cloud of fine water drops was produced for all expansions greater than 1·25. In this way he showed that the charged ions produced in gases by the X-rays became nuclei for the condensation of water at a definite supersaturation.

This condensation property of ions, discovered by Wilson, was utilised by Sir J. J. Thomson to count the number of ions present, and to determine that fundamental electrical unit, the charge carried by an ion in gases. Recently Mr. Wilson has perfected the expansion method to detect the effects of individual α and β particles.

A further study by this extraordinarily delicate method promises not only to afford a practical means of counting the α and β particles in a gas, but also to throw light upon some of the more important and recondite effects produced by the passage of different types of ionising radiation.

NOTES.

The Birstall Urban District Council initiated about twelve months ago a movement to commemorate, in his native town of Birstall, the distinguished philosopher and man of science Dr. Joseph Priestley, the discoverer of oxygen. The town of Birstall, which is the birthplace of other distinguished men and women, including Margetson, Primate of Ireland, Curwen, of tonic sol-fa fame, and others, was a fitting birthplace for a man of clear vision, cool thought, and high speculation such as Priestley. Backed by the high Adwalton Moor on the north and north-east, the Priestley homestead of Fieldhead looked out on a fine panorama, with Castle Hill, Huddersfield, and smaller Yorkshire towns rising high on either side of Batley and the stretch beyond. For many years the inhabitants of Birstall have been desirous that something should be done to express by permanent memorial the town's pride in her illustrious son, and the present movement is the outcome. It is proposed to erect a life-size figure of Dr. Priestley on a handsome pedestal, to be placed in the most prominent position in the large market-place. For this purpose 1000*l.* is required, and already about 450*l.* has been secured; but the local committee is now desirous of appealing to a wider public, and especially to all interested in the various branches of chemistry. The London City and Midland Bank, Batley, are the bankers of the "Priestley" Fund.

On Tuesday, December 5, a deputation of aëroplane and aëromotor manufacturers, with representatives from the Royal Aëro Club and the Aëronautical Society, waited on Colonel Seely in connection with the proposed Military Aëroplane Competition. The deputation, which was introduced by Sir Chas. D. Rose, asked for immediate conditional orders so that manufacturers might have some guarantee of return for the outlay necessary for entering the competition, pointing out that they, representing a struggling and unsupported industry, were asked to compete against flourishing and State-aided industries from abroad in an international competition. Colonel Seely in his reply stated that, with the exception of the principal prize, not all the prizes would be open to the world, and intimated that some orders would be given before the competition. He further said that the answer to the question whether orders would be given for all machines passing the tests would be found in the specification for machines and the rules of the competition, which would be published in about a fortnight's time, and that it was the intention that aëroplanes selected for Government service, which would not be confined to one type, should be manufactured in this country by the civil industry and not in Government factories. He intimated that large orders would be given for the chosen machines, and that if the consensus of the manufacturers' opinion was against holding the competition early in the summer (June) he would see that recommendations to that effect were made in the proper quarter. The deputation subsequently decided to forward a resolution that it would be in the best interests of the competition to postpone it until September.

An interesting demonstration in connection with electrochemical culture will be given on Saturday, December 9, at 4 o'clock, at the Royal Botanic Society's Gardens in Regent's Park, when practical demonstrations will be made with an electric apparatus to show the effect of electricity on the germination of seeds.

The Physical Society's annual exhibition, which is to be held on Tuesday, December 19, at the Imperial College of Science, South Kensington, will be open in both the

afternoon (from 3 to 6 p.m.) and in the evening (from 7 to 10 p.m.). The Hon. R. J. Strutt, F.R.S., will give a discourse at 4.30, and again at 8 p.m., on "Electric Discharge and the Luminosity which survives it." About thirty firms will exhibit apparatus.

WE regret to see announced the death, on November 23, of Mr. Arthur Cottam, at seventy-five years of age. Employed as an official in a Government department during a great part of his life, he was an enthusiastic amateur astronomer. He was elected a fellow of the Royal Astronomical Society so far back as 1862, and was one of the original members of the British Astronomical Association, being its secretary from its foundation in 1890 to 1892, when he resigned owing to increasing pressure of official duties. In 1898 he became director of the Jupiter section of the association, an office which he retained until 1903. Mr. Cottam is best known by an excellent star atlas, "Charts of the Constellations," which he published in 1889. These charts show all stars down to about the 6·5 magnitude, from the North Pole to between 35° and 40° of south declination, for the epoch 1890. Originally projected as companions to Webb's "Celestial Objects" and Smyth's "Bedford Catalogue," their scope was considerably enlarged, and they show many original features. Each map usually gives one constellation only with the region around it, and the brighter stars have much larger discs than usually given, so that the leading stars in the maps are those which catch the eye by their brightness in the heavens.

IN *Die-Woche* of November 25 we find an article on the Middle European earthquake of November 16. It describes the districts which were most disturbed, the one most strongly shaken being that of the northern Alps. The central earthquake station in Strassburg places the origin to the south-east of Lake Constance. From time observations the epicentral area lies in 47 degrees north latitude and 10·30 east longitude. But before anything definite can be said as to this and other matters connected with earthquake, it is necessary to wait for reports from other stations. In the article reference is made to the geological character of the northern Alps and the Rhine Valley, the numerous faults which occur, and the relationship of these to tectonic earthquakes.

PROF. W. C. BRÖGGER (Christiania), Geh. Rath Prof. T. Curtius (Berlin), Prof. P. A. Guye (Geneva), and Geh. Regiersrung Rath Prof. H. Rubens (Berlin), have been elected honorary members of the Royal Institution. Dr. W. Bateson, F.R.S., has been appointed Fullerian professor of physiology for a term of three years. At a meeting of the managers of the institution on December 4 the following resolution was passed unanimously:—"That the managers offer their special thanks to the Fullerian professor of chemistry for his munificent gift to the institution in the decoration and furnishing of the lecture room, and at the same time they wish to express their high appreciation of the occasion upon which it has been made, namely, in commemoration of his having, on October 22, 1911, occupied the chair of chemistry as long as it was held by Faraday."

THE following are among the lecture arrangements at the Royal Institution before Easter:—Dr. P. Chalmers Mitchell, a Christmas course of six illustrated lectures on the childhood of animals, adapted to a juvenile auditory: (1) "Introductory"; (2) "The Duration of Youth"; (3) "Colours and Patterns of Young Animals"; (4) "Young Animals at Home"; (5) "The Feeding of Young Animals"; (6) "The Play of Young Animals." Dr. W. Bateson, six lectures on the study of genetics; Prof. E. G. Coker, two lectures on optical determination of stress and some applications to engineering problems; Dr. T. Rice Holmes, three lectures on ancient Britain; Prof. A. W. Bickerton, two lectures on the new astronomy; Prof. A. M. Worthington, two experimentally illustrated lectures on the phenomena of splashes; Mr. F. A. Dixey, two lectures on dimorphism in butterflies: (1) "Seasonal Dimorphism," (2) "Sexual Dimorphism"; the Rev. John Roscoe, two lectures on the Banyoro: a pastoral people of Uganda: (1) "The Milk Customs," (2) "Birth and Death Customs"; Sir J. J. Thomson, six lectures on molecular physics. The Friday evening meetings will commence on January 19, when Sir James Dewar will deliver a discourse on heat problems. Succeeding discourses will probably be given by Prof. Bertram Hopkinson, Dr. J. Mackenzie Davidson, Dr. J. A. Harker, the Rt. Hon. Sir John H. A. MacDonald, Mr. G. K. B. Elphinstone, Dr. W. J. S. Lockyer, Mr. F. Soddy, Prof. D'Arcy W. Thompson, Sir J. J. Thomson, and other gentlemen.

THE Lord Mayor will preside at the sixth annual meeting of the National League for Physical Education and Improvement, to be held at the Mansion House to-morrow, December 8, at 3.30 p.m. The meeting will be addressed by Sir Archibald Geikie, president of the Royal Society; the Lady St. Davids; Dr. Christopher Addison, M.P. (on legislation and public health); Prof. Bostock Hill, county medical officer of health for Warwickshire (on the organisation of a National Health Week); Mr. Henry Jephson, and others. Among those who have promised to attend are Sir Lauder Brunton, Sir John Tweedy, Sir Wiliam Church, Sir Edward Brabrook, Muriel Viscountess Helmsley, Lieut.-General Sir Robert Baden-Powell, Admiral the Hon. Sir E. Fremantle, and Archdeacon Sinclair.

A SPECIAL weights and measures committee of the Central Chamber of Agriculture recommended recently that agricultural produce should be sold by weight. It reported that suitable weights were the lb., the cental (100 lb.), and the short ton of 2000 lb. Dealing with this suggestion in a circular, which has been distributed, the Decimal Association points out that advocates of the metric system offer a solution of the difficulty by proposing that farmers should urge the compulsory introduction of the metric system into this country. Less disturbance would result from the adoption of the metric system than would follow the introduction of the cental and short ton, for the reason that the larger measures of the metric system differ but little from the cwt. and ton. The increase of the lb. by about 10 per cent. to make it equal to the half-kilo would lead to a metric cental of 110 lb. (100 metric pounds), and a ton of 2000 metric pounds equal to 2204 present lbs. Our Consul at Copenhagen reports that the Metric System Act, which will come into force next April, was passed by the Danish Upper and Lower Houses, in both of which the majority are agriculturists.

BY the authority of the Dominion Government, the director of the Canadian Meteorological Service has established a department of physics in connection with the Central Office at Toronto. Mr. John Patterson has been placed in charge of this new department; and it is proposed to carry on research work in atmospheric electricity, solar radiation, ionisation, and the exploration of the upper atmosphere. A kite station has been equipped near the magnetic observatory some fourteen miles from Toronto, and good results are being obtained. Since February last registering balloons carrying the Dines meteorograph have

been sent off with regularity on the international days, and of sixteen balloons liberated, eight have been returned to the Central Office with good records. In comparison with the results obtained in Europe, the percentage of successful ascents may be regarded as very encouraging. The heights reached have varied from 11·2 to 23·2 kilometres. The isothermal layer has been found at an average height of 13 kilometres. The lowest temperature recorded was −70° C. at 15 kilometres on July 5, and the highest altitude reached was 23·2 kilometres on September 9, when the lowest temperature, −55·5° C., was recorded at 14 kilometres.

THE premises of the Institute of Chemistry, the lease of which will expire shortly, and cannot be renewed, have become inadequate for the increasing activities of the institute. To carry on the work, the council of the institute requires new buildings, which should include more commodious meeting rooms, library, laboratories, examination rooms, and offices. It is proposed to begin the preparation of plans next year, and it is estimated that the necessary building and fittings will cost about 15,000*l*. An appeal has been made to fellows and associates of the institute, which has already resulted in the receipt of contributions and promises amounting to more than 8000*l*. With more than half of the required sum assured, it may be confidently hoped that the appeal will result in the completion of the necessary amount at an early date. It is gratifying to notice that the preliminary list of contributions includes the names of some of the great city companies and of business firms not directly connected with the institute. Contributions may be forwarded to the president, Dr. G. T. Beilby, F.R.S., at 30 Bloomsbury Square, London, W.C., or may be sent direct to the account of the Institute of Chemistry (Buildings Fund) with the London County and Westminster Bank, 214 High Holborn, London, W.C.

THE annual meeting of the American Association for the Advancement of Science will be held this year in Washington on December 27–30. The retiring president, Dr. A. A. Michelson, will, on the evening of December 27, introduce the new president, Dr. C. E. Bessey, of the University of Nebraska, and afterwards deliver his address on "Recent Progress in Spectroscopic Methods." On December 27 the presidential addresses in the sections will be:—the resins and their chemical relations to the terpenes, Mr. Frankforter; adaptation, Mr. Reighard; some current conceptions of the germ plasm, Mr. Harper. On December 28:—work of the electrical division of the Bureau of Standards, Mr. Rosa; aërial engineering, Mr. Rotch; the teaching of general courses in science, Mr. Hill. On December 29:—on the foundations of the theory of linear integral equations, Mr. Moore; the independence of the culture of the American Indian, Mr. Dixon; the cause of high prices, Mr. Burton. The presidents of the sections for the ensuing year are as follows:—A, Mathematics and Astronomy, E. B. Frost, Yerkes Observatory; B, Physics, R. A. Millikan, University of Chicago; C, Chemistry, F. K. Cameron, U.S. Department of Agriculture, Washington, D.C.; D, Mechanical Science and Engineering, C. S. Howe, Case School of Applied Science, Cleveland, Ohio; E, Geology and Geography, B. Shimek, State University of Iowa; F, Zoology, H. F. Nachtrieb, University of Minnesota; G, Botany, F. C. Newcombe, University of Michigan; H, Anthropology and Psychology, G. T. Ladd, Yale University; I, Social and Economic Science, J. Pease Norton, Yale University; K, Physiology and Experimental Medicine, W. T. Porter, Harvard Medical School, Boston; L, Education, E. L. Thorndike, Columbia University. Thirty scientific and other learned societies have indicated their intention to meet at Washington on the same dates in affiliation with the American Association for the Advancement of Science. The permanent secretary of the association is Dr. L. O. Howard, Smithsonian Institution, Washington, D.C.

THE twentieth report of the Board of Health on Leprosy in New South Wales for the year 1910 (dated July 31, 1911) states that nineteen lepers remained under detention at the lazaret, and that five new cases were reported in 1910. The histories of these new cases are detailed, together with surveys of the white patients remaining under treatment. Nine excellent plates of the condition of some of the lepers are appended.

IN *The Quarterly Journal of Experimental Physiology* for October (iv., No. 3) Messrs. Vernon and Stolz discuss the influence of forced breathing and of oxygen on athletic performance. It is well known that several deep inspirations enable the breath to be held for a longer period than without this preliminary, but it is shown that to obtain this result the forced breathing should be continued for two or three minutes. An addition of oxygen much lengthens the period during which the breath can be held. Thus Mr. Vernon found that after six minutes of forced breathing of air, followed by four breaths of oxygen, he could hold his breath for no less than 8m. 13s.

IN *Himmel und Erde* for November (Jahrg. 24, Heft 2) Dr. E. W. Schmidt, under the title of "Die Panspermie-Hypothese," gives an account of the views of Arrhenius on the possible transference of living germs through interstellar space from one star or planet to another; Prof. Ficker continues his series of articles on bacteria as enemies and friends of man; and Dr. Emil Carthaus discusses the origin of pearls, and gives many interesting historical details concerning them.

IN a recently published pamphlet entitled "The Fight against Tuberculosis and the Death-rate from Phthisis" (Dulau and Co., pp. 35, price 1*s*. net), Prof. Karl Pearson criticises the evidence which has been advanced in favour of a belief that the prevalence of phthisis can be, or has been, diminished by measures intended to reduce the opportunities of infection. Prof. Pearson strongly urges the importance of some constitutional factor, and publishes diagrams which, in his opinion, render it difficult to suppose that the fall in the phthisis death-rate which has been observed in modern times can be attributed to increased segregation of the diseased, bettered environment, or changes in treatment. The pamphlet will repay perusal, although its style, which is more vigorous than urbane, is not likely to facilitate an impartial consideration of Prof. Pearson's views.

THE report of the Manchester Museum for 1910–11 contains plans and a view of the front elevation of the proposed new wing, part of which is now in course of construction, while the remainder is reserved for the future. It appears that in the original scheme for the natural history museum Egyptology and anthropology were not included; but during the last thirty years large collections in these subjects have accumulated, which require adequate accommodation, and it is for these that the new building is being erected. The cost of the whole scheme of extension is estimated at 10,000*l*., of which 5000*l*. has been given by Mr. Jesse Haworth, while 2825*l*. has been raised by public subscription. The general progress of the museum has been very satisfactory during the year, and the attendance at the courses of lectures fairly good.

In the second part of the Transactions of the Bristol and Gloucestershire Archæological Society Miss M. L. Bazeley contributes an important paper on the relations of the Forest of Dean with the Crown during the twelfth and thirteenth centuries. She describes in detail the ancient boundaries of the forest, the animals found in it, and the periodical Royal visits for the purpose of sport. Fallow deer were abundant, with red deer and roes in smaller numbers. Wild boars seem to have been exceedingly numerous. On one occasion King John had twenty captured for use on the Feast of St. David at Westminster; twenty boars and sixty sows were sent to him for the Feast of the Nativity, and Henry III. had as many as a hundred for the Christmas dinner in 1254. These requisitions seem to have seriously reduced the supply. We hear of hunts of wolves and wild cats in 1281, when of the former we are told that they "as injurers of the venison frequently return for the venison and stay in the said wood, on account of the thickness thereof."

The report of the Marine Biological Association of the West of Scotland for 1910 indicates that the work of that body has been carried on steadily during the period under review; and it may be noted that a special effort has been made to provide, in full efficiency, all the facilities for study and research available at Millport. A large number of visitors entered the museum and aquarium, the latter of which is steadily increasing in popularity.

In the November issue of *The Zoologist* Dr. James Murie discusses the introduction of the American slipper-limpet (*Crepidula fornicata*) into this country, and its influence on oyster-culture in Kent and Essex. The mollusc appears to have been introduced into the estuary of the Crouch and other rivers on imported American oysters somewhere about 1880, and by 1893 had become comparatively abundant; it is now too firmly established to be eradicated. Its introduction has entailed considerable extra labour on oyster-beds, as the oysters have from time to time to be dredged and freed from the parasite, which adheres tightly to their shells. But this is not all, as this constant and excessive dredging causes the growing oysters to have broken or imperfectly formed margins to their valves, whereby their commercial value is lowered. Investigations with the view of mitigating the evil appear to be urgently required.

In connection with the letter from Messrs. Puran Singh and S. Maulik in NATURE of November 23 on the nature of the light from fireflies, it may be mentioned that the subject has been recently discussed in vol. iii., No. 1, of the Annals of the Transvaal Museum by Mrs. A. B. Howard, who observes that this light is unique in being unaccompanied by perceptible heat, and is therefore produced at the least possible expenditure of energy. In the American species, on which the investigations were made, light is emitted by both sexes, although that of the flightless female is feebler than that of her partner. In the latter the light is produced by a pair of plates lying beneath the thin skin and filling the lower half of the fourth and fifth abdominal segments. These light-giving organs consist of an upper and a lower layer, of which the latter is composed of polygonal cells filled with coarse granules. Although the minute size of the structures renders investigation very difficult, it is considered probable that the light is due to the oxidation of some substance—very likely fatty—contained in the cells of the lower layer of the light-organs.

As those who have studied the subject are aware, there are features connected with "fairy rings" which are not immediately explicable. In the latest paper, which appears in *The Journal of Economic Biology* (vol. vi., No. 4), Miss J. S. Bayliss points out that it is not known how the fungus first infects the soil or why it grows in rings; but otherwise the paper provides acceptable explanations of observed features and experiments in connection with the ring growth of *Marasmius oreades*. Two zones are easily recognised, an inner dark green grass zone and a dead grass zone where the fungus is growing. Dr. Bayliss directs attention to another dark green zone on the outside that is particularly well developed in September. The action of the fungus is complicated, since it apparently produces a stimulating effect, as shown by the outer green zone, while it excretes a toxic substance leading to the complete destruction of the grass; subsequently it poisons the ground for its own development, and then decomposes into manure for the grass.

During the past few years various expeditions from the University of Chicago have secured from the fossil fields of northern Texas the largest and best collection of Permian vertebrate fossils in the world. During last summer an expedition from the University, under the direction of Prof. S. W. Williston, explored the Permian deposits of north-western New Mexico with valuable results. *Science* says that these Permian deposits, of small extent, in Rio Arriba County, were discovered more than thirty years ago, but have been neglected by explorers ever since, and their precise location even was unknown to geologists. As a result of Prof. Williston's excavations, numerous fossils have been shipped to the University, many of which are unknown to science. This collection includes six or seven new genera of reptiles and amphibians, one of which is represented by one of the most perfect skeletons, about 6 feet in length, ever found in any deposit in America.

To *Symons's Meteorological Magazine* for November Mr. F. W. Henkel contributes an interesting article entitled "Is the Zodiacal Light a Meteorological Phenomenon?" The author points out that a complete and satisfactory answer to the question cannot be given, and that our knowledge of the subject is but little greater than was possessed by the first discoverers. Even in recent times considerable confusion has existed between the phenomenon and the aurora. He refers to the various observations made since the time of Cassini, of Paris (about 1683), and to the descriptions of the counter-glow (at an angular distance of 180° from the sun) by Brorsen and others. One of the most recent theories of the latter phenomenon is that suggested by Mr. Innes in NATURE of June 16, 1910.

The Weekly Weather Report issued by the Meteorological Office gives a summary of the temperature, rainfall, and bright sunshine for the several districts of the United Kingdom for the thirteen weeks ended December 2, which embraces the whole period of autumn. The mean temperature was generally below the average in Scotland, it was in good agreement with the average in Ireland, whilst in England an excess of temperature occurred for the most part. The range of temperature was unusually large, due chiefly to the exceptional heat in the recent abnormal summer, which was prolonged into the early autumn. In the Midland counties the range was 69°, from 94° to 25°, and in the south-west of England it was 71°, from 91° to 20°. The autumn rains have varied considerably in different parts of the kingdom; they were in excess of the average over the eastern portion of Great Britain, in the north-west of England, the south of Ireland, and in the English Channel. The least aggregate autumn

rainfall is 6·88 inches, in the Midland counties, which is 0·48 inch below the normal; whilst in the south-east of England the aggregate fall is 10·47 inches, which is 1·98 inches more than the average. The absolutely largest rain measurement is 13·78 inches, in the north of Scotland, which, however, is 1·82 inches less than the normal. The number of rainy days are nowhere very different from the average, the greatest number being fifty-eight days, in the north of Scotland and in the south of Ireland; the least forty-seven days, in the south-east of England. The duration of bright sunshine was in excess of the average over the entire kingdom, except in the English Channel. The greatest duration is 382 hours, in the south-east of England, which is sixty-nine hours more than usual.

MR. M. A. HUNTER, of the electrical engineering department of the Rensselaer Polytechnic, Troy, has succeeded in producing metallic titanium in a state of purity greater than has been hitherto possible. He uses the method of Nilson and Petersson, *i.e.* reduces the tetrachloride of titanium by heating it with metallic sodium in an air-tight steel bomb capable of withstanding an internal pressure of more than 5000 atmospheres. With a charge of 500 grams of the tetrachloride and 245 grams of sodium, after heating the bomb to redness to start the reaction and then allowing it to cool, he obtained 71 grams of molten metal, 31·5 of coarse and 4·5 of fine powder, as against a theoretical yield of 126 grams. Analysis of the product appears to indicate that the molten material is pure titanium. Messrs. Hunter and Jones find that the density of the metal is 4·50, and its specific heat between 0° C. and 100° C. is 0·1462.

VOL. iv. of the Journal of the Municipal School of Technology, Manchester, a record of the investigations carried out by the staff and students, and published in the technical Press or the Proceedings of scientific societies during the year 1910, is not so bulky as its immediate predecessors, although it runs to 250 pages. The papers reprinted are, on the whole, short, and they deal principally with the applications of electricity in engineering or of chemistry in textile processes. Of the longer papers, those of Prof. Schwartz and his staff on the physical and electrical properties of indiarubber and on the field of the polyphase motor may be mentioned. In an important paper by Prof. Haldane Gee and Mr. Harrison, reprinted from the Transactions of the Faraday Society, the authors bring forward weighty experimental evidence in favour of the electrical theory of dyeing. According to this theory, a basic dye is positively, and an acid dye negatively, charged, and the processes through which the fabric passes before it is brought into the dye are such as to charge it negatively or positively respectively, so that there may be electrical attraction between dye and fabric. The number of "laws of dyeing" which the electrical theory places on a firm scientific basis is remarkable.

AMONG primary plant materials, the pentosans, so widely diffused, form a class of substances the origin and function of which are still uncertain in spite of numerous researches which have been made to throw light on these problems. An interesting contribution to the question is found in a paper by Ciro Ravenna in the *Gazzetta Chimica Italiana* (vol. xli., p. 115). It is shown as the result of a large number of experiments, in which the pentosans were estimated in the very young, primary leaves of the beech and of *Vicia faba minor*, at dawn and sunset, that no marked variation in their amount can be traced during the period of chlorophyllian activity; but at night considerable but irregular variations occur, generally in the direction of increase, but sometimes in that of decrease. When, however, the stalk of the growing leaf is immersed in a nutritive solution containing 2 per cent. of dextrose, and the plant allowed to continue its growth for several days exposed to sunlight in an atmosphere free from carbon dioxide, the proportion of pentosans is very largely increased, being often nearly doubled. A similar, but not so well marked, result was obtained in experiments in which the plant continued its growth in the nutritive solution in darkness, but in an atmosphere containing the ordinary proportion of carbon dioxide. It is contended that the pentosans are elaborated, not from the complex polysaccharides, such as starch and cellulose, by down-grade changes, as is generally supposed, but that they are formed direct from the simple carbohydrates. It is also shown that when the chlorophyllian activity is inhibited, the pentosans diminish in relative amount, so that it would appear that, in addition to their other functions, they are capable also of acting as reserve material for the plant.

A PROPOSAL for the reform of income tax and estate duty is put forward by Mr. Douglas White in *The Economic Journal*, xxi. 83. According to the author's proposed system, the rate per pound at which an income would be taxed would be proportional to the logarithm of the income, so that as incomes increased in geometric progression the rate of the tax would increase in arithmetical progression. If, as Mr. White proposes, this system were carried out rigorously with the use of logarithm tables, it would certainly, as alleged, remove the discontinuities of the present system, where what a man pays is regulated largely by whether his income falls on a lucky number such as 499*l.*, or an unlucky one such as 501*l.* In practice it would be sure to be simplified by retaining these discontinuities, for which a much simpler, obvious remedy is possible.

A PAPER on the design of tall chimneys was read by Mr. Henry Adams before the Society of Engineers on December 4. Tall chimneys ought to be designed upon scientific principles so that there is an absolute guarantee for their stability. The object of Mr. Adams's paper was to elucidate these principles and apply them to practice. There are several rules for determining the height of a tall chimney; in some towns 45 feet may be sufficient, but in others 90 feet is the minimum allowed. The height may be determined from the amount of coal burnt, or from the length of boiler and flues. Four different rules were given for the sectional area, depending upon the amount of coal burnt per hour, the fire-grate area, the horse-power of the engine, or a combination of these with the height of the chimney. The shape may be square, octagonal, or circular, the effective wind pressure varying in each case. The author's formula for wind pressure takes account of height and width, increasing with the distance from the ground and increasing also with reduced width. Eight authorities were quoted for the coefficient of pressure for a circular shaft varying from 0·5 to 0·7854. The thickness of the brickwork varies $4\frac{1}{2}$ inches every 20 feet in height, but the top length will be from one to one and a half bricks thick, according to the height and diameter. The over-all width at base must be at least one-tenth, and if circular at least one-twelfth, of the total height. After the section is drawn out to suit the conditions, the stability should be calculated at each set-off. The principles of stability can be illustrated by considering a solid square brick pier.

MR. LIVINGSTONE SULMAN, president of the Institution of Mining and Metallurgy, delivered an address at the annual prize distribution of the Sir John Cass Technical

Institute on November 29. In the course of his address Mr. Sulman pointed out that the dominant thought which impressed one to-day was the many-sidedness, the increasing scope, and the intense vigour which now marks metallurgical progress. The interaction of associated sciences is now beginning to play its part in the development of metallurgical industries. Certain of the factors of so-called molecular energy find expression in some of the newer processes and phenomena of metallurgy, as shown in the methods adopted to the harnessing of molecular attractions which reside upon the surfaces of solids, to the purposes of ore concentration. These methods, which have, for example, completely changed the economic outlook of the great Broken Hill deposits of silver-lead-zinc ores, are there used to separate the blends constituent in saleable form from the "tailings" left behind after the bulk of the lead and silver have been recovered. But they are applicable, in general, to all sulphide ores, as well as to finely divided metals and non-metals, such as gold, graphite, carbon, diamond, sulphur, and so on; and they are frequently spoken of as "oil processes," from the fact that in several of them oil is used in larger or smaller quantities, usually in smaller. In such processes there are no chemical reactions to speak of; physical forces of previously unsuspected range and power, so far as commercial applications are concerned, have been induced to do the work more easily and much more economically, the force mainly concerned being what is called "surface energy." Equally new, and probably of great importance to the metallurgist of the future, are the developments in colloidal chemistry. The plasticity of clays and "ultra-sliminess" of "slimes" are due to this class of bodies, in which inorganic materials ape the reactions of organic; a clay colloid may almost be said to masquerade as a fatty acid. Mr. Sulman also referred to the extended application of improved magnetic and electrostatic methods for the separation of dry ores, and to catalytic processes of metallurgical importance.

A SELECTED "List of Educational Books for Schools, Colleges, and Self-tuition," issued by Messrs. W. and G. Foyle, 135 Charing Cross Road, London, W.C., has reached us. Nearly all the books included in the catalogue can be supplied secondhand at half the published prices; and Messrs. Foyle will send any book in stock on approval.

MESSRS. WILLIAM WESLEY AND SON, 28 Essex Street, London, W.C., have sent us a copy of the latest issue of their "Natural History and Scientific Book Circular." It contains a catalogue of 356 selected books on natural history, with coloured illustrations, followed by a list of works published by, or on sale with, Messrs. Wesley and Son, who are, it may be added, agents for the Smithsonian Institution and the U.S. Government departments.

MESSRS. J. WHELDON AND CO. (38 Great Queen Street, Kingsway, W.C.) have just issued a supplement to their scientific and geological catalogues. The supplement comprises recent purchases in astronomy, chemistry, geology, palæontology, mineralogy, mining, &c., and includes a small collection of works on applied chemistry, metallurgy, and other subjects.

Erratum.—We are asked to state that in the abstract of Mr. Hutchinson's paper read before the Mineralogical Society (p. 165) the temperature at which gypsum becomes optically uniaxial should be 95° C., not 25° C. The incorrect value was given in the typewritten report received by us, and the error was not corrected in the proof submitted and returned to the printers.

OUR ASTRONOMICAL COLUMN.

DISCOVERY OF A NEW COMET, 1911*h*.—A telegram from Kiel announces the discovery of a new comet by M. Schaumasse, at Nice, on November 30. Its position at 17h. 15·9m. (Nice M.T.) was

R.A. = 13h. 12·2m., dec. = 5° 51′ N.,

and its daily motion was found to be +3m. 32s. in R.A. and −13′ in declination; the magnitude is 12·0.

A second telegram gives an observation by Dr. Abetti at Arcetri on December 2, the position at 17h. 26·9m. (Arcetri M.T.) being

R.A. = 13h. 19m. 17·6s., dec. = 5° 24′ 29″ N.

The comet is thus seen to be moving in a south-east direction through Virgo.

BORRELLY'S COMET, 1911*e*.—Borelly's comet, rediscovered by Mr. Knox Shaw on September 19, is approaching both the sun and the earth. As the perihelion passage will take place on December 18, when the comet is nearly in opposition with the sun, and as the comet is moving northwards rapidly, it may become visible with opera-glasses during the latter part of December and in January, 1912 (*L'Astronomie*, November).

THE PRODUCTION OF STAR STREAMS.—A paper by Prof. Benjamin Boss, in No. 629 of *The Astronomical Journal*, discusses, in relation to a star stream he has found among seventy-one large proper-motion stars given in the Preliminary General Catalogue, the somewhat startling suggestion that community of direction and velocity in such streams may be caused by the initiation and maintenance of their motions in an electromagnetic field of universal extent.

The directions and proper motions of eleven of these large proper-motion stars, together with their radial velocities and parallaxes where available, agree so well as to preclude the idea of chance occurrence, and some physical explanation is sought.

Assuming that the stars form from nebulæ, the motion of the latter might explain the phenomena; but the extended nebulæ do not exhibit such *motus peculiaris*, and Prof. Boss seeks the common cause elsewhere.

The suggestion is that the nebulæ are the seat of tremendous ionisation forces producing segregation, and electromagnetic polarities in the segregated masses. In the course of time a relatively strongly polarised mass becomes expelled from the matrix and commences a stellar existence. Initially the directions would be haphazard, but the action of the supposed universally existent electromagnetic field would be to swing the polarised masses into paths along the approximately parallel lines of force. Assuming the B-type stars to be the newest, Prof. Boss finds support in the fact that such stars display random motions, while those in his group of large proper-motion stars, exhibiting community of direction, are of the types F, G, and K. Further, the action of a constant acceleration such as is suggested would tend to level up the differences found in the initial velocities, thus producing the community of velocity observed.

DOUBLE-STAR MEASURES.—In No. 4534 of the *Astronomische Nachrichten* Prof. Burnham publishes a long list of recent measures of double stars related largely to the proper motion of stellar systems contained in his General Catalogue. The measures were made with the 40-inch refractor at the Yerkes Observatory, and follow on Prof. Burnham's similar publications in the same journal.

In No. 4537 Herr J. Voûte publishes a second list of double-star measures, which will later be published *in extenso* in the Annals of Leyden Observatory.

RADIAL VELOCITY OF α CYGNI.—Some time ago we directed attention to a result obtained by Prof. Belopolsky and Mr. Neuimin in which they found what appeared to be a real difference between the radial velocity of α Cygni as determined from the metallic lines and that determined from the hydrogen and helium lines. At the suggestion of Prof. Frost, Mr. O. J. Lee has examined some measures of the spectrum made by him in 1910, and he fails to find any confirmation of the Pulkowa results. He suggests that the discrepancy found by Neuimin and Belopolsky

may be due to slight differences of complexity in the hydrogen-line images (*Astrophysical Journal*, vol. xxxiv., No. 4).

THE SPECTRUM OF THE OUTER PLANETS.—In No. 4537 of the *Astronomische Nachrichten* Dr. Otto Büry publishes a note in which he shows that the well-known characteristic absorption-band spectrum of the outer planets can be fairly well matched by combining Chappuis's and Schöne's ozone spectra with the spectrum of the higher oxides of nitrogen obtained by Chappuis. As shown on the plate accompanying the paper, the chief bands in Vogel's spectrum of Uranus, for example, are fairly well represented in the ozone and peroxide spectra; such differences as exist might perhaps become explained if the terrestrial spectra were experimented with more exhaustively under different temperatures and pressures; for Chappuis has shown that the ozone spectrum is sensitive to such changes.

SUN-SPOTS AND CLIMATE.—Considering the climate of Berlin as depicted in the temperature records from 1756 to 1907, and the precipitation records from 1848 to 1907, Herr Otto Meissner finds a possible connection between these climatic features and the periodicity of sun-spots. In a table which he gives in No. 4533 of the *Astronomische Nachrichten* he arranges the years of the eleven-year period from 1 to 11, and opposite each gives the departures of the year's temperature and rainfall from the means. This indicates that the sun-spot maximum years are cold and wet, while the minimum years accord fairly well with the mean. A further investigation considering pressure is to be undertaken.

PROPOSED MEMORIAL TO PROF. P. G. TAIT.

ON Thursday last, November 30, a representative meeting of former students and friends of the late Prof. Tait was held at Edinburgh University, to consider the question of extending the memorials to him. His former colleague, Principal Sir William Turner, K.C.B., presided. About 150 apologies for absence were intimated, amongst these being expressions of approval and support from the Rt. Hon. A. J. Balfour, M.P., the Chancellor of the University; the Right Hon. Lord Aberconway; Sir Archibald Geikie, K.C.B., President of the Royal Society; Sir John Murray, K.C.B., and the Right Hon. Lord Haldane of Cloan, P.C. Lord Haldane wrote:—"I cannot be with you on the 30th, but I wish to say that I am very glad indeed that you are taking the step of raising a memorial fund in connection with Prof. Tait. The publication of his Life affords a suitable occasion for doing this. I shall be glad to be a contributor, for I feel that a record should be preserved of the regard in which his old students and the nation generally held this remarkable man. We have too few figures of the stature of Tait to let them pass away without endeavouring to keep a permanent memorial of their greatness."

As it is now almost a decade since Prof. Tait's death, his successor in the natural philosophy chair (Prof. J. G. MacGregor) made the following statement:—In explanation of the present state of this movement, it may be pointed out that Prof. Tait's main work can be divided into three portions: (1) his educational work, (2) his own experimental researches, and (3) his work in mathematical physics. An appropriate memorial might be raised in connection with any one or more of these. When he entered upon the work of the natural philosophy chair he was deeply impressed by the soundness of Prof. Tait's educational policy, and by the difficulties in the way of applying and extending it; and he suggested as a fitting memorial a fund which would make it possible to carry it out. Without the aid of any appeal, this suggestion led to the receipt of subscriptions to the amount of about 1500*l*. But before action could be taken, it was found that the University itself was organising, and could not defer, a general extension scheme. It was the unanimous opinion of those who had charge of this scheme that it would be unwise to carry on two competing movements at the same time; and the Tait memorial was for this reason made a department of the general extension scheme.

As such it could not be brought to the attention of old students and associates generally, but only to a comparatively small number of them. Nevertheless, additional subscriptions were made to the original fund to the extent of about 500*l*., and a special fund, yielding about 200*l*. per annum, was provided by Sir John Jackson, to be called a Professor Tait's Memorial Fund, and to be used, under the direction of trustees, for research on the lines of Prof. Tait's experimental work.

There are thus memorial funds connected with two of the chief departments of Prof. Tait's activity, but none connected with the third.

The best form for a memorial connected with the professor's work in mathematical physics would obviously be a Tait chair in that subject; and Tait himself advocated the establishment of such a chair. In 1872 he wrote in an article in *Macmillan's Magazine*:—"Would it were not absolutely hoping against hope to proceed as follows. In the Scottish universities, let there be in each a professor of experimental physics and a professor of applied mathematics, in place of the present solitary professor of the enormous subject of natural philosophy."

Many old students have intimated that they would like to have the opportunity of contributing to a memorial. He was satisfied that a very large proportion of them would be found to share this feeling.

It will thus be seen that, as a Tait memorial has been founded, the question before this meeting is, shall we take for ourselves, and arrange to give to the whole body of the professor's students and associates and admirers, the opportunity of contributing towards the memorial, and, by enlarging the original fund, or founding a Tait chair, or in any other way that may be determined, making the memorial more worthy even than it now is of the man whose great work, personal and scientific, it is intended to commemorate?

On the motion of Mr. B. Hall Blyth, seconded by Sir G. M. Paul, a resolution agreeing to the proposal was carried.

A general and an executive committee were then appointed. Information will be willingly furnished by Prof. J. G. MacGregor, Edinburgh.

BIRD-NOTES.

IN the October number of *British Birds* another straggler is added to the British list—this time in the shape of the slender-billed curlew (*Numenius tenuirostris*), a small flock of which was observed towards the end of September, 1910, on Romney Marsh, Kent. Of these, an immature pair were shot on September 21, while an adult male was killed two days later. Two of them were examined in the flesh by Mr. M. J. Nicoll. Although stragglers have occurred in Heligoland, Holland, Belgium, northern France, and Germany, the slender-billed curlew is a native of the Mediterranean countries, whence it travels to Siberia to breed. Approximating in size to the whimbrel, the species is distinguished by its short and slender beak and the pear-shaped dark markings on the flanks. The colouring of the crown is unlike that of the whimbrel, showing black and buff streaks like those of the curlew.

In the same issue Dr. E. Hartert points out that English green woodpeckers differ from the central European representative of the species (*Picus viridis pinetorum*) by the still shorter and more slender beak, and on this character proposes that it should be recognised as a separate race (*P. v. pluvius*). Scandinavia, Russia, and eastern Prussia are the home of the typical race; the Italian form, on account of the beak being slenderer than in English birds, is named *P. v. fronus*, and the Spanish *P. v. sharpei* has long been recognised as distinct.

Most ornithologists, when pointing out the features in the plumage by which young partridges may be distinguished from old ones, content themselves with the statement that the tip of the first flight-feather of the wing is pointed in the former, but rounded in birds which have undergone their second autumnal moult. Dr. Louis Bureau, director of the Nantes Museum, in an article (in French) published in the October *Zoologist*, goes, however, much further than this. After stating that there are ten primary wing-quills, he observes that the tenth of the first plumage is the first to fall, this taking place about the end of the first month; when the replacing quill (second plumage) has attained a

length of about 15 mm.—which it does in three days—the ninth quill of the first plumage is moulted and replaced in a similar manner. After this the eighth, seventh, sixth, fifth, fourth, and third quills are successively shed and replaced, but at regularly increasing intervals, the rate of the development of their successors during twenty-four hours decreasing in the same order. The second and first quills are not shed at all during the first moult, but persist until the completion of the second moult, in September or October of the following year. This renders it possible to determine during a period of fifteen or sixteen months whether a partridge is young or old, the tip of the first quill being pointed up to that age and rounded subsequently. After this period age-determination by the plumage is impossible. The author adds that, by following the formula given above, the exact age of young partridges is determinable during the time that quill-moulting is in progress, although it has to be borne in mind that there may be a small "personal equation," some individuals moulting slightly in advance of, and others behind, their fellows.

In this connection it may be noted that *Country Life* of October 21 contains an article by the present writer on the breeding-ages of birds, in which attention is directed to the imperfect state of our knowledge on this subject.

The results of an expedition to the pheasant-countries of Asia are recorded by Mr. C. W. Beebe in the July issue (recently to hand) of the New York Zoological Society's Bulletin. It is stated that "this expedition, organised for the purpose of gathering original data for the preparation of a monograph of the pheasants, jungle-fowl, and pea-fowl, and made possible by the generous gift of Colonel A. R. Kuser, has been completed. The most sanguine expectations were exceeded in the amount of territory covered and the results attained. Voluminous notes have been taken, reinforced by a great number of photographs (some of which are reproduced in the article) and sketches, concerning the habits and ecology of the pheasants found in the countries visited, much of the material being new to science. Although the collecting of living birds was a secondary object of the expedition, several large shipments were sent back." In the same number it is stated that a female passenger-pigeon now in the Cincinnati Zoological Gardens is believed to be the last living representative of that once abundant species.

The need of a longer close season for the Australian stubble-quail (*Coturnix pectoralis*) is strongly urged by Mr. G. A. Keartland in the September number of *The Victorian Naturalist*. For a short time the close season was from August 1 to December 20; it was extended at different times to February 1, March 1, and April 1; but this year it has been put back to February 14, which the author urges is much too early, as many of the broods are then "cheapers." R. L.

THE SEVENTEEN-YEAR CICADA.

THE Cicadidæ are an interesting group of insects, which chiefly inhabit warm countries. They are represented in England by a small species (*Cicadetta montana*) which is almost confined to the New Forest, where it is scarce and local. In classical times they were known under the name of Tettix, and the loud stridulation of the males attracted much attention. As in England, so in the eastern United States, there is only one species which is common and well known, *Tibicina septendecim*, the peculiarity of which is that its life-cycle occupies seventeen years in the northern, and thirteen in the southern, States, and only at these intervals are they specially abundant. In America they are often improperly called locusts, and are reckoned among destructive insects, for the larva feeds on the roots of trees; and it is ranked among injurious insects.

The eggs are laid on the twigs of trees, and when the larvæ are hatched they drop to the ground and gather in clusters on the roots, from which they suck the sap. The pupa-state lasts only a few days, and when ready to emerge they form galleries, through which they ascend to the surface of the ground, and emerge, leaving their cast skins behind them. The perfect insect is easily recognisable, having a short, broad black body rather pointed at the hinder extremity, and four long and moderately broad wings with conspicuous reddish nervures, the fore wings being considerably larger and more pointed than the hind wings.

The Times of November 3 directs attention to the emergence of numbers of these insects during the last summer from the soil in the Bronx Zoological Park in New York; but when the writer adds, somewhat inconsequentially, "It is probable that the species is approaching extinction in view of modern conditions of cultivation, and the extension of building areas," we imagine that the contingency can hardly be so near as he supposes, although the complete extermination of once common insects in consequence of the changed conditions to which he refers is no uncommon occurrence. W. F. K.

SCIENTIFIC PROGRESS AND PROSPECTS.[1]

ALL advance in the relations between man and nature whereby man gains to any greater extent the mastery may be described as scientific progress; and in this connection we must recognise that many things which we now look upon, and have for ages regarded as entirely commonplace, were, at the time of their inception, really very remarkable indeed. Take, for instance, the application to human needs of fire. Animals, even of the highest types, make no use of it. There must have been a period when man also did not understand its properties, and, like the animals from which he has sprung, was afraid of it and left it severely alone. A time must next have come, and with that time the valorous man who first had the temerity to experiment with this very powerful and destructive agent.

Think of this prehistoric investigator into the means and effects of combustion in that far distant age; consider his inferior mental equipment; imagine his savage surroundings; take into account, also, his lack of any but the most primitive appliances. Must we not laud his enterprise and admire his courage? Must we not also acknowledge the enormous advantages his investigations have gained for all his posterity? The warming of their bodies and the cooking of both animal and vegetable nutriment would, no doubt, be the first uses to which our remote ancestors would apply the new agent; but soon would follow the firing of pottery, up to that date merely sun-baked, then the reduction and smelting of metals, and finally the whole galaxy of the arts. What is scientific progress if this is not? And yet it leaves off where what we usually mean by science begins, namely, about the Græco-Roman period. Look out, however, into London to-day, and recognise how little of all we see around us could have ever existed but for those early high-temperature experiments made so many thousands of years ago. Without them, could human beings even live in this northern climate?

Here may I point out that, curiously enough, it is only when we go back to the earliest evidences of primitive human life upon this planet that we take the true philosophical course of naming the periods we are dealing with after the main material advances in scientific progress made during those periods by the human race. We talk of the Stone age, of the Bronze age, or the Iron age, to denote those vast expanses of time during which the primitive inventor was discovering the means of applying new materials to what was then the great necessity of mankind, namely, weapons for the chase, for self-protection, and for war upon his enemies.

Later in history we find that this really philosophical method is abandoned. As we come to know more as regards the position, supremacy, and conditions of particular races, and still further when we become better acquainted with the deeds and achievements of particular individuals, we find that historians have a tendency to overlook the enormous influence of the results obtained by scientific investigators and discoverers, and to make it appear as though the current of events were really governed by those who, from accident of birth, official position, political influence, or martial achievements, have made for themselves reputations as leaders of men.

To see that this view is wrong we have only to survey the past. Can it for an instant be doubted that the labours of the unknown prehistoric individual to whom I have just

[1] From the presidential address delivered to the Röntgen Society on November 7 by Mr. A. A. Campbell Swinton.

alluded, who first discovered the properties of fire, or of those who originated the smelting of metals, who launched their frail, and at that time novel, coracles upon the ocean, and first applied wheels to the primitive cart, are more living factors to-day than the valour of all the warriors, the wisdom of all the statesmen, or the wiles of all the politicians that the world has seen? It is a truism, indeed, that the world knows little of its greatest men.

Can it be questioned that the discoveries of Archimedes and his disciples have more effect to-day than the battles of Alexander or of Hannibal? Or, if we turn to modern times, can it be gainsaid that Watt and Stephenson, Davy and Faraday, have done more to change both the course of history and the material conditions of life than did Napoleon or Wellington, Walpole or Pitt?

The fact is, as I once remember hearing lamented by no less a statesman than the late Lord Salisbury, that while the work of the politician, the statesman, the soldier, or the leader of men, however great and however fortunate, is of necessity but transitory, what is accomplished by one man being undone by another—the work of the scientific discoverer and inventor is everlasting. However insignificant this work may apparently be, provided it is new it adds something more to that great store of human knowledge and experience which is slowly accumulating, and enables man more and more to triumph over nature. Moreover, results that appear of but slender importance at the time of their discovery often turn out in the end to be of the greatest moment.

For the undue amount of influence on the progress of the world that is attributed to leaders of men, in comparison with that exerted by investigators of nature, historians are no doubt to blame. In stating this, however, one must in justice remember that, after all, most histories are written to sell, or, if not that, to bring fame to their authors. Further, we must allow that the story of scientific investigation is frequently not very interesting, at any rate to the general public, who may justly find such a story dull as compared with accounts of the stirring episodes that occur in the Senate or the feuds that are settled on the battlefield. Thus the tale of, say, Marlborough's campaigns makes probably more picturesque reading, and is more likely to interest the average student, than would be a history of the patient scientific work that led up, about the same period, to the enunciation, say, of Boyle's law of the expansion of gases. We can admit this, though there can be no doubt that the permanent influence of Boyle's discovery on the history of the world has been in the past, and will continue to be in still greater ratio in the future, incomparably greater than was that of all the battles of the day, inasmuch as Boyle's law was an important link in the chain of discoveries that led up to the steam engine and modern industrial development; while to-day the effects of the wars of the seventeenth century have, for all practical purposes, passed away.

The fact is that there is a glamour attached to the position of those who are supposed to direct the history of nations that prevents the real directing forces from being seen in their true proportions. The great statesment, the great generals, leaders of mankind in general, are, after all, nothing much more than glorified policemen, whose utility to the world is only occasioned by the imperfections of human nature. As organisers they are no doubt useful, but they generally benefit particular nations at the expense of others; and, as a rule, they leave little behind them that will stand the test of centuries.

Another product of human endeavour which also seems to have an undue amount of importance attached to it in regard to its influence on human progress is literature, which I am here considering apart entirely from its æsthetic claims upon us as a means of relaxation. That literature has a directive influence, and that a powerful one, no one can deny; but I fancy that all scientific men will agree that it is not to be compared with that exercised by material discoveries and inventions. In saying this, I know that it is the fashion to ascribe the beginning of all modern science to what is contained in the "Novum Organum"; but I rather fancy that if we could truly estimate the influence on the world's history of the two men, we should find that Roger Bacon, the inventor of gunpowder, would come before the better known Francis Bacon, who, some centuries later, wrote his great work on the new learning. Indeed, probably the chief merit of the "Novum Organum" was that it assisted a return to experimental methods as opposed to what had become the benumbing system of Aristotle, who, by the way, is interesting to this society for the reason that he was the author of the immortal, if not very illuminating, phrase that "nature abhors a vacuum." Anyway, since the earliest times there has never been a better organised and more successful mutual admiration society than that formed by the writers of the world, who have always been chiefly concerned to discuss one another and one another's scripts. This, and the fact that the written word endures, has given to the wielders of the pen a prominence in history to which they are scarcely entitled by their influence on progress.

At the present time, when it is the fashion to ascribe the production of all wealth to the manual labourer and all progress to the politician, it is more than ever necessary that correct views should be insisted on. Let us, therefore, emphasise the fact that from the beginning of the world all advance has been due, not to the many, but to a few exceptional individuals; and had it not been for the genius of these we should still be naked savages, not even painted with the proverbial woad.

As an instance, take the electric telegraph, which has had more effect on civilisation than almost anything else during the past century, and gives employment to thousands. The names of those to whom it is due, beginning with Franklin, Volta, and Galvani, going on with Morse and Cook, and ending with, say, Wheatstone and Kelvin, can literally be counted upon one's fingers. Nor is it very different with the steam engine or with the railway itself, which, to read some of the newspapers of to-day, one would almost think had been invented by the rank and file of the railway workers.

Most really scientific workers feel that knowledge for knowledge's sake is a sufficiently worthy object for pursuit, and are content with the extension of knowledge and the satisfaction that it brings without immediately desiring precise information as to the practical results that are likely to follow from any particular line of investigation. It is well that this is so, as otherwise many of the lines of scientific research that have been most fruitful in bringing lasting benefits to mankind would never have been begun or followed up.

As an instance of this, could there be a better example than the history of that most remarkable and important discovery in physics which was the primary cause of the foundation of this society?

Consider for a moment the position of affairs many years ago, when Sir William Crookes first commenced his laborious experiments on the electric discharge through rarefied gases. Could anything be imagined of more purely academic interest, and, at the time, seemingly less likely to lead to results of a practical nature? The small scale, the extreme delicacy of the apparatus, the uncertainty of the results, the minuteness of the forces involved, all tended to give to the investigations an air so entirely aloof from the practical concerns of everyday life that one can scarcely wonder that for years it was only a few of the very foremost scientific intellects who had sufficient insight to take much interest in the matter.

Yet we all know how things have turned out; how, as a direct result from these very recondite investigations, we have had the discovery of the Röntgen rays, with their practical applications to the investigation of the human frame, to the relief of suffering, and to the cure of disease; and also, as another result, perhaps the most momentous and far-reaching upheaval in scientific thought on the constitution of matter and the nature of electricity, that has taken place for centuries, heralding the birth of a new idea, that of radio-activity, which may in future be destined to prove the salvation of the whole human race from annihilation. Here, of course, I refer to the vast and previously unsuspected source of energy that modern investigations have shown to lie hidden away in the atoms of matter, a store which is revealed by the energy given out by radium and other radio-active substances, and one which we may hope to see made available for human use in centuries to come, when others, such as those contained

in the coal and oil of the earth, at present being exploited, are exhausted.

So far as I am aware, the results of modern discovery have had no effect in weakening our belief in the truth of the great principle of the conservation of energy as defined in what is commonly called the first law of thermodynamics, which law is really a statement that the sum of energy in the universe, just as the amount of matter, is a constant, and cannot be either increased or diminished by any means whatever.

When, however, we come to the so-called second law, which, as stated by Clausius, is that it is impossible for a self-acting machine, unaided by external agency, to convey heat from one body to another at a higher temperature, or, as given by Lord Kelvin in a somewhat different form, that it is impossible by means of inanimate material agency to derive mechanical effect from any portion of matter by cooling it below the temperature of the coldest of the surrounding objects, we find that even the authors of these statements are prepared to admit that this second law stands on a totally different basis from the first law, and, as declared by Maxwell, can only be said to be statistically correct, or correct only when we are dealing with masses of matter and not with individual molecules.

Indeed, it was in this connection that Maxwell propounded his celebrated proposition, in which he supposes that a demon who could see individual molecules, and was possessed of superhuman dexterity, could open and close an aperture in a partition dividing a vessel into two separate portions, A and B, so as to allow only the swifter molecules to pass from A to B, and only the slower ones from B to A, in which case, without the expenditure of work, the temperature of B would be raised and that of A lowered, in contradiction to this second law.

It will further be observed that in the definitions quoted above Clausius is careful to qualify his statement by words to the effect that there must be no external aid, while Lord Kelvin is even still more specific, and expressly limits the whole law to things inanimate.

Now lately, in London, we have had—I suppose as the result of Prof. Bergson's remarkable writings—one of the usual periodic outbreaks of more or less metaphysical discussion, and, incidentally, there has been raised quite seriously the question as to whether living organisms are subject to these laws of thermodynamics or not.

So far as the first law is concerned, there seems to be complete agreement that there can be no question of any but an affirmative reply, as we can scarcely suppose living things to be capable of creating energy any more than of creating matter.

But when we come to the second law there are apparently those who hold that it is different—who, in fact, believe that there is good reason for doubting whether this second law, which prevents us by the use of any mere machine from getting mechanical effect from the general stock of heat, applies to living organisms at all. Indeed, on the contrary, it is contended that it is probable that, in the case of certain animate bodies, this is actually being accomplished all the time; in other words, that there exist living things which in some fashion or other do very much what was the business of Maxwell's demons to do, and in this manner extract the energy that they require from the general stock. Here, obviously, is a most important matter for investigation, and one, having regard to its combined physiological and physical aspects, peculiarly adapted to be tackled by the members of the Röntgen Society, that is to say, if those who put it forward can make out a sufficient case to make actual experiment worth while.

The interest of the question will be especially apparent to anyone who has seen the so-called Brownian movements which can be perceived by ultramicroscopic methods in finely divided solid matter, such as particles of colloidal gold suspended in a liquid or of tobacco smoke in a gas. These movements are now believed to be due to the actual jostling of the minute particles by the moving molecules themselves, and give the most wonderful notion of the ceaseless state of agitation that exists among the molecules of all substances at any temperature above that of the ultimate zero, and the vast amount of energy that is stored in these perpetual movements.

Indeed, so remarkable do the Brownian movements appear that their original discoverer, who detected them in finely divided vegetable matter, came to the conclusion that the particles were alive.

To return to the main question, however, without presuming to pronounce any opinion one way or another on the very startling idea that living matter is not always subject to the second law of thermodynamics, but finds means, in some cases at all events, to evade its provision, I desire to direct attention to the stupendous consequences that would follow could such a view be established. Here, at last, we should have the equivalent of the perpetually burning lamp of the story books, which consumed no oil; the perpetual fire of the burning bush, which required no fuel. We should have immediately to hand the means of producing the perpetual motion dreamed of by mediæval philosophers. We should only have to cultivate the right kind of organisms in sufficient masses, and they would do all this for us. Moreover, there would be nothing lost; the heat that was thus accumulated locally for our needs would dissipate itself again into the common store, as would also the mechanical effects after they had done their work. The unordered molecular motions of which the Brownian movements give us an indication—motions which constitute heat—would merely be directed for a time in the particular manner needful to give us the power that we require. Life would be the directing force; but it would be a directing force only, and would do no work.

It is a fascinating prospect, giving us a glimpse of what some may perhaps think is destined to take the place of fuel a few hundred years hence, when the latter is all exhausted and before means have been found to unlock the still greater stores of atomic energy that have already been alluded to. To those, however, who have been brought up to rely on the orthodox doctrines of thermodynamics, it seems not only very revolutionary, but also very heterodox from a physical point of view. Personally, as one totally ignorant of biology, I am only here concerned to point out the inevitable consequence of admitting that living matter is not subject to the second thermodynamic law, a proposition which I venture to believe has never before now been put forward seriously in any responsible quarters.

Among the many scientific problems that await solution, problems which, if satisfactorily solved, would have an enormous effect on the habits of mankind, is that of distant electric vision, or the power to see objects a great way off by electrical means; in other words, to do for the sense of sight what the telephone has done for the sense of hearing. Indeed, if this extension of our sense of vision was obtained, we could well afford to dispense with any extension of our other senses, namely, those of taste, smell, and touch, the senses of sight and of hearing being, for all ordinary purposes, much more important to us than are the others.

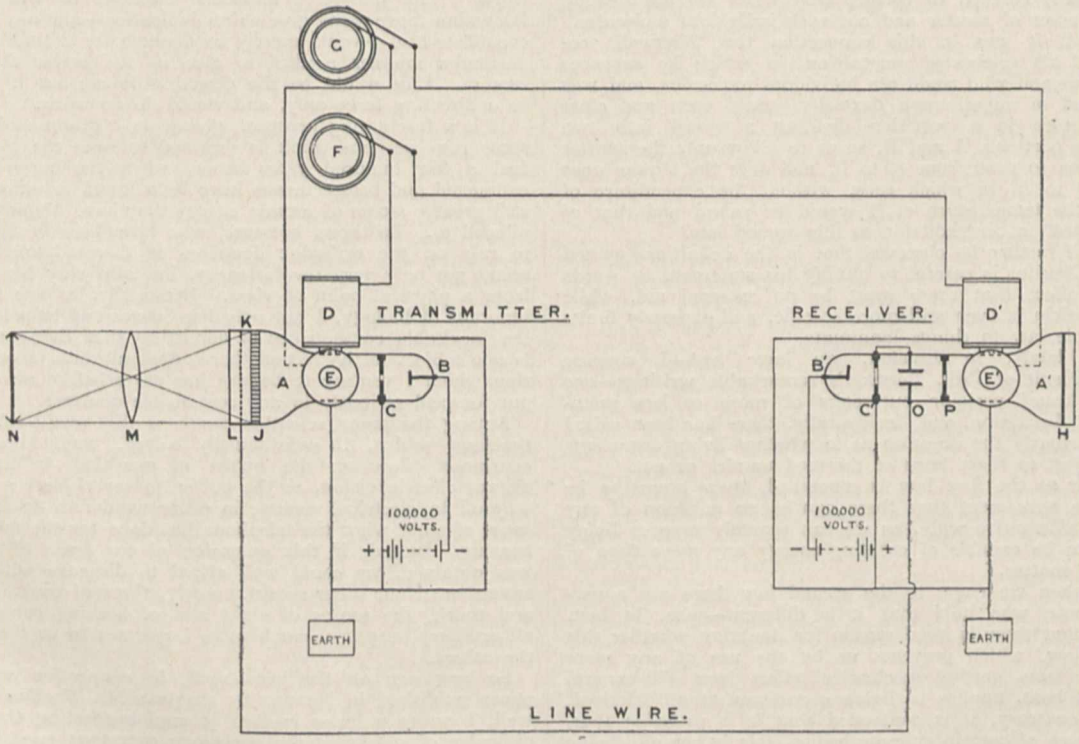
So long ago as the year 1908, in connection with a paper published in NATURE by the late Mr. Shelford Bidwell, I wrote a letter in that journal suggesting that the difficulty of obtaining the necessary enormous numbers of synchronised operations per second could possibly be solved by the employment of two beams of kathode rays, one at the transmitting and one at the receiving station, sychronously deflected by the varying fields of two electromagnets placed at right angles to one another and energised by two alternating electric currents of widely different frequencies, so that the moving extremities of the two beams would be caused to sweep synchronously over the whole of the required surfaces within the one-tenth of a second necessary to take advantage of visual persistence; and that, so far as the receiving apparatus was concerned, the moving kathode beam would only have to be arranged to impinge on a sufficiently sensitive fluorescent screen, and, given suitable variations in its intensity, to obtain the desired result. As, since that date, I have several times been asked to explain more in detail this idea, I now propose to do so, though it must be distinctly understood that my plan is an idea only, and that the apparatus has never been constructed. Furthermore, I would explain that I do not for a moment suppose it could be got to work without a great deal of experiment, and probably much modification. It is, indeed, only an effort of my imagination, and can be useful merely as a suggestion of a direction in which

experiment might possibly secure what is wanted. What, however, is claimed is that, so far as I am aware, it is the first suggested solution of the problem of distant electric vision in which the difficulty of securing the required extreme rapidity and accuracy of motion of the parts is got over by employing for these parts things of the extreme tenuity and weightlessness of kathode rays. Indeed, apart from the revolving armatures of the alternators employed for synchronisation, which present no difficulty, there is no more material moving part in the suggested apparatus than these almost immaterial streams of negative electrons. Furthermore, as will be seen, only four wires, or three wires and earth connections at each end, are required.

In the diagrammatic illustration the transmitter is shown on the left-hand side and the receiver on the right-hand side. The transmitter consists of a Crookes tube A fitted with a kathode B, which sends a kathode-ray discharge through a small aperture in the anode C, the kathode rays being produced by a battery or other source of continuous electric current giving some 100,000 volts. D and E are two electromagnets placed at right angles to one another,

Similarly, in the transmitting apparatus, the kathode rays fall on a screen J, the whole surface of which they search out every tenth of a second under the influence of the magnets D and E. Further, it is to be remarked that as the two magnets D and D′ and the two magnets E and E′ are energised by the same currents, the movements of the two beams of kathode rays will be exactly synchronous, and the kathode rays will always fall on the two screens H and J on each corresponding spot simultaneously.

In the transmitter the screen J, which is gas-tight, is formed of a number of small metallic cubes insulated from one another, but presenting a clean metallic surface to the kathode rays on the one side, and to a suitable gas or vapour, say sodium vapour, on the other. The metallic cubes which compose J are made of some metal, such as rubidium, which is strongly active photoelectrically in readily discharging negative electricity under the influence of light, while the receptacle K is filled with a gas or vapour, such as sodium vapour, which conducts negative electricity more readily under the influence of light than in the dark.



which, when energised by alternating current, will deflect the kathode rays in a vertical and in a horizontal direction respectively.

The receiving apparatus consists similarly of a Crookes tube A′ fitted with a kathode B′, which, in circumstances to be further described, transmits kathode rays through an aperture in the anode C′. D′ and E′ are two electromagnets placed at right angles, similar to those in the transmitter, the two magnets D and D′, which control the vertical motions of the kathode-ray beam, being energised from the same alternating dynamo F, which has a frequency, say, of ten complete alternations per second; while the other two magnets E and E′, which control the horizontal movements of the kathode-ray beam, are energised by a second alternating dynamo G having a frequency of, say, 1000 complete alternations per second.

In the receiver H is a fluorescent screen, upon which, under conditions to be further described, the kathode rays impinge, and the whole surface of which they search out every tenth of a second under the combined deflecting influence of the two magnets D′ and E′, with the result that under these conditions the screen fluoresces with what appears to the eye as a uniform brilliancy.

Parallel to the screen J is another screen of metallic gauze L, and the image to be transmitted of the object N is projected by the lens M through the gauze screen L on to the screen J through the vapour contained in K. The gauze screen L of the transmitter is connected through the line wire to a metallic plate O in the receiver, past which the kathode rays have to pass. There is, further, a diaphragm P fitted with an aperture in such a position as, having regard to the inclined position of B′, to cut off the kathode rays coming from the latter and prevent them from reaching the screen H unless they are slightly repelled from the plate O, when they are able to pass through the aperture.

The whole apparatus is designed to function as follows:—

Assume a uniform beam of kathode rays to be passing in the Crookes tubes A and A′, and the magnets D and E and D′ and E′ to be energised with alternating current, as mentioned. Assume, further, that the image that is desired to be transmitted is strongly projected through the lens M through the gauze screen L on to the screen J. Then, as the kathode rays in A oscillate and search out the surface of J, they will impart a negative charge in turn to all the

metallic cubes of which J is composed. In the case of cubes on which no light is projected, nothing further will happen, the charge dissipating itself in the tube; but in the case of such of those cubes as are brightly illuminated by the projected image, the negative charge imparted to them by the kathode rays will pass away through the ionised gas along the line of the illuminating beam of light until it reaches the screen L, whence the charge will travel by means of the line wire to the plate O of the receiver. This plate will thereby be charged; will slightly repel the kathode rays in the receiver; will enable these rays to pass through the diaphragm P, and, impinging on the fluorescent screen H, will make a spot of light. This will occur in the case of each metallic cube of the screen J, which is illuminated, while each bright spot on the screen H will have relatively exactly the same position as that of the illuminated cube of J. Consequently, as the kathode-ray beam in the transmitter passes over in turn each of the metallic cubes of the screen J, it will indicate by a corresponding bright spot on H whether the cube in J is or is not illuminated, with the result that H, within one-tenth of a second, will be covered with a number of luminous spots exactly corresponding to the luminous image thrown on J by the lens M, to the extent that this image can be reconstructed in a mosaic fashion. By making the beams of kathode rays very thin, by employing a very large number of very small metallic cubes in the screen J, and by employing a very high rate of alternation in the dynamo G, it is obvious that the luminous spots on H by which the image is constituted can be made very small and numerous, with the result that the more these conditions are observed the more distinct and accurate will be the received image.

Furthermore, it is obvious that, by employing for the fluorescent material on the screen H something that has some degree of persistency in its fluorescence, it will be possible to reduce the rate at which the synchronised motions and impulses need take place, though this will only be attained at the expense of being able to follow rapid movements in the image that is being transmitted.

It is further to be noted that as each of the metallic cubes in the screen J acts as an independent photoelectric cell, and is only called upon to act once in a tenth of a second, the arrangement has obvious advantages over other arrangements that have been suggested, in which a single photoelectric cell is called upon to produce the many thousands of separate impulses that are required to be transmitted through the line wire per second, a condition which no known form of photoelectric cell will admit of.

Again, it may be pointed out that sluggishness on the part of the metallic cubes in J or of the vapour in K, in acting photoelectrically, in no wise interferes with the correct transmission and reproduction of the image, provided all portions of the image are at rest; and it is only to the extent that portions of the image may be in motion that such sluggishness can have any prejudicial effect. In fact, sluggishness will only cause changes in the image to appear gradually instead of instantaneously.

Many modifications are, of course, possible in detail. For instance, the plate O of the receiver might perhaps better be replaced by an electromagnet or solenoid so arranged as to repel the kathode beam when energised. Again, the somewhat crude form of photoelectric cell described, composed merely of insulated cubes of rubidium in contact with sodium vapour, might be improved upon. Indeed, it is highly probable that research will reveal much more sensitive materials, the use of which would vastly improve this part of the apparatus, which at present is probably the one least likely to give the desired results.

GEOGRAPHY OF BRITISH CENTRAL AFRICA.[1]

ATTENTION was first directed to "British Central Africa" by Dr. Livingstone in 1859. By the term "British Central Africa" I mean the present protectorate of "Nyasaland," together with north-eastern Rhodesia; that is, the British territory bordering on the Shire River, and on Lakes Nyasa, Tanganyika, Mweru, and Bangweulu.

[1] From a paper on "The Geography and Economic Development of British Central Africa," read before the Royal Geographical Society on December 4, by Sir Alfred Sharpe, K.C.M.G., C.B.

Records show that the Portuguese had some knowledge of the Nyasa regions so far back as the seventeenth century, though they never established any stations there. They followed the line of "least resistance," the Zambezi River, which was navigable for small craft up to the Kebrabasa rapids. It may be taken as practically certain that at the very ancient period when at "Zimbawe" and elsewhere in Mashonaland there existed a flourishing gold-producing industry, the River Zambezi was known and navigated by the same ships which brought traders to the port of Sofala. No ancient rock-workings for gold have been found north of the Zambezi similar to those in Mashonaland, but it is not improbable that the traders of those days obtained copper from Katanga, and used the Zambezi as their most available transport route. With regard to the ruins in Mashonaland, no African race unaided ever erected these stone buildings, nor, in my opinion, can they be dated back to anything but the most ancient times. The idea that Solomon got his gold there has sometimes been ridiculed; but why not? We know that in those times fleets were sent out from the Red Sea periodically, which returned with gold, apes, ivory, and feathers—all products of Africa. These ships were probably identical with the Red Sea dhows of to-day. Where would explorers with vessels of that type be likely to go first, on leaving the Red Sea? Out into the Indian Ocean? or down the African coast? They would, of course, follow down the land; and whether or not in King Solomon's days he got his gold from the east or the south, it may be taken as certain that the whole East African coast was then known and frequented by traders. It is interesting to note that the question as to who were the ancient people who worked the gold-mines of South-east Africa is no new one. In that fascinating book, "A History of Africa," by John Ogilby, published in 1670, the matter is thoroughly discussed, and the arguments for and against King Solomon are fairly stated. Ogilby says, in speaking of the kingdom of Monomotapa: "In this country far to the inland on a plain stands a famous structure called Zimbawe, built square like a castle with hewn stones of a wonderful bigness. Above the gate appears an inscription which cannot be read or understood, nor could any that had seen it know what people used such letters. Near this place are more such buildings by the same name, signifying a court or palace. The inhabitants report it a work of the devil, themselves only building with wood." Also, as regards Sofala, he says: "The inhabitants aver that this is the very true Ophir from whence King Solomon had his gold." Then follows a full statement of the arguments *pro* and *con*.

The geographical position of Nyasaland is a somewhat remarkable one. The Shire valley and Nyasa form the southern portion of one of the greatest "rifts" in the African continent. This depression, after a break north of the lake, is carried on for 400 miles by Lakes Rukwa and Tanganyika, and, with a few short breaks, runs on by Lakes Kivu, Albert Edward, and Albert, to the Nile valley. Following this route, a journey by boat could be made from the mouth of the Zambezi to the Mediterranean, a distance of more than 4500 miles, covering 50 degrees of latitude, with a total distance of land portages of not more than 500 miles. A curious point about this great line of depression is that for a great part of its length it lies almost alongside the backbone of tropical Africa, the watershed in some parts approaching within a few miles of the lakes which lie along its course.

Most of British Central Africa has an average elevation of some 3000 to 4000 feet above sea-level. Here and there are higher plateau masses and peaks, which in some cases rise to close on 10,000 feet. The most notable of these plateaux are "Nyika" in the North Nyasa district and "Mlanje" in the Shire Highlands. The former has an average altitude of 7000 to 8000 feet with an area of 2000 square miles, and a European climate; the Mlanje plateau lies at 6000 to 7000 feet, and has an area of some 250 square miles. Both are what Sir Harry Johnston used to call "Jack and the Beanstalk" countries, the plateau sides rising precipitously from the surrounding country, and being almost unclimbable. On Mlanje grows the *Widdringtonea whytei* (Mlanje cypress), a large handsome conifer, a very valuable timber of excellent quality, durable and impervious to the attacks of white ants.

British Central Africa is drained (*a*) by the Nyasa-Shire-Zambezi outlet, (*b*) the Loangwa-Zambezi, (*c*) the Luapula-Congo. That portion of the Nyasa-Tanganyika plateau which borders on the route of the "Stevenson road" drains in five directions: (1) To Lake Tanganyika and the Congo, (2) to Nyasa, (3) to the Chozi and Luapula, (4) to Lake Rukwa, which has no outlet, (5) to the Loangwa and Zambezi.

But while the bulk of this portion of Africa lies at elevations over 3000 feet, the two main drains to the south, Nyasa-Shire and Loangwa-Zambezi, form deep depressions of considerable width, not attaining an altitude of anything above 1500 feet in their northernmost (highest) parts. One result of this is that British Central Africa has two climates, that of the low country, hot and somewhat unhealthy, and that of the uplands, pleasant and fairly healthy.

When I first knew Nyasaland, in 1887, there was an available line of water transport some 700 miles in length from the Zambezi mouth to the north end of Lake Nyasa, with one break only, the Murchison cataracts of the Shire River (which extend for some 40 miles). During recent times the course of the Shire has so rapidly and persistently silted up, both above and below the cataracts, that at the present day the upper portion is almost unnavigable at any season, and the lower river, instead of being available as a transport route all the year round from the sea to the foothills of the Shire Highlands, can only be used for a few months of the year so far as the junction with the Ruo River. The Shire gathers very little water on its course, and is the overflow pipe from the Nyasa tank. When that tank almost ceases to overflow, as is the case at present, the pipe *must* be more or less empty, and no human power can fill it.

This enforced abandonment to a great extent of the Shire as a transport route has been a terrible handicap on the growing planting industries of Nyasaland, which at this moment is unable to find a means of transporting to the sea-coast the cotton, tobacco, rice, maize, tea, rubber, and other marketable articles she is actually producing. The suggested extensions of the railway north and south will enable the protectorate not only to deal with what she is now producing, but to open up large additional tracts of land.

For the present fall in level of Lake Nyasa, the result of which is a far scantier and only intermittent overflow into the Shire River, it is difficult to assign any reasonable cause except a decreased rainfall in the basin; but such observations and records as have been kept at lake stations during the last few years do not seem altogether to bear out this supposition. A theory which might to some extent account for definite cycles of rise and fall of the level of Nyasa (presumably due to lessening and increasing rainfall) has suggested itself to me, and I advance it for what it is worth. We are aware that Tanganyika has a natural outlet to the Congo. When Livingstone and Stanley were there this outlet was found (the Lukugu), but it was blocked up; it was clear from native evidence that the lake had been rising in level for a number of years. The prophecy was then made that sooner or later it would break out at its old outlet. This subsequently took place, and for years Tanganyika has sent its surplus waters to the Atlantic. I am not aware whether the Lukugu has yet closed again. A noticeable feature on Nyasa is an old beach-mark, 6 or 8 feet above the highest level to which the lake now rises. This mark is distinct and clear, especially on the rocks, and is carried round the lake both in the open and in the most secluded and sheltered bays. It is abundantly evident that at some not very distant time the lake had this higher level, from which there must have been a *sudden* fall. Some few years ago, during the dry season, Nyasa ceased to overflow, and the bed of the Shire River at its exit began to silt up, reeds and other plants took root, and natives were able to walk across with only a few inches of water here and there. It would only have needed a few similar seasons for the outlet to have become entirely choked up, as was the case with the Lukugu. Is it not probable, therefore, that this has actually taken place at previous periods, and that the level of the lake subsequently rose until it overflowed the barrier and finally burst it? Is it not, moreover, probable that these cycles of fall, blocking up, rise, and outburst have been going on for ages? A sort of recurring decimal.

The Nyasaland basin is very limited in extent. The bulk of the water which enters the lake comes in at its northern end from high country lying beyond the Anglo-German boundary. Part of this country consists of a very interesting volcanic district in "Kondeland," which is dotted over with the craters of extinct volcanoes. On the east side of Nyasa the watershed between the lake and the Indian Ocean lies within a few miles. No rivers of any size enter the lake from the east.

To refer to the climate of British Central Africa. Throughout the higher levels, from May to September inclusive, it would be hard to find a pleasanter climate. October and November are hot, but dry; December to March constitutes the rainy season; April is cool and finer (the finishing of the rains). Malaria is, of course, the chief trouble. If this could be checked there is no reason why the elevated plateaux, not only of British Central Africa, but of many other parts of tropical Africa, should not be as healthy as Queensland. Knowledge which has been gained during the last ten years, largely through the exertions of the London and Liverpool Tropical Schools of Medicine, has enabled us not only to get a very much better insight into the causes of malarial fevers, but also to some extent to prevent their occurrence. Most tropical diseases are now known to be communicated by various biting insects, and if it were possible to protect ourselves against the attacks of these we should be able to prevent fevers. The difficulty, however, is to carry this out successfully.

A few years ago the first cases of sleeping sickness were discovered in British Central Africa. The disease reached this part of the continent from the Congo State, having, no doubt, been carried to the shores of Tanganyika and Mweru, and to the Luapula Valley, by the numerous expeditions from the Congo to the eastern boundaries of the Free State. It quickly established itself on Tanganyika and Mweru and in the Luapula Valley, also along the banks of several of the larger rivers running into Mweru and Tanganyika. Quite recently cases have appeared in the valley of the Luangwa, and also in the country bordering on the south-western shores of Lake Nyasa; and it is evident that there is in this part of Africa some hitherto unknown agent which carries the germ of sleeping sickness, as the tsetse-fly known as *Glossina palpalis* does not exist in the protectorate of Nyasaland (although it is found on Lakes Tanganyika and Mweru). More than one expedition is now at work investigating these interesting questions, and especially as regards the connection between tsetse-fly and big game. Whatever the results obtained by these expeditions may be, however, it is, I think, already evident that sleeping sickness will not prove to be such a scourge in these parts as it has been in Uganda.

It has been believed by many that the presence of game, and especially buffalo, is responsible for the existence of tsetse-fly. After many years spent in travelling over every part of Nyasaland and much of northern Rhodesia, Portuguese and German East Africa, and the Upper Congo, I arrived at the conclusion that the weight of evidence is against this theory, so far as tropical Africa is concerned; and in this belief, namely, that *tsetse in these regions does not depend on big game for its existence*, I think that all who are entitled to speak with authority, including Mr. Selous, are now agreed.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE annual prize distribution and students' conversazione of the Northampton Polytechnic Institute, Clerkenwell, E.C., will be held to-morrow, December 8. Sir William H. White, K.C.B., F.R.S., will distribute the prizes and certificates.

THE organising committee for the Imperial University Congress to be held in London next July has appointed Dr. Alexander Hill, formerly Master of Downing College, Cambridge, to be secretary to the congress, in succession to the late Dr. R. D. Roberts.

A STUDY of the calendar for the session 1911–12 of the University College of North Wales emphasises how much has been accomplished in recent years in making more easily available the advantages of higher education. It can no longer be said that university education is possible only for the child of wealthy parents. The present calendar shows that the fees of an ordinary arts student at the University College of Bangor amount only to 13*l.* 1*s.* per session, and of a science student to 17*l.* 1*s.* per session. The total cost of living in lodgings and tuition in Bangor averages from 35*l.* to 45*l.* for the session.

THE annual meeting of the trustees of the Carnegie Foundation for the Advancement of Teaching was held in New York on November 17. According to a Press notice, says *Science*, Mr. Carnegie gave 200,000*l.* of the 1,000,000*l.* which he had promised in case the State-supported institutions were admitted to the benefits of the foundation. The endowment is 2,425,200*l.*, yielding an annual income of 118,000*l.* Last year, it is said, the sum of 105,200*l.* was paid for pensions to 370 professors and widows of professors. Forty-eight were added to the list for the year, and fifteen died. The University of Virginia was added to the list of accepted institutions.

THE fourth annual dinner of the old students of the Royal College of Science, London, will be held at the new Imperial College Union, Prince Consort Road, South Kensington, on Wednesday, December 13. Sir Alexander Pedler, F.R.S., president of the Old Students Association, will preside; and the guests will include the President of the Board of Education, the Rt. Hon. A. H. D. Acland, Sir Robert Morant, K.C.B., Sir Arthur Church, K.C.V.O., Sir Alfred Keogh, K.C.B., Prof. S. H. Cox, and Prof. W. E. Dalby. Tickets for the dinner may be obtained on application to the secretary of the Old Students Association, 3 Selwood Place, S.W.

IT was proposed recently that steps should be taken to establish a University of Brighton, and a meeting is to be held on Tuesday next, December 12, by invitation of the Mayor of the town, to consider the subject. It is suggested that there might be affiliation with the Municipal College at Portsmouth and the Hartley University College, Southampton, to constitute a new university for the South Coast, or that the present radius of the University of London should be extended to include the proposed new University College. Hitherto, Brighton has not shown any very marked desire to take a prominent part in technical or university education. The town has a population of 131,000, yet there are only between sixty and seventy day students in the Municipal Technical College, and nearly two-thirds of these are first-year students. This does not provide a very promising nucleus upon which to constitute a university or a university college, or indicate keen local interest in higher education. We should be sorry, however, to discourage the proposal, and we trust that next Tuesday's meeting will lead to the formation of a scheme which will be successfully carried out in due course.

THE report of the council of the Royal Agricultural Society, adopted at the annual general meeting held yesterday, contains, among other interesting particulars, information concerning certain alterations in the regulations and syllabuses of the society's examination in agriculture. The National Agricultural Examination Board is of opinion that the time has arrived when the practice of examining in elementary science might be discontinued, and the subjects of examination will in future be:—practical agriculture (two papers), farm and estate engineering (including surveying, buildings, machinery, and implements), agricultural chemistry, agricultural botany, agricultural book-keeping, agricultural zoology, and veterinary science. Candidates will have the option of taking the whole eight papers in one year, or of sitting for a group of any four in one year, and the remaining group of four in the next year. In order to be eligible to sit for the new examination, a candidate must present a certificate from a recognised agricultural college that his attainments in the subjects of general botany, general chemistry, geology, and physics and mechanics, as attested by class and other examinations, are, in the opinion of the authorities of the college, such as to justify his admission to the examination.

So much attention has been directed during the year to the question of the legitimate place of public examinations in our system of education that a special interest is attached to an unsigned article in the Journal of the Royal Society of Arts of November 10 on the number of candidates offering themselves for the public examinations held during the year 1910. It appears that some 300,000 pupils were examined, without counting students presenting themselves for university and professional examinations and all the competitive examinations for the Army, Home and Indian Civil Services, and so on. This very large total included about 23,000 candidates in each case for the Local examinations held by the Universities of Oxford and Cambridge, some 6000 for the London Matriculation examinations, about 113,500 for the science and art examinations of the Board of Education, 24,500 for the technological examinations of the City and Guilds of London Institute, 11,500 for the London Chamber of Commerce examinations, 9000 for those of the College of Preceptors, about 14,500 for those of the National Union of Teachers, 42,000 for the examinations of the Lancashire and Cheshire Union of Institutes, and more than 27,000 for those of the Royal Society of Arts. As the writer of the article remarks: "Most people will admit that, whether examinations are or are not desirable, the thing is somewhat overdone."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 23.—Sir Archibald Geikie, K.C.B., president, in the chair.—Sir Norman **Lockyer**: The iron flame spectrum and those of sun-spots and lower-type stars. Previous publications are referred to indicating that the spectral lines of the metallic elements have been separated into two series, one seen best in the hotter stars and when high temperature and great electric energy are employed. These were termed "enhanced lines." The other set, existing in stars of the solar type, but not in high-temperature stars, and seen with lower degrees of heat and electric energy in the laboratory, were called "arc lines." These lines have been shown to be strengthened in sun-spot spectra, while the enhanced lines are weakened. It seemed important to consider as a third term the spectrum given by the comparatively low temperature of the oxyhydrogen flame and see how the lines in the spectrum behave in the spectra of sun-spots and lower-type stars. Photographs have been recently obtained of the oxyhydrogen flame spectrum of iron, using greater dispersion than has hitherto been employed on that spectrum at Kensington. It has been found that the lines existing in the flame spectrum nearly all behave in a similar way in sun-spot spectra, these lines being extensively winged in passing from the Fraunhoferic spectrum to the sun-spot spectrum, and, generally speaking, more conspicuous in the latter. It has also been found that the flame lines are just those which are relatively strong in the electric furnace spectra of iron, the spectrum furnished by the lowest temperature conditions dealt with in the furnace being almost identical with the oxyhydrogen flame spectrum. With regard to the behaviour of the flame lines in the spectra of lower-type stars, it is found that in the region λ 4000 to λ 4330 they are mainly unaffected in the spectrum of Arcturus. In the region λ 4330 to λ 4500 the evidence tends to show that most of the lines are strengthened both in Arcturus and α Orionis, but this point cannot be definitely established until stellar spectra of greater dispersion are available.—Sir Robert **Hadfield**: Sinhalese iron of ancient origin. There being little definite evidence regarding ancient iron, the author describes some specimens from the buried cities of Ceylon. His paper supplements one by Dr. G. Pearson, read to the society in 1795, on Indian steel of modern manufacture. The specimens investigated, obtained through the kindness of the Governor-General of Ceylon, Sir Henry McCallum, are (1) a steel chisel, fifth century A.D.; (2) an ancient nail, probably of same place and date; (3) a bill

hook. This date has been verified by Dr. A. Willey, F.R.S. Examination of the chisel showed—

	C	Si	S	P	Mn	Fe	Specific gravity.
Composition :	traces	0·12	0·003	0·28	nil	99·3%	7·60

Difference being slag and oxide.

Frémont shear test showed 16 tons per square inch elastic limit, 26 tons per square inch breaking load. Shock test showed 17 kg. with 85° bend before breaking. Brinell ball test showed hardness numbers 144 and 144 on opposite sides. Scleroscopic hardness, 35. Transverse section shows the specimen to be somewhat carbonised, with carbonised areas on two sides. The presence of martensite and hardenite suggests the important information that the chisel was quenched. The analyses in the paper probably represent the only modern complete determination of the composition of authentic specimens of ancient iron. The percentage of phosphorus, though high, does not greatly differ from modern bar iron. Sulphur is extremely low, showing the employment of a very pure fuel. There is very little silicon, while manganese is entirely absent, which is somewhat remarkable, since nearly all iron contains some manganese. From microscopical examination and other tests it results that the specimens represent wrought iron rather than steel. They somewhat resemble puddled iron, and seem to have been made from rather impure ore. The percentage of carbon is low, as is the case for other impurities, with the exception of phosphorus. Slag is present in considerable quantity in a lumpy, irregular form, indicating that the material was not submitted to the amount of forging undergone by modern wrought iron.—Prof. J. S. **Townsend**: The conductivity of a gas between parallel plate electrodes when the current approaches the maximum value.—Hon. R. J. **Strutt** and A. **Fowler**: Spectroscopic investigations in connection with the active modification of nitrogen. II.—Spectra of elements and compounds excited by the nitrogen. The chief results are as follows:—(1) The spectra generated by the nitrogen afterglow do not differ fundamentally from those which can be produced by other means of excitation. In many cases, however, band spectra are better displayed, and the more refrangible parts of the spectrum are more completely developed. The method therefore adds to our resources for the production of spectra. (2) The spectra of metallic substances approximate to those obtained in the electric arc, or are intermediate between arc and flame spectra. (3) The band spectra given by iodine, chloride of tin, and mercuric iodide are very similar to those obtained from vacuum tubes. (4) The spectra exhibited by sulphur, sulphuretted hydrogen, and carbon disulphide consist of bands which are quite distinct from those given by sulphur in a vacuum, but resemble the bands of the carbon disulphide flame in air. (5) The cyanogen spectrum which is developed in the glow by cyanogen and certain other compounds of carbon differs in several respects from that observed in the cyanogen flame or carbon arc. Some of the differences appear to be due to the production of the spectrum at a relatively low pressure in the glow. A new set of bands, occupying positions near the most refrangible edges of the violet groups, occurs in the glow spectrum, and has also been observed during the phosphorescent combustion of cyanogen in ozone.—A. **Fowler** and H. **Shaw**: The less refrangible spectrum of cyanogen, and its occurrence in the carbon arc. (1) Revised wave-lengths are given for the bands forming the less refrangible part of the cyanogen spectrum. Numerous bands which have not previously been recorded are included. (2) The heads of the bands can be arranged in regular series similar to those constituting the first positive band spectrum of nitrogen. (3) There are considerable variations in the relative intensities of the various bands, according as the spectrum is obtained from the flame of the burning gas, from a vacuum tube, or from the luminous glow produced by the interaction of certain compounds of carbon with active nitrogen. (4) The complex spectrum of the carbon arc in the red and yellow is almost entirely due to cyanogen. (5) The spectrum of cyanogen in the sun is not of sufficient intensity to give visible indications of the red and yellow bands.—Sir W. **Ramsay**: Note on the monatomicity of neon, krypton, and xenon.—H. M. **Budgett**: The adherence of flat surfaces. This paper deals with the various causes producing adherence between plane surfaces which have simply been "wrung" together, and experiments are described which were carried out with specially prepared steel gauges. It is shown that the effects of atmospheric pressure and molecular attraction between the opposing faces are very slight, and that the adherence is chiefly due to the presence of a minute liquid film between the gauges. Tables are given comparing the force required to pull the gauges apart when various liquid films were present, and also comparing the readings obtained when separation occurred in air and in a vacuum. Photomicrographs are shown illustrating the distribution of a paraffin film over the steel, and proving that only a small area of the faces is covered by the liquid. The breaking strains of various liquids are estimated from microscopic measurement of the area of cross-section under strain, and it is shown that the tensile strength of water approaches 60 atmospheres under these conditions.—G. D. **West**: The resistance to the motion of a thread of mercury in a glass tube. It is shown by theory and experiment that if a mercury index is to be moved along a glass tube of small bore with a velocity v, the difference of pressure P on the two ends of the index is given by

$$P = 0{\cdot}038/a + 8l\eta\, v/a^2,$$

when a is the radius of the tube and η the coefficient of viscosity of mercury.—A. J. **Berry**: The distillation of binary mixtures of metals in metals *in vacuo*. Part I.—Isolation of a compound of magnesium and zinc. Attempts have been made to isolate definite compounds of two metals, one of which, at least, is readily volatile, by distillation of the excess of the more volatile constituent; compare Heycock and Neville (Trans. Chem. Soc., 61, 1892, p. 914). In the present case it has been shown that the compound $MgZn_2$ discovered by Grube (*Zeitsch. anorg. Chem.*, 49, 1906, p. 77) can be prepared by heating a mixture of magnesium with an excess of zinc *in vacuo*. The excess of zinc distils off, and the residual alloy consists of the intermetallic compound. It has further been shown that this compound can be distilled without decomposition.—F. J. **Selby**: Analysis of tidal records for Brisbane for the year 1908. This paper gives the results of an analysis of one year's tidal records for Brisbane. The analysis was made by the method of Sir G. H. Darwin, the tidal abacus devised by him being employed. The results are generally in good agreement with those given by Rolin A. Harris for Sydney, as deduced from a year's observations of high and low waters. Using the constants given by the analysis, a curve was run off on the Indian tide-predicting machine at the National Physical Laboratory, and from a comparison of this with the actual records it was concluded that the values of the constants obtained were satisfactory.—Henry E. **Armstrong**, E. Frankland **Armstrong**, and E. **Horton**: Herbage studies. I.—*Lotus corniculatus*, a cyanophoric plant. Early in the summer last year plants of *Lotus corniculatus* growing on the Thames banks near Reading were found to contain a cyanophoric glucoside, but hydrogen cyanide could rarely be detected in plants from various localities collected later in the season. This year specimens have been obtained from a great variety of British localities, and these have rarely been tested without obtaining positive results. The climatic conditions during the two seasons have been very different, so that the differences observed between plants grown in the two years would seem to be mainly due to climatic differences. This year plants have also been obtained from all over Europe—from Norway, France, Holland, Germany, Russia, Servia, and Italy. In no case was cyanide found in plants growing in Norway, where the conditions have been such as to favour luxuriance rather than "maturity" of growth. The specimens obtained from other European localities in a majority of cases contained cyanide. The glucoside is usually accompanied by a corresponding enzyme, but this may occur without the glucoside. Wherever collected, the variety of *L. corniculatus* known as *major* (*uliginosus villosus*) has been found to be free from glucoside and enzyme; it would therefore seem that

botanists are justified in ranking this form as a distinct species.—B. **Hopkinson**: A high-speed fatigue tester and the endurance of metals under alternating stresses of high frequency. In this apparatus the test-piece ($\frac{1}{4}''$ diameter by $4''$ long) is fixed vertically, the lower end being attached to heavy masses. The upper end of the piece carries a weight. The weight is attracted by an electromagnet placed above it and excited by alternating current. The pull thus applied varies periodically between zero and a maximum value, the frequency of the variation being twice that of the current. The test-piece behaves as a spring, the lower end of which is held fixed, while the upper end carries the weight and is free to move in a vertical direction. The adjustments are such that the natural period of vertical oscillations of this system is approximately equal to the period of the varying magnetic pull, which accordingly sets up large forced oscillations of its own period. By thus using the principle of resonance with a current frequency of 60 periods per second the range of pull applied by the magnet may be magnified from 20 to 70 times, and the stress produced in the piece can readily be made to alternate between 20 tons per square inch tension and 20 tons per square inch compression. The number of complete cycles per minute is 7200, and 1,000,000 reversals can be performed in $2\frac{1}{2}$ hours. The test-piece is fitted with a simple form of optical extensometer whereby continuous observation can be kept of the change of length occurring in a cycle of stress. From the change of length the stress can be calculated if the piece is approximately perfectly elastic under the stress which is being applied. An independent estimate of the limits of stress can also be obtained by observing with a microscope the range of movement of the weight and calculating its acceleration from that range on the assumption (the justification of which is fully discussed in the paper) that the motion is simple harmonic. These two methods of getting the stress were found to agree closely for the mild steel used in the experiments up to a range of stress of about 30 tons per square inch. Endurance tests made in the new machine on mild steel showed that the steel would stand at least twenty million cycles of stress covering a range of 29 tons per square inch. Comparative tests of the same steel made by Dr. Stanton at the National Physical Laboratory in a direct-stress testing machine giving about 1100 reversals per minute showed that at this speed the probable life of the material under the same range of 29 tons per square inch would be less than 100,000 reversals. Similar comparisons with both higher and lower ranges of stress confirmed the conclusion that at the high speed of more than 7000 reversals per minute the endurance is much greater than at 1100 reversals per minute, both in the number of cycles and in the actual time required to produce fracture.

Royal Meteorological Society, November 15.—Dr. H. N. Dickson, president, in the chair.—C. **Harding**: The abnormal weather of the past summer. The author presented statistics showing the distribution of temperature, rainfall, and sunshine week by week in the various districts of the British Isles, and also made a comparison of the results with the Greenwich Records back to 1841. From the facts thus brought together, Mr. Harding showed that so far as temperature is concerned the summer of 1911 was unique. The maximum temperature of 100° at Greenwich on August 9 is the highest temperature recorded in the British Isles since the establishment of comparable observations. The mean temperature for the summer was also higher than for any similar period during the last seventy years. The maximum temperature of 96° in July has only been slightly exceeded on two previous occasions, and the September temperature of 94° has not previously been equalled during that month. So many hot days during the summer have never before been recorded. Mr. Harding further showed that the rainfall for the three summer months has only been smaller in three previous years during the period of seventy years, and also that the duration of bright sunshine was greater than in any previous summer since the introduction of sunshine recorders in 1881. As a consequence of the exceptional weather the harvest was everywhere commenced at an earlier date than usual, and was quickly concluded under the most favourable conditions. The effects of the drought, other than in relation to the water supply and vegetation, were very far reaching.—W. **Larden**: Observations of solar halos.

Zoological Society, November 21.—Dr. S. F. Harmer, F.R.S., vice-president, in the chair.—Dr. Geoffrey **Smith**: The fresh-water crayfishes of Australia. The object of this paper was to revise the classification and nomenclature of the Australian and Tasmanian crayfishes, and to give diagnoses of the genera and species with their limits of distribution. The work was based on a large material obtained from all parts of the continent and from Tasmania. Many of the specimens had been collected by the author, but the majority formed a very large collection brought together during the past twenty years by Prof. Baldwin Spencer. Four genera were recognised, Astacopsis, Chærops, Parachærops, and Engæus; the first three genera included the fresh-water crayfishes proper, and the last-named genus contained the land crayfishes, which were not dealt with in this paper. The geographical distribution of these genera and its bearing upon the geographical problems of Australia was discussed, and the view was supported that the Bassian subregion represented the home of the Australian crayfish, and that Astacopsis was nearest the ancestral form.—F. E. **Beddard**: A new genus of tapeworms from the bustard (*Eupodotis kori*). Four complete specimens and some fragments of this cestode had been obtained from a South African bustard in the society's gardens, and the author regarded it as a member of the group Tetracotylea, but could not reconcile its characters with those of any other genus of that group at present known. He briefly described its anatomical characters and discussed its systematic position, and proposed a new genus and species for its reception.—A. E. **Cameron**: The structure of the alimentary canal of the stick-insect, *Bacillus rossii*, Fabr., with a note on the parthenogenesis of this species. The author stated that this insect had a rather limited distribution, occurring in the south of Europe and in the north of Africa, and that in the wild state it was not found north of Orleans. Certain peculiarities of the alimentary canal were dealt with which were regarded as adaptations to the mode of life of the species. Attention was directed to the fact that the male was only rarely found in the wild state, and that parthenogenetic reproduction of *B. rossii* had been verified, for during four generations the specimens kept by the author had showed no males. The fact that the males were disappearing suggested that parthenogenesis was not the primitive method of reproduction, but that the species had become adapted to it through the failure of sexual reproduction.—H. B. **Preston**: A collection of terrestrial and fluviatile shells made by Mr. Robin Kemp in British and German East Africa. One new genus and thirty-four new species were described, which represented only a very small portion of the large number of species collected.—G. A. **Boulenger**: The habits of British frogs and toads. The paper gave information for those who might feel inclined to carry out further observations on the subject of the migrations of Amphibia as dealt with in a paper recently read before the society. The common toad was strongly recommended as the most suitable batrachian on which to institute series of experiments on distant orientation.—R. **Lydekker**: Milk-dentition of the ratel. The author described an instance of primitive features present in the milk-dentition being entirely lost in the teeth of the permanent series. So far as he was aware, no such atavistic feature had been hitherto recorded in the case of any existing mammals.

Geological Society, November 22.—Prof. W. W. Watts, F.R.S., president, in the chair.—Prof. T. G. **Bonney**, F.R.S., and Rev. E. **Hill**: Petrological notes on Guernsey, Herm, Sark, and Alderney. Further study has been given to the relations of the igneous masses. The old distinction between diorite and syenite cannot be maintained; there exists, especially in Guernsey and Alderney, a dioritic magma, which underwent differentiation. The results of this are described, the most basic being found at Fort Albert (Alderney) and Bon Repos Bay (Guernsey), and the most acid, which are really tonalites, in the north-west of the latter island. These and a felspathic variety

sometimes intrude, sometimes pass into the others, so they also must have been at high temperature. The so-called "granites" at the two ends of Sark are hornblendic, the southern one being really a tonalite; so are those of Alderney, Herm, Jethou, and Guernsey, and it is suggested that these granites may be yet more acid terms in a differentiation series. Of the numerous dykes, the most acid are either aplitic microgranites or quartz-felsites. Diabase-dykes are common, and mica-traps have been found in all the islands except Herm. At Pleinmont, in the south-west of Guernsey, a mass resembling a greenstone proves to be sedimentary. The time-relations of the several rocks are discussed. The gneiss of Guernsey is the oldest, and had acquired its structure before the intrusion of the diorites. They were followed by the hornblendic granites, and these by the aplitic microgranites. All were pre-Cambrian. The date of the diabase-dykes is more uncertain. The mica-traps are probably late Palæozoic.—H. **Woods**: The evolution of Inoceramus in the Cretaceous period. The species of Inoceramus found in the Gault, the Upper Greensand, and the Chalk are considered to have descended from two stocks which occur in the Lower Greensand, one being *I. salomoni*, d'Orb., the other of the type of *I. neocomiensis*, d'Orb. (1) *I. concentricus*, Park. (Lower and Upper Gault), is of the same type as *I. salomoni* (Folkestone beds and Mammillatum bed), from which it has been derived. *I. sulcatus*, Park. (Upper Gault), closely resembles *I. concentricus*, except that it possesses strong radial ribs. Between these two species every gradation is seen. *I. tenuis*, Mant. (Red Chalk and Chalk Marl), is allied to *I. concentricus*, from which it has been derived by an increase in the length of the hinge and a decrease in the prominence of the left umbo. (2) *I. anglicus*, Woods (Gault and Upper Greensand), resembles *I. neocomiensis*, but the posterior part of the shell has become more compressed, and the ventral curvature of the ribs has increased. From *I. anglicus* two species appear to have arisen, namely, *I. pictus* and *I. crippsi*. (*a*) *I. pictus*, Sow. (Chalk Marl to *H. subglobosus* zone), approaches the form of *I. anglicus*, which has more numerous and more regular ribs; and in it the ribs have become still more numerous and more regular, and the anterior area has become more extensively developed. (*b*) *I. crippsi*, Mant. (Upper Greensand to zone of *H. subglobosus*), agrees in many respects with the form of *I. anglicus*, which has fewer and less regular ribs; but in this species the hinge has become somewhat shorter, the postero-dorsal part of the shell less compressed, the anterior area smaller, the ribs fewer and more irregular, with a less strongly marked posterior curvature.

CAMBRIDGE.

Philosophical Society, November 13—Sir George Darwin, K.C.B., F.R.S., president, in the chair.—Sir J. J. **Thomson**: Application of positive rays to the study of chemical reactions. The author describes the results of the application to chemical reactions of a method which he brought before the notice of the society at a previous meeting. The production of carbon monosulphide when an electric discharge passes through the vapour of carbon bisulphide was detected by this means. The author gives the results of investigations on the chemical combination between hydrogen and oxygen and hydrogen and nitrogen, and discusses the source of curves corresponding to atomic weights 1–6, 2–5, 20–21, 39, 50–51, which do not fit in with recognised elements or compounds.—N. **Bohr**: Electron theory of metals. In the paper an attempt is given to generalise the theory of H. A. Lorentz, retaining, however, the main assumptions used by this author. It is shown that, by making alterations in the special assumptions used by Lorentz, results can be obtained for the electric and thermal conductivities and for the galvano-magnetic phenomena, which agree more closely with the experiments. On the other hand it is shown that the calculation of the absorption and emission of heat rays with long times of vibration in all the considered cases leads to the same law of heat radiation as given by Lorentz, and that, further, the remarkable conformity between Lorentz's calculation of the thermoelectric phenomena and the thermodynamic theory of these phenomena given by Lord Kelvin will remain unchanged in all the considered cases. Finally, it is shown that the presence of free electrons, contrary to the generally adopted opinion, will not give rise to any magnetic properties of the metals.—J. C. **Chapman**: Secondary characteristic Röntgen radiation from elements of high atomic weight. The secondary Röntgen radiation has been examined from lead which belongs to the more or less unknown second group (group L, Barkla, *Phil. Mag.*, September) as regards its characteristic radiation. It was found that lead shows a marked homogeneous constituent mixed with the scattered radiation. λ/ρ in Al = 16·8 ($I = I_0 e^{-\lambda x}$; ρ = density of Al). The absorption by the element lead in the form of lead oxide was measured for a series of homogeneous beams of group K, and it was shown that it exhibits a marked selective absorption in the region where it commences to be excited; thus between selenium, $\lambda/\rho = 18{\cdot}5$, and bromine, $\lambda/\rho = 16{\cdot}3$, the ratio of the absorption by lead to that by aluminium commences to rise, and continues to do so until the absorption band is passed. This would suggest that the mechanism of production and the resulting radiation in both groups is of the same type.

EDINBURGH.

Royal Society, November 13.—Prof. J. C. Ewart, F.R.S., in the chair.—Angus B. **Fulton**: Experiments to show how failure under stress occurs, its cause, and comparative values of the maximum stresses induced when timber is fractured in various ways. The objects of the research were to study the effects of the medullary rays on the strength of timber when strained in various ways, and to connect up the maximum induced stresses in cross-bending with those obtained in tension and compression. Some of the conclusions arrived at were that the initial cause of fracture lies in the medullary rays; that rectangular beams when laid on a tangential face are stiffer and have a higher fracture value than when laid on a radial face; that rectangular beams of unequal sides are stiffer, but not materially stronger, when laid on the broad side of the section; that fracture by shearing does not take place in timber beams of the commoner woods, supported on the two ends and loaded in the middle, where the ratio of span to depth of beam exceeds seven.—Dr. G. Rutherford **Jeffrey**: A new method of measuring mental processes in normal and insane people, with special reference to maniac depressive insanity. The object of the research was to ascertain whether or not any definite characteristic of the mental working process could be detected in the disease, or group of diseases, described as maniac depressive insanity. The reckoning test, recently described by Maloney, was used. The test consisted of the addition of digits in pairs, each pair being taken to represent a constant unit of mental work. Not only was the number of units of mental work done throughout a given period ascertained, but also the number of units per minute throughout the same period. The number per minute of these mental units was then plotted against the time, and a curve obtained showing objectively the mental working capacity throughout the period. The experiment consisted in allowing thirty cases of maniac depressive insanity to perform the reckoning test for fifteen minutes on each of five successive days. Seven normal people were tested under the same conditions and for the same length of time. An average normal mental curve was obtained in this way, and this was compared with the curves obtained from the insanity cases already mentioned. The normal curve did not support Hylans's assertion that the middle period of five minutes represented best the maximum working capacity. As compared with the normal curve, the work curve of the maniac depressive cases differed markedly in two ways:—(1) a tendency toward a high output characterised the third five-minute interval, which the author regarded as being probably due to the difficulty which such patients experience in getting under weigh in the mental task, and as being an expression of their exaggerated psycho-motor inertia; (2) the small extent of the terminal spurt, possibly due to the fact that the imminence of the end of the task, which acts as an incentive to greater effort in normal people, is not realised. The curves varied in form according as the patients were in the quiescent, depressed, or excited phases of the disease. For example, in the depressed patient's chart, the

recovery was performed in a series of steps, while in the excited cases the curve demonstrated incessant and abrupt transitions of mental energy in a morbidly excited brain. The author agreed with Maloney that the reckoning test was of distinct therapeutic, and possibly also diagnostic, value in psychiatry.—Prof. Alex. **Smith** and C. M. **Carson**: The freezing points of rhombic sulphur and of *soufre nacré*. When pure liquid sulphur freezes into the monosymmetric, the rhombic, or the *soufre nacré*, the freezing points are respectively 119·25°, 112·8°, and 106·8° C. When the liquid sulphur contains the insoluble sulphur in equilibrium, the freezing points become respectively 114·5°, 110·2°, and 103·4° C.

PARIS.

Academy of Sciences, November 27.—M. Armand Gautier in the chair.—The president read a letter from Prince Roland Bonaparte putting at the disposition of the academy a sum of 250,000 francs to be used for facilitating research by young scientific men. It is not to be given in the form of a reward for work already done. The intention is that the amount should be given in five annuities to men who have already given proof of their capacity for original work, and, not being members of the academy, lack sufficient resources to pursue their investigations.—A. **Chauveau**: A phantom image of the Eiffel Tower observed in 1900. A detailed description of the phenomenon observed is given, together with an explanation as to its probable cause. It would appear to be analogous with the shadows known as the spectres of the Brocken.—M. Leclainche was elected a correspondant for the section of rural economy in the place of M. Eugène Tisserand, elected free academician.—F. A. **Forel**: The Fata-morgana. A discussion of the conditions under which this phenomenon appears on Lake Leman.—E. **Barré**: The minimum surfaces produced by a circular helix.—Emile **Cotton**: The instability of equilibrium.—M. **Jouguet**: The velocity and acceleration of waves of shock of the second and third species in wires.—André **Léauté**: Certain difficulties presented by the use of exponential developments.—J. **Danysz**: The β rays of the radium family. It has been shown in a previous communication that a glass tube containing radium emanation gives off at least seven bundles of β rays with different and determinate velocities. Fresh experiments on these rays have been carried out with a view to determine their velocities with the highest possible precision. Twenty-three bundles were distinguished, seven of which are strongly marked on the plate. The emanation from 0·3 gram of radium chloride was utilised for these experiments; the strength of the magnetic fields used varied from 600 to 6000 gauss.—Félix **Leprince-Ringuet**: The geometrical properties of the point representing the earth in the diagram of the voltages of a polyphase network.—G. Ter **Gazarian**: A general relation between the physical properties of bodies: application to viscosity, capillarity, surface energy, heat of vaporisation, and the rectilinear diameter. If q_1 and q_n are the quotients of the numbers representing the densities of bodies compared at temperatures t_1 and t_n, equally removed from the critical points, then the relation $q_n = q_1 + c(t_n - t_1)$ has been proved in a previous paper. The same equation has now been extended to other physical properties, the calculated and observed values of q showing a good agreement.—Albert **Colson**: The dissolecule and the formula of van 't Hoff. A reply to the criticisms of Girard and Henri. The author objects to the identification of osmotic pressure in solution with the pressure of gaseous molecules.—René **Dubrisay**: Chemical equilibria in solution. A study of the effect of the addition of acetone on the hydrolytic dissociation of bismuth nitrate.—L. C. **Maillard**: The condensation of the acid amines in presence of glycerol; cycloglycylglycines and polypeptides. A mixture of glycocoll with four or five times its weight of glycerol heated in a sealed tube to 170° C. gives a good yield of cycloglycylglycine.—J. A. **Le Bel**: The dimorphism of rubidium bichromate.—A. **Goris** and M. **Mascré**: The chemical composition of some of the higher fungi. Urea is present in some species and absent in others. Two cholesterols were also extracted, and a new substance, as yet not identified.—Paul **Macquaire**: Tyrosine as a fixing agent in the preparation of the iodopeptones.—H. **Labbé** and L. **Violle**: The ingestion of mineral acids in a dog from which the pancreas had been partially removed.—J. **Courmont** and A. **Rochaix**: The duration of immunisation, by the intestine, against experimental Eberthian infection in the rabbit. The immunity was found to be appreciable at the end of six months.—André **Lancien**: Electric colloidal rhodium. Starting with carefully purified rhodium, colloidal rhodium has been obtained by a modification of Bredig's method. The diameter of the particles of colloidal metal was about 5 $\mu\mu$. The colloidal rhodium solution was found to be without toxic properties when injected into fish, frogs, rabbits, and dogs, although the solution prevented the development of certain micro-organisms. Details are given of the application of this solution in therapeutics with beneficial results.—Etienne **Rabaud**: The cause of the isolation of solitary larvæ.—Edgard **Hérouard**: Parthenogenesic progenesis in Chrysaora.—M. **Rappin**: Antituberculous vaccination and serotherapy. Tubercle bacilli, after their virulence has been modified by a chemical treatment, are injected into the horse, from which a serum is prepared possessing a high agglutinating power. Experiments with this serum are described.—F. **Mesnil** and J. **Ringenbach**: The action of serums from the Primates on the human trypanosome of Rhodesia.—Carl **Renz**: The extension of the Trias in the middle portion of eastern Greece.—H. **Douxami**: The seismographic observation at Lille of the earthquake of November 16, 1911. The true displacement of the ground at Lille varied between 0·2 and 0·3 millimetre.

NEW SOUTH WALES.

Linnean Society, October 25.—Mr. W. W. Froggatt, president, in the chair.—R. **Greig-Smith**: Contributions to a knowledge of soil-fertility. No. iii., Bacterial slimes in soil. Many of the bacterial colonies that develop on saccharine media, after sowing with dilute suspensions of soil, contain gum or slime. As the bacteria actively produce the slime upon isolation, it is reasonable to suppose that their slime-forming faculty was being exercised while they were in the soil. Bacterial slimes, therefore, should be detectable in soils, if the conditions had been such as to prevent their decomposition. The investigation of a rich soil showed that slime was present; and, as it contained galactans which are typical of bacterial slimes, it probably had a bacterial origin.—A. H. S. **Lucas**: The gases present in the floats (vesicles) of certain marine algæ. The author, not having been able to find any account of actual analyses of the gases present in the floats of marine algæ, made a number of analyses of the gases found in the floats of *Phyllospora comosa, Hormosira banksii,* and *Cystophora monilifera*. In all cases, the gases consisted of oxygen and nitrogen only; in most cases the proportion of the oxygen was less than if air had been taken directly into the floats, and in all notably less than in air dissolved in water. In the floats of growing Hormosira, the proportion of oxygen was about 12 per cent. only of the total volume of contained gases. While there is no absolute evidence of the source of the gases, the author inclined to the view that they are derived from the air dissolved in the sea-water, the plant using up a considerable proportion of oxygen for its process of metabolism.—D. **McAlpine**: The fibrovascular system of the apple [Pome], and its functions. In a transverse section of the stalk of an apple, just as it enters the fruit, there are normally ten vascular bundles—or twelve if six carpels are present; eight if four—though sometimes two adjoining bundles may become confluent. These, on entering the fruit, spread out to form ten main trunks with numerous branches, and conveniently situated midway between the skin and the centre. The earliest branching and the most direct course is towards the carpels and the seed; then the flesh is supplied by numerous diverging branches, which unite to form a network of vessels, and finally terminate, beneath the skin, in a perfect maze of the most delicate forked veinlets. By macerating an apple in a weak solution of potassium hydrate for a week, and then removing the soft parts in water, with the aid of a brush and a needle, the fibro-vascular system may be isolated in a more or less intact condition. This system must not be conceived of as a vast network of tubes conveying food-material to a definite terminus, but as being tapped on the way by living tissue wherever growth is going on, or storage is required.

BOOKS RECEIVED.

Plane Trigonometry. By Prof. L. K. Ghosh. Pp. viii+271. (Calcutta: G. N. Halder.) Rs. 1/8.

Bergson. By J. Solomon. Pp. 127. (London: Constable and Co., Ltd.) 1s. net.

Cambridge County Geographies:—East London. By G. F. Bosworth. Pp. x+256. Monmouthshire. By H. A. Evans. Pp. x+183. Carnarvonshire. By Prof. J. E. Lloyd. Pp. xi+171. The Isle of Man. By the Rev. J. Quine. Pp. x+178. (Cambridge: University Press.) 1s. 6d. each.

Examples in Applied Mechanics and Elementary Theory of Structures. By C. E. Inglis. Pp. iii+77. (Cambridge: University Press.) 2s. 6d. net.

Morphologie Médicale. Étude des Quatre Types Humains. Applications à la Clinique et à la Thérapeutique. By A. Chaillou and L. MacAuliffe. Pp. iii+248. (Paris: O. Doin et Fils.) 5 francs.

Tierhaaratlas. By Dr. H. Friedenthal. Pp. 19+xxxv plates. (Jena: G. Fischer.) 40 marks.

The Wilderness of the Upper Yukon. A Hunter's Explorations for Wild Sheep in Sub-Arctic Mountains. By C. Sheldon. Pp. xxi+354. (London: T. F. Unwin.) 12s. 6d. net.

Reinforced Concrete Compression Member Diagram. By C. F. Marsh. (London: Constable and Co., Ltd.) 3s. 6d. net.

The British Journal Photographic Almanac, 1912. Edited by G. E. Brown. Pp. 1436. (London: H. Greenwood and Co.) 1s. and 1s. 6d. net.

Photographic Lenses. By C. Beck and H. Andrews. Seventh edition, completely revised, with index. Pp. 324. (London: R. and J. Beck, Ltd.) 1s. net.

Die Mechanik der Wärme. By R. Mayer. Herausgegeben von A. von Oettingen. (Ostwald's Klassiker der Exaktenwissenschaften, Nr. 180.) Pp. 90. (Leipzig: Engelmann.) 1.60 marks.

The Heat Treatment of Tool Steel. An Illustrated Description of the Physical Changes and Properties Induced in Tool Steel by Heating and Cooling Operations. By H. Brearley. Pp. xvii+160. (London: Longmans and Co.) 10s. 6d. net.

Psychic Phenomena, Science, and Immortality. By H. Frank. Pp. 556. (London: T. W. Laurie.) 10s. 6d. net.

Transactions of the American Institute of Chemical Engineers. Vol. iii., 1910. Pp. iv+406. (London: E. and F. N. Spon, Ltd.) 25s. net.

Poliedri, Curve e Superficie secondo i metodi della Geometria Descrittiva. By Prof. G. Loria. Pp. xv+235. (Milano: U. Hoepli.) 3 lire.

Entomology for Medical Officers. By A. Alcock, C.I.E., F.R.S. Pp. xx+347. (London: Gurney and Jackson.) 9s. net.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 7.

ROYAL SOCIETY, at 4.30.—Lapworthura: a Typical Brittlestar of the Silurian Age, with Suggestions for a New Classification of the Ophiuroidea: Miss I. B. Sollas and Prof. W. J. Sollas, F.R.S.—The Physiological Influence of Ozone: Dr. Leonard Hill, F.R.S., and M. Flack.—On the Factors Concerned in Agglutination: H. R. Dean.—The Action of Dissolved Substances upon the Auto-fermentation of Yeast: Dr. A. Harden, F.R.S., and S. G. Paine.—Further Experiments upon the Blood Volume of Mammals and its Relation to the Surface Area of the Body: Prof. Georges Dreyer and W. Ray.—The Origin and Destiny of Cholesterol in the Animal Organism. Part viii. On the Cholesterol Content of the Liver of Rabbits under Various Diets and During Inanition: G. W. Ellis and J. A. Gardner.

LINNEAN SOCIETY at 8.—The Internodes of Calamites: Prof. Percy Groom.—On Some Mosses of New Zealand; H. N. Dixon.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Notes on National and International Standards for Electrical Machinery: Dr. R. Pohl.

FRIDAY, DECEMBER 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.—On the Errors of Measurements on Photographic Plates: Winifred Gibson.—(1) Nouvelles étoiles doubles, 7me série; (2) Mesures d'étoi'es doubles à l'Observatoire de Lille: R. Jonckheere.—Prevention of Dew Deposit on Glass Surfaces: J. Franklin Adams.—A Critical Comparison of the Overlapping Section of the Oxford and Potsdam Astrographic Catalogue: G. D. C. Stokes.—The Constitution of the Solar Corona. I. Protofluorine: J. W. Nicholson.—*Probable Paper:* The Determination of Differential Star-places by Photographic Methods: H. H. Turner.

MONDAY, DECEMBER 11.

VICTORIA INSTITUTE, at 4.30.—Natural Law and Miracle: Dr. Ludwig von Gerdtell.

ROYAL SOCIETY OF ARTS, at 4.30.—The Carbonisation of Coal: Prof. Vivian B. Lewes.

TUESDAY, DECEMBER 12.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Experiments on the Strength and Fatigue Properties of Welded Joints in Iron and Steel: Dr. T. E. Stanton and J. R. Pannell.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—A New Perigraph: J. Gray.

WEDNESDAY, DECEMBER 13.

ROYAL SOCIETY OF ARTS, at 8.—Continuous Service in Passenger Transportation: W. Yorath Lewis.

THURSDAY, DECEMBER 14.

ROYAL SOCIETY OF ARTS, at 4.30.—The Fisheries of Bengal: Dr. J. Travis Jenkins.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Residence Tariffs: A. E. Seabrook.

CONCRETE INSTITUTE, at 8.—Some Recent Works in Reinforced Concrete: G. C. Workman.

FRIDAY, DECEMBER 15.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—*Discussion:* Double-cutting and High-speed Planing Machines: J. Hartley Wicksteed.—*Probable Paper:* Oil-burning Locomotives on the Tehuantepec National Railway, Mexico: R. Godrey Aston.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Tests on Reinforced Concrete: E. F. Hunt.

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