THURSDAY, DECEMBER 12, 1901.

THE BACTERIAL PURIFICATION OF SEWAGE.

Sewage and the Bacterial Purification of Sewage. By Dr. S. Rideal. Pp. iii + 308. (London: Sanitary Publishing Co., 1901.) Price 14*s.* net.

THE practicability of effecting the purification of town sewage on the large scale by bacterial agency has now been abundantly proved. The process has passed beyond the experimental stage, and must now be acknowledged as the only method which can convert the putrescible matter of sewage on the large scale into inoffensive and harmless substances. Accordingly all trustworthy information respecting the results which have been arrived at from the lengthy experimental trials, and from the application of these results on the large scale, will be welcome to public sanitary authorities, and perhaps even still more acceptable to the professional advisers of these bodies. The treatise under review has been written by one who has carefully watched the progress, and who has had a long and varied experience, of bacterial treatment. The book is, therefore, undoubtedly worthy of careful perusal and consideration by those who are responsible for disposing of the sewage from houses, villages or towns.

The author covers a wide ground. He treats of the general character of sewage, and gives an historical sketch of the processes which have been resorted to for disposing of it. He also enters fully into the modern methods which have been recommended for the chemical examination of sewage and of sewage effluents, and states the standards of purity which have been suggested. Probably his description of the methods of collecting and examining these liquids will be of special value, since no such general description seems to be at present available. The summary of Dr. Houston's work on the identification of the bacteria present in raw sewage, a detailed account of which has appeared in the reports published by the London County Council, will also be useful, together with the account of the most important chemical changes which are brought about by bacteria. Naturally, also, some account is given of the treatment of sewage by irrigation and by chemicals, and of the "sterilisation" processes—processes which appear in the light of present knowledge of doubtful advantage, since they destroy the vast number of bacteria which effect or complete the purification of sewage, in order to make sure that a small minority of possibly injurious bacteria are disposed of.

The latter portion of the book will undoubtedly command most general attention, since here the author deals with bacterial purification. This is treated of in some detail, and the information which is given has been collected from the most trustworthy sources generally available. One can only regret that the large amount of useful matter accumulated has not been somewhat more systematically arranged and carefully summarised and compared; and, above all, that the author has not stated very clearly and emphatically the conclusions which he himself has arrived at from its careful consideration. The author has, however, apparently not been willing generally to act as assessor of the relative value of the different bacterial methods and apparatus, and due acknowledgment should be made of the time and trouble which he has expended in bringing together important information much of which, until now, has existed only in the form of scattered reports and papers. That the work which he has done in this direction is really valued is shown by the fact that a second edition of the book has been issued twelve months after the original publication; and it may be stated that the author has, as far as possible, availed himself of the opportunity which a new edition afforded him of bringing the matter up to date.

The author speaks in his preface "of the experiments on bacterial purification, which have now been carried out on a sufficiently large scale to establish the safety of embarking on the treatment of sewage on bacterial lines for even the largest centres of population." This statement proves that he is in touch with the recent experimental trials of the method at the sewage outfalls of our great towns. And it cannot be too emphatically stated that the near future is to see the adoption on the large as well as the small scale of this most rational process of "self-purification" of sewage. For after all bacterial purification is natural purification. It simply amounts to allowing the living agents of purification, which are present in the raw sewage in immense numbers, to carry out their useful function under the most favourable conditions. This adoption of natural methods must surely commend itself; and no one who looks at sewage treatment from a disinterested point of view will regret the approaching general relinquishment of artificial chemical or electrical treatment in favour of allowing natural agencies to have free course, provided only that reasonable efficiency and economy can be assured in making the change. This natural treatment may in some localities be effected on sewage farms by the development of bacteria in a suitable soil; but in most localities great advantage is obtained by substituting for the soil properly constructed bacteria beds, in which the treatment can be carried out on a smaller area and under more complete control than by means of the bacteria in the soil.

The experience and knowledge derived from several years' natural purification of sewage on the small scale in coke bacteria beds at the London and Manchester outfalls should suffice to give satisfactory assurance in these respects. After varied and continued trials it has been found independently at both these important centres that the raw sewage on its arrival at the outfalls should be roughly screened and then subjected to sedimentation without previous admixture with any chemicals. It has been shown that sedimentation may be appropriately allowed to take place in open tanks or channels in two stages. Much sand, road detritus and cellulose matter can thus be first removed, and this may be simply thrown out upon the land or dealt with in destructors without causing offence; while in the second sedimentation "sludge" consisting of fæcal and putrescible matter subsides. If the substances which are separated out by the latter sedimentation are simply left in contact with the sewage, which constantly flows over them, at least 40 per cent. of the solid sediment disappears

by bacterial action. Accordingly by the double sedimentation an average of more than 60 per cent. of the suspended solid matter or "sludge," which was present in the raw screened sewage, has been caused to disappear. This implies a very considerable diminution of cost in sludge removal and disposal; but it secures the further advantage that the still impure liquid flowing from the settling tanks has become admirably adapted for undergoing adequate purification in the bacterial coke-beds. It is noteworthy that the full power of disposing of sludge is only developed in the sludge after it has remained in contact with the flowing sewage for some considerable length of time; and it is only stale sludge which is efficient in resolving the solid insoluble matter into soluble and gaseous forms. This delay is due to the necessity of cultivating in the sludge the necessary species of bacteria, which are derived from the sewage itself.

The most efficient and rapid method of dealing with the impure liquid, which flows from the settling or so-called "septic" tanks, has been found to consist in treating it intermittently in coke-beds, which have been primed with bacteria by being placed for some weeks frequently in contact with sewage. The complete cycle of treatment in the London beds consists in filling the coke-bed, emptying it after a couple of hours, and then leaving its coke contents in contact with the interstitial air for another period of two hours. It has been found possible to repeat this cycle four times in twenty-four hours, and using beds six feet in depth to purify the settled sewage at the rate of two million gallons per acre per twenty-four hours. By this purification an effluent is obtained which is saturated with dissolved oxygen, which remains entirely inoffensive in smell for an indefinite period in an incubator at summer heat, and which, therefore, when discharged into a water-course would maintain the respiration of fish and would never render the water offensive.

Chemical examination shows that the treatment in the coke-bed has reduced the readily oxidisable dissolved matter in the settled sewage by from 60 to 70 per cent., and the whole oxidisable matter in the unsettled raw sewage by more than 90 per cent.

Bacteriological examination indicates that the effluent contains large numbers of bacteria; but the presence of these bacteria is useful in effecting inoffensively the removal of the organic substances, which still remain in the effluent, as soon as the effluent mingles with the well-aërated river water.

It is noteworthy that the sewage capacity of a newly-made coke-bed progressively decreases for a time, while its purifying power is being developed by contact with settled sewage. But the capacity ultimately becomes equal to about 30 per cent. of the whole cubic space which has been charged with coke; and, if the treatment is carried out regularly under proper supervision, this capacity fluctuates by only a few units per cent. above and below this final capacity throughout the period of many years during which the bed has as yet been worked.

The decrease of capacity to 30 per cent. is the so-called "choking" of the bed. It is due to a bacterial jelly-like growth of bacteria and zoogloœa upon the coke-surfaces. If this jelly is removed and exposed to air over mercury, it will rapidly absorb oxygen from the air, and will therefore produce a partial vacuum. It appears that this growth is actually charged with oxygen during the aëration or resting of the coke-beds between the chargings with sewage liquid. The growth upon the coke-surfaces, which reduces the capacity of the bed, appears, therefore, to be the essential element of successful purification.

It is noteworthy that the growth may be unduly developed, with corresponding decrease in the sewage capacity of the bed, by over-frequently filling the bed; and by resting the bed, or reducing the number of fillings, the growth may be diminished and the capacity of the bed correspondingly increased. A great increase in the development of the jelly involves increased purification, but reduction in the amount of sewage dealt with, and *vice versâ*. Accordingly a working rate which is most advantageous on all grounds must be arrived at by trial and experience.

Careful examination of the composition of the interstitial air, even at the bottom of a coke-bed thirteen feet in depth, proves that the air is not deficient in oxygen to an extent greater than 25 per cent. of that normally present in fresh air. It appears, therefore, that although oxygen is being rapidly absorbed during the resting or aëration of the bed, the oxygen which is absorbed is rapidly replaced by natural diffusion, and mechanical aëration of the bed is unnecessary.

It has been proved that the chemical refuse which is found in the sewage of manufacturing towns seldom exerts any prejudicial action on the action of the bacteria or upon the coke-beds. In some towns, however, a preliminary treatment of the sewage has been adopted in order to remove special chemical refuse when it is present in very large quantity. This is not the case either in London or in Manchester.

One hears occasionally of so-called failures in securing bacterial purification of sewage. It is not too much to say that such failures have been due to the improper construction or working of the bacteria beds. Apparently we have still to learn of want of success when an intelligent attempt has been made under competent and experienced direction.

Although the process of natural purification of sewage must eventually become general, its adoption will undoubtedly be delayed by the lack of knowledge on the part of the majority of our public bodies and even on the part of some of their advisers. Those who wish to see the satisfactory results of experimental inquiry usefully and advantageously applied on the large scale will accordingly welcome the appearance and success of such treatises as the one which has suggested the present review.

FRANK CLOWES.

FIFTY YEARS OF BIOLOGICAL STUDY IN AUSTRIA.

Botanik und Zoologie in Oesterreich in den Jahren 1850 *bis* 1900. *Festschrift v.d.K.K. Zoologisch-Botanischen Gesellschaft in Wien.* Pp. x+620; with 38 plates and 9 cuts. (Vienna: Alfred Holder, 1901.)

THIS magnificent work illustrates in every way the jubilee of the K.K. Zoological and Botanical Society of Vienna. Twenty-two authors have collabor-

ated in its production ; and its contents are as follows :—(A) A short preliminary history of the Society. (B) A descriptive history of the institutes and corporations dealing with zoology and botany, including horticulture and agriculture. (C) A history of botany in Austria during the fifty years, under the three headings of (*a*) phytogeography ; (*b*) morphology, ontogeny, and systematics of cryptogams ; (*c*) morphology, ontogeny, and systematics of phanerogams ; (*d*) anatomy and physiology of plants.

(D) A history of zoology in Austria during the last half-century : (1) morphology and systematics, including bionomics and zoogeography ; this enormous range is treated in monographs of unequal compass—Protozoa, Cœlenterata, Echinoderms and Worms are the subject of one, Tunicates and Molluscs of another, Molluscoids of a third, while the classes of Vertebrata and Arthropods, and the orders of insects among the latter, receive distinct consideration ; (2) a separate article deals with animal morphology and physiology.

A bibliography of the introductory discourses ("Wrogrammaufsätze") of the educational establishments closes the text. The plates are all well-executed lithographs of (deceased) workers at our sciences, and the cuts are for the most part full-page illustrations of biological institutions. Separate indexes of singular completeness are appended, and greatly enhance the value of the book as a work of reference. Unfortunately, in the nominal index no special reference is given to the pages on which the short biographical sketches are to be found, which, as in the case of Claus and Wiesner, for example, may rise to the dignity of scientific biographies.

Thus the work contains a singularly complete record of the work done in natural history in the Empire-Kingdom practically since its inception in the forties of the late century ; for previous to 1845 there existed only agricultural, horticultural and medical societies, which dealt incidentally with nature study. In that year a union of "Freunde der Naturwissenschaften" was founded in Vienna. A year later was the Vienna Academy of the Sciences founded, by the exertions of Prince Metternich, a name associated in other domains with reactionary obscurantism. The modest union formed by Haidinger, which met in the Botanic Gardens, worked quietly on, independently, through the troublous times of '48–'50 ; but in 1850 the primary intention of converting the occasional publication of *Mittheilungen* into a regular *Zeitschrift* developed into the formation of a Zoological and Botanical Society, leaving the geological sciences to the Reichsanstalt. George Frauenfeld, the zoologist, was the founder of the movement, and the first secretary of the Society, which attracted all workers at the study of organisms living and extinct. As in England at that time the biological sciences were largely cultivated by amateurs of the highest birth and rank, so did the young Austrian society gain aristocratic support from the beginning. The first president was Prince Richard zu Khevenhüller Metzch, the second Prince Colloredo Mannsfeld, and we read of the latter that "few were the board meetings from which his Serene Highness was absent." In a country where one-half the population is illiterate, we can understand that education in the highest sense must assume an aristocratic tinge, and the noble particle "von" recurs frequently among the workers whose names are cited. This much we gather from the short history of the Society, related by Dr. Brunner v. Wattenwyl.

In the histories of botany and zoology, those of phytogeography and zoogeography hold the first places. One of the first objects set before the Vienna society at its foundation was the study of the native organisms of the Fatherland, and many of the provincial bodies have devoted their chief energies to this pursuit. When the faunistic and floristic studies of Austrian travellers are added, we can but admire the wonderful and successful work of a country usually held to be rather behind the average advancement of Europe.

But to say this gives no adequate account of the activity of Austrian biologists. In botany, over against such systematists as Endlicher, Fenzl and Engler may be set Unger, the discoverer of cilia in the lower plants ; Ingen Housz, one of the fathers of plant physiology ; Wiesner and Leitzeb, the histologists and physiologists ; Kerner v. Marilaun, whose grasp of plant-bionomics was of the strongest and widest ; and Čelakowsky, with his unrivalled knowledge of the morphology of flowering plants and their "monstrosities."

When we turn to the history of zoology we find a similar catholic productivity. Unfortunately, the matter is much more scattered, as we have seen in our survey of the contents of the book. Austrian zoologists, indeed, occupy a commanding position : we need but note C. Claus, systematist and morphologist, whose epoch-making works on the Crustacea and brilliant studies on the Cœlenterates were perhaps second in importance to his stimulating powers as an exponent and teacher ; and v. Stein, who practically laid the foundations of our knowledge of the Flagellates. But in every section of zoology Austrians have distinguished themselves, and one of them, F. Eilhard Schulze, is the professor at Berlin.

If we ask ourselves the causes of the extraordinary scientific fertility of a union of countries numbering in all fewer inhabitants than Great Britain, and half of them illiterate for the greater part of the last half-century, the first that presents itself is probably provincial patriotism : each country is anxious that its own possessions shall be duly recognised ; and no one can doubt the efficiency of such a stimulus to the capable student of nature. But the desire is useless without the power to accomplish. We can only find this in the encouragement given to children in Central Europe in the study of systematic and descriptive natural history, and especially that of the local flora. This teaches system, careful observation, accurate detailed description and record—a combination of acquirements realised in none of the disciplines in our own school use. Such work may commend itself as essentially "heuristic" to our enthusiastic band of reformers of school programmes. Moreover, it *does not* involve the direct teaching of philosophical ideas, but recently acquired by the pioneers of science and unintelligible to the young mind, which is, on the other hand, trained not to shirk the irksome accumulation of facts : indeed, the results will depend largely on the work of the scholar himself, and not on his passive reception of the teacher's ideas.

Hæckel has, we know, spoken disparagingly enough of mere systematism, and compared it to "postagestampology" (the word "philately" had not then been invented). But we read in the dedication of the "Generelle Morphologie" to Gegenbauer how, as a boy of twelve, he had collected a herbarium of local plants with a set of intermediate forms between the "critical species," and already had been led thereby to doubt the orthodox view of the constancy of species; we know his masterly unravelling and grouping of the appalling wealth of forms in the Radiolaria. De Bary once said to the writer: "Without a good systematic knowledge to begin with, no botanist can tell where he is, nor what he is dealing with." Charles Darwin began as a collector, and monographed the Cirrhipedia, and Alfred Russel Wallace was a collecting naturalist. If we want to place ourselves on a par with Austrian and German biologists we must reform our teaching of botany on the common-sense lines followed so successfully abroad, and once introduced by Henslow into the primary teaching of his village school in East-Anglia. As a preliminary to the morphology and bionomics of our academic programmes, there must be laid a sound foundation in the knowledge of organic external form and variety. And so the scientific training of the individual will be pursued on lines corresponding to the acquirement of scientific knowledge by the race, a course which should, at least in this case, commend itself to all educational reformers. M. H.

GEOGRAPHICAL DISCOVERY.

L'Epoca delle grandi Scoperte geografiche. Di Carlo Errera. Con 21 carte, &c. Pp. xvi + 432 (text, 357). (Milano: Hoepli, 1901.) Price L.6.50.

THIS useful, brightly-written and well-illustrated summary of the geographical progress of Christendom, from the beginning of the Middle Ages, is divided into twelve parts, of which the first eight deal with the pre-Columbian time and the last four with the great age of discovery, from Columbus to Magellan. Among the twenty illustrations are four reproductions of early mediæval maps, from Miller and Beazley, one of Carignano's Portolano of 1300, one of Fra Mauro's map of 1459, one of a section of Juan de la Cosa's chart of 1500, one of the Strassburg Ptolemy of 1513, and one of the 1529 mappe-monde of Diego Ribero. Most of the latter are reproduced from Ruge's "Geschichte des Zeitalters der Entdeckungen." In its text the present work is also mainly based, for its later chapters, upon the same and other works of Ruge's, as well as upon Kretschmer's "Entdeckung Amerikas," Nordenskjöld's "Facsimile Atlas," Harrisse's "Christophe Colomb" and other studies, and Günther's "Zeitalter der Entdeckungen"; for its earlier upon Nordenskjöld's "Periplus," Hughes' "Storia della Geografia," Heyd's "Commerce du Levant," Uzielli and Amat's "Studi biografici . . . sulla Storia della Geografia," K. Miller's "Mappæmundi," Beazley's "Dawn of Modern Geography," Avezac's edition of, and introduction to, Carpini, Yule's Marco Polo, &c.

But although essentially a compilation from more extensive and specialised studies on the history of exploration, Prof. Errera's contribution to the "Collezione Storica Villari" has great merits. It describes with excellent lucidity, compression, and good sense the chief epochs in the great drama of European awakening to a fuller knowledge of the world. No attempt, indeed, is made to treat (except allusively) of Arab or Chinese exploration and geographical study; and it might be said that a somewhat fuller appreciation of the latter is almost indispensable for a complete understanding of the European advance to which Prof. Errera restricts himself. It might also be objected that a chapter on the exploration of the north (No. vii. "La Conoscenza del Settentrione"), including the description of the Scandinavian voyages to Iceland, Greenland and Vinland, should precede, and not follow, chapters (iv.–vi.) on the growing knowledge of Asia among Europeans during the thirteenth, fourteenth, and fifteenth centuries.

Once again, more attention might have been given to the career and first voyage (1497) of Giovanni Caboto; and, to instance a very small point, Konrad Miller's "Ebstorfkarte" is not separate from his "Mappæmundi: Die ältesten Weltkarten," but heft v. of the same. But little fault, as a whole, can be found with the way in which the author brings out, section by section, his epitome of what he defines, in his preface, as the "progressive extension of the knowledge of the superficies of our planet," down to the era of the first voyage round the world.

A special word of thanks is due to the excellent critical judgment with which the difficult voyages of the Zeni are handled—a subject hard enough in itself and doubly hard for a fellow-countryman of Nicolo and Antonio Zeno. Italians, perhaps, did more than any other people—more even than Scandinavians and Portuguese—for the advance of European trade and exploration, as well as for the perfecting of geographical science; from Antoninus of Placentia to Marco Polo and Ludovico Varthema, from Malocello and the Vivaldi to Columbus, Verrazano and the Cabots, from Flavio Gioja to Fra Mauro and Toscanelli, Italian travellers, merchants, and men of science bore a foremost share in the work of opening up the world. Among the early Portolani, the first true maps ever set forth, an overwhelming preponderance (413 out of 498) are Italian; and the whole of modern trade, with all the possibilities of civilising progress which it contains, might almost be called a discovery of Italian genius. Italian scholars of the present day may, therefore, be said to have a special claim upon the subject here discussed, as the subject has a special claim upon them; and although this *breve storia* has not the original value of Marinelli's remarkable study on the geography of the Dark Ages, it deserves a most cordial welcome.

OUR BOOK SHELF.

Die Tierwelt der Schweiz in ihren Beziehungen zur Eiszeit. Von Prof. Dr. F. Zschokke. Pp. 71. (Basel: B. Schwabe, 1901.) Price Mk. 1.20.

HERE in short compass we have set forth the relation of the flora and especially of the fauna of Switzerland to the Glacial period. Geologists have been wont to cite the occurrence of Arctic plants in the Alps and the mountains of middle Europe as strongly confirming their belief in the former prevalence of a glacial climate in what are now temperate latitudes. In his present work the author shows that, however cogent that evidence may be, it is in no degree stronger than that derived from a

study of the animal life, and more particularly of the water-life, of the Alpine lands. After briefly summarising the evidence supplied by the Arctic-Alpine plants, Prof. Zschokke refers to the former distribution of Arctic-Alpine vertebrates in the low grounds at the foot of the mountains, and gives a succinct account of the land-shells, butterflies and beetles met with in the higher Alps—many of which are true Arctic species. The major portion of his treatise, however, is devoted to the origin of the fauna of the Alpine lakes and streams. It would appear that many of the forms now flourishing in the ice-cold waters of the higher Alps hail from Arctic regions. Even in the large lakes at the foot of the mountains a glacial relict-fauna is encountered. Special reference is made to the Salmonidæ of these lakes, which are now cut off from the headquarters of their kind in the far north. They doubtless immigrated from the north during Glacial or early post-Glacial times, when such vast tracts of middle Europe were under water, or traversed by swollen rivers and great "canals," and when many of the Alpine lakes were in free communication. It is noteworthy that the Alps stopped migration further south, and that the fish in question do not occur in the Italian lakes. Eventually the limitation and interruption of water-communication with the north led to the trapping of the Salmonidæ in the great lakes. And now so long a time has elapsed since then that varieties and even new species have been developed. The fish can no longer migrate from lake to sea as their northern cousins do; but it is interesting to learn that at spawning time they still gather in shoals, as if they were about to set out on a journey. Perhaps this may be a remembrance of former conditions. Prof. Zschokke traces very graphically the changes in the life of the Alpine lands which ensued on the gradual disappearance of the extreme glacial climate. In the ice-cold waters of the higher Alps the Arctic types of life flourish at the surface, just as they do in the lakes and streams of Greenland. At the foot of the mountains, however, they are no longer met with at the surface, but have descended to the cold dark depths of the great lakes. As the mountains of middle Europe became at the close of the Glacial period "cities of refuge" to which the Arctic-Alpine flora retreated, so in like manner they have afforded shelter here and there to colonies of those Arctic forms of animal life which are still so abundant in the tarns and streams of the higher Alps, but have their headquarters in the ice-cold waters of the Arctic regions.

A Treatise on Elementary Statics for the Use of Schools and Colleges. By W. J. Dobbs, M.A. Pp. xi + 311. (London: A. and C. Black, 1901.) Price 7*s.* 6*d.*

THE author has already written an excellent book on geometrical statics, and it has been his present object to produce an elementary treatise which shall cover the well-trodden ground of the parallelogram of forces, moments and couples, centres of gravity, work, machines and friction, and at the same time shall develop the subject simultaneously from its geometrical and analytical aspect. It is sufficient to open the book almost anywhere to find evidence of originality in the treatment. Thus in the introduction the author does not leave his readers ignorant of the existence of non-rigid bodies (p. 7). Again, in dealing with the parallelogram of forces, he wisely eschews the fallacious so-called dynamical proof and gives an ingenious modification of Duchayla's proof, together with an experimental verification in which three strings stretched by spring balances, instead of being knotted together, are attached to a triangular string which forms a funicular triangle of the forces. This plan has the advantage of also showing that three forces in equilibrium meet at a point when produced. The proof of the formula for the resultant of two parallel forces is based on the "funicular" method—a change that will be most refreshing to examiners. Whenever a question is set in any examination, in which candidates are asked to find the resultant or centre of a number of parallel forces in such cases as that of a rod loaded at different points, where the answer comes out in a line by taking moments, pages and pages of work are usually sent up with the old familiar figure and proof for the resultant of *two* parallel forces: "(1) when the forces are like; (2) when the forces are unlike," and so on, finishing up with the lame conclusion that the resultant "may be found." The author's treatment of friction strikes us as a very sensible innovation, the laws of friction being based on a consideration of the angle of friction, and the coefficient of friction being defined as the tangent of this angle. There are a few points we do not altogether care about; for example, a crowbar problem on p. 119, where "perfect roughness" exists between the stone and the ground and between the crowbar and ground, and "perfect smoothness" between the sharp edge of the stone and the crowbar. In connection with such a problem, too, the author might do well in Chapter v. to say something about the direction of the reaction when an *edge* of one body rests against, but does not dig into, the surface of another. The book is copiously supplied with examples.

The Country Month by Month. By J. A. Owen and G. S. Boulger. New edition. Pp. viii + 492. (London: Duckworth and Co., 1902.) Price 6*s.* net.

THE best testimony to the appreciation of this work by the reading public is that it has reached a second edition—this being enlarged by the addition of notes written by the late Lord Lilford. Mrs. Owen, who, as editor of the delightful series of books bearing the signature "A Son of the Marshes," has had a large experience of works dealing with English country life, is responsible for the portion of the present volume treating of the habits of animals, while Prof. Boulger has written the botanical portion. The partnership may be said to have turned out in every way a success.

As the authors say in their preface, popular works on natural history absolutely swarm at the present day, but there is no other which gives in such detail the changing phases of animal and vegetable life throughout the twelve months of the calendar. It is, in fact, an expansion of Gilbert White's "Naturalists' Calendar," written in an interesting and attractive style and containing much information which should be of use to the working naturalist. In addition to the accounts of the habits of animals, there are many observations scattered through the book which, if not new, are at all events out of the common.

For instance, on p. 111 we find the remark that while the French commonly name birds from their notes, the English more generally call them after their appearance or habits. The observation (p. 418) that night-herons are increasing in number in Britain may perhaps be connected with the depopulation of country districts of which we hear so much nowadays. And Lord Lilford's note (p. 188) that frogs, small eels and young birds form the favourite food of the otter strikes us as entirely novel, since in Bell's "British Quadrupeds" we are told that "the otter lives exclusively on fish, when it can procure them." Nor do the authors confine their observations to wild animals, an interesting statement being made on p. 468 that the Angora rabbit (or at all events one individual thereof) sheds its coat entire. Misprints and other errors appear few and far between, although on p. 419 we notice "nob" standing in place of "knob." We may add that we fail to see the advantage of putting the date 1902 on a book which was in the reviewer's hands by the middle of November 1901.

To all lovers of the wild nature of our country this work should prove, not only acceptable, but invaluable.

R. L.

Strange Adventures in Dicky-Bird Land. By R. Kearton, F.Z.S. Pp. xiii + 195. Illustrated with photographs direct from Nature by Cherry Kearton. (London: Cassell and Co., Ltd.) Price 3*s.* 6*d.*

"Ugly," a Hospital Dog. With Recitations and Readings. By G. H. R. Dabbs, M.D. Pp. viii + 200. (London: C. W. Deacon and Co., 1901.) 1*s.*

Wonders in Monsterland. By E. D. Cuming. With illustrations by J. A. Shepherd. Pp. xii + 258. (London: George Allen, 1901.)

The Child's Pictorial Natural History. Part I. Pictured by C. M. Park. Pp. 24. (London: Society for Promoting Christian Knowledge, 1901.) 1*s.*

THE four books of which the titles are given above have been published at a time when people are finding suitable gift-books for Christmas presents to children who have an interest in natural history.

Mr. Kearton's volume is an attempt to express incidents in the lives of birds in an autobiographical form. The style of composition is inelegant in places, and it requires a good imagination to think of birds using such colloquialisms as: "It strikes me very forcibly we are in for more hard times," "Good old Bunny," "Guess what got her, and beware my up-to-date young friend," "Go for him, Mr. Missel Thrush." But perhaps this free and familiar form of expression will be appreciated by juvenile readers, who will certainly admire the excellent illustrations.

The first part of Dr. Dabbs's book is also in the autobiographical form, the narrator being a bull-dog who attaches himself to a hospital, and renders assistance to various members of the staff at different times. The second part of the book contains recitations and readings for odd hours.

"Wonders in Monsterland" is a nonsense-book in which the subjects are some extinct animals, disguised under such names as the Master Don, Dino Therium, Phee and Oh-don't-'op Teryx, Icky Ornis, Mackie Rodus and Ann Thropithecus. The narrative is very funny in places, and young people cannot fail to find enjoyment in reading it. The book could appropriately be described as a comic history of extinct monsters.

Popular characteristics of twelve wild animals of other countries, such as the tiger, elephant, wolf and giraffe, are described and illustrated in Mr. Park's book, with occasional Biblical references. A child might profitably read the book in connection with a visit to the Zoological Gardens.

What's What. A Guide for to-day to Life as it is and Things as they are. By Harry Quilter, M.A. Pp. xii + 1182. (London: Sonnenschein and Co., Ltd., 1902.) Price 6*s.* net.

THERE is an astonishing amount of information upon a variety of subjects in this book. The volume is, in fact, a kind of "Enquire Within for Everything," but with this difference—matters of fact are, perhaps, less frequent than matters of opinion. The introduction of this personal element imparts a lightness to the contents not usually possessed by books of reference, but after a while the reader comes to the conclusion that the editor might usefully have abridged his views and those of his contributors in order to increase the number of subjects described.

At present the book cannot be depended upon as a volume of reference; that is to say, words or terms which we expect to find in it are absent as often as not. Something is said about chemistry—not very instructive, it must be confessed—but nothing about physics; light occurs, but not the spectroscope; conservation of energy, but not conservation of matter; the moon, but not the sun; botany, but not zoology; the Hessian fly, but not the gipsy moth or Colorado beetle; hypnotism, but not hygiene; hydraulics, but not pneumatics; pathology, but not histology; geography, but not geology; equator, but not ecliptic; epilepsy, but not paralysis; and these are but a few examples of the inconsistencies of the book. In general, the information given is correct, but the following remarks upon the celestial equator form one of the exceptions to this statement:—"This does not always remain fixed, never passing exactly the same stars, but turning in 26,000 years a little nearer to the axis of the ecliptic. This causes the precession of the equinoxes, each of which occurs 20 minutes earlier in point of time than the last." A reader would be justified in speaking disrespectfully of the equator after trying to understand an explanation of this kind.

The Self-Educator in Botany. By R. S. Wishart, M.A. Pp. xiv+226. (London: Hodder and Stoughton, 1900.) Price 2*s.* 6*d.*

THIS book is ostensibly written to enable students to obtain a knowledge of botany without receiving personal supervision and instruction. Thus the author sets before himself an onerous task the difficulties of which he has quite failed to realise. Indeed, the book displays throughout the crudest knowledge of the subject, and this is set forth in a loose and disjointed fashion without any particular arrangement or continuity of argument. Even where a good exercise is given, or an instructive experiment described, as at p. 92, the full value is lost through inadequate explanation or incomplete description. The aim of the writer to provide practical scientific knowledge in a logical manner has certainly not been attained; rather it is to be feared that the student who should work through the book will even then find that he does not know much, and most assuredly he will not know accurately.

Bastarde zwischen Maisrassen mit besondere Berücksichtigung der Xenien. By Prof. C. Correns. Bibliotheca Botanica. Pp. 53. (Stuttgart: E. Nägele, 1901.)

XENIA is the name given to the results of the crossing of the plant by a foreign pollen, exhibited in some peculiarity which appears in the seed itself, and does not —as would be the case in a hybrid—remain in abeyance until the plant which the seed produces has grown up.

Thus if a certain race of maize which produces yellow-skinned grains is crossed with pollen from a race which has violet-skinned grains, it is found that the resulting seed in many cases will be violet. It has also been discovered that this is because the potency of the pollen of the violet-skinned race makes itself effective, by means of one of the pollen nuclei, on the endosperm, and the latter acquires a violet outer layer in place of its accustomed yellowish one. In other cases of xenia other characters of the pollen-yielding parent make themselves effective on the embryo-sac—*e.g.* sugary in place of starchy cell-contents.

In the paper under review Prof. Correns has undertaken—and, be it remarked, has very successfully carried out—a large number of experiments on hybrids and xenia of maize, the results of which are set forth in great detail and illustrated by two plates of brilliantly coloured figures.

A Country Reader for Use in Village Schools. By H. B. M. Buchanan, B.A. Pp. vii+248. (London: Macmillan and Co., Ltd., 1901.) Price 1*s.* 6*d.*

COMMON domestic and wild animals are described in this book in a simple and instructive style, capable of being understood by the elder children in village schools, and by adults who are only familiar with words of every-day life in the country. The book will impart to those who read it an intelligent knowledge of animal life in and around a farm. The illustrations, mostly reproduced from photographs, are very fine.

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.*]

Histrionic Capacity of Grey Parrots.

THE capacity of the grey parrot for repeating words and sentences of human language and for imitating the cries and sounds made by other animals, both beasts and birds, is well known. The remarkable aptitude which this parrot shows for "saying the right thing at the right time" is also, I believe, well known to those who have been familiar with intelligent specimens of the bird. But I was not, until recently, aware that the bird can be not only an excellent mimic but also a good actor; and it is possible that some of your readers may be able to give other instances of what I now propose, with your permission, to relate.

My daughter had a very clever young grey parrot, which, unfortunately, died on the first of this month, after a severe illness of three weeks' duration. He was brought to my daughter straight from the nest in Africa, and had he lived another month would have been about two years old. He was a singularly clever bird, and of a charming disposition to his friends, though very shy and inclined to be hostile to strangers. He was an exceptionally good talker for his age, and showed remarkable intelligence in fitting his sayings to the occasion. He was very fond both of fruit and sugar, but I never knew him ask for sugar at dinner or for apple at breakfast. For nuts, which were kept in a cupboard in the room, he would ask at any time; and in many similar ways he showed a vivid association between the words and the things represented by them.

But the remarkable, and to me novel, power which he displayed at so young an age was that of acting. He played with a bit of wood exactly as a clever little girl plays with her doll. For example, he would take the wood in his claw and would say to it, imitating the voice and gestures of my daughter or of one of the servants, "What! are you going to bite me? How dare you? I will take the stick to you!" Then he would shake his head at the wood and say, "I am ashamed of you! Whom did you bite? Go on your perch!" Then he would take the wood to the bottom of his cage, and putting it down on the floor would hit it with his claw several times, saying, "Naughty! I'll cover you up, I will!" Then he would step back from it one or two paces, put his head on one side and say, as he looked at it, "Are you good now?"

No attempt was ever made, deliberately, to teach him this or any other of his histrionic performances. He picked them up spontaneously from his own observation and memory.

It would interest me much to know whether this capacity for acting is often found in grey parrots. D. R. FEARON.

The Athenæum, Pall Mall, S.W.

Use of the Arms in Locomotion.

I CANNOT help feeling a special interest in the two letters appearing at pages 80 and 102 of NATURE. Let anyone stand on a table and jump down, he will find that he throws up the arms to lighten the fall. Let him go quickly up or down stairs and see what use he will then make of his arms.

When I was a small boy, brought up in the country, the motions of the body indicated in these letters were natural ones to me and my brothers and sister. But as I got older I went to school, and at twelve years of age had to join a cadet corps.

Then were the natural movements drilled out of me; the body had always to be square to the front, the arms motionless by the sides. We were exercised on the flat, and one regulation quick step was practised, having one length of pace, one of time and one in stiffness.

At seventeen I went to the Royal Military College at Sandhurst, where the same system was continued, but varied, I was thankful to find, by an excellent gymnastic training.

At eighteen I became an officer and remained as such for ten years, when I retired. During the last four or five years of my service I was adjutant of my regiment and *taught* the system I have described. The British Army was indeed *smart*, it was beautiful to look at, we rejoiced in it, we were proud of ourselves.

Since my retirement in 1878 soldiers are allowed to swing the arms when marching and it is said that since the war in South Africa there are to be many *real* reforms. I shall believe in them when I see them.

At fifty-two years of age I find that in my daily walks or mountain excursions, when I am walking (1) on the flat, (2) uphill, or (3) downhill, then (1) the length of pace, (2) the time of each pace and (3) the attitude and movements of the whole body must differ in each case, so as to ensure the best work with the least possible fatigue, the least risk of falling, overstrain or other mishap. There is an art in the performance of what may seem to some the simplest actions of our lives, and it is surprising what a man can do in climbing the hillside if he knows the right way to set about it.

The British soldier is not properly taught how to march, and the war has abundantly shown that most of his drill is worse than useless.

In building a house it is usual to commence with a good foundation and finish with the roof. But what I read in the newspapers on *officially proposed* Army reform is indeed painful to me. I am a practical man and can assure you that if the British taxpayer is going to be satisfied with the creation of Army boards and Army corps, and a far too large and costly staff—the roof of the Army—and does not see to a solid foundation in a greatly improved training of the individual soldier by the *officers immediately over him—i.e.* company officers, who should be properly paid for their work—and not adjutants and sergeant-majors, he might just as well throw the millions he will be asked to expend into the Atlantic Ocean.

This is not usually the place for the discussion of Army matters, and I must stop here, hoping you will consider that what I have said fairly arises from the lead that has been given me.

But I hope I may urge in conclusion that the arms should be worked habitually by all people, solders and civilians, men and women. Medical men now recognise that in these days of civilisation the leisured classes use the lower limbs far more than the upper ones and that the true way to cure many cases of weak heart, lungs or digestion is to daily exercise the muscles of the arms, shoulders and chest, the healthy action thus set up strengthening the internal organs of the body. Serious cases of nervous disorder and brain trouble can often be successfully combated with a judicious exercise of the arms under skilled advice.

The gist of the whole matter is this. Our lives have become too fictitious; we should go to the teachings of *Nature* and endeavour to be *natural*. GILES A. DAUBENY.

Las Colondalles, Montreux, Switzerland, December 8.

The Value of the Horns in Bighorn Wild Sheep as Ear-trumpets.

IN the case of spiral-horned *domestic* sheep, as observed chiefly in the Alps, the ear is as large as is usual in sheep, and the horn (which grows homonymously, *i e.* the right horn has a right spiral direction and the left a left) curls round the ear in such a fashion that the ear caged in the open spiral is confined to certain limits by the curves of the horn and lies in the long axis of the open spiral of the horn, from which it only now and then escapes by accident.

An extraordinary difference is seen in the wild sheep, especially to be noted in *Ovis nivicola* (for a figure and description *vide* p. 214, vol. i., Guillemard's "Voyage of the *Marchesa*"). The horns in this creature are enormous, but the ear is remarkably short, though still situated exactly in the axis of the spiral and in such a fashion that the ear appears to be at the apex of a hollow cone formed by the great spiral horn. A similar condition and relation of ear to horn is found in *Ovis montana*, the Siberian argali, and others. The form of the horn and the position of the ear enables the wild sheep to determine the direction of sounds when there is a mist or fog, the horn acting like an Admiralty megaphone when used as an ear-trumpet, or like the topophone (a double ear-trumpet, the bells of which open opposite ways) used for a fog-bound ship on British-American vessels to determine the direction of sound signals.

By taking a horn off the skull the listening ear, if properly placed, can distinguish the tick of a watch in one position best in the axis of the coil, and thus test the value of the horn for determining the direction of sounds—though no evidence of improved hearing for distance could be discovered by any such simple experiment. The functions suggested would be especially of advantage to wild sheep when feeding on mountains in mist and fog in making them more wary and difficult of approach.

Cambridge, December 7. GEORGE WHERRY.

The Influence of Temperature on the Action of Nitric Acid on Metals.

THE following simple but striking experiments illustrating the influence of temperature upon the action of nitric acid on metals may possibly be of interest to those who are engaged in the teaching of chemistry.

If three tubes containing strong nitric acid are cooled below −10° C. by means of a freezing mixture of snow or pounded ice with salt, and then copper turnings added to one, granulated zinc to another and magnesium ribbon to the third, it will be found that no action takes place, the nitric acid being practically inert at this temperature. If the tubes are then exposed to air at about 22° C. so that the temperature rises slowly, it will be found that little or no action occurs until a certain temperature is reached, when a sudden and violent ebullition of brown fumes occurs, the metal rapidly dissolving and the temperature abruptly rising from 80° C. to as much as 104° C.

The critical point for this violent action lies in the case of zinc between 0° C. and 2° C., in that of magnesium between 17° C. and 19° C., and in that of copper between 19° and 21° C. Before these temperatures are reached very feeble action may occur and a few bubbles of gas be disengaged, especially in the case of the zinc. These bubbles consist partly of hydrogen gas, and if magnesium is added to cold dilute ($\frac{1}{6}$–$\frac{1}{8}$) nitric acid an active evolution of nearly pure hydrogen takes place at first, although as the solution becomes warm and the percentage of magnesium nitrate increases, the production of hydrogen rapidly diminishes. This is in somewhat striking contrast to the common statement in chemical text-books to the effect that in no circumstances can hydrogen be obtained by the action of nitric acid on metals.

ALFRED J. EWART.

Meteorological Work for Science Schools.

IT has often occurred to me that the collection of data, such as those necessary for the investigation of fog distribution, might well be entrusted to the science schools over which the Technical Education Board of the London County Council exercise control.

There is, in such a research, that element of originality which is needed in the work of our school laboratories.

For interpretation the collected data may afterwards be distributed to the schools engaged in the work.

I foresee only the difficulty due to the intervention of vacations.

J. V. H. COATES.

41, East Dulwich Grove, S.E., November 25.

[We have referred the foregoing letter to the Secretary to the Meteorological Council, who has been good enough to send the following remarks upon it.—Editor, NATURE.]

THE primary difficulty in the way of using science schools, as suggested by Mr. J. V. H. Coates, for the immediate purposes of such an inquiry as that of the distribution of fogs is that the schools have fixed hours of attendance to which the fogs pay no heed. To carry out such an investigation effectively the twenty-four hours must be taken into account. Of course the inquiry might be restricted to those fogs which begin or end within the hours of attendance, but that would be a very serious limitation. As confirmatory evidence, careful observations within school hours might be very useful. The necessity for securing a suitable uniformity among observers as regards the terms employed in the estimation of fogs makes it necessary, however, to proceed with caution in extending the number of separate observers.

The kind of cooperative investigation which is appropriate for organised science schools is one which can be dealt with primarily by observations at fixed hours. On special occasions it might doubtless be pursued beyond those hours in following up some definite point. Several inquiries of this nature may be suggested. For example, in relation to the fog inquiry, it is desirable to know something of the effect of wet ground during rapid falls of temperature. For this purpose an investigation of the temperature of wet soil or sand suitably exposed and its relation to the temperature of the air would be a very useful adjunct to the ordinary meteorological data. It is a part of the inquiry more suitable for science schools than for routine observation, because the conditions of exposure require examination and consideration as well as the readings of the thermometers. The hours of non-attendance could be bridged by registering minimum instruments or, in some enterprising schools, by self-recording instruments, the development and investigation of which would be in themselves a useful study.

Another line of cooperative inquiry, of much greater difficulty, suggested to me in various forms by several scientific friends, has reference to the large amount of fuel consumed daily within the London area. The combustion must of necessity raise the temperature of the air in or over London above that of its surroundings. The raised temperature should give rise on calm days to a diminished pressure and an inflowing air current. Ordinary meteorological observations are not of a sufficiently high order of accuracy to exhibit these effects, but by cooperative, and in the best sense competitive, effort between science schools in different parts of the metropolis progressive steps could be reached which might ultimately have the very satisfactory result of exhibiting quantitatively the effects of the local heating. If this ultimate purpose should not be achieved, the light thrown upon the practicable limits of observation would not be without interest.

Then, again, the chemical composition of air at different points during foggy days would be a useful inquiry. Probably the results obtained at the first attempt would not be accepted as final, but the discussion of the results from different centres would lead to more accurate determinations and ultimately to definite information of substantial value. Incidentally, such cooperative inquiries would be of very great educational influence and advantage. Supposing, for example, that it were decided to make observations of any rapidly varying element at a definite point of time, the mere carrying out of the comparison of the time-keepers at the different schools would be most instructive. The comparison of their length-standards with a view to accurate barometric measurement might be beyond the reach of available apparatus, but even the demonstration by appeal to experience that the best comparisons that could be effected with the apparatus at command, left a margin of inaccuracy of a certain defined magnitude would be sufficiently instructive to make the experiment worth trying.

W. N. SHAW.

November 30.

The Date of Stonehenge.

THE remarkable paper on Stonehenge, by Sir N. Lockyer and Mr. Penrose, in NATURE of November 21 has greatly interested me. Just two years ago I was working at the subject, and wrote to Prof. Petrie to inquire what azimuth he had used for the axis of the temple in his estimate of the date, which he gives as 730 A.D. ± 200 years, with a possible date of 400 A.D. As I received no reply I employed the angle 50° 12′ E. of N., given in Mr. Edgar Barclay's "Stonehenge," 1895. With this azimuth I obtained by means of a formula, kindly supplied by Dr. Downing, F.R.S., a date of 425 A.D. I find that, for the given azimuth, even this date is too early, as I did not allow enough for refraction, &c. Applying the same formula to the figures given in Sir N. Lockyer's paper, the date comes out about 1700 B.C., as stated, so that the formula was correct, and the chief error was in the erroneous azimuth of the axis, which differs by about 38′ from the 49° 34′ 18″ so carefully determined in the published paper. Now as an increase of some 90″ in sunrise azimuth at the solstice means a decrease of some 46″ in declination and represents the lapse of about a century, the discrepancy is clearly explained. Allowing for refraction, &c., I make the present azimuth of the sun at sunrise at the solstice about 50° 26′ 21″ E. of N., the sun's declination being 23° 27′ 8″ N. Consequently since the date, 1700 B.C., the solstitial sunrise azimuth has shifted 52′ 3″ further E. and the declination has decreased 27′ 22″, representing a lapse of about 3600 years, when the appropriate formula is applied.

At the distance (250 feet) of the Friar's Heel, or Sun-stone, from the centre of the ruin, a change in azimuth of 52′ would shift a point on the axis only 3 feet 9 inches, and, as the avenue is 50 feet wide, some idea may be formed of the necessary delicacy of the measurements. The azimuthal shift of the sun himself is less than two diameters. It seems to me very improbable that any estimate of the date closer than that arrived at by Sir N. Lockyer and Mr. Penrose can be made on astronomical grounds. Recent excavations have given valuable information, but much more yet remains to be done in this direction. I may add that an exhaustive study of the "Blue-stones" (igneous rocks foreign to the locality) by the methods of modern petrology may lead to

some definite knowledge of their origin and so throw fresh light on the whole problem. C. T. WHITMELL.

Leeds, November 23.

P.S.—For sunrise (in accordance with p. 57) I take the tip of the visible sun to be 2′ above the local horizon.

Change of Pitch in certain Sounds with Distance.

SEVERAL years ago the late Prebendary Simpson, of Fittleworth, Sussex, told me of an interesting observation he had made, which some of your readers may be able to explain. While walking up and down the platform of a railway station, he noticed a peculiarity in the sound of a steam jet from an engine standing on the lines. The pitch of the sound appeared to rise as he retreated from the engine and to fall as he drew near to it. Some time after, Mr. Simpson observed the same thing again, but in this instance the noise was made by a gas flare in the open air, about which some men were at work. Since then I have found that this alteration of pitch with distance occurs with any fizzing noise of the kind, such as that of air jets, burning logs, frying fat, pouring rice or coffee beans, waterfalls, or even the rustling leaves of a single tree; with all those noises, in fact, whose sources are sufficiently localised to admit of observations of the kind being made. I found, also, on withdrawing from such a source that a point is reached after which the pitch ceases to rise, and remains practically stationary as far onward as the sound continues audible. This point is sometimes pretty definitely marked, and varies in distance from the source with different sounds, and the pitch of the stationary portion also varies in the same way. I do not think, however, that the pitch of the whole volume of sound changes, though it often appears to do so, for a similar impression is created by moving a fizzing air jet to and fro close to a wall. As it nears the wall, the whole sound seems gradually to rise in pitch and to sink again as the jet is withdrawn. But here the effect is clearly due to successive reinforcement of one part of the noise after another in the order of their wave-lengths. It is only a shifting of the point of greatest intensity, and not an actual change of pitch at all. Assuming, then, that the effect noticed by Mr. Simpson is of the same nature, that is to say, caused by a readjustment of the relative intensity of the parts, how is it to be accounted for? Is it simply a process of *sifting* by distance, the weaker groups of small noises, of which the fizzing sound is composed, dropping out of earshot in succession, as the observer retires from the source, till only the largest and loudest group is left, which last continues to be heard for the remainder of the distance without sensible change of pitch? If that is so, then the deeper tones of such noises would seem to have a proportionally shorter range of audibility than the higher ones; for, so far as I have observed, the pitch always sinks on approach to the source and rises on withdrawal from it, never the reverse way, as might be expected in the case of very bass roaring sounds. Perhaps, however, others may have noticed instances of the latter sort. The behaviour of the air-jet fizz at the wall illustrates a kind of reciprocal action, which no doubt plays an important part in the adjustment of the pitch. The tone which is loudest for the moment appears to dominate and obscure the rest, so that, near the source, where the deeper tones are most powerful, these latter, to some extent, subdue and lower the principal one, while further off, where they become enfeebled by distance, they are in their turn still more diminished by the presence of the principal far-reaching tone.

Downshire Square, Reading. FREDERICK M. WEST.

Pine Grosbeak in Berkshire.

IS it not of rare occurrence that a pine grosbeak (*Pyrrhula enucleator*) has been seen here, not on one day, but on two? I was informed this morning that Mr. O. T. Perkins had seen this handsome bird out of his window, apparently either eating beech buds or else hunting for insects on them. During this the bird was attacked by three sparrows, who began making a great noise and eventually drove him off. This morning I saw the same grosbeak, or another one, in a like manner feeding on beech. And what is more strange he was again attacked by sparrows and had to beat a hasty retreat. I may add that the bird, to all appearances, was in excellent condition, its plumage being brilliant. I wonder if any other of your readers have noticed any of these handsome but rare birds? C. M. ROGERS.

Blucher, Wellington College, Berks.

THE "ARMORL" ELECTRO-CAPILLARY RELAY.

WE commented in our notes columns a short time ago upon the announcement that a new system of wireless telegraphy had been worked out by Messrs. Orling and Armstrong. From what could be gathered from the information at that time available we judged that the method made use of earth conduction; we have since learned that this is the case and that the inventors rely upon the novel design of their transmitting and receiving apparatus for the efficiency of their results. We have had an opportunity of inspecting drawings of the receiving apparatus, and are enabled to give a description of it, though we have not seen the actual apparatus itself, but only a working model. We understand that it is proposed to read a paper shortly on the transmitter before one of the scientific societies and that in consequence it is not desired to publish the details of its construction as yet. It is to be hoped that

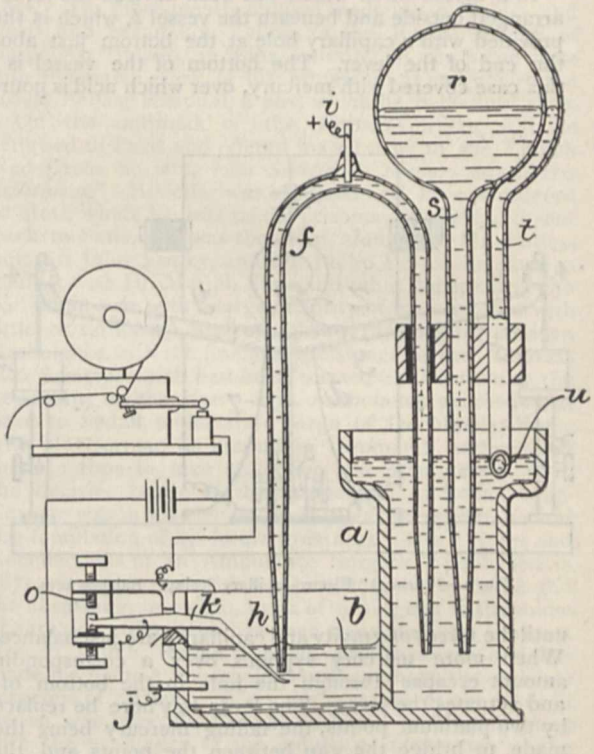

FIG. 1.—"Armorl" Electro-capillary Relay. Syphon form.

at the same time an account will be given of the experimental results obtained, with trustworthy data from which the probable value of the invention may be gauged, for as yet there is nothing to go upon but the statements of the inventors.

In the meantime we must content ourselves with giving a description of the receiver, which is of interest independently of its use with the Orling-Armstrong or any other wireless telegraph, as it could be used for the detection of any sort of electrical current. The instrument consists essentially of a capillary electrometer which is arranged so that it can actuate a relay. The extreme sensitiveness of the capillary electrometer for very small currents and low electromotive forces is well known, and the instrument is used considerably, especially for physiological work. The arrangement adopted in the present instance is shown in Fig. 1. A syphon, *f*, is

filled with mercury, one limb dipping into a vessel of mercury, *a*, and the other into a bath of dilute acid, *b*, the level of the mercury being considerably higher than that of the acid. The mercury is prevented from syphoning over by drawing out the end, *h*, of the syphon into a capillary tube. A contact is sealed into the top of the syphon at *i* and a second contact is made to the acid at *j*. When a difference of potential is set up between *i* and *j* in such a direction that *i* is positive to *j*, the capillary forces are overcome and the mercury syphons over; in so doing the mercury as it flows out of *h* falls on to a delicately balanced lever, *k*, which is thereby tilted and makes contact with a stop, *o*, thus closing a local relay circuit. The level of the mercury in *a* is maintained constant by means of the arrangement shown to the right of the syphon; a reservoir, *s*, is partly filled with mercury, which is held up by keeping a partial vacuum in *r*; when the level in *a* sinks the end, *u*, of the side tube, *t*, is opened, thus allowing a certain amount of air to enter and causing mercury to flow out until it again closes the aperture.

In a modification which has been devised the lever is arranged outside and beneath the vessel *b*, which is then provided with a capillary hole at the bottom just above the end of the lever. The bottom of the vessel is in this case covered with mercury, over which acid is poured

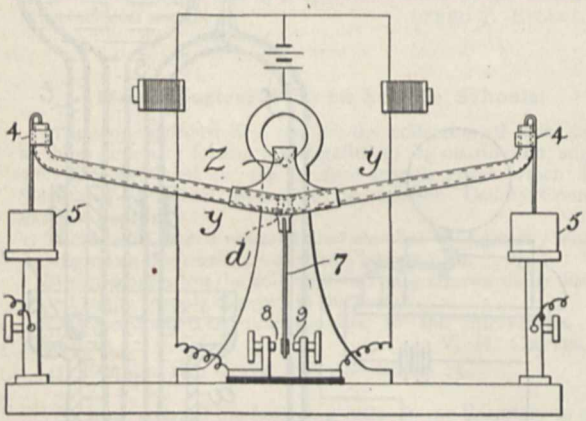

FIG. 2.—"Armorl" Electro-capillary Relay. Balance form.

until the forces of gravity and capillarity are just balanced. When more mercury syphons over a corresponding amount escapes through the hole in the bottom of *b* and actuates the lever. The lever may here be replaced by two platinum points, the falling mercury being then made to bridge the gap between the points and thus complete the relay circuit.

An alternative form of the apparatus is shown in Fig. 2. A glass tube, *y*, is balanced on a knife edge, *z*, and is filled with mercury except for a drop of acid in the centre at *d*. The current is led into this tube through metal rods, 4, 4, dipping into mercury cups, 5, 5. If a current is passed through the tube the meniscus between the mercury and acid is displaced in the direction of the current and the balance is consequently disturbed, as one arm now contains more mercury than the other; the pointer, 7, is deflected and makes contact with either the stop 8 or 9 and thus closes the local circuit. The construction is, however, said not to be so satisfactory as that shown in Fig. 1. It is claimed that the apparatus is extremely sensitive and very trustworthy in its action, and even that it could be used as a substitute for the coherer in ætheric telegraphy or the syphon recorder in cable work; but these claims remain to be established in practice.

THE OASIS OF KHARGA.[1]

DURING the last few years the Survey Department of the Public Works Ministry of Egypt has shown considerable activity in the prosecution of investigations connected with the geological survey of the valley of the Nile, and the publications which it issues from time to time show that the results which it obtains from them are of great interest and importance. Until comparatively recently the conclusions formed about the stratification of Egypt and its past geological history were based upon researches which were undertaken without sufficient preparation, often indeed without sufficient knowledge on the part of those who made them, and the statements made on the subject were often confusing and sometimes contradictory. Under the direction of Sir W. Garstin, however, things have taken a turn for the better, and the geological publications prepared with his sanction and approval really help to put our knowledge of the geology of Egypt upon a sure base.

The publication before us, by Mr. John Ball, is interesting from every point of view and reflects great credit upon the department to which he belongs. There is much in it, of course, which will appeal only to the engineer and geologist who are concerned with the practical administration of the district of the Oasis of which it treats, but there is also much which will claim the careful attention of the archæologist and antiquary. The work is divided into four chapters, which treat of the surveying methods employed and their general results, of the roads between the Nile Valley and the Kharga Oasis, and of the topography and geology of the Oasis; besides these we have an introductory chapter, five appendices, nineteen maps and plates, and sixteen illustrations. The book is satisfactory because it tells us, not only what are the results which have been obtained, but also *how* they have been arrived at, and the plans, maps, and illustrations enable the reader to follow these results with ease.

The Oasis of Kharga has been a source of wonder to untold generations of men, and the curiosity of all cultivated students has been roused more and more as each traveller has returned from it and unfolded in his written descriptions of the place stories of its people and antiquities. Concerning the origin of the Oasis experts are in doubt, but Mr. Ball thinks that its whole area has undergone disturbance which has resulted in folding and faulting; and since the faults affect the highest rocks on the plateaux, it is clear that they took place since the deposition of all the strata which are now found in the Oasis, the calcareous tufa, of course, excepted. The date of the folding and faulting cannot be fixed precisely; all that can be said from the examination of the Oasis itself is that it took place since Lower Eocene times. It is possible that it may be connected with some younger faulting seen in the Nile Valley at the First Cataract, but we have as yet insufficient information for a definite connection of this faulting with the folding of the strata in the Oases. The faulting produced much cleaving and crushing of the rocks, but we have to find out what was the particular agency which excavated and carried away the cracked-up limestones, and to account for disintegration and removal of hundreds of cubic miles of limestone rock, some of it being of considerable hardness. It is probable that the excavation was begun by the action of water, and that after this ceased, owing to a total change in the climatic conditions, *i.e.*, the change from a moist climate to a dry one in Egypt, the work was continued and is still going on by the agency of wind and sand. The superficial erosion both of the Oasis and of the hills within and round about it is due to wind-borne sand, but this has never been realised by travellers, for they have usually visited

[1] "Kharga Oasis; its Topography and Geology." By J. Ball. (Cairo, 1900.) Pp. 82.

the Oasis in the calm winter and spring months. Even at the present day the Oasis is enlarging its boundary, and the surface of the plateau is being ground away by sand, and the underlying clays on the faces of the scarps are being steadily excavated. The water in the Oasis is derived from the rainfall of the highlands in the interior of Africa, which, coming by way of the permeable underground strata, appears where these strata rise to the surface or are pierced by wells, though strangely enough the wells are chiefly on the down-throw side of the fault, *i.e.* to the eastward of it.

The history of the Oasis of Kharga in its relation to Egyptian history is full of interest in every way. That it was well known to the Egyptians under the Early Empire is tolerably certain, for from the inscription of the officer Una who made expeditions into the deserts of Libya and the Sûdân we know that the tribes of the districts in the neighbourhood of it were in the habit of waging war against each other. Under the eighteenth dynasty the Oasis of the North and the Oasis of the South were subject to the great kings Thothmes III. and Amenhetep III., and there is no doubt that a considerable trade between them and Egypt was in existence in still earlier times. Every now and then the tribes revolted against the rule of Egypt, but their triumph was short-lived, for Egyptian soldiers appeared and the rebellion was stamped out in a peculiarly firm manner, and the trees were cut down and the gardens destroyed. In the twenty-second dynasty the Oases were still reckoned as a part of Egypt, and under the Persians Kharga was chosen by Darius I. as the site of the fine temple which he built there; this temple was finished by Darius II., and must have been, judging by its present remains, a striking and a remarkable object. It is curious to note that the Egyptians at one time believed that the souls of the dead made their way to the Oases, and it is obvious that the green fields and gardens full of vines and palm trees easily connected themselves in their minds with the Elysian Fields, wherein every Egyptian hoped eventually to live. Before the end of the twenty-sixth dynasty Kharga was used as a place of banishment for criminals and evil doers, and the Romans found it necessary to maintain a garrison at Hibis, the chief city of the Oasis, to keep order. Christianity was introduced into the Oasis by one of the Apostles, who is said to have died and been buried there, and when Nestorius was banished there A.D. 435 he found flourishing Christian communities at several places in the Oasis who would, no doubt, accord him a far from hearty welcome.

Mr. Ball has consulted the works of travellers such as Cailliaud and Hoskins, Rohlfs and Brugsch, and although he has little new to say about the temples and other buildings which they described, his notes on the temples of Hibis, Nadura, Kasr al-Guehda, Kasr Zaiyân, Kasr Dûsh, or Kysis, are most useful, especially as they are accompanied by clear plans. His remarks on the Christian antiquities are somewhat meagre, but then he is an engineer and not an archæologist. In the next edition of his work the paragraph on p. 78 in which he states that the Christian tombs are those of the followers of Nestorius should be modified, for we know on the authority of Christian tradition and writings that there were several congregations of Christians in the Oasis of Kharga one or two centuries before the time of Nestorius, and it is evident that they must have left graves behind them. The tombs may then as well belong to the third and fourth as to the fifth and sixth centuries; and seeing that Nestorius was a violent opponent of the Monophysites in Egypt, it is more than doubtful if he had any followers at all among the Jacobite Christians of Kharga. But these considerations in no way affect the value of Mr. Ball's engineering work, though they do show that an engineer is not also necessarily an archæologist.

SIR WILLIAM MACCORMAC, BART., K.C.B., K.C.V.O.

SIR WILLIAM MACCORMAC, whose death occurred suddenly and unexpectedly on the morning of December 4 at Bath, where he had gone for treatment of an illness which his intimate friends, although feeling considerable anxiety on his behalf, little thought would end so tragically, was one of the most prominent figures in the medical profession in London. He was the son of a well-known Belfast physician, Dr. Henry MacCormac, the author of such philosophical works as "The Philosophy of Human Nature," published in 1837, and "Aspirations from the Inner Life," in 1860, as well as of works on the nature, treatment and prevention of consumption, which attracted much attention at the time and have come again into notice recently as having anticipated the modern doctrine of the open-air treatment of tubercular disease. Sir William MacCormac was born in Belfast on January 17, 1836; he was educated in his native city and graduated as M.A. of the Queen's University of Ireland in 1858. He subsequently studied medicine in Dublin and Paris and became a Fellow of the Royal College of Surgeons, Ireland, in 1864, entering at the same time into the active work of his profession as surgeon to the Royal Belfast Hospital, a post which he held until 1870.

On the outbreak of the Franco-German war he returned to Paris and offered his services to the French Red Cross Society, "*La Société de Secours aux blessés militaires.*" His offer was accepted and he was ordered to Metz, where he was taken prisoner, released and sent back to Paris. It was then that, along with Mr. Furley, now Sir John Furley, and Dr. Philip Frank, he came in contact with Dr. Marion Sims and other Americans (who had come over with a large quantity of material, but with little or no funds), and established the Anglo-American Ambulance with the financial assistance of the National Aid Society, which had been formed in London at the beginning of the war. The Ambulance proceeded at once to Sedan under the charge of Dr. Marion Sims, with MacCormac as second in command, and arrived there in time to take an active and prominent part in the decisive battle of the campaign. At Sedan MacCormac was in his element, and it was there that he laid the foundation of his future greatness. His "Notes and Recollections of an Ambulance Surgeon," published in 1871, vividly described his experiences of the battle and the absorbing, incessant work of a surgeon in the midst of carnage. The book has been translated into German, French, Dutch, Italian, Russian and Japanese, and has made his name a household word amongst the military surgeons of Europe. When the pressure of the work in Sedan was over MacCormac returned to England, and with the assistance of the influential committee of the National Aid Society was appointed to the staff of St. Thomas's Hospital, which had just been opened. He took the Fellowship of the Royal College of Surgeons, England, at the same time, and remained associated with St. Thomas's in the varying capacities of assistant surgeon, surgeon and lecturer on surgery in the medical school, and consulting surgeon and Emeritus lecturer on clinical surgery. He also held many other consulting appointments in London and was examiner in connection with the naval and military medical services.

His reputation as an authority on gunshot wounds was not allowed to lapse for want of opportunity. In 1876 he accompanied the late Lord Wantage, then Colonel Loyd-Lindsay, to Alexinatz during the war between Servia and Turkey. His period of stay at the seat of war was, however, brief, as he and his companion were obliged to take flight with the retreating army. In 1899 he was appointed a consulting surgeon to the field force in South Africa, and saw much of the results of the earlier and fiercer struggles of the war.

The European fame of Sir William MacCormac as a British surgeon almost equals that of Lord Lister. Honours were showered upon him by the Governments and learned societies of foreign States, and his friends included some of the most famous continental surgeons of modern times. Stromeyer, Esmarch, Langenbeck, Coler, Billroth, Mundy, Larrey, Pozzi and many others knew and admired his work and valued his friendship, while his commanding presence was recognised and acclaimed in all assemblies of military surgeons, wherever he went. Indeed it may be said of him that no man in this country kept up his connection with colleagues abroad as he did. His hospitality to them and to all his friends was proverbial.

MacCormac's minor contributions to the literature of his profession are chiefly found in the St. Thomas's Hospital reports and in the medical journals. His larger works, in addition to articles on "Gunshot Wounds" in Heath's "Surgery," "Diseases of the Bones and Joints" in Quain's "Dictionary of Medicine," and "Hernia" in Treves' "System of Surgery," are "Antiseptic Surgery," the development of an address delivered at St. Thomas's Hospital, published in 1880 and translated into French and Russian, and "Surgical Operations," the first part of which, the ligatures of arteries, was published in 1885, and the second, operations on joints and nerves, in 1889. With the exception, however, of his "Notes and Recollections of an Ambulance Surgeon," none of his writings are likely to have the same historical interest as his father's work on consumption, and it can scarcely be claimed that the success of his career was due to any exercise of a power for scientific investigation, although he undoubtedly possessed that power. He was skilful as an operator, lucid and loved as a teacher; but it was his wisdom in counsel, the sanity of his judgment, the common sense of his oratory, rather than any marked advances made by him in the science and art of surgery, that gained him the unique distinction of being elected president of the Royal College of Surgeons four times in succession. He was knighted in 1881 for his services as general secretary of the Seventh International Medical Congress in London, and was created a baronet on the occasion of the Queen's Jubilee in 1897. He was appointed a K.C.V.O. in 1898 and a K.C.B. in February last after his return from South Africa. He was appointed Surgeon-in-Ordinary to H.R.H. the Prince of Wales and Honorary Sergeant-Surgeon to the King on his Majesty's accession to the Throne. The last year of his life was somewhat saddened by the controversies that arose in consequence of his outspoken support of the Army Medical Service during the war. He felt bitterly how much the country had been misled by those who decried the work of the Army medical officers and who knew little of war and still less of the surgical possibilities of war.

Sir William MacCormac married, in 1861, Miss Charteris, of Belfast, but had no family. Lady MacCormac, who was his life-long companion and accompanied him wherever he went, survives him.

The funeral of Sir William MacCormac took place on Monday, the first part of the funeral service being observed at the church of St. Peter, Vere Street. His Majesty the King was represented by General Godfrey Clerk. The French and German Embassies in London were represented, respectively, by M. E. Daeschner and Major Count von Bredow. The French Consul-General in London was also present. The council of the Royal College of Surgeons was represented by Mr. J. Langton, Mr. H. G. Howse, Mr. T. Bryant, Mr. A. Willett, Mr. R. Harrison, Mr. H. T. Butlin and Mr. W. W. Cheyne. Prof. C. Stewart, conservator of the museum, was also present, as well as many others connected with the Royal College of Surgeons and the profession of surgery. The Royal College of Physicians was represented by Sir W. S. Church (president), Sir Dyce Duckworth (treasurer) and Dr. E. Liveing (registrar). Of St. Thomas's Hospital, with which Sir W. MacCormac had been so long connected, there were many representatives. Among other institutions represented were the French Hospital, the Army Medical Department, Medical Department of the Navy, the Italian Hospital, Queen Charlotte's Hospital, the University of London, the British Museum and the British Association. Among many others present were Lord Lister, Sir William Broadbent, Sir Norman Lockyer, Sir Thomas Smith, Sir Lauder Brunton, Dr. T. Seymour Tuke, Dr. P. H. Pye-Smith, Major-General Sir Owen Tudor Burne, Mr. Andrew Clark, Sir J. and Lady Fayrer, Dr. and Mrs. D'Arcy Power, Sir F. and Lady Semon, Lady Dyce Duckworth, Sir A. S. Wells, Sir S. Wilks, Sir J. W. Williams and Sir James Blyth.

THOMAS MEEHAN.

THE eminently successful life of Thomas Meehan, distinguished as a gardener, a botanist and a citizen, closed on November 19. Mr. Meehan was born in London in March 1826, and received what little schooling he had in the Isle of Wight, where his family had settled. Leaving school at an early age, and displaying a marked aptitude for gardening, he was employed under his father in the gardens of Colonel Francis Vernon Harcourt, at St. Clare, near Ryde. When only fourteen he succeeded in raising the first hybrid Fuchsia, St. Clare, and in appreciation of a paper which he published on Rubus was elected, when only nineteen, a member of the Wernerian Society. After holding various gardening appointments he entered the Royal Botanic Gardens, Kew, in 1846, on the recommendations of Dr. Bromfield and Prof. C. C. Babington. At Kew, where he stayed a little more than two years, he made the acquaintance of Berthold Seemann, with whom he was a candidate for the appointment of botanist to the *Herald* expedition. On leaving Kew he became head-gardener to the Earl of Shrewsbury at Alton Towers, a post which, owing to his religious opinions, he was soon obliged to relinquish. Though offered tempting inducements to remain in his native country, Meehan determined to make America his home, and reached Philadelphia in March 1848.

His career there opened in the humble position of a nursery labourer. But advancement quickly followed. He obtained employment in the famous Bartram Gardens of Philadelphia, and in 1853, with remarkably little capital, established a nursery business of his own, which, in conjunction with his sons, he continued to the end of his life. He was a voluminous writer on horticultural and botanical subjects. He founded the well-known *Meehan's Monthly*, and half a century ago published his "Handbook of Ornamental Trees." In 1878–79 appeared "The Native Flowers and Ferns of the United States," a handsome illustrated work in two large octavo volumes. His botanical papers contributed to various scientific journals, and chiefly to the *Proceedings* of the Academy of Natural Sciences of Philadelphia, number considerably more than a hundred. Enthusiastic in all his undertakings, Meehan became a leading member of the Philadelphia Academy, of which he was vice-president for more than twenty years; a representative of his ward in the Common Council, and a member of the local school board; while his botanical attainments secured for him the proud position of Botanist to the Pennsylvania State Board of Agriculture.

Reviewing his life's story, the heroic toil, the splendid energy, the brilliant success achieved in spite of all obstacles, a tribute of praise such as this, and from a far wider world, is due to the memory of Thomas Meehan.

S. A. SKAN.

THE PHOTOGRAPHS OF NOVA PERSEI.

REFERENCE has already been made in NATURE to the important photographs of the nebula associated with Nova Persei obtained by Mr. Ritchey at the Yerkes Observatory with the 2-foot reflecting telescope, the exposure being four hours. The *Astrophysical Journal*

FIG. 1.—The Yerkes Photograph, September 20.

for October contains an enlarged (five diameters) copy of the photograph and a diagram made from the original negative, which are now reproduced.

Still more recently the results secured at the Lick Observatory by Mr. Perrine with the Crossley 3-foot reflector with an exposure of more than seven hours, which were telegraphed over in the first instance, have now reached us in some detail. The communication (*Bulletin* No. 10) is accompanied by a diagram which shows remarkable changes of position in the more pronounced condensations. This diagram is referred to as follows:—

"The four masses of nebulosity are designated by the letters A, B, C, D; the positions which the centres of figure occupied on September 20, as shown in the reproduction from Mr. Ritchey's photograph, are occupied by the left-hand or north-west end of each of the short lines; the positions on November 7-8 are occupied by the right-hand or south-east ends of the lines.

"The line drawn between these positions for each condensation indicates the direction and amount of motion in the interval of forty-eight days. Condensation A is much the best adapted for accurate measurement, from its greater strength and from its forked appearance; condensations B and C are not quite so good for measurement as A, but still are very determinate; but while condensation D is the brightest of all, it is large, and so near the image of the Nova as to make its amount and direction of motion somewhat uncertain.

"It will be seen that the displacements agree well and amount to about $1\frac{1}{2}'$. The directions are not so consistent and could perhaps be explained by irregular motions in the nebulous mass, by a general translation of the nebula in one direction or by a spiral motion. It is certain, however, that the motion is not radial.

"The amount of motion is almost incredible, being no less than at the rate of 11′ per year. The greatest displacement (proper motion) in the stellar universe, so far observed, is less than 9″ per annum."

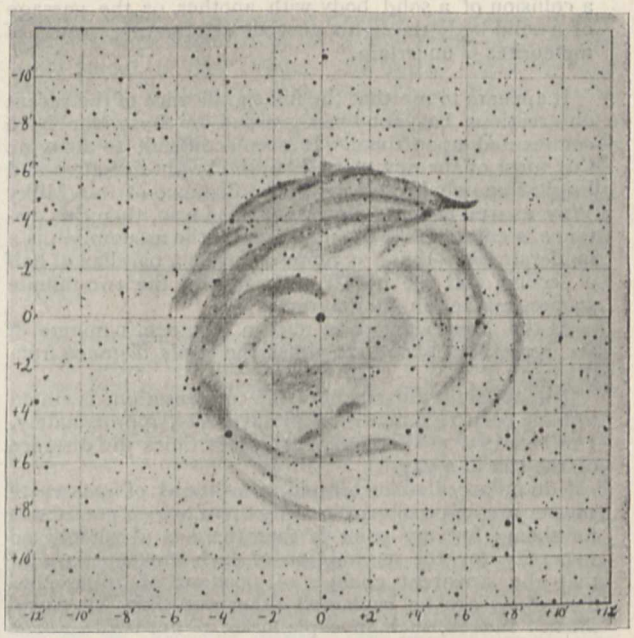

FIG. 2.—Drawing showing details and condensations.

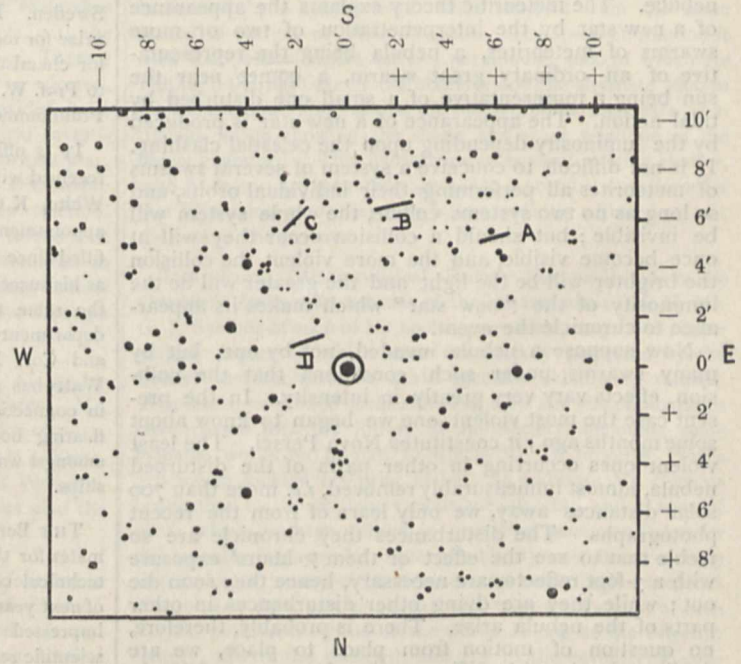

FIG. 3.—Diagram showing changes in position in the condensations as determined by the later observations at the Lick Observatory on November 7-8.

The note then goes on, "such an exceptional velocity as is here indicated leaves little doubt of the intimate connection of this nebulous matter with the Nova and its outburst. It is, perhaps, too soon to say just what bearing the foregoing observations will have upon the explanation

of the phenomena connected with new stars. It would seem, however, that such great velocities pointed rather to a violent collision of some sort than to an outburst within a dark and comparatively cool body; but whether a collision of a solid body with another, or the passage of a solid body through a gaseous nebula or a swarm of meteorites is uncertain."

It appears to me that the full significance of the recent observations has not been grasped by those who have commented upon them. It seems difficult to imagine that most of the new stars, like the bright-line stars and bright-line nebulæ, are *not* at the distance of the Milky Way as well as in its plane. If this be so, then this distance is enormous. Let us assume—the assumption is a moderate one—that it is represented by a parallax of half a second, and see how it works out on the two-minute squares marked in the diagrams.

At the Nova situated at such a distance, 1 minute of arc represents about 120 times the sun's distance from the earth.

The apparent movement of the condensations is stated to have been 1½ minutes in 48 days, say, approximately, 1 minute in a month, say, again, four times the distance of the sun in a day.

I do not say that such rapid translations of masses of matter are impossible, certainly there are no precedents for them; but my point is that there is absolutely no necessity for the assumption of such movements, and that the apparent change of position of these condensations can be explained otherwise than by movement. Indeed, such an explanation is not hard to seek when the meteoritic theory of new stars is closely considered in all its aspects. It is a well-known fact that the majority of new stars that have been recorded in more modern times, when the spectroscope has been available for their study, have ended by becoming nebulæ. The meteoritic theory explains the appearance of a new star by the interpenetration of two or more swarms of meteorites, a nebula being the representative of an ordinary great swarm, a comet near the sun being a representative of a small one disturbed by tidal action. The appearance of a new star is produced by the luminosity depending upon the celestial clashing. It is not difficult to conceive a system of several swarms of meteorites all performing their individual orbits, and so long as no two systems collide, the whole system will be invisible; but should a collision occur they will at once become visible, and the more violent the collision the brighter will be the light and the greater will be the luminosity of the "new star" which makes its appearance to chronicle the event.

Now suppose a nebula invaded, not by one, but by many swarms, under such conditions that the collision effects vary very greatly in intensity. In the present case the most violent one we began to know about some months ago; it constitutes Nova Persei. The least violent ones occurring in other parts of the disturbed nebula, almost immeasurably removed, *i.e.* more than 700 solar distances away, we only learn of from the recent photographs. The disturbances they chronicle are so feeble that to see the effect of them 7 hours' exposure with a 3-foot reflector are necessary, hence they soon die out; while they are dying other disturbances in other parts of the nebula arise. There is probably, therefore, no question of motion from place to place, we are dealing simply with different disturbances occurring in different places.

It is impossible to think that the great nebula which has now been photographed while the new star is still in being did not exist there a few months ago; and it is important, further, to remark that the nebulous matter already photographed in the region round the Nova is very probably only a portion of the actual amount of matter existing there, and that if the disturbances continue, more of the remaining portion may become visible. This, in fact, seems already to have been established, for Ritchey found later that the nebula "seems expanding in all directions." At the same time it may be stated that Campbell notes that the condensation D has remained unchanged, while there has been a further "movement" in the case of A and B, the "movement" of C being doubtful. There seems little doubt that later photographs will throw light on this question, but a matter to be regretted in this connection is that no photographs are available for the period during which the well-marked variability of the Nova was observed. These occasional outbursts of light were, we can now imagine, due to other disturbances of the nebula intermediate in intensity between that which caused the Nova itself and the other exceedingly faint ones now being photographed.

One important conclusion can, at any rate, be deduced from the Lick photographs, and that is that such explanations as explosions on solid globes, worlds on fire, volcanic eruptions, &c., must be considered less probable now that a great nebula is shown to be associated with many disturbances of very varying intensities. Formerly we had to wait for the death of a new star before the appearance indicating the existence of a nebula was manifested, and hence arose the idea that a star changed into a nebula, thus reversing the ordinary process of evolution.

NORMAN LOCKYER.

NOTES.

THE four Nobel prizes were distributed at Stockholm on Tuesday evening before a distinguished audience, among whom were the Crown Prince and other members of the Royal family o Sweden. Each prize was of the value of 200,000 francs. The prize for medicine was awarded to Dr. E. A. Behring, the prize for chemistry to Prof. J. H. van 't Hoff, the prize for physics to Prof. W. K. Röntgen, and the prize for literature to M. Sully Prudhomme.

IT is officially announced that the Board of Admiralty have received with much regret the resignation by Sir William H. White, K.C.B., F.R.S., in consequence of ill-health, of the appointment of Director of Naval Construction, which he has filled since 1885 with great distinction. They have appointed as his successor Mr. Philip Watts, F.R.S., who has held during the same time the post of director of the war shipbuilding department of Messrs. Sir William Armstrong, Whitworth and Co., Ltd., and naval architect to the company. Mr. Watts has done much original scientific and experimental work in connection with investigations of the stability of ships and floating bodies, the oscillations of ships in still water and amongst waves, and the propulsion and manœuvring powers of ships.

THE Berlin correspondent of the *Times* states that the estimates for the German Army include a vote for the new military technical college which the Government will open in the course of next year. The necessity for some such institution has been impressed upon the military authorities by the advancing scientific requirements of modern warfare, which are now too numerous and too varied to be provided for adequately by the resources at the command of the existing Staff College. There are branches of technical knowledge which, although they cannot strictly be classed as military, are nevertheless indispensable for the soldier. Among such subjects are steam-power, electricity, mechanics, the construction of boats and bridges, and the establishment of means of communication. In recognition

of this fact the college which is shortly to be opened will have for its objects the extension of general technical knowledge in the Army and also the special technical training of engineer officers, as well as of those officers who desire to prepare themselves there for a career in the railway, ballooning and other special departments of the service. It is expected that the college will be opened on October 1, 1902. The ordinary annual expenses are estimated at 300,000 marks.

AMONG the lecture arrangements at the Royal Institution, before Easter next year, we notice the following:—Prof. J. A. Fleming, six lectures (adapted to young people) on waves and ripples in water, air and æther Dr. A. Macfadyen, six lectures on the cell, its means of offence and defence, immunity; Mr. W. N. Shaw, two lectures on the temperature of the atmosphere, its changes and their causes; Prof. E. B. Poulton, two lectures on recent researches on protective resemblances, warning colours and mimicry in insects; Dr. A. S. Murray, three lectures on recent excavations at Delphi and in the Greek Islands; six lectures on some electrical developments, by Lord Rayleigh. The Friday evening meetings will commence on January 19, when Lord Rayleigh will deliver a discourse on the interference of sound.

A CIRCULAR just issued announces that the Andrew Carnegie research scholarship or scholarships, of such value as may appear expedient to the Council of the Iron and Steel Institute from time to time, will be awarded annually, irrespective of sex or nationality, on the recommendation of the Council. Candidates, who must be under thirty-five years of age, must apply, on a special form, before the end of March to Mr. B. H. Brough, the secretary of the Institute. The object of this scheme of scholarships is not to facilitate ordinary collegiate studies, but to enable students who have passed through a college curriculum or have been trained in industrial establishments to conduct researches in the metallurgy of iron and steel and allied subjects, with the view of aiding its advance or its application to industry. There is no restriction as to the place of research which may be selected, whether university, technical school or works, provided it be properly equipped for the prosecution of metallurgical investigations. The appointment to a scholarship will be for one year, but the Council may at their discretion renew the scholarship for a further period instead of proceeding to a new election. The results of the research will be communicated to the Iron and Steel Institute in the form of a paper to be submitted to the annual general meeting of members, and if the Council consider the paper to be of sufficient merit, the Andrew Carnegie gold medal will be awarded to its author.

THE death is announced of the Rev. Hugh Alexander Macpherson, of Glendale, at the early age of forty-three. Mr. Macpherson was an authority on the fauna of the lake country, and had published an elaborate work on the subject, "A Vertebrate Fauna of Lakeland, including Cumberland and Westmorland, with Lancashire North of the Sands." He was also the author of a book entitled "British Birds."

THE "Association Internationale des Botanistes," founded in August at Geneva, having purchased the *Botanisches Centralblatt*, will continue it as the organ of the Association. It will be published by Messrs. Brill, of Leyden, and the first number will be issued on January 1, 1902. The journal will appear weekly and will contain abstracts of all important publications on botanical subjects. The cooperation of a large staff of highly competent special editors in various countries has been secured, and the abstracts will be published in English, French or German. The annual subscription of members of the Association is 25*s*., and they will receive the journal post free. Applications for membership may be made to Dr. J. P. Lotsy, Oude Rijn, 33A, Leyden, Holland, who acts as the editor-in-chief. A feature of the journal will also be a very full list of the current publications in the science. In order to assist the editor, authors of botanical publications are invited to send copies of their works to him, or to the special editor in their own branch, in their country. The special editors for Great Britain are as follows:—Algæ, Miss Barton, British Museum (Nat. Hist.); Fungi, Mr. Massee, Royal Gardens, Kew; Archegoniatæ, Mr. A. Gepp, British Museum (Nat. Hist.); Phanerogams, Mr. Daydon Jackson, 21, Cautley Avenue, Clapham Common, S.W.; Cytology, Prof. Farmer, Roy. Coll. of Science, S. Kensington; Physiology, Prof. Vines, Headington Hill, Oxford; Morphology, Dr. W. H. Lang, University, Glasgow; Palæontology, Prof. Scott, Old Palace, Richmond, Surrey.

A NEW form of stereoscopic fluoroscope, worked out by Mr. E. W. Caldwell, is described by him in the New York *Electrical Review* for November 16. The method employed is the same as that first brought forward by Dr. McKenzie Davidson, but some modifications are introduced which, it is said, make it more easy to operate. Instead of using two different tubes as the sources of Röntgen rays, a single tube is used into which two antikathodes are sealed. The tube is excited by an alternating current by connecting it to the secondary coil of a transformer the primary of which is connected to the street mains through a Caldwell liquid interrupter; when a direct-current supply only is available, a small rotary converter is used to give an alternating current. The antikathodes are thus alternately sources of Röntgen rays, and the shadows these cast on the fluoroscope screen are viewed through a rotating shutter which only allows the right eye to see the shadow from one antikathode and the left eye that from the other. The shutter is rotated by a synchronous motor supplied from the same source of current as the X-ray tube. The speed of rotation is such that 7200 shadows are cast per minute, 3600 of which are visible to the right eye of the observer and the alternate 3600 to his left eye; the result is that the radiograph is seen as a continuous image showing the shape and space relations of the object examined. The fluoroscope screen and rotating shutter, with its motor, are mounted together in a portable form in order that in surgical cases they may be conveniently adjusted to suit the case of the patient.

THE Royal Meteorological Society has published in its *Quarterly Journal* an account of the bequest made to it by Mr. G. J. Symons of such of his books, pamphlets, maps and photographs, copies of which were not already possessed by the Society, and exclusive of works specially relating to rainfall. As a result, some 6200 books and pamphlets and 900 photographs have passed into the library of the Society, including some valuable works on rainfall to which Mr. H. Sowerby Wallis generously yielded his prior claim. In addition, Mr. Symons bequeathed to the Society various medals, &c., and a sum of 200*l*., which has been utilised in providing accommodation for this valuable legacy. Mr. Symons's library was almost entirely meteorological; many of the volumes were exceedingly scarce and of very early date, and he endeavoured to procure a copy of each edition published. Nine of the works belong to the fifteenth century, 128 to the sixteenth and 214 to the seventeenth centuries. One of the earliest daily records of weather kept in London (1668–1689) is contained in a work entitled "Nauticum Astrologicum: or the Astrological Seaman," by John Gadbury (London, 1710). Another early record in London is "A Meteorological Journal kept in Paternoster Row" (1786–1792), by W. Bent. Mr. Symons's note is, "Excessively scarce. I never saw or heard of another copy." A later publication, carrying the

observations down to 1800, and containing a summary of the previous observations, is not so scarce. Although not included in the bequest, the Society wisely obtained by purchase a bibliography compiled by Mr. Symons containing about 60,000 titles of meteorological and kindred subjects.

AN International Exhibition of Automobiles was opened at Paris on Tuesday. Among the exhibits of scientific interest are steerable balloons and motors to drive them. The cigar-shaped balloon "Ville de Paris," which M. Deutsch proposes to try next spring, is shown, and also a steerable military balloon invented by Major Renard.

PROF. G. VICENTINI has communicated to the *Atti* of the Venetian Institution a paper on the supposed efficacy of canon-firing in preventing hailstorms. In this paper the author briefly reviews the work of the second International Congress held at Padua, and his general conclusion is that the matter requires to be studied in a more scientific and statistical manner than has been hitherto done. For this purpose it may be desirable on account of expense to restrict the investigation to a limited region, but in the absence of more exact investigations it is thought that the experiments hitherto carried out can be hardly regarded as conclusive.

WE received a few days ago the Report, dated March 1901, of the International Association for Promoting the Study of Quaternions and Allied Systems of Mathematics. From the address of the president, Prof. C. J. Joly, of Dublin, we learn that the Association was founded about the year 1900, at the instigation of Mr. S. Kimura, of Japan, and Dr. P. Molenbroek, of the Hague, and Sir Robert Ball was its first president. The society proposes to publish a bibliography of the subject, and a report on the position of quaternions and allied branches of mathematics in the curricula of universities and colleges throughout the world is also projected.

WE have received from the author, Mr. G. W. Cole, a copy of a pamphlet entitled "Bermuda and the *Challenger* Expedition," being a bibliography of the results obtained by that expedition at and near Bermuda. Owing to the establishment of a biological station, each year witnesses the arrival in the islands of an increasing number of zoologists, and it is for their use that this useful pamphlet has been chiefly compiled.

THE observations of Herr E. Wasmann on the relations subsisting between the staphilinid beetles dwelling parasitically (or commensurally) in the nests of ants and termites are already classic. The subject is further elaborated in a paper (the first of a series) which appears in the *Biol. Centralblatt* for November, in which the author suggests that in some of these parasites we have instances of the actual evolution of species going on before our eyes.

OUR contemporary *Die Umschau*, of December 7, contains an interesting summary, by Dr. F. Knauer, of recent investigations —especially those of E. Wasmann—connected with the life-history of ants and termites, particular attention being directed to those insects living in commensalism in their nests, and the plants they cultivate. Attention is first directed to the so-called "crippled" or "pseudogynous" ants of certain species, which have the head and abdomen of a worker and the body of a female. Following this, the author refers to the curious circumstance that not only do the beetles living in commensalism with ants show an extraordinary enlargement of the abdomen, but that the same feature characterises the recently-discovered flies of the genus Termitoxenia. The paper concludes with a notice of the funguses and other plants cultivated by ants.

THE new editions of Darwin's "Descent of Man" and "Origin of Species" which have recently been published by Mr. John Murray are the most remarkable specimens of cheap and authoritative scientific literature which have come under our notice. Either of the books named can now be obtained in the form of a well-printed and neatly-bound volume for half-a-crown, and a popular edition of the "Origin of Species" has been published at the price of one shilling. No one interested in the great problems of natural history need, therefore, be without the two works which determined the direction of inquiry in the last century and still exert a profound influence upon biological thought. It is worth while to remind naturalists that though the copyright of the "Origin of Species" has now expired, only the imperfect edition can be reprinted without the authority of the author's executors. The only complete and authorised edition is that published by Mr. Murray.

THE Report for the year 1900 of the Botanic Garden and Domains, Sydney, New South Wales, by the director, Mr. J. H. Maiden, shows steady work in the improvement of the Gardens and the increased efficiency of the herbarium and library. The details are chiefly of local interest.

WE have received from the U.S. Department of Agriculture (Division of Botany) two interesting pamphlets (*Bulletins* Nos. 27 and 28): Seeds of Commercial Salt-bushes—*i.e.* species of Atriplex—grown as forage-plants in the arid regions of the West, by Mr. G. N. Collins; and The Chayote, a Tropical Vegetable, by Mr. O. F. Cook. The chayote or tayote, *Sechium edule*, a member of the Cucurbitaceæ, is better adapted for a tropical climate than most herbaceous plants. It has been grown from time immemorial by the aborigines of South America for its succulent fruit, but, like so many cultivated plants, is unknown in the wild state.

THE *Journal* of the College of Science of the Imperial University of Tokyo (vol. xv. part iii.) contains several interesting botanical articles, mostly in German; among the rest: On the organisms concerned in the fermentation of the Japanese spirit "awamori," by Mr. T. Inui, which is attributed mainly to a new species, *Aspergillus luchuensis*, accompanied also by *Aspergillus perniciosus*, sp.n., *Saccharomyces Awamori*, sp.n., and *S. anomalus*; on the transpiration of evergreen trees in winter, by Mr. S. Kusano; both transpiration and assimilation are continued through the winter in the climate of Tokyo; on the action of cupric sulphate on plants, by Mr. N. Hattori; and on the more important fibre-plants of Japan, by Mr. K. Saito.

THE first instalment of the second edition of Prof. van 't Hoff's "Vorlesungen über theoretische und physikalische Chemie," dealing with chemical dynamics, has been published by Messrs. F. Vieweg und Sohn, Brunswick. This is the part of the work which has been translated into French and English and already noticed in the review columns (vol. lix. pp. 458, 557, 1898).

THE Polygraphisches Institut of Zürich has just issued the first and second parts of a series of plates and descriptive text entitled "Arboretum Amazonicum." The author of this iconography is Dr. J. Huber, head of the botanical section of the Museum of Natural History and Ethnography at Para, and the work will be completed in ten parts. When the whole of the parts have been received a review of their contents will appear in these columns.

A SHORT address on the progress of physics during the nineteenth century, recently delivered before the St. Louis Academy of Sciences by Prof. F. E. Nipher, has been issued in the *Transactions* of the Society (vol. xi. No. 6). He remarks, in concluding his survey, "If the history of the last century has taught us anything, it has established the practical or commercial value of research in pure science. It is from such work that all of the great achievements have directly

come. And whenever any people forgets the source from which these great things have come, and allows engineering to supplant science, that people is on the way to the civilisation of China."

MESSRS. MARION AND CO. have just commenced the publication of reproductions of a fine series of photographs of "The Empire: its Cities, Palaces and Buildings." The views can be obtained in half-tone process prints or reproduced by collotype process. In the collection of pictures of "Famous Buildings of London," which forms one number of the series, we notice views of the Imperial Institute and the British Museum. The Natural History Museum deserves to be included, but there are few other fine buildings devoted to scientific research and education in London. Fine buildings do not necessarily make fine work, but they facilitate it and show in what regard the nation holds those who contribute to its scientific and industrial progress.

ABSTRACTS of the papers read before the Royal Society of New South Wales appear regularly among our reports of societies and academics. The volume of *Proceedings* containing the complete papers read before the Society in 1900 has now been received, and calls for a note of admiration. Among the subjects dealt with are the sun's motion in space, and the volumes of solids as related to transverse sections, by Mr. G. H. Knibbs; several papers on eucalyptus oils, by Mr. H. G. Smith; customs of Australian aborigines, by Mr. R. H. Mathews, Mr. W. J. Enright and Miss M. M. Everitt; the crystalline structure of some gold, silver and copper nuggets, by Prof. A. Liversidge, F.R.S.; and an experimental investigation of the strength of brickwork when subjected to compressive and transverse stresses, by Prof. W. H. Warren and Mr. S. H. Barraclough.

THE additions to the Zoological Society's Gardens during the past week include a South Albemarle Tortoise (*Testudo vicina*) from the Galapagos Islands, a Conical Eryx (*Eryx conicus*) from India, deposited; a Shag (*Phalacrocorax graculus*), European, purchased; an Axis Deer (*Cervus axis*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

NEW VARIABLE STARS.—The following newly-detected variables are announced in the *Astronomische Nachrichten* (Bd. 157, No. 3751):—

94, 1901, *Cygni*.—

A.G. Bonn (B.D. +41°·4114)
R.A. = 21h. 17m. 42s. } (1875·0)
Decl. = +41° 51′·8 }

Herr Fr. Deichmuller states that there is a variation of about half a magnitude; the times are not sufficiently continuous to deduce a value of the period.

95, 1901, *Pegasi*.—Dr. T. D. Anderson announces variability in the star B.D. +24°·4462, whose position is

R.A. = 21h. 37m. 56s.·0 } (1855·0)
Decl. = +24° 20′·6 }

The star is sometimes about 10 magnitude, but at intervals becomes much fainter.

96, 1901, *Cygni*.—Mr. Stanley Williams finds from photographs taken with a 4·4-inch portrait lens that variability exists in the star B.D. +29°·4231.

R.A. = 20h. 49m. 2s.·1 } (1855·0).
Decl. = +29° 51′·8 }

The following variations are recorded:—

1901 Sept. 21 ...	10·81 mag.	1901 Nov. 1 ...	9·88 mag.
Oct. 7 ...	10·26 ,,	,, 3 ...	10·47 ,,
,, 14 ...	9·79 ,,		

These indicate a maximum of 9·7 magnitude on 1901 October 21. The star was invisible on plates taken on 1899 October 6 and 9, 1900 October 26, 27 and November 15, so that it must have been fainter than 12 magnitude. The period is at present uncertain.

BRIGHT METEOR OF DECEMBER 4.—A brilliant meteor was seen by several observers shortly after five o'clock in the evening of Wednesday in last week, December 4. Prof. J. P. O'Reilly, writing from Dublin, says:—"At 5h. 11m. p.m. this evening I saw in the south-eastern sky a brilliant meteor, which appeared at a point about 30° above the horizon and had a course about equal in length to the belt of Orion. The fore part was brilliant bluish-white, the after part red sparks. The direction of movement made with the horizon an angle of about 60° to 65°, the inclination of the line of movement being to the south. There were no stars visible by which I could more distinctly fix its position."

Mr. C. Waterer (Highfield, Northdown Avenue, Margate) and two friends saw the meteor while walking towards Kingsgate, near Margate. He remarks, "The trail remained visible to us all for some seconds. We were then looking west, and its direction was approximately from north to south. The time by my watch was 5.35 p.m."

"COMPANION TO THE OBSERVATORY," 1902.—This almost indispensable handbook for the practical observer has recently been issued for the coming year. The contents and arrangement are similar to those of previous issues. A small addition which will be useful to spectroscopists is the list of spectroscopic double stars, with their periods so far as is at present known.

THE VARIATIONS IN THE MAMMALIAN EYE.[1]

DR. LINDSAY JOHNSON'S work, in the investigation of the deep anatomy of the mammalian eye as displayed by the ophthalmoscope, has been of a very extensive and persevering, not to say of a very adventurous character; and the volume before us, containing his contribution on the subject to the *Transactions* of the Royal Society, represents no more than a fraction of the material which he has collected, and which he intends, we understand, one day to publish. Not the least interesting part of it will be that which will deal with his methods, with the perils occasionally attendant upon them, and with the contrivances by means of which a living lion and a living whale were compelled to submit themselves to ophthalmoscopic examination. Mirror in hand, Dr. Johnson has not only visited the zoological gardens of many countries, but also the native haunts of many wild creatures; and in the book before us some of his discoveries are displayed in twenty-six plates, containing fifty coloured drawings of eyegrounds, beautifully finished and exquisitively reproduced in chromo-lithography, and in three plates with drawings in black and white, showing variations in the forms of persistent hyaloid artery, rudimentary forms of pecten, and different types of the appendages which are found on the pupillary margins of many of the ungulata.

The general result of Dr. Johnson's observations is to show the existence among mammalia of very wide differences in two respects; first, as regards the vascular supply of the optic nerve and retina; secondly, as regards the presence, coloration and pigmentation of the tapetum.

With regard to the first of these, it may be said that the general type presented by the human eye, that is, the presence of a central artery and vein of the retina, finding entrance and exit among the fibres of the optic nerve, and constituting a practically closed and complete retinal circulation, is more or less preserved in monkeys, lemurs, the carnivora, some of the ungulata, some of the rodentia, and some marsupialia, but is either absent or concealed by tapetum in the Australian fruit-bat, the Indian rhinoceros, Burchell's zebra, the American tapir, the African elephant, the Canadian beaver, the chinchilla, the guinea-pig, the Central American agouti, the Brazilian porcupine, the hairy armadillo, the wombat, the squirrel-like phalanger and the echidna; while among these latter animals there are great differences in the blood-supply of the optic disc itself, which in some of them, as in the Indian rhinoceros and the hairy armadillo, is of a dead white like the whiteness of atrophy in the human subject; while in others, as the zebra, it is abundantly vascular, and is surrounded by a radiation of small

[1] "Contributions to the Comparative Anatomy of the Mammalian Eye, chiefly based on Ophthalmoscopic Examination." By George Lindsay Johnson, M.D., F.R.C.S. From the *Philosophical Transactions* of the Royal Society of London for 1901. Pp. 82, with 26 plates in colour and 4 in black and white. Price 21*s*.

vessels extending a short distance from its periphery. In many animals the optic disc is deeply excavated up to its margins, and resembles that of chronic glaucoma in the human subject, a state of which the best examples are furnished by the seal, the serval, and the red and white flying-squirrel. The condition presented by the rabbit, in which some of the fibres of the optic nerve carry their sheaths through the lamina cribrosa to form an opaque patch on the retina, is met with in many other animals, but with much variety in the depth and distribution of the opacity.

The coloration of the tapetum varies greatly in different animals; and Dr. Johnson calls particular attention to his drawing of the eye of Monteiro's galago, in which the general yellow of the central part of the fundus is surrounded by a zone of pigmentation precisely resembling what is called "pigmentary retinitis" in the human subject. Dr. Johnson inclines to the belief that the affection so described is not really a disease, but rather a reversion to a type of structure which is the rule in night-seeing animals.

It is impossible to withhold a tribute of admiration from the perseverance with which Dr. Johnson has conducted his researches, or from the beauty of the drawings in which the results of his observations are displayed; but it is for the moment necessary to retain a suspended judgment with regard to the value of his work. As an observer he stands alone; and the drawings which he has made, notwithstanding their great and obvious merit, are as yet mere personal records, liable, it may be, to some disturbing influence from a personal equation. It is much to be regretted that photography has not been made available for taking pictures of the eyeground from which this element of uncertainty would be removed. Even if this were done, it would still be necessary to determine, by more extended portraiture, whether the conditions described are normal ones or subject to variation in individuals. We cordially welcome Dr. Johnson as a pioneer, and we feel sure that he will fully appreciate the necessity for caution in accepting his conclusions.

THE COAL-TAR COLOUR INDUSTRY IN GERMANY AND ENGLAND.

WITH the object of ascertaining our present and future prospects in the chemical trade of the world, Mr. A. G. Green, in a paper read before the section of chemistry of the British Association, at this year's meeting, described the relative progress of the coal-tar industry in England and Germany during the past fifteen years. The council decided to print the paper *in extenso*, and the subjoined particulars extracted from it convey an idea of what England has lost by the neglect of the scientific foundations of an industry. The paper may be regarded as a sequel to one by Prof. Meldola published in NATURE fifteen years ago (vol. xxxiv. p. 324), when the position of the industry in Germany and England was described, and a warning was given to British manufacturers.

The exports of coal-tar colours manufactured in England have fallen from 530,000*l.* in 1890 to 366,500*l.* in 1899. Comparing these figures with the rapidly increasing export trade of Germany, it is seen that whereas formerly the English export trade in artificial colours was about one-quarter that of Germany, it does not now amount to a tenth part. It is therefore only too apparent that we have had but little share in the great increase which this industry has experienced during the past fifteen years, and that we have not even been able to supply the expansion in our own requirements. In order to ascertain what proportion of our own needs we at present furnish, I am able to lay before you the following interesting figures, which have been kindly supplied me by the Bradford Dyers' Association and the British Cotton and Wool Dyers' Association, who together form a very large proportion of the entire dyeing trade:—

Colouring Matters used by Bradford Dyers' Association.

English, 10 per cent.; German, 80 per cent.; Swiss, 6 per cent.; French, 4 per cent.

Colouring Matters used by British Cotton and Wool Dyers' Association.

Aniline Colours.—English, 22 per cent.; foreign, 78 per cent.

Alizarine Colours.—English, 1·65 per cent.; foreign, 98·35 per cent.

The *English Sewing Cotton Company* have also very kindly supplied me with a detailed analysis of their consumption, from which it appears that out of a total of sixty tons of colouring matters and other dyeing materials derived from coal tar, only 9 per cent. were of English manufacture.

The following table of statistics of the six largest German firms gives a fair picture of the present dimensions of the industry in that country (*vide* next page).

The joint capital of these six firms amounts to at least 2½ millions. They employ together about 500 chemists, 350 engineers and other technologists, 1360 business managers, clerks, travellers, &c., and more than 18,000 workpeople. Compared with such figures as these the English colour manufacture assumes insignificant proportions. The total capital invested in the coal-tar colour trade in England probably does not exceed 500,000*l.*, the total number of chemists employed cannot be more than thirty or forty, and the number of workmen engaged in the manufacture does not amount to more than a thousand.

A similar relative proportion is maintained in the number of patents for new colouring matters and other coal-tar products taken by the English and German firms, as is shown by the following table:—

Comparison of Number of Completed English Patents for Coal-tar Products taken during 1886–1900 *by six largest English and six largest German Firms.*

German Firms.	
Badische Aniline Works	179
Meister, Lucius, & Brüning	231
Farbenfabriken Bayer & Co.	306
Berlin Aniline Co.	119
L. Cassella & Co.	75
Farbwerk Mühlheim, Leonhardt & Co.	38
Total of six German firms	948
English Firms.	
Brooke, Simpson, and Spiller	7
Clayton Aniline Co.	21
Levinstein	19
Read, Holliday, & Co.	28
Claus & Ree	9
W. G. Thompson	2
Total of six English firms	86

Nor does the potential loss which we have sustained by our inability to take advantage of a growing industry represent the sum total of our losses. The new colouring matters, made almost exclusively in Germany, have in many cases been introduced as substitutes for natural products, which were staple articles of English commerce. Madder and cochineal have been replaced by alizarine and azo-scarlets, the employment of many dyewoods has greatly decreased, whilst at the present moment logwood and indigo are seriously threatened. Regarding the indigo question so much has been written that I do not propose to occupy space in its further discussion, but will only point out that the complete capture of the indigo market by the synthetic product, which would mean a loss to our Indian dependencies of 3,000,000*l.* a year, is regarded by the Badische Company as so absolutely certain that, having already invested nearly a million pounds in the enterprise, they are at present issuing 750,000*l.* of new debenture capital to provide funds to extend their plant for this purpose! In the last annual report of the company they say: "As regards plant indigo, the directors are prepared and determined to meet this competition in all its possible variations in value. Much strange matter has been published in India as to improvements in the cultivation and preparation of natural indigo, but the illusions of the planters and indigo dealers are destined to be dispelled before facts, which, although they are not known to them, will make themselves more felt the larger the production of artificial indigo becomes."

Besides the loss of material wealth which the neglect of the coal-tar trade has involved to the country, there is yet another aspect of the question which is even of more importance than the commercial one. There can be no question that the growth in Germany of a highly scientific industry of large and far-reaching proportions has had an enormous effect in encouraging and stimulating scientific culture and scientific research in *all*

Position of the Six Largest Colour Works in Germany in Year 1900.

—	Badische Aniline Works.	Meister, Lucius and Brüning.	Farbenfabriken Bayer and Co.	Berlin Aniline Co.	Cassella and Co.	Farbwerk Mühlheim, Leonhardt and Co.	Total of six largest firms.
Capital	£1,050,000	£833,000	£882,000	£441,000	Private concern	£157,000	About £2,500,000
Number of Chemists	148	120	145	55	60	450	About 500
Number of engineers, dyers, and other technologists	75	36	175	31			About 350
Commercial staff	305	211	500	150	170		About 1,360
Workpeople	6,485	3,555	4,200	1,800	1,800		About 18,260
Dividends in 1897	24 per cent.	26 per cent.	18 per cent.	12½ per cent	Not known	9 per cent.	—
,, ,, 1898	,, ,,	,, ,,	,, ,,	15 ,,	,, ,,	3 ,, ,,	—
,, ,, 1899	,, ,,	,, ,,	,, ,,	,, ,,	,, ,,	5 ,, ,,	—
,, ,, 1900	,, ,,	20 ,,	,, ,,	?	,, ,,	nil	—

branches of knowledge. It has reacted with beneficial effect upon the universities, and has tended to promote scientific thought throughout the land. By its demonstration of the practical importance of purely theoretical conceptions it has had a far-reaching effect on the intellectual life of the nation. How much such a scientific revival is wanted in our country the social and economic history of the past ten years abundantly testifies.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—An interesting ceremony took place on Saturday last, when a portrait of Prof. G. D. Liveing, painted by Sir John Reid, president of the Royal Scottish Academy, was presented to St. John's College as a mark of recognition of Prof. Liveing's services to science. The portrait was provided by subscription, and the funds obtained will also enable a bronze bust of Prof. Liveing to be placed in the Chemical Laboratory at Cambridge. The Vice-Chancellor (Dr. Ward, Master of Peterhouse) presided at the meeting of subscribers, and the attendance included the Lord Lieutenant, Sir John Gorst, Sir Richard Jebb, the Masters of Trinity, St. John's, Clare, Jesus, Christ's, and Downing, Profs. Sir George Stokes, E. C. Clark, J. Dewar, W. J. Lewis, A. R. Forsyth, J. Westlake, J. J. Thomson, J. A. Ewing, W. W. Skeat and J. S. Reid, besides many other resident members of the Senate.

PRINCIPAL RÜCKER, F.R.S., will distribute the prizes and certificates to students of the South-Western Polytechnic, Chelsea, to-morrow evening, December 13. The chair will be taken by Mr. Sidney Webb.

PROF. EDGAR CROOKSHANK, who lately resigned the active duties of the chair of comparative pathology and bacteriology in King's College, London, which he occupied for fifteen years, has had the title of Emeritus Professor conferred upon him by the Council in consideration of his long and brilliant services.

THE St. Petersburg correspondent of the *Times* states that the Minister of Public Instruction has made a decree expelling all the first-year students at the Kharkoff Veterinary Institute for insulting the professor of chemistry at that college. The reason for this action on the part of the Minister is the fact that on November 28 the first-year students sent a signed request to the professor of chemistry that he should resign his chair on the ground that his teaching was unsystematic and obscure. The decree adds that the professorial staff were agreed that the charge against their colleague was without foundation.

THE *British Medical Journal* states that the municipality of Hamburg has adopted a scheme by which all the scientific institutions of the city are to be grouped together into a university. The directors of these institutes and the lecturers, who have the title of professors, will form the professorial college, which every year will elect its own president. It will also be the duty of the college every year to draw up a programme of lectures and practical courses. The programme for the current winter semester includes courses by 117 lecturers. This movement is a step towards the foundation of a fully-equipped university in Hamburg, a project which has long been under consideration.

AFTER a meeting of the U.S. Cabinet on Tuesday it was stated that the President had received a communication from Mr. Carnegie on the subject of the creation of a fund for the extension of higher education. The amount said to have been offered is ten million dollars. It is understood (says the *Times* correspondent at Washington) that the proposal does not involve the establishment of university buildings at Washington, but that it is intended rather to place a fund in the hands of Government trustees, from which the expenses of deserving students may be paid for the encouragement of original research at home or abroad. It is believed that the proposal has not yet taken concrete form, except as regards its general terms and the amount of the gift. The President will consult with members of Congress with regard to the proposed gift before making its terms public.

MR. HANBURY, President of the Board of Agriculture, distributed the prizes at the Derby Municipal Technical College last week, and gave an address upon some aspects of technical education. In the course of his address he remarked that he believed that partly where the United States and Germany had the advantage of England was not in the technical education of their working classes, but among the great leaders of commerce and industry. Commercial education must spread from the top to the bottom. They wanted to have commercial instincts and business capacity instilled into their leading commercial men, even up to the universities themselves. England was far behind America in that respect. Twenty years ago there was only one college of the kind to which he referred in the States, and that was in Pennsylvania; now there were at least nine or ten universities in the Union which were giving that commercial education to the leaders of the country's commerce and industry. It was, unfortunately, the fact that they were lacking in a good system of secondary education. He hoped something would be done in the matter in the next session of Parliament. The foundation for the work of technical schools was a good, sound education, which could only be obtained in the secondary schools. This was the reason why at the present moment they did not find in technical schools those advanced students and day scholars which he hoped, under the new system, they would find flocking into them.

THE movement in favour of reformed methods of mathematical teaching can be assisted by discussions at provincial scientific societies and university centres. A discussion of this kind took place at the meeting of the Royal Glasgow Philosophical Society, held on December 6, Prof. Gray being in the chair, when the subject of the teaching of mathematics to engineers was opened by Prof. Barr. It was remarked by him that the engineer uses mathematics as a tool, and it is not essential for the man who uses tools to manufacture them. He did

not think it necessary that strict mathematical proofs should be given for everything. An engineer learned physical constants, and physical data might be taken for granted. He believed that the education of the engineer in mathematics would gain and not lose if instead of strict proof there was more of illustration. Prof. Barr gave the calculus an important position, but expressed his desire for the portable formulæ advocated by Prof. Perry. Dr. H. S. Carslaw, in the course of some remarks, said if teachers in schools would anticipate the teachers in the colleges by using graphical methods they would not hear mathematics spoken of as killing thought and destroying education. At present Euclid is given far too prominent a position in school work, with the result that algebra and trigonometry suffer. Prof. G. A. Gibson expressed general agreement with the views of Prof. Barr. He would not, however, insist too much on doing away with logical demonstration. The foundation for the teaching of mathematics should be laid at school, and he complained that two years of a schoolboy's life were worse than wasted by the enormous amount of rules which he had to commit to memory, which were of no intellectual interest and which he was almost certain to forget.

THE Education Committee of the General Medical Council presented a second report on the steps to be taken for the improvement of preliminary examinations at the meeting of the Council last week. Sir John Batty Tuke, chairman of the Committee, in presenting the report explained that in November, 1898, the Education Committee was asked to report when, in its opinion, it would be practicable to raise preliminary examination to the senior and higher standards. In June, 1899, the Committee reported, after consultation with a large number of educational authorities, that it would be better if educational experts were appointed to review the circumstances of all examinations. Experts were appointed, and in December, 1899, the Committee submitted a report, along with a report of the experts, who held that it was impossible to raise the standard to the senior or higher grade in the present condition of secondary education in Great Britain. Thereupon the experts were asked to state reasons for the belief. In March, 1900, they gave these reasons, and the Committee was then enabled to work upon certain fixed principles. The principal difficulty met with was how to produce a rise in the character of examinations in reality, a real *bonâ-fide* rise. It was easy to make an examination look more serious on paper than it really was. The Committee had not asked for this to be done, but had made representations to the various examining bodies, asking them to raise the standard of the pass-marks rather than increase the difficulty of an examination. Feeling that the Council had the true interests of education at heart, the various examining bodies had met the Committee in the most conciliatory spirit and had, wherever necessary, provided examinations in order to bring about a common good. The Committee expressed the opinion that it would not be practicable to raise the standard of the examinations until the state of secondary education in the country was in a less chaotic condition than it is now. The responsibility lay with the country, and it was sincerely to be hoped that the Government during the next session would bring forward a strong measure by which this important object might be attained. After some discussion, the Council adopted the motion "That the report of the Education Committee on the steps taken for the improvement of preliminary examinations be approved."

SCIENTIFIC SERIAL.

Bulletin of the American Mathematical Society, November.—On wronskians of functions of a real variable, by Prof. Bôcher, has for its object the settling certain questions connected with the subject so as to clear the way for further investigations—such as whether the roots of wronskians of sets of linearly independent solutions can have an infinite number of roots in a given interval, and also the question to what extent the theory of the adjoint (adjungirte) differential equation remains valid when the coefficients of the differential equation are not assumed to be analytic but merely continuous functions. To do this he considers the slightly more general subject of linear families of which the solutions of a homogeneous linear differential equation form a special case. The paper was communicated at the August meeting of the Society, as also was the following, on the configurations of the 27 lines on a cubic surface and the 28 bitangents to a quartic curve, by Prof. L. E. Dickson. After determining four systems of simple groups in an arbitrary domain of rationality which include the four systems of simple continuous groups of Lie, the author was led to consider the analogous problem for the five isolated simple continuous groups of 14, 52, 78, 133 and 248 parameters. The groups of 78 and 133 parameters are related to certain interesting forms of the third and fourth degrees respectively (Cartan's thèses), and these suggest certain forms discussed in the paper.—Dr. G. A. Miller gives an account of the mathematical work done at the fiftieth annual general meeting of the American Association for the Advancement of Science. There are given the titles, with abstracts, of twenty-five papers.—Prof. J. S. Ames reviews "Die partiellen Differentialgleichungen der mathematischen Physik" (nach Riemann's Vorlesungen in vierter Auflage neu bearbeitet von Heinrich Weber, erster bd. 1900, zweiter bd. 1901).—Amongst the notes are included the Cambridge mathematical courses for the current academic year.—New publications as usual.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 21.—"On the Properties of the Arterial and Venous Walls." By John A. MacWilliam, M.D., Regius Professor of Physiology in the University of Aberdeen. Communicated by Sir Michael Foster, K.C.B., Sec. R.S.

November 28.—"A Comparative Study of the Spectra, Densities and Melting Points of some Groups of Elements, and of the Relation of Properties to Atomic Mass." By Hugh Ramage, B.A., A.R.C.Sc.I., St. John's College, Cambridge. Communicated by Prof. Liveing, F.R.S.

It has been usual for investigators to rest satisfied when the properties of the elements were shown to be "a periodic function of the atomic mass." Diagrams drawn by the method employed in this paper will show in what degree the properties vary with the atomic mass, and will make it easier to establish the exact quantitative relations.

The work and results presented by the author make it clearer that the properties of the elements are fundamentally due to the structure, as revealed by their spectra, of the atoms rather than to the quantity of matter in them. It is inconceivable, for instance, that the change from calcium to strontium proceeded through the intermediate elements when we consider that the strontium molecules must have a similar structure to those of calcium. This structure is so simple that the fundamental (Bunsen flame) spectrum of each of these elements contains only one line attributed to the element. The anomaly, according to Mendeléeff's law, in the atomic masses of tellurium and iodine is further evidence of this. The properties of these elements may have nothing whatever to do with each other. They are, however, closely related to and in correct order with those of the elements of their respective groups. The genesis was not in the direction of tellurium to iodine, but from, or perhaps through, oxygen and fluorine respectively. So also is this the case with the other groups.

It is more probable that in the genesis of the elements the properties of certain fundamental matter are modified by successive additions of matter to them, or by causes of which this is to us the apparent result. The regularity in the changes in the properties of lithium, beryllium, boron and carbon, as seen in the diagrams, is very remarkable. It is, furthermore, very suggestive, for the changes in properties are approximately proportional to the quantity of matter in the atom in excess of a constant quantity (which is about 6), as if it were the same matter that is added in each case.

Geological Society, November 20.—Mr. J. J. H. Teall, V.P.R.S., president, in the chair.—Dr. Vaughan Cornish exhibited photographs of waves and ripples in water, cloud, sand and snow.—Notes on the Genus Lichas, by Mr. F. R. C. Reed. The Lichadidæ are divided into two great groups: (1) that with a pair of bi-composite lateral lobes to the glabella and a more or less definite fourth pair of lateral lobes; and (2) a group with a pair of tri-composite lateral lobes, through the fusion of the fourth pair with the bi-composite pair of the preceding group. Names are proposed for each group, and also, where necessary, for the eight sections, of subgeneric value, into which each group is subdivided. The

paper closes with a list of the British members of the family Lichadidæ, to show their distribution among the groups and sections.—Some remarks on the meteorological conditions of the Pleistocene epoch, by Dr. Nils Ekholm. The opinion of the author on this subject differs in some important respects from that of Mr. Harmer. He considers the subject under two heads: (1) What are the meteorological conditions necessary and sufficient to produce a permanent ice-sheet such as that of the Great Ice-Age? (2) What will be the influence of such glaciation on the meteorological conditions, especially on the cyclones and anticyclones, of the ice-covered land and on its neighbourhood? The snow-line does not correspond with the mean annual isotherm of 32°, for Verchojansk in Siberia is not glaciated, whereas the southern point of Greenland is. The former has a winter anticyclone, while the latter is traversed by the central or northern part of cyclones during the whole year. The area of Pleistocene glaciation in America and Europe coincides with the areas now traversed by the most regularly frequented storm-tracks. There seems to have been about the same difference between the mean annual temperatures of Europe and North America in the Great Ice-Age as now, and it is generally agreed that a lowering of the present snow-line by 1000 metres would give rise to a similar Ice-Age. The hypothesis that a glaciation of North America would raise the temperature of Europe, and *vice versâ*, seems to the author physically untenable. The positions and movements of anticyclones are not generally ruled by the ground temperature in our latitudes: they are in most cases eddies formed by the air-circulation in general, and in this the greater area and receipt of heat by the equatorial regions must always be a preponderating factor. The author considers that the influence of the Glacial Period on atmospheric circulation would probably be similar to that of a cold winter nowadays. The cyclones would be gradually deviated into a more and more southerly track, while an anticyclone would be formed in the north, not, however, a stationary one, but travelling like a cyclone, only more slowly and irregularly. The summer must have been cold and stormy, with frequent fogs, somewhat like that of Cape Horn or Kerguelen Island at the present day. The author considers that Mr. Harmer underrates the effect of insolation and overrates that of the winds. "The temperature of the summer only is essential for the phenomenon of glaciation."—On the origin of certain concretions in the Lower Coal-Measures, by Mr. H. B. Stocks. In certain of the Lower Coal-Measures of Lancashire and Yorkshire and in the "hard-bed coal," peculiar concretions known as "coal-balls" occur, which have a considerable interest because they contain well-preserved plant-remains. The author's analysis shows that they consist mainly of calcium-carbonate and iron-pyrites, in varying proportions. Carbonate of lime appears to have been introduced by osmosis through the cell-walls; and that it was introduced in small quantity and under exceptional circumstances appears to be proved by the comparative rarity of the concretions and their presence in this seam of coal only. During the decay of the vegetable matter of which coal is formed, in contact probably also with animal matter, some of the organic matter would pass into solution in water, causing the absorption of the oxygen in solution; the result of this is that further decay would take place under anaërobic conditions. This, occurring in water containing sulphates, would give rise to sulphuretted hydrogen and mud blackened by the presence of ferrous sulphide, while carbonates would also be produced. Experiments were tried (1) on the precipitation of carbonate of lime under varying conditions (in presence of organic matter, &c.); (2) on the action of salts of lime and of iron on wood; and (3) on the action of bacteria on solutions containing calcium-sulphate in solution and ferric oxide in the deposit. In the first series carbonate of lime was deposited in spheres; in the second it was found that iron-salts are preservatives but lime-salts are not; and in the third, black mud largely consisting of ferrous sulphide was produced, while the calcium-sulphate was converted into carbonate. It is considered that these experiments explain the origin of the "coal-balls."

Linnean Society, November 21.—Prof. S. H. Vines, F.R.S., president, in the chair.—Dr. A. B. Rendle showed specimens of *Rubus australis*, Forster, the New Zealand "lawyer-vine," which had been sent by Mr. F. W. Burbidge from the Trinity College Botanic Gardens, Dublin. The specimens, which comprised three forms, furnished a striking example of variability within the range of a single species. One, the leafy form, bore leaves with three large leaflets somewhat prickly on the stalks and midrib, recalling our native blackberry. In an intermediate form the leaflets were much reduced in size, while the stalks were longer and much more prickly. In a third the flat leaf-surface had completely disappeared, the leaves now consisting of an elongated stalk bearing long naked midribs, beset, like the leaf-stalks and the stem, with strong, short, recurving prickles, by means of which the plant climbs over surrounding vegetation. Mr. Burbidge states that the three forms are from three distinct plants, reared from seeds sent from New Zealand; they are said to be permanent under cultivation.—The president gave some account of his investigation of the proteolytic enzyme of Nepenthes. He began by pointing out that in the higher animals there are two distinct proteolytic enzymes: (1) pepsin, secreted by the stomach; (2) trypsin, secreted by the pancreas. The action of pepsin upon the more complex proteids (albumin, fibrin, &c.) is to convert them by hydrolysis into simpler proteids known as peptones; whereas the action of trypsin is not only to convert these proteids into peptones, but, further, to decompose the peptones into non-proteid nitrogenous substances, such as leucin, tyrosin, &c. Among these final products of tryptic digestion there is a substance termed tryptophan, which has the property of giving a pink or violet colour on the addition of chlorine-water. Hence this colour-reaction may be used as a means of determining the nature of the digestion to which any proteid may have been submitted. As the result of previous researches upon the nature of the digestion effected by the enzyme of Nepenthes, the president had come to the conclusion that it was not peptic, as had been supposed, but essentially tryptic. This conclusion has recently been called in question by Clautriau (Acad. Roy. de Belgique, 1900), who reasserts the peptic character of the enzyme. By means of the tryptophan-reaction, which is readily given by the products of a Nepenthes digestion, the president has been able to establish the correctness of the view that the enzyme is tryptic. The tryptophan-reaction has also been found to be given by a number of extracts of plants which are known to contain a proteolytic enzyme; for instance, pineapple-juice, papaïn, figs, germinating bean-seeds, &c. It seems probable, therefore, that proteolytic digestion in plants is always tryptic—that there is, in fact, no peptic enzyme in plants. But there is this peculiarity about the trypsin of plants, that it has to work in an acid medium.—A paper by Mr. T. F. Cheeseman on the flora of Rarotonga was read on his behalf by Dr. O. Stapf, who also showed some of the more interesting plants collected on the island.

Entomological Society, November 20.—Mr. G. H. Verrall, vice-president, in the chair.—Mr. A. H. Jones exhibited various Lepidoptera from the Cevennes, including a series of *Lycaena dolus*, var. *vittata*, *L. damon*, *L. meleager*, *Melanargia iapygia*, var. *cleanthe*, and *M. galatea ab. leucomelas;* also a dark form of *Thais cerisyi* bred from a pupa received from Armenia. He also exhibited a specimen of *Vanessa antiopa* taken this year at Eltham, and two specimens of *Cerastes erythrocephala* bred from ova laid by parent moth captured at sallows near Canterbury.—Mr. H. Rowland-Brown exhibited a remarkable var. of *Melitaea didyma*, taken at Chateau de la Câze, Tarn, in which the black markings of the under wings were almost entirely absent, and a series of *Lycaena dolus*, var. *vittata*, from the Cevennes, with *L. admetus*, var. *rippertii*, from Digne, showing the remarkable affinity of the two species, which, however, were never found on the same ground or in the same localities while collecting.—Dr. Chapman exhibited butterflies taken by himself and Mr. G. C. Champion in the Sierra Albarracin, Spain, last July, practically the same district as that traversed and described by Mrs. Nicholl in her paper in the Society's Transactions for 1897, and not many new butterflies were added to Mrs. Nicholl's list. *Z. quercus* was taken at Tragacete. *Augiades sylvanus* was taken both at Albarracin and Tragacete. *Adopaea actaeon* was met with a Cuenca (Castile), while *Adopaea linea* seemed to be more abundant than *A. lineola* at all stations. *L. hylas* and its variety *nivescens* were found on the same ground. The common form of *L. corydon* seemed to be *corydonius* or near that variety, while the very large pale form *hispana* was the commonest at Albarracin, where the *corydonius* form was rare.—Mr. L. B. Prout exhibited and commented upon a number of Geometridæ also taken by Dr. Chapman and Mr. Champion in Spain.—Mr. F. Merrifield exhibited specimens of *Pieris rapae* and *Pieris ergane* from

Dalmatia, showing that the two species are extremely difficult to separate, even if they are not identical.—Mr. C. P. Pickett exhibited varieties of *Argynnis paphia* and *A. aglaia* from the New Forest.—Mr. C. J. Watkins sent for exhibition micro-photographs of the larva in its case and the perfect insect of an *Oxyethira*, one of the *Hydroptilidae*, a family of *Micro-Trichoptera;* these had been taken by Mr. Mearns, of Aberdeen. Also a drawing made by himself under the microscope of a larva (in its case) of the same genus.

Royal Microscopical Society, November 20.—Mr. Wm. Carruthers, F.R.S., president, in the chair.—Four microscopes of great interest were presented to the Society. Descriptions of three of these prepared by Mr. Nelson were read. With regard to one made by Powell and Lealand in 1848. Mr. Nelson writes:—This form was the first instance in which the microscope was hung in a tripod, and it was also the first where the fine adjustment moved a nose-piece by means of a lever inside a bar movement, and this specimen must have been about the last microscope made with the fine-adjustment screw at the side of the bar, for it was in this year, 1848, that the screw was placed vertically above the lever, where it has remained ever since. Other features were referred to, and Mr. Nelson characterised it as historically an important and not very common form of Powell and Lealand's microscope. The next microscope described was an old one made by Hugh Powell, certainly before 1841, as in that year Mr. Lealand joined the firm, and his name would have been coupled with that of Powell, and the presence of a substage condenser prevents it being dated earlier than 1839. An important feature is the stage, which has an arrangement for focussing by means of three wedges, moved by a micrometer screw. The stage has also a transverse micrometer movement for the measurement of objects. The third microscope was made by John Cuff. The date of its introduction was 1744 and it was called "A New Constructed Double Microscope." After the John Marshall microscope this is historically one of the most important instruments in the Society's collection. The other microscope presented was made by Plössl and Cie, Vienna, and has already been described in the *Journal* of the Society.—Messrs. R. and J. Beck exhibited a new pattern microscope embodying several new features. The substage was fitted with coarse and fine adjustments and means of throwing out the condenser while it was in focus. The stage, 5 inches diameter, was rotating and graduated on the periphery, with a removable mechanical stage graduated as a finder. The body was very short, fitted with double draw tube, which allowed the body to be extended to 11½ inches. The body was fitted with Ashe's new double fine adjustment.—Mr. Conrad Beck gave an exhibition of antipoints, and said they were extremely difficult to show on account of the trouble there was in obtaining points of light sufficiently small and bright, and it was only possible to obtain faint images with so much diffused light as there was in that room. There were six microscopes, all having ½-inch objectives, and the points of light in the first two cases were produced by minute apertures in tinfoil, in the others the light was reflected from small mercury globules. With the first microscope a point of light was viewed with ½-inch objective of ordinary aperture and showed a *point* of light surrounded with faint diffraction circles. With the second microscope a similar point of light was viewed with a ½-inch objective of very small aperture and showed a *disc* of light and diffraction rings. The other microscopes showed the effects produced by placing various stops behind the objectives, and also by viewing the point of light through a grating which extended the whole aperture of the objective. Mr. J. W. Gordon said he had listened with great interest to Mr. Beck's explanation of the demonstration and was anxious to see the examples, and no doubt the experiments would demonstrate the existence and appearance of the antipoint in each case; but there was another and equally important image which he would like to see and that was the antipoint which was formed in the eye, and he hoped some day Mr. Beck would be able to give a demonstration of this.—A paper on stereomicrography, by Prof. G. P. Girdwood, of M'Gill College, Montreal, was read by the secretary. Prof. Girdwood's method of obtaining stereo-microphotographs was by placing the slide or object in a tilting frame attached to the stage of the microscope. The frame with the object was tilted to one side to the proper angle and a photograph was taken; the frame was then tilted to an equal amount in the opposite direction and another photograph was taken. Prints from the negatives were then mounted in the usual way to form stereoscopic pictures. The paper was illustrated by a diagram on the blackboard, and a specimen of the stereoscopic photographs, placed in a stereoscope, was passed round the room.

DUBLIN.

Royal Dublin Society, November 20.—Prof. W. Noel Hartley, F.R.S., in the chair.—Prof. T. Johnson gave an account of the results of field experiments he had conducted during the past two years in the west and north-west of Ireland in the prevention of "smut" (*Ustilago avenae*, Jens.) in oats. The fungicides used were potassium sulphide (weak and strong solution), copper sulphate, formalin alone, and followed by ammonia, and the new fungicide "sar" (essentially sodium sulphide) recommended by the United States Department of Agriculture. The latter was found by the author to be the most efficient remedy.—Dr. F. T. Trouton, F.R.S., described some experiments made by him at the request of the late Prof. G. F. FitzGerald, in which it was sought to detect an effect depending on the relative motion of the earth and ether. A charged condenser placed with its plates edgeways to its motion through the ether should possess a magnetic field. The question to be investigated was the source of the energy for this field. FitzGerald's supposition was that at the moment of charging the condenser should experience an impulse in the direction opposed to its motion and on discharging in the direction of motion. A condenser was therefore delicately suspended at the end of a cross-arm with a balance weight at the other end held by a torsion wire. The arm stood north and south and it was sought to detect at 12 o'clock if there was an impulse acting on the condenser when it was charged and discharged. This was effected synchronously with the period of the apparatus by a clock. No effect was observed though the calculated effect was long within the range of delicacy. FitzGerald had anticipated the possibility of a negative result being obtained through the same cause as was suggested by him and Lorenz to account for the negative results obtained by Michelson and Morley in their interference experiments, namely, the alteration in the weight of matter with direction of motion through the ether. The alteration thereby produced in the electrostatic energy would in this way provide the necessary energy for the magnetic field. The author pointed out that if it be thought that the energy from the magnetic field is attributable to the charging battery, it follows that charge condensers tend to set themselves at right-angles to the earth's motion through space. For on this hypothesis a condenser charged in the latter position and rotated must have work done on it to energise the magnetic field thereby produced. Thus, in this case it would be a couple that should be looked for and not a directed impulse. He proposed to test this by delicately suspending a light condenser charged to a high voltage. It was also pointed out that if this were true it would be possible to obtain continuous rotation thereby, and thus to construct a machine to utilise the vast stores of energy in the earth's motion through space.—Prof. W. N. Hartley read a paper on haze, dry fog and hail. Last February a paper by the author, conjointly with Mr. Hugh Ramage, was communicated to the Royal Society, on the mineral constituents of dust and soot from various sources. Solid particles brought down by rain, hail, snow and sleet were submitted to analysis by means of the spectrograph, an instrument by which the composition of very minute quantities of substances is ascertained by photographing their spectra. For comparison with these different kinds of dust, and to ascertain their origin, the spectra of various other kinds of matter were photographed, for instance, meteorites, volcanic dust, soot, and flue dust from different chemical works and iron smelting furnaces. The result of this examination showed that the origin of the dust could in certain cases be ascertained from its composition. In the present paper the author described the discharge of vast volumes of dust and fume at very high temperatures into the upper atmosphere which he had observed in furnace operations at various metallurgical works in England and Wales. He had arrived at the conclusion that such material as had fallen in Ireland was the product of the industrial centres of South Wales or South Staffordshire and possibly the pottery district of North Staffordshire. In certain cases it may have come from the centre of the alkali manufactures about Widnes in Lancashire and Runcorn in Cheshire. There is also a likelihood that the neighbourhood of Glasgow contributes a good deal, as, for instance, on the occasion in 1898, when with a slight north-easterly wind black rain fell in Ireland over an area of 500 square miles.

EDINBURGH.

Royal Society, November 18.—Lord M'Laren in the chair.—In a paper on the equilibrium of stellar atmospheres, Dr. Halm applied the principles of thermodynamics to the problem of the convective equilibrium of masses of gas such as constitute the atmospheres of celestial bodies. A theoretic formula was established from which, under given conditions of boundary temperatures, the minimum temperature consistent with convective equilibrium could be calculated. In the case of our own atmosphere, it appeared that thermostatic equilibrium could exist when the temperature was lower than 45° or 50° F.; but that at higher temperatures the equilibrium must be convective. In the case of the sun, however, it was found that even with very extreme assumptions as to the temperature of the uppermost layers of the atmosphere there could be a layer of only inappreciable thickness in which thermostatic equilibrium was maintained. The equilibrium was practically convective throughout the whole mass, a result in full accordance with the facts of observation. The theory also gave a formula for calculating the height of a stellar atmosphere. When applied to the case of the sun the height of the hydrogen atmosphere came out much smaller than the observed height—a discrepancy which may be removed by the assumption that there is dissociation going on, so that the specific heat of hydrogen greatly increases at the higher temperatures. A full discussion of these and related results was held over for a subsequent paper.—Dr. Peddie read a paper on quaternion binaries, an extension of quaternions giving an eight-element system applicable to ordinary space. In this system vectors are regarded as translators only. A special operator R transforms them into rotors, and a second application of the same operator transforms the rotor into a translator. The system is formally Hamilton's, with the removal of the restriction that vectors shall act as translators in addition and as rotors in multiplication. The quantities ijk being unit rectangular vectors, the fundamental equations may be written

$$Rij = k,\ Rjk = i,\ Rki = j,$$
$$i^2 = j^2 = k^2 = -1,\ R^2 = +1.$$

The fundamental properties of the quaternion binary $B = q + Rr$, where q and r are quaternions, were investigated, the applications being restricted to the theory of screws, in particular to screws upon a cylindroid.—Prof. Chrystal, in a further note on Miller's trisectrix, pointed out its relation to the quartic trisectrix, and exhibited a seven-bar linkage for tracing all varieties of limacon. It was built up of a rhombus guided in its motions by two contraparallelograms.

PARIS.

Academy of Sciences, December 2.—M. Fouqué in the chair.—On the essential singularities of differential equations, by M. Paul Painlévé.—Observations of Leonids made at Athens, by M. D. Eginitis. On the nights of November 14, 15 and 16 the conditions were favourable for observations, and in all some 147 meteors were seen. They were generally red and brilliant, and appeared to radiate from two distinct points separated by some degrees.—On the deformation of surfaces and of quadrics in particular, by M. L. Raffy.—On the number of roots common to several equations, by M. G. Tzitzeica.—On an application of the prism of Govi to the realisation of an apparatus for verifying rules, by M. A. Lafay.—A method allowing of the evaluation in absolute measure of very low temperatures, by M. Henri Pellat. It has been known for some time from the researches of Lord Kelvin that the rate of change of the electromotive force of a thermocouple with the temperature is equal to the ratio of the coefficient of the Peltier effect to the absolute temperature. A method is sketched out by the author in which this relation is applied to the practical calibration of a thermocouple in absolute temperatures. It is estimated that the method would permit of an accuracy of 0°·5 in the neighbourhood of 150° C. absolute, and of from 1° to 1°·5 at 75° and 20° absolute.—The application of the Lagrangian equations to electrodynamical phenomena, by M. E. Carvallo.—On the disruptive discharge in electrolytes, by M. H. Bagard. Methods are described by which the results obtained by MM. Broca and Turchini in the case of disruptive discharge of electrolytes that are good conductors can be reproduced in a much simpler manner.—On the spark of the Hertz exciter, by M. C. Tissot. A photographic study of the sparks given by a transmitter used in wireless telegraphy shows that the images of successive sparks are not rigorously equidistant, the first being always longer than the others. This appears to be connected with the fact observed by M. Hemsalech, that the spectrum of the first discharge contains only air lines, whilst the rays of the metal appear in the others.—On the induced radio-activity produced by radium salts, by MM. P. Curie and A. Debierne.—The influence of radio-active substances on the luminescence of gases, by M. Alix de Hemptinne. It has been found that if a radio-active substance is brought near a tube containing air at low pressure and submitted to electrical vibrations, it becomes luminous at a higher pressure than is the case if the radio-active substance is not present, the light, which was of a violet-red colour in the latter case, being a greenish-yellow under the action of the radium.—Contribution to the study of the tin-aluminium alloys, by M. Leon Guillet. Two well-defined alloys of tin and aluminium have been isolated in the form of crystals, corresponding to the formulæ AlSn and Al_4Sn.—The action of pyridine bases on the tetra-halogen derivatives of quinones, by M. Henri Imbert.—On *Dorstenia klaineana*, and on the chemical composition of its root compared with that of *Dorstenia brasiliensis*, by MM. Heckel and F. Schlagdenhauffen.—The composition of the reserve carbohydrates in the albumen of the seeds of some Liliaceæ and in particular of the butcher's broom, by M. Georges Dubat. The hydrolysis of the seeds gives about 70 per cent. of reducing sugars, of which about one-fifth is invert sugar, two-fifths glucose, and two-fifths mannose.—On the constitution of wheat, by M. E. Fleurent.—On the modifications which the hæmoglobin of the blood undergoes under the influence of a reduction in the atmospheric pressure, by M. J. Vallot. From experiments carried out on Mont Blanc it was found that the rarefaction of the air produces immediately, in man an increase in the activity of the exchanges, tending to compensate the deficiency of oxygen. Fatigue tends to oppose this increase, and may so far overbalance it as to produce mountain sickness. But this effect disappears after prolonged rest at a high altitude, and the increase in the activity of the exchanges goes on for some time until the body becomes acclimatised. On descending, the return to the normal rate of exchange is prolonged in proportion to the length of sojourn above.—The physical and chemical phenomena of respiration at different altitudes during a balloon ascent, by MM. J. Tissot and Hallion.—New researches on the dissociation of carbonoxyhæmoglobin, by M. N. Gréhant. The destruction of carbonoxyhæmoglobin existing in the blood is much more rapid when pure oxygen is breathed than when air is breathed; in the latter case the amount of carbon monoxide in the blood remains constant for nearly twenty minutes after the breathing is commenced.—Researches on the effect of the stings of *Latrodectus 13-guttatus*, by M. L. Bordas. In Corsica and other countries the effect of these stings is considered very dangerous, but it is shown in the present series of experiments that such stings are never mortal in man or the larger animals, although proving rapidly fatal to certain insects, coleoptera and orthoptera.—The influence of diseases of the parents upon the imperfections of the offspring. Tuberculous lesions without microbes, by MM. A. Charrin and Gabriel Delamere.—On two diseases of the leaves of chrysanthemums not previously described, by M. H. Joffrin.—On the existence of a principle, toxic to the pear tree, in the berries, seeds and stems of mistletoe, by M. Émile Laurent.—The phenomena of the capture of superficial water courses by subterranean streams in calcareous districts, by M. E. Fournier.—On the three crystophyllian series of the western Alps, by M. Pierre Termier.—Experimental complement to the history of the striated gravels, by M. Stanislas Meunier.

NEW SOUTH WALES.

Royal Society, October 2.—Mr. H. C. Russell, C.M.G., F.R.S., president, in the chair.—On the relation between leaf venation and the presence of certain chemical constituents in the oils of the Eucalypts, by Mr. R. T. Baker and Mr. Henry G. Smith. In this paper the authors show that there exists a marked agreement between the venation of Eucalypts leaves and the characteristic constituents in their oils. The venation shown by the leaves of the "bloodwoods" *E. corymbosa*, *E. trachyphloia*, &c., is indicative of a predominance of pinene in the oils and an absence of phellandrene. It is this end of the Eucalyptus series that is more closely associated with the Angophoras, because the venation of the leaves is similar and the chemical constituents in agreement.

As the series descends through such species as *E. botryoides*, *E. saligna*, &c., we reach those Eucalypts of which the principal oil constituents are pinene and eucalyptol, the latter constituent increasing in amount until such excellent eucalyptol oils as those of *E. globulus*, *E. Smithii*, *E. longifolia*, &c., are reached. The venation of the leaves of these species is similar, is more open, the individual lateral veins having become more distinct, and with the bending of the marginal vein, commencing to form the looping so characteristic of the phellandrene-peppermint group, the species of which include those of *E. dives*, *E. radiata*, *E. amygdalina*, *E. Sieberiana*, &c. The principal constituent in these oils is phellandrene, and at the extreme end this constituent is present in such abundance as to exclude, almost entirely, the eucalyptol. The pinene which was such a prominent constituent in the oils of the earlier members of the series is only present in the oils of this group in minute quantities. The looping appearance of the venation of the members of the phellandrene-peppermint group has become more open, and the spaces between the principal lateral veins are larger. With the subordination of many of the original lateral veins the spaces provided for the formation of the oil glands is larger, and consequently we find these more numerous in the members of this group; the yield of oil obtainable is therefore much greater, and it is this feature which enables such enormous yields of oil to be obtained from such species as *E. amygdalina*, *E. dives* and *E. radiata*.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 12.

ROYAL SOCIETY, at 4.30.—On the Action of the Spurge (*Euphorbia hiberna*, L.) on Salmonoid Fishes: Dr. H. M. Kyle.—Contributions to the Chemistry of Chlorophyll. No. VIII. Changes undergone by Chlorophyll in passing through the Bodies of Animals: Dr. E. Schunck, F.R.S.—The Result of Chilling Copper-Tin Alloys. Second Communication. C. T. Heycock, F.R.S., and F. H. Neville, F.R.S.—The Effective Temperature of the Sun: W. E. Wilson, F.R.S.

MATHEMATICAL SOCIETY, at 5.30.—Flexure of a Circular Plate: J. H. Michell.—Non-uniform Convergence, and the Integration of Series: Dr. Hobson, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Physical Properties of certain Aluminium Alloys and some Notes on Aluminium Conductors: Prof. E. Wilson (conclusion of discussion).—Some Principles underlying the Profitable Sale of Electricity: Arthur Wright.

CHEMICAL SOCIETY, at 8.—Extraordinary General Meeting.

FRIDAY DECEMBER 13.

PHYSICAL SOCIETY, at 5.—On Circular Filaments and Circular Magnetic Shells equivalent to Circular Coils, and on the Equivalent Radius of a Coil: Prof. Thomas R. Lyle.—Air Pressures used in playing Brass Instruments: Dr. Barton and S. C. Laws.—A New Hygrometric Method: E. B. H. Wade.

ROYAL ASTRONOMICAL SOCIETY, at 5.—The Observed Motion and Duration of the Radiant Point of the Leonids: W. F. Denning.—Observations of Nova Persei: J. E. Gore.—Apparent Paucity of the Leonid Stream: Rev. S. J. Johnson.—Contribution to the History of the Reflex Zenith Tube: S. C. Chandler.—*Probable Papers*: On the Accuracy of Measures on Photographs: Remarks on Recent Papers by M. Lœwy and Mr. H. C. Plummer: A. R. Hinks.—Description of Adams's MSS. on the Perturbations of Uranus: R. A. Sampson.

MALACOLOGICAL SOCIETY, at 8.—On the Anatomy and Relationships of *Voluta musica*, Linn.; with Notes upon other supposed Members of the *Volutidae*: S. Pace.—Descriptions of a New East African *Ennea* and a N.W. Australian *Thersites* (*Rhagada*): H. Fulton.—*Eulota blakeana*, Newc., and *E. luna*, Pils.: G. K. Gude.—Note on the Pairing of *Pyramidula rotundata* with *Vitrea lucida*: Mons. Caziot.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—Dysentery in Asylums: Dr. Mott, F.R.S.

SATURDAY, DECEMBER 14.

ESSEX FIELD CLUB (at Essex Museum of Natural History, Stratford), at 6.30.—Contributions to the Pleistocene Geology of the Thames Valley. I. The Grays Thurrock Area, Part II.: A. C. Hinton and A. S. Kennard.—The Water-Mites (Hydrachnidæ) of Epping Forest: C. D. Soar.—Manganiferous Nodules in the Boulder-clay Soils of Essex: Miss Thresh.

MONDAY, DECEMBER 16.

SOCIETY OF ARTS, at 8.—The Chemistry of Confectioners' Materials and Processes: William Jago.

IMPERIAL INSTITUTE, at 8.30.—The Economic Resources of the Straits Settlements and the Malay Peninsula: H. N. Ridley.

TUESDAY, DECEMBER 17.

ZOOLOGICAL SOCIETY, at 8.30.—On the Structure of the Larval *Polypterus*: J. S. Budgett.—On the Spawn and Young of a Polychæte Worm of the Genus *Marphysa*: L. A. Borradaile.—On the Anatomy of Gruiform Birds, with Special Reference to the Correlation of Modifications: Dr. P. Chalmers Mitchell.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Motive Power from Blast-furnace Gases: Bryan Donkin.

ROYAL STATISTICAL SOCIETY, at 5.—The Suspension of the Berlin Produce Exchange, and its Effect on Corn Prices: R. H. Hooker.

WEDNESDAY, DECEMBER 18.

SOCIETY OF ARTS, at 8.—Range Finders: Prof. George Forbes, F.R.S.

GEOLOGICAL SOCIETY, at 8.—Coal- and Petroleum-Deposits in European Turkey: Lieut.-Colonel Thomas English.—(1) On the Geological and Physical Development of Dominica, with Notes on Martinique, St. Lucia, St. Vincent and the Grenadines; (2) On the Geological and Physical Development of Barbados, with Notes on Trinidad: Prof. J. W. Spencer.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Further Observations and Conclusions in relation to Atmospheric Transparency: Hon. F. A. Rollo Russell.—Remarkable Phosphorescent Phenomenon observed in the Persian Gulf, April 4 and 9, 1901: W. S. Hoseason.—On the Mechanical Principle of Atmospheric Circulation: Captain R. A. Edwin, R.N.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Development and Structure of Eyes, illustrated by Micro-slides: F. W. Watson Baker.

THURSDAY, DECEMBER 19.

LINNEAN SOCIETY, at 8.—On the Brain of Recent and Fossil Lemurs: Dr. G. Elliot Smith.—On the Ostracoda collected round the Funafuti: F. Chapman.—Exhibitions: A Gigantic Argulus from Japan and a Specimen dredged at the Cape: Prof. G. B. Howes, F.R.S.—A New Polyzoon from Tanganyika: J. E. S. Moore.—An Example of White's Thrush (*Turdus varius*), shot near Clavering, Essex: Miller Christy.

CHEMICAL SOCIETY, at 8.—(1) Corydaline. Part VII. The Constitution of Corydaline; (2) The Relation of Corydaline to Berberine. The Oxidation of Berberine with Nitric Acid: J. J. Dobbie and A. Lauder.—The Magnetic Rotation of some Polyhydric Alcohols, Hexoses, and Disaccharoses: W. H. Perkin, F.R.S.—Stereoisomeric Halogen Derivatives of α-benzoylcamphor: H. O. Forster and F. M. G. Micklethwait.—Is Argon an Elementary Substance? G. Martin.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

FRIDAY, DECEMBER 20.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Transmission Dynamometers: A. M. Morgan.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Microscopical Examination of the Alloys of Copper and Tin: W. Campbell.

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