THURSDAY, MARCH 31, 1904.

SCIENCE IN THE DAYS OF THE INQUISITION.

Giordano Bruno. By J. Lewis McIntyre, M.A., D.Sc. Pp. xvi+365. (London: Macmillan and Co., Ltd., 1903.) Price 10*s.* net.

Galileo: His Life and Work. By J. J. Fahie, M.I.E.E. Pp. xvi+451; with 27 illustrations. (London: John Murray, 1903.) Price 16*s.* net.

IT is a remarkably opportune coincidence that these two volumes, dealing as they do with the lives of two pioneers of science of the Italy of three hundred years ago, should have appeared almost simultaneously. Each book would be interesting in itself, but when taken together the lives of Bruno and Galileo afford us a striking insight into the state of scientific knowledge at the commencement of the seventeenth century, the great advances made by the philosopher and the physicist, each working on independent lines, the opposition which their labours aroused and the manner in which that opposition was affected by the character of the new ideas which they propounded

Whether we read the life of Bruno or of Galileo we find the same story told regarding the obstacles against which the two workers had to contend. These were (1) the widespread and deeply-rooted belief in Aristotle, (2) the prevailing opposition to the Copernican doctrine, and (3) the hostility of the Church of Rome towards any philosophy or doctrine which could be interpreted as coming into conflict with the teaching of the Bible, even though the exponent himself was at heart a zealous churchman.

The philosopher was necessarily brought into conflict with these influences at every step of his progress; not so the mathematician and physicist, who, so long as he came before the world as an inventor only, was standing on safe ground on which he could gain for himself an immense reputation. Accordingly, we find that while Bruno met with an early martyrdom, and his works sank into an oblivion from which they were not rescued until recently, Galileo's fame never suffered extinction, and the petty persecutions to which he was subjected are believed by the present writer of his life to have stopped short of actual personal torture.

Giordano Bruno was born at Nola, near Naples, in 1548, and at the age of fifteen entered the Dominican monastery at Naples. His advanced views soon brought him into trouble. In 1576 he left Naples, and, after sojourning three years in various parts of Italy, he arrived finally in Geneva, where he appears to have found the Calvinistic spirit of the times but little less narrow-minded and little more tolerant than the Catholicism which he had left behind in Italy. At Paris he met with an enthusiastic reception, gaining the support and admiration of King Henry III. Here he brought out his works "De Umbris," "Ars Memoriæ," "Cantus Circæus," "De Compendiosa Architecturâ," and his comedy, "Il Candelaio"; moreover, he was appointed to a university readership.

Not contented, however, he migrated to England and tried to establish a footing in Oxford, where he found little encouragement from a University in which implicit belief in the teachings of Aristotle was enforced by fines and penalties. His career was cut short by his success in "flooring" his opponent in a controversy. We note among many other interesting points that "what Bruno condemned in Oxford was the undue attention it gave to language and words, to the ability to speak in Ciceronian Latin, and in eloquent phrase, neglecting the realities of which the words were signs." In London the French Ambassador, Mauvissière, gave him a home, and he became acquainted with Sidney, Greville and other distinguished men. "No fewer than seven works from Bruno's facile pen were published in England." His experiences of English life in the Elizabethan times are interesting reading, but the English attitude of indifference to his teachings appears to have been highly irritating to a man of his disposition. At Wittenberg (1586–1588) he lectured to a sympathetic and appreciative university, and published a number of important books; as his biographer remarks, it was the last or nearly last spell of happiness that life had in store for him. At Helmstadt he was less fortunate, being excommunicated by the pastor Boethus. In 1590 he left for Frankfort, where he superintended the printing of his two great works "De Minimo" and "De Immenso."

Bruno's desire to be received back into his church probably formed one of his motives for accepting an invitation from one Mocenigo, of Venice, which proved to be his death-trap. A few months later he was denounced to the Inquisition, his case came before a tribunal, and he was sent to Rome, where, after a period of incarceration of about seven years, he was burnt as a heretic.

Of Bruno's philosophy we can only touch on a few points. He believed in an infinite deity and an infinity of worlds, his argument in favour of the latter doctrine being based on the perfection of the universe. There is room in the universe for an infinity of worlds, Bruno would contend, and a universe containing them must be more perfect than one without them, therefore we cannot believe in Divine perfection without admitting their existence. Of the "coincidence of contraries," now better understood to mathematicians as the "change of sign in passing through infinity, Bruno gives some illustrations which nowadays appear curious. For example, the coincidence of infinitely quick and infinitely slow motions is deduced from the fact that a body moving infinitely quickly in an orbit is at every instant at every point of the orbit and, "therefore, it stands still" (p. 179). His notion of matter as atomic (p. 241) led Bruno in "De Minimis" to formulate a geometry, offered as a simplification of Euclid, of which it is difficult to judge by existing standards. In regard to rectifying the circle through the ultimate coincidence of arc and chord, he agreed fairly well with modern theory, but he did not admit that a figure of one shape could ever be equal to a figure of another shape except approximately. An angle, though it could be multiplied indefinitely, could

only be divided into two equal parts; a circle had not an infinite number of radii, for from the centre only six lines could be drawn; a line could not always be bisected, for it might contain an odd number of atoms, and geometrical bisection was at best an approximation.

In his views on the value of riches, on progress, peace, happiness and such matters there is little to which objection could be raised nowadays. He appears to have believed in the transmigration of souls. In other matters of religion he arrived at views not differing much from those of a thinking man of the present age. He approved of religious worship as appealing to a class of intellect to which a purely philosophical religion would be incomprehensible.

Against the philosophers who, in the words of Socrates, "think they are wise when they are not," Bruno casts many a dash of sarcasm. "Many of the Peripatetics," he says in the *Cena*, "grow angry and flush and quarrel about Aristotle, yet do not understand even the titles of his books" (see p. 122). Does not this represent the position of the average present-day politician in regard to the Fiscal Question?

Bruno's philosophy was so far in advance of the narrow views of his time that he could not fail to make enemies. His endeavour to influence men for the better brought on him a fate which others had shared before him, and his name was quickly forgotten, not to be restored until nearly two centuries later.

The discoveries of Galileo have been brought more conspicuously before the world than the philosophy of Bruno, and their study presents little difficulty to the least advanced student of physics; nevertheless, there is much for everyone to learn from a perusal of this excellent biography. His discovery of the pendulum, whether from observations of the famous "Lampa di Galileo" at Pisa or otherwise, his restatement of the principle of Archimedes, his claims to be regarded as the inventor of the telescope, his discoveries of Jupiter's satellites, and of the appendages of Saturn, recognised as a ring forty-six years later by Huyghens, his observations of the crescent form of Venus, of the mountains of the moon, and of sun-spots, his attempts to solve the problem of longitude at sea by means of Jupiter's satellites, his investigations on floating bodies, and on uniformly accelerated motion, his discovery of the librations of the moon, his geometrical and military compass, all these and many other results of his genius are well and faithfully described.

In regard to the telescope we infer that, although the inverting telescope had been previously arrived at by accident by Dutch opticians, Galileo's erecting telescope with concave eyepiece embodied a different principle, but the biographer might have made this point clearer.

Of the difficulties against which Galileo had to contend much is said. His futile early attempts to obtain a chair of mathematics met at last with success at Pisa when he was only twenty-five, but his salary there was but 13*l.* per annum. Moreover, his refusal to adopt blindly the doctrines of Aristotle brought him into conflict with the University authorities, who showed their animosity against him by fining him for loss of lectures and by the countless little persecutions which the dons of unenlightened universities have from the earliest times brought to bear against men of independent reasoning power. The same hostility against Galileo was maintained by Pisa up to the end.

His happiest years were spent as professor at Padua, where students from all parts of the world flocked to hear his lectures and to receive private tuition from him. His classes overflowed the great hall of the university, and he even had to lecture in the open air. His discoveries attracted the admiration and esteem of the great potentates of the age, and his telescopes were eagerly sought for. His very success was indirectly the cause of his later troubles. That there is no rest but the grave for the pilgrim of science is well illustrated by his experience. For though his public duties only occupied him for sixty half-hours in the year (p. 118) his time was so taken up with private pupils that he gladly accepted an offer from his friend and old pupil, Cosimo II., Grand Duke of Tuscany, of a permanent endowment for research under the title of First Mathematician and Philosopher.

So long as he was under the Venetian Republic Galileo breathed in a free atmosphere. A comparison with Bruno's unfortunate experience in no way contradicts this view. Galileo was only appointed at Padua in September, 1592, about two months after the Venetian tribunal had concluded its sittings on Bruno, and it further appears that the State offered considerable resistance to Bruno's extradition, and only yielded to Papal pressure after it had been pointed out that Bruno was not a Venetian subject, and further that he was the subject of charges instituted previously in Naples and Rome. It was not till eighteen years later that Galileo left Padua for Florence, where his real troubles began. The discoveries of his telescope excited the hostility of the Aristotelian faction, and they supported the Copernican doctrine to such an extent as to bring him under the ban of the Romish Church. He was denounced to the Inquisition in 1612, but it was not until 1633 that proceedings were taken which resulted in the philosopher of seventy years being bound by oath to abjure the Copernican doctrine and being treated as a prisoner for the last nine years of his life. During that time, in his exile at Siena and Arcetri, his interest in science never waned, despite his infirmities, and he devoted his attention to dynamical problems on which he was still at liberty to express opinions. That Galileo discovered the principle of virtual velocities is a fact that may come as news to some of us.

In all the proceedings against Galileo his old *Alma mater* and enemy, Pisa, figures prominently. Of the obstinate spirit of the Aristotelians we have instances in Galileo's early experiments in dropping falling bodies from the Leaning Tower.

"With the sound of the simultaneously fallen weights ringing in their ears they still persisted that the 10lb. weight would reach the ground in $\frac{1}{10}$ of the time taken

by one of 1lb., because they were able to quote chapter and verse in which Aristotle assured them that such is the fact."

Others later on positively refused to look through his telescopes or to test his experiments on floating bodies.

The connection between music and mathematics was maintained in Galileo's case. He played on the lute and his father was a well-known authority on music.

Of the books themselves we can speak in the highest terms. Dr. McIntyre has evidently made an exhaustive study of recent editions of Bruno's works. His is the only English work dealing completely with Bruno's life and philosophy, and it is illustrated by a frontispiece of the statue erected in 1889 on the site on which Bruno was burnt. Mr. Fahie has been fortunate to secure the assistance of Prof. Antonio Favaro, himself the author of a monumental collection of Galileo's works. Every minute point, such as the familiar "Eppur si muove" anecdote is examined critically and the book is beautifully illustrated.

Let us not close these volumes without comparing the positions of scientific workers three hundred years ago and at the present time. The comparison brings little credit to our nation. Science teachers have quite recently been deprived of their posts, and their careers have been ruined by inquisitions. The attitude of the peripatetics towards experimental science finds its counterpart in the attitude of the modern "practical man" towards all pure science above B.Sc. standard. As for the hostility of Pisa towards Galileo, it has been pointed out elsewhere that workers at the two older English Universities have, in several cases, had to contend against similar and equally persistent opposition on the part of their *Alma mater* quite recently. It is true that men are no longer imprisoned, tortured, or burnt on account of their convictions. But, on the other hand, philosophers and mathematicians to grand dukes have ceased to exist. G. H. BRYAN.

A MONOGRAPH ON IMPORTED PARROTS.

Parrakeets. A Handbook to the Imported Species. By David Seth-Smith, M.B.O.U., F.Z.S. Pp. xix+281; with 20 coloured plates and other illustrations. (London: R. H. Porter, 1903.) Price 40*s.* net.

MR. SETH-SMITH'S valuable monograph of the imported species of parrakeets is now complete, and forms a handsome, well-proportioned volume. Scientifically speaking, there is no distinction between a "parrot" and a "parrakeet," the latter word being merely a popular term used for the smaller parrots. It cannot be applied to any particular family, or to those species with long or short tails. The title of this work must therefore be interpreted in the sense in which it is generally used by aviculturists. The work treats of about 130 species belonging to the families Loriidæ, Cacatuidæ, and Psittacidæ (subfamilies Nasiterninæ, Conurinæ, Palæornithinæ, and Platycercinæ). No less than thirty-three species are represented on the beautifully executed coloured plates, and there are more than a score of illustrations in the text, chiefly illustrating the nesting and other habits. Moreover, the author has been careful to indicate the work or works in which a coloured illustration of those species not figured by him may be found. Full and most useful directions as to feeding and managing the different species are given, as well as for breeding those species which have reared, or are likely to rear, their young with us. It is also pointed out which species are most suitable for large aviaries, and which are more adapted for smaller cages. The whole book throughout is most readable and instructive. For as well as all worth reproduction which has been written about the different species in captivity, the author has collected from the folios of Gould, Mr. A. J. Campbell's "Nests and Eggs of Australian Birds," Dr. Mivart's "Monograph of the Loriidæ," and many other works a great deal that has been written about the life-history and habits of the birds in a wild state, so that his work forms an excellent history of these beautiful birds, and is alike interesting to the field naturalist and the aviculturist.

Turning over these interesting pages we notice especially the lorikeets or brush-tongued parrots, some of the most gorgeous of the tribe; the familiar cockatiel, which, with the exception of the budgerigar, is the commonest Australian species with English bird-keepers, breeding regularly in captivity; and the numerous race of the American conures. This group contains two species of especial interest, viz. the Carolina conure and the grey-breasted parrakeet. The former is the only North American parrot, and although once so abundant, seems likely to share the fate of the passenger pigeon. The latter, belonging to a genus containing but two known species, is one of the most interesting in the whole parrot family from the fact that these are the only nest-building parrots known, with the exception of the love-birds (Agapornis), which line their nest-hole with the pliant pieces of bark from green twigs, and may therefore be termed nest-building parrots. The present species, however, builds a large nest of sticks among the branches of tall trees, which no other parrots, so far as is known, ever do. It is gregarious, always living in flocks, and the nests, which perhaps at first are single and inhabited by a single pair of birds, are gradually added to until they become of enormous size. There is a porch to each chamber, and the present writer has often seen the black beady eyes of these little parrots peeping out as he passed under trees bearing these wonderful nests.

Then we come to the large genus Palæornis, to which belong parrots that have been known to civilisation from a remote period, *e.g.* the blossom-headed parrakeet, believed to have been described in the fifth century B.C. The restricted genus Polytelis includes the beautiful parrakeet known to Australians as the "green leek." The love-birds are remarkable, as before mentioned, for their nest-building habits, and those gorgeous little birds, the hanging parrakeets, for their curious habit of suspending themselves head downwards when sleeping. Among those species the beauty of which singles them out among a beautiful host, we have the broad-tailed parrakeets, of which the Rosella is the best known; the rarely imported

Alexandra parrakeet, discovered during the Stuart Expedition into central Australia in 1862; the paradise parrakeet, classed with the golden-shouldered parrakeet as the most lovely of all the Australian parrakeets; and the splendid parrakeet the wonderful colours of which, as well as those of the species last mentioned, are displayed on two of the plates.

It has been the aim of the author to make the present book a complete monograph of the imported species of parrakeets. New species may be expected to arrive from time to time. For instance, when the first part of the work was issued no living specimen of the varied lorikeet (*Ptilosclera versicolor*) had ever been known in this country, but a few months later a few pairs reached London, and this species has accordingly been included (with a coloured plate) in the appendix, in which additional information respecting several other parrakeets is to be found. O. V. A.

MULTIPLICATION TABLE.

Table of Multiplication, Division and Proportion for the Ready Calculation of Quantities and Costs, Estimates, Invoice Prices, Interests and Discounts, Weights and Strengths, Wages and Wage Premiums. By Robert H. Smith, M.I.M.E., &c. (Westminster: Archibald Constable and Co., Ltd., 1903.) Price 6*s.* net.

THIS consists simply of a gigantic multiplication table for every figure up to 100 times 160, there being 100 horizontal lines of products arranged in 160 vertical columns on a sheet 5 feet long and 11½ inches wide. The sheet is mounted like a map upon canvas, so as to open at any part of the length and exhibit two pages, each page containing 10 vertical columns indexed right and left with every 10th number up to 100. To guide the eye wider spacing is provided at every fifth line and column, and still wider at every tenth, as in logarithm tables. The index numbers are equivalent to a repetition of the first column on every page, so that any line up to the 100th can at once be found. As in any other multiplication table, the figure found at any place is the product of the first figure on the line and the top figure of the column on which it is found.

On the back of the sheet are a corresponding series of pages on which Prof. Smith has explained how the table may be used for all the purposes described in the title.

If two numbers have to be multiplied together the product can, of course, be read directly if they do not exceed 100 and 160, but if that was all the table was for, even though it is well arranged, it would hardly be worth getting out of its place. If only one of the figures exceeds these by not more than two digits, it may be broken up into two parts, *e.g.* 3781 into 3700 and 81, and the two partial products read, preferably in a single column when that is possible, and mentally added. If both factors exceed these amounts then four partial products have to be found, and two columns must be employed, which may be on different pages. This necessitates writing down the four partial products of probably four digits each, and taking care that the units place is properly placed in each. Then on adding, the product is found exact, of course to the last figure. It is not worth while in this notice to refer to rules or practice as to placing the decimal point if the factors contain decimal figures.

Division, of course, is performed by finding the quotient in the body of the table on the line or column of which the first figure is the deviser. Then the quotient will be the first figure of the column or line. This is only possible when the dividend is an exact product of two numbers not exceeding 100 and 160. Of course, in practice it never is, and then interpolation is necessary. Prof. Smith gives two methods. Where, however, both the diviser and quotient exceed 100 and 160 the double interpolation necessary seems to the writer to involve so much trouble, and to provide such opportunity for mistakes, that he would prefer to perform the operation with a pencil and paper in the usual way of the school if slide rules, logarithm tables, or calculating machines were not sufficient or available.

Simple proportion can, of course, be performed where the four quantities are all actually existing in the table by direct inspection, but again, in practice they never would be, and interpolation, either single or double, would be necessary.

The other processes described in the title which involve one or other of these operations are explained in the text on the back. It might very well be that for certain classes of calculation or of office work where the computer or clerk had the same kind of thing to do indefinitely, the table would afford the readiest means of finding an exact result, but for general use by people who could not for want of practice be quite adept, it is a question whether the constantly recurring interpolation complication would not give more trouble than direct arithmetic, besides leading to endless mistakes. C. V. B.

THE ZOOLOGICAL RECORD FOR 1902.

The Zoological Record, vol. xxxix., relating chiefly to the Year 1902. Edited by D. Sharp. (London: Zoological Society, 1903.)

ALTHOUGH on the title-page this volume, which slightly exceeds its predecessor in bulk, bears the date 1903, as a matter of fact it was not in the hands of the public until the beginning of the present year. This slight delay, as the editor informs us, is more than accounted for by certain unexpected changes in the staff of recorders, notably the loss of the services of Prof. J. A. Thomson, who has felt himself compelled to relinquish the compilation of that very important section of the undertaking entitled "General Subjects." His place, apparently at short notice, has been taken by the editor, who, in addition, is responsible for the insects, as well as for the general supervision of the whole text, and must therefore have had very hard work to complete his task so nearly within the appointed time-limit. The other contributors the

loss of whose cooperation the editor has to deplore are Prof. Herdman and Mr. W. A. Brown.

In these circumstances, we have to offer special congratulations to Dr. Sharp on the appearance of this volume. We may at the same time take the opportunity of mentioning our satisfaction at the decision of the council of the Zoological Society to continue, at all events for the present, the publication of this invaluable record. Without in any way disparaging the "International Catalogue of Scientific Literature," it is quite certain that, in present circumstances, the zoological portion could not be issued with that promptness which renders the "Record" before us so invaluable to working naturalists.

Since all the contributors are specialists, thoroughly acquainted with their respective subjects, there is little or nothing to criticise in the *technique* of their work, and the present volume seems remarkably free from typographical errors. As usual, some of the recorders treat their subject, both in the way of introduction and in the class of papers quoted, at much greater length than others. In some sections—the mammals, for example—it appears to be the recorder's custom to exclude papers which do not contain absolutely new matter, and also those in which there is merely more or less incidental allusion to the particular subject, or summaries of previous work. In other sections—like the one on echinoderms—precisely the opposite course is followed, papers containing even the most remote and unimportant references to the subject being catalogued. Consequently, some of the pages in the section last cited look more like a geological than a zoological record.

It is not, of course, for us to decide which course is preferable. If, however, the more comprehensive plan is necessary in one section, it is apparently required in all, and *vice versâ*. The universal adoption of the fuller plan would largely increase the bulk of the annual volume, while if the system of elimination were followed throughout, its size would be proportionately reduced.

As an instance of our meaning, we may note that some writers quote the articles on their respective subjects from the volumes of the "Victoria County History," while by others they are omitted. Again, in one section (Echinoderms) we find the "Guide to the Dublin Museum" entered, which is surely unnecessary. In the same record also occurs Prof. Sollas's paper on the method of investigating the structure of fossil animals by means of sections, a paper which should have appeared only in "General Subjects," where it is conspicuous by its absence.

How absolutely essential to zoological workers—if they are to avoid using preoccupied names—is the prompt appearance of the "Record" may be inferred from the long list of new generic and subgeneric terms at the end of the present volume, which runs to 18 pages, against 16 in its predecessor.

In conclusion, we may direct attention to the request that authors would send copies of their papers to the editor. Labour would thus be saved to the recorders, and the prompt insertion of papers would be secured.

R. L.

OUR BOOK SHELF.

Æther and Gravitation. By W. G. Hooper. Pp. xiv+358. (London: Chapman and Hall, Ltd., 1903.) Price 12*s.* 6*d.* net.

FROM a psychological point of view this treatise of 358 pages is very interesting. The author "has endeavoured to perfect a theory which will bring ætherial physics more into harmony with modern observation and experiments." He "has taken Newton's Rules of Philosophy as his guide in the making of the new theory, as he believes that if any man knew anything of the Rules of Philosophy, that man was Sir Isaac Newton."

These rules are:—

(1) "Simplicity of conception." "If there are apparently two causes to the same phenomenon, then the simpler cause is the true and correct one."

(2) "Agreement with experience, &c."

(3) "Satisfactorily accounting for and explaining all phenomena sought to be explained."

These rules are first applied to gravitation. "The Law" (of gravitation) "is not a simple law. It is compounded primarily of three parts. 1st, a primitive impulse; 2nd, a centripetal force; 3rd, a centrifugal force. To these must be added the three laws of motion."

No known medium has been found to be absolutely frictionless. "Accepting therefore experience as a guide we are compelled to come to the conclusion that there is no such thing in the Universe as a frictionless medium. Such a hypothesis is contrary to all laws and rules of Philosophy," "and therefore as either experience or a frictionless medium has to go, we will part with the frictionless medium." "With the present conception of a frictionless æther, however, it is philosophically impossible for the æther to exert force on any body that may exist in it. Because to the extent that it is frictionless, to that extent it ceases to possess mass. If it does possess mass, then it cannot be frictionless."

The next point dealt with is matter, which is thus defined:—"Matter is that which can be perceived by the senses, or is that which can be acted upon by motion, or which can exert motion."

Incidentally we learn that vortex atoms cannot be cut in two. "It will be found that when the knife is brought near to them they seem to recoil from the knife."

Chapter iv. is entitled "Æther is Matter." In this chapter we learn something of the constitution of atoms.

"If therefore it holds good in Philosophy that the small things are the index to the greater, then the converse holds good, that what is true of the large is true of the small, and that the laws governing the great also govern the small." "So that gathering up those chief properties of the earth to which I have already referred, and applying them to an ætherial atom, or any other atom if necessary, we arrive at the conclusion that an atom must be spherical in shape, must possess rotation, and must have an orbit, must possess polarity, and also be subject to the universal Law of Gravitation." "Further, if we are to be strictly correct, in our analogy between the earth and the ætherial atom, its polar diameter must be shorter than its equatorial diameter, as that is one of the facts observable regarding the shape of our earth."

Similar lines of argument are applied in succeeding chapters to heat, light, electricity, and the universe in general. The author has read many books. He has not always succeeded in understanding them.

W. M. H

Highway Construction in Wisconsin. By E. R. Buckley, State Geologist of Missouri. Pp. xvi+339. (Published by the State at Madison, Wis., 1903.)

THIS book forms part of the Economic Series of works published by the State of Wisconsin, and is an evidence of the trouble that is taken in the United States to furnish the officers having charge of the various departments with the fullest information as to their work that is available.

It contains eight chapters, relating respectively to the classification of highways, and the agents that destroy pavements; materials used in improving highways; methods of constructing different kinds of pavements; drainage; pavements constructed in the larger cities; abrasion and cementation tests.

In the introduction the writer points out that a purchaser or seller who is separated from a railway station by ten miles of good roads is actually nearer his market than the person who is separated by five miles of unimproved roads. Good roads mean heavier loads, more rapid transit, and a longer life for vehicles and horses.

That such a work as that now under notice is urgently required in the State of Wisconsin may be inferred from a further statement made by the author, that a dog is able to draw a load to market in many European countries which a horse cannot draw in the United States, and that up to the present time highways in Wisconsin are simply narrow tracks connecting different parts of the country, the one idea of construction being to fill the gullies and level off the roadway with such material as might be closest at hand.

There is some useful information contained in the book as to the tests carried out by the State for ascertaining the relative wearing values of different kinds of stones used in road-making, from which a lesson might well be learnt by the county councils in this country as to the advantage to be gained by maintaining an establishment for supplying their road surveyors with trustworthy data of this character.

There is one kind of pavement in use in some of the cities that might with advantage be used in this country, that is, blocks made of asphalt and laid in the same way as granite pavings. This pavement is stated to be non-slippery, while at the same time it is noiseless and non-absorbent. The cost is about the same as sheet asphalt.

Practical Chemistry. Part ii. By William French, M.A., F.I.C., and T. H. Boardman, M.A. Pp. xiii+126. (London: Methuen and Co., 1904.) Price 1*s.* 6*d.*

THIS book contains a well arranged series of experiments of a kind suitable for young students who have already spent a fair amount of time at practical chemistry. The physical properties of gases, the laws of chemical combination, sulphur and its compounds, some nitrogen compounds, and carbon and its simpler compounds, are among the chief subjects included in the volume.

Marsh-Country Rambles. By Herbert W. Tompkins. Pp. xi+307. (London: Chatto and Windus, 1904.) Price 6*s.*

MR. TOMPKINS confines his rambles, with few exceptions, to the marshlands east of the road which leads from Prittlewell to Maldon and Colchester, and south of the road from Colchester to St. Osyth. He does not pretend to offer the reader detailed descriptions of villages and towns, but rather to provide an interesting narrative in which history and legend are incidentally touched upon. With the exception of a frontispiece the book is not illustrated.

LETTERS TO THE EDITOR.

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

The Occurrence of Thorium in Ceylon.

THE Government of Ceylon determined last year to carry out, with the cooperation of the scientific and technical department of the Imperial Institute, a systematic survey of the economic minerals of Ceylon. Mr. A. K. Coomaraswamy and Mr. H. G. Parsons were selected to conduct the survey in Ceylon, and to dispatch specimens of the minerals found to the Imperial Institute for chemical examination and commercial valuation. Among the specimens thus received were those of a mineral existing in small black cubical crystals found in the refuse from gem washings near Balangoda, in the Sabaragamuwa Province, which had been identified by Mr. Holland, a resident in Ceylon, as probably uraninite or pitchblende. The same mineral has been since observed by Mr. Coomaraswamy in a vein of pegmatite at Gampola, in the Central Province of Ceylon.

The specific gravity of the mineral was found to be 9·32, and an analysis by Mr. G. S. Blake, of the scientific staff of the Imperial Institute, furnished the following results:—

		Per cent.
Thorium oxide	ThO_2	76·22
Cerium oxide ...	CeO_2	} 8·04
Lanthanum and didymium oxide	La_2O_3 Di_2O_3	}
Zirconium oxide	ZrO_2	trace
Uranium oxide	UO_3	12·33
Ferric oxide	Fe_2O_3	0·35
Lead oxide	PbO	2·87
Silica	SiO_2	0·12
		99·93

The mineral is clearly not pitchblende, since the percentage of oxide of uranium is only about 12 per cent., whilst the principal constituent is oxide of thorium (thoria), which is present to the extent of more than 75 per cent., an amount far higher than that contained in any mineral hitherto examined. This mineral appears to be new, and I suggest for it the name of *thorianite*. Since it is radioactive, it will no doubt be found to be an important source of radium or radio-active earths, and will probably furnish helium, points which will be investigated as soon as more material has been obtained.

A second part of the same specimen furnished the following results on analysis:—

		Per cent
Thorium oxide	ThO_2	72·24
Cerium oxide	CeO_2	6·39
Lanthanum and didymium oxide	La_2O_3 Di_2O_3	0·51
Zirconium oxide	ZrO_2	3·68
Uranium oxide	UO_3	11·19
Ferric oxide	Fe_2O_3	1·92
Lead oxide	PbO	2·25
Silica	SiO_2	1·34
Insoluble residue		0·41
		99·93
Specific gravity		8·98

The two sets of analytical data prove that the material has essentially a uniform composition, the differences observed being apparently due to inclusions of zircon in the second portion analysed.

In the meantime Sir William Crookes has received a specimen of the supposed pitchblende from Ceylon, and has found it to be radio-active to about the same extent as Cornish pitchblende.

Sir William Crookes was good enough to give me a part of his specimen, which is being analysed.

The second mineral examined was found by Mr. Holland in the same gem washings at Balangoda, and was identified as probably monazite. This mineral was pale brown, and when fractured exhibited a purple brown interior with a

resinous lustre. The specific gravity was 4·98. An analysis by Mr. Blake furnished the following results :—

		Per cent.
Thorium oxide	ThO_2 ...	66·26
Cerium oxide (and Cerium earths) ...	CeO_2 ...	7·18
Zirconium oxide	ZrO_2 ...	2·23
Uranium oxide	UO_3 ...	0·46
Ferric oxide	Fe_2O_3 ...	1·71
Calcium oxide	CaO ...	0·35
Phosphoric oxide	P_2O_5 ...	1·20
Silica	SiO_2 ...	14·10
Water	H_2O ...	6·40
		99·89

This mineral is therefore thorite, consisting chiefly of thorium silicate. Both these minerals are under further investigation at the Imperial Institute. Careful explorations are now being made as to the extent of their occurrence in Ceylon.

It is obvious that apart from the scientific interest attaching to the determination of their composition, the discovery in Ceylon of two minerals rich in thoria, now so largely employed for the manufacture of incandescent gas mantles, may be of considerable commercial importance.

Imperial Institute, March 29. WYNDHAM DUNSTAN.

Ionisation of Air.

SOME experiments have been recently made at the Cavendish Laboratory which seem to throw light on the question of the "spontaneous" ionisation of air. The anticipation of a detailed report of these in a short summary of the results obtained may serve some useful purpose by preventing a waste of energy on the part of others who are engaged in investigating the same subject.

The experiments consist in the determination of the saturation current through rectangular vessels, lined with the metal under investigation, the volume of the vessels being capable of alteration by the motion parallel to itself of one of the sides of the vessel. On plotting a curve the ordinates of which are the saturations currents and the abscissæ the distance of the movable side from the side opposite to it, it becomes clear that there are two separate distinct kinds of radiation causing the ionisation of the gas :—(1) a radiation coming from the sides of the vessel which is completely absorbed by some 5 cm. of air, and which, therefore, when the volume is considerable, gives an ionisation proportional to the surface of the vessel; (2) a much more penetrating radiation, which at all volumes gives an ionisation proportional to the volume of the vessel. Further experiments were then made by surrounding the vessel with lead sheets about 3 cm. thick and repeating the determination of the variation of the ionisation with the volume. The lead screen diminished the ionisation; by this method it was possible to discover which part of the radiation suffered diminution.

Up to the present time four metals have been investigated, lead, aluminium, zinc and tin foil. Of these, in the absence of the screen, the first three gave approximately the same value for the penetrating radiation causing volume ionisation. The absorbable radiation causing surface ionisation was greater for the aluminium than for the zinc, and still greater for the lead. When the screen was applied the penetrating radiation was diminished to about two-fifths of its value for all three metals. In the lead and the aluminium the value of the surface ionisation remained unaltered by the screen, but in the zinc this was decreased, and fell to about three-fifths of its original magnitude.

The tin was quite peculiar in its behaviour. The normal volume ionisation was only about one-third of that in the other metals, and when the screen was applied both the surface and the volume ionisations fell in the same proportion to two-thirds of their former values.

It is pretty clear, therefore, that at least in the case of tin and zinc we have secondary radiation given off from the surfaces of those metals under the influence of penetrating radiation coming from outside.

Some numbers may be useful to give an idea of the respective magnitudes of the radiations mentioned. Taking an arbitrary unit, the values for the ionisation caused by one square centimetre of surface of the metals are as follows :—lead 38·6, tin 33, aluminium 10, zinc 7·9. On the same scale the values of the ionisations due to the penetrating radiation in 1 c.c. of air enclosed in a vessel of these metals is for lead, aluminium and zinc between 3·2 and 2·8; for tin it is 0·9.

It is probable that many of the discrepancies that have appeared between the results obtained by different physicists may be explicable by a difference in the metal of which their vessels were composed. For example, it is clear that it might be possible to detect the effect of a screen on a zinc vessel, while in a lead vessel the diminution of ionisation due to the same screen would be inappreciable; similarly, it would be possible to measure in a lead vessel effects due to the surface radiation which could not possibly be detected if zinc were substituted for the lead. Further experiments on different metals, and with other modifications, are in preparation, which it is hoped will throw more light on this interesting problem.

NORMAN N. CAMPBELL.

Trinity College, Cambridge, March 25.

Respiration in Frogs.

Is the buccal cavity of the frog a respiratory chamber? In a letter to NATURE, March 24, Mr. M. D. Hill accepts this conception of it, and yet the only evidence which can be offered in support of this view is the rich blood supply of its lining membrane. The lungs and skin, which are known to be respiratory surfaces, are supplied by a special circulation; the buccal cavity is neither more nor less supplied with blood than the other parts of the alimentary tract, which are certainly not respiratory.

The oscillatory movement of the frog's pharynx, which occurs when the lungs are filled and the opening to the larynx closed, is one of a number of points connected with the respiratory system which have not yet been satisfactorily explained. The other points are :—(1) the evolution of the reptilian method of respiration from the amphibian; (2) the meaning of the laryngeal and bronchial musculature found in amphibians, reptiles, birds and mammals; (3) the closure of the auditus laryngis of the amphibian during the respiratory phase; (4) the attachment of part of the transversalis and rectus abdominis to the pericardium and roots of the lungs; (5) the air in contact with the respiratory surface of the lungs is always very impure. All these points, with the exception of the last, find their explanation in the fact that the act of respiration in all forms of vertebrate life produces two effects within the lungs :—(1) air is drawn into the air spaces; (2) blood is drawn into the pulmonary capillaries. Further, the rate of flow in the pulmonary capillaries, which are situated in the septa between the air cells, is determined by the pressure within the air cells. The air within the lung is used as a brake for regulating the pulmonary flow of blood. That is to say, the act of respiration in reptiles, mammals and birds has two effects, one on the air and another on the blood within the lung. In amphibians these two effects are apparently obtained by separate means.

In the major movement of amphibian respiration the air is forced within the lungs by the muscles of the pharynx and expelled by the contraction of the muscles of the body wall. In both phases of that movement, which are for the renewal of air within the lung, the pulmonary circulation is retarded by the positive pressure of the breathed air. When the lungs are filled and the opening of the larynx closed, the minor movements set in. They vary in different genera of frogs, but taking the noisy frog (*Rana clamata*) as a type in which to observe these movements, it will be noticed that the body wall muscles, especially the transversalis, contract and rather expand the body at the same time as the larynx is drawn downwards. In all Amphibia the larynx, pharynx, and their muscles are so closely bound up with the lung that the pressure of the pulmonary air must be affected by their movement. In short, the oscillatory movements of the pharynx in the Amphibia (and also in turtles and tortoises) create a negative pressure within the amphibian lung, and thus regulate and accelerate the flow of blood through that organ. For that reason

the larynx is closed in the inspiratory phase, and parts of the transversalis and rectus abdominis are attached directly or indirectly to the pulmonary roots.

Thus parts of the muscles of the amphibian trunk become inspiratory in action, for they contract during the inspiratory phase and tend by their contraction to enlarge the pulmonary space. If, then, the larynx were to be opened in this phase, air would be drawn within the lungs (regulated in its rate of inflow by the laryngeal, tracheal and bronchial musculature), and a thoracic type of respiration would be thus evolved. Thus the minor movements which occur in amphibians when the lungs are filled with air are evidently the precursors of the normal respiratory movements of reptiles, birds and mammals.

One other point in connection with the respiration of the frog may be mentioned; it has not received the attention it deserves. The air which the frog breathes is a mixture of the air just expired with a fresh supply drawn within its mouth. Further, I believe it never empties its lungs completely in expiration. Thus the air within the lungs is always a highly impure air. That is also the case with the air within the pulmonary alveoli of mammals, birds and reptiles. The explanation I offer is that when air breathing vertebrates were evolved from water breathing forms, the oxygen of the atmosphere had to be diluted to a proportion more nearly corresponding with the amount held in water, to which the system of branchial breathing forms were adapted. A. KEITH.

London Hospital Medical College, E.

Degradation of Elements.

A STATEMENT reported as having been made by Sir William Ramsay, that radium breaks down into helium, has been received with a chorus of wonder as something absolutely new. May I point out that in NATURE, October 10, 1889, p. 584, you have something very similar, in an account of some observations on gases in sealed tubes, communicated by the late Prof. Piazzi-Smyth to the British Association in 1889.

The whole of the paper is astounding, stating as it does that many substances break down into hydrogen, but perhaps the most remarkable part is:—"Again, an iodine tube which had a comparatively large quantity of solid iodine granules introduced into, and sealed up in, its interior eleven years ago, and showed then a splendid spectrum of 148 measured iodine lines, extending discontinuously from red to violet, and had nothing else save these very faint, puny images of the three principal lines of hydrogen—this tube, in 1889, has not a single iodine line now left; but its spectrum, which is now brighter than ever, is composed of nothing but hydrogen lines, so that the once solid iodine granules would seem to be partly changed into hydrogen, and partly deposited on the inside of the tube as a yellow haze, besides leaving a trifle of loose dust."

When in 1894 I saw this quoted in Preston's "Theory of Heat," I thought it momentous, and wondered why it had not been followed up and more made.

Some to whom I have mentioned it consider that it comes in the same category as the alleged complete metalepsis of manganese acetate communicated by Wöhler to Liebig's *Annalen*, vol. xxxiii. p. 308. S. H. WOOLHOUSE.

Parmiter's School, Victoria Park, N.E., March 14.

I THINK it was generally believed that Prof. Piazzi-Smyth's results were due to the iodine being absorbed by, and the hydrogen being evolved from, the electrodes. There are many other recorded transformations, among them Dr. Samuel Brown's conversion of carbon into boron (or *vice versâ*, I forget which). The difference between the more recent work and the earlier consists in the fact that the transformation of radium emanation into helium is accompanied by a great energy change, while we do not know that the former supposed transformations are.

Although in all probability the result would be negative, the re-investigation of the old recorded cases is not to be discouraged. WILLIAM RAMSAY.

University College, London.

Remarkable Destruction of Birds in Cardigan Bay.

THE following incident, which has excited much interest here, seems to me to be of more than local interest, and to be worthy of record in the columns of NATURE.

On Friday, March 18, many of my pupils in the Pwllheli County School, on returning from dinner at 2 p.m., informed me that "hundreds and thousands" of birds—starlings, thrushes, blackbirds, woodcock and snipe—had just been cast upon the shore at high tide.

Further, that, during the small hours of the morning, large numbers had fallen "dead beat" upon the deck of a vessel entering the harbour, and also that some had fallen, in a helpless and dying condition, among, and even upon the backs of, workmen employed at the granite quarries on the Gimblet Rock. At first I was naturally somewhat sceptical, but on inquiry in several quarters I found that my informants had correctly stated the case, and that large numbers of birds—all land-birds, be it noted—had been found all along the coast from a point some distance east of the town so far as Aberdaron, several miles to the west. The theories put forward to account for the occurrence were many and varied. Some held that electricity was to be held accountable—either the ordinary atmospheric sort or that uncanny variety manipulated by Mr. Marconi. Others suggested, in all seriousness, a special miraculous intervention of Providence, on the ground that the frost this year had not killed a sufficient number of the featherèd tribe!

On the following day I visited the shore with the view of finding some clue to the mystery. I found enough to lead me to believe the following to be the simplest explanation. The warm weather and copious rains of the last few days must have melted large masses of snow on Snowdon and neighbouring ranges. This may have caused in some of the valleys opening out into Cardigan Bay a flood of sufficient magnitude to carry away bushes and trees on the banks of the swollen mountain torrents. Assuming this to have occurred during the night—moonless, starless and possibly foggy—it is conceivable that birds roosting in the branches would cling to them and be carried out to sea. At dawn, finding themselves literally and metaphorically "at sea," the birds would fly hither and thither, and finally sink exhausted. A strong easterly breeze then prevalent would account for the rest. There was, in my opinion, abundant evidence of a flood. In addition to the birds (thrushes, starlings and blackbirds, according to my personal observations) lying about three feet, vertically, above the ordinary high-water mark—the Friday mid-day tide being a spring tide—I found many twigs and a few good-sized branches of alder and willow, besides a branch of a pruned apple tree. Several onions and some cabbages were lying at the same level as the birds, together with a square wicker basket with rope handles. The latter probably indicate a flooded garden, which may enable us later to localise the flood.

The main difficulty to my mind lies in the failure of the birds to leave their drifting perch before getting out to sea. Perhaps some readers of NATURE better acquainted with bird life than myself may be able to throw light on this remarkable occurrence.

C. W. HERBERT GREAVES.

The County School, Pwllheli, N. Wales, March 21.

Distribution of the Nightingale.

THE fact that the distribution of the nightingale is restricted to the drier parts of these islands is well known, but the causes of this are obscure. If an excessive amount of rain be one of them, it is probable that last summer would have had the effect of reducing the number of young birds, and consequently of the immigrants of this spring. I should therefore be much obliged to any of your readers who live in a nightingale country if they will inform me towards May 1 whether they observe any difference in the number of these birds.

I may mention that the nuthatch, a bird which, though not altogether migratory, has a similar range (I have never met with it in North Wales, where I lived many years), has disappeared from here entirely this winter, though it was abundant in former winters. ALFRED O. WALKER.

Ulcombe, Maidstone, March 19.

THE NATURAL HISTORY OF VENEZUELA.[1]

WHY the title of this volume should be what it is is not apparent. We know of British, of French, and of Dutch Guiana, but the volume before us has to do with neither of these political areas, but is concerned solely with the central portion of Venezuela. The author gives an account of two journeys undertaken by him, from Trinidad as a starting point, up the Orinoco and some of its tributaries to within 5° of the Equator. It is the land of the fabled El Dorado, a land which excited the cupidity of the early adventurers of whom Raleigh was one, the home of alleged natives "whose heads do grow beneath their shoulders," as Shakespeare, copying Raleigh, asserted.

Humboldt and Bonpland dissipated many of the illusions relating to this country in the early part of the last century, and now we have, from the pen of Mr. André, a plain, matter-of-fact narrative which adds considerably to our knowledge of the country. The author is well known as a collector of birds, insects, orchids, and other objects of natural history, and the account that he gives of his expeditions is full of interest, replete with incident, but told with a modesty and straightforwardness which invite sympathy and beget confidence.

The district traversed is mainly one immense forest more or less impenetrable except along the river-banks, interspersed here and there with open savannahs, and varied with mountains of fantastic shape and surpassing grandeur. The natural resources of the country are great, but the political state is such as to obstruct all progress, while the interior is difficult of access and the climate deadly. The author was foiled in his attempt to ascend the Améha, but, from what he tells us of that mountain, its physical features would seem to be like those of Roraima.

He had repeated attacks of fever, but his direst misfortune was in the rapids of Arichi, where in a few short seconds the work of months was lost, and for weeks thereafter the party had to struggle on foot to reach that settlement (La Prision) which some of them were doomed never to see. The account of this disaster is told in the simplest and therefore most graphic manner.

But this story of hairbreadth escapes, though attractive to the general reader, is not what will appeal most strongly to the readers of NATURE. They will be interested in the numerous notices of birds, insects, mammals, and orchids which are scattered through the pages of the volume, and greatly add to its value. There are very interesting accounts of the gathering and harvesting of the tonka-bean, which forms one of the principal industries of the country, and of the collection of the balata and other caoutchouc containing products. Among the orchids, *Cattleya superba*, one of the most beautiful of a lovely genus, is the one most often mentioned. The flowers are some five inches across, rich rosy purple in colour, and very fragrant. Among other commercial products exported from Ciudad Bolivar are the feathers known in the trade as ospreys. The swamps bordering the rivers Apure and Arauca are the abode of numberless flocks of wild fowl, among which two varieties of egret are abundant.

"It is from these egrets that the feathers which form so expensive an article of commerce are obtained. The small egret (*Ardea candidissima*) produces the most valuable plumes; from the larger birds (*Ardea garzetta*) a coarser feather is obtained which is not so much appreciated, but the wily dealer can sort his plumes so as to introduce a fair proportion of the inferior article without danger of detection. Quite a number of birds have to be slaughtered to produce a pound of feathers, only a few drooping plumes from the backs of the birds being taken. The season for collecting extends through the months June, July and August; that is through the mating and breeding period. The egrets are wary birds and difficult of approach, except when they are nesting or rearing their young, and it is at this time that the collector obtains his feathers. The persistence with which the same localities are chosen by the birds for this purpose, year after year, is an instance of that extraordinary predilection on the part of many birds to repair to the spot where they themselves have been reared, for the purpose of nesting. These spots are called *garceros*, and as they are generally on private lands, the owners make quite an income by hiring out the privilege to kill egrets. As much as 2000 pesos, equal to 1000 dollars of United States money,

FIG. 1.—Young of the Snowy Egret. (From "A Naturalist in the Guianas.")

[1] "A Naturalist in the Guianas." By Eugène André. Pp. xiv+310; with thirty-four illustrations and a map. (London: Smith, Elder and Co.) Price 14s. net.

have been paid for this privilege on a single *garcero* during one season. In spite of the slaughter of thousands of these birds, the *garceros* continue to be used by the egrets, but in ever diminishing numbers. The beauty of a few feathers on their backs will be the cause of their extinction. The love of adornment common to most animals is the source of their troubles. The graceful plumes which they doubtless admire in each other have appealed to the vanity of the most destructive of all animals. They are doomed because the women of civilised countries continue to have the same fondness for feathers and ornaments characteristic of savage tribes."

In concluding this notice of a very interesting book, we have only to add that there are numerous illustrations—of which, through the courtesy of the publishers, we reproduce one—a map showing the author's route, and a full index.

PATENT LAWS.

THE question of our patent law legislation is again coming into prominence, probably owing to its close relationship to other great economic controversies now occupying the mind of the country. It is, however, singular that although this is mainly an economic question, the subject of our patent laws is invariably discussed solely from the standpoint of the inventor. There are in reality two interests which must always be jointly considered, namely the interests of the inventor and the interests of the community.

In a letter which recently appeared in the *Journal* of the Society of Arts, Mr. C. D. Abel, the well-known patent agent, argues that our patent laws are certainly more advantageous to the inventor than either the law of the United States or of Germany. If this be true, may I ask who derives the benefit of our benevolence? Is it not chiefly the foreign inventor and the foreign manufacturer who are the gainers, and our community who pays for it? Natural inventiveness and natural ingenuity being equally spread over the white races, we should possess the portion allotted to a population of forty-two millions as compared with a total white population of roughly 440 millions. It it be true, therefore, as Mr. Abel states, that this country confers greater advantages on inventors than any other, are these advantages not conferred on ten foreign inventors to each one of our own country?

Space forbids me to analyse closely the minor points in which Mr. Abel seeks to find advantages for the inventor in our law not afforded by the American or German law. Let me turn at once to what Mr. Abel calls (from the inventor's point of view) the crux of the question.

Mr. Abel appears to be thoroughly satisfied with the examination into novelty which has been adopted by the Act of 1902. This need occasion no surprise, as he states that he himself proposed the system. I must, however, as I did when Mr. Abel first published them, raise strong objections to the figures by which he attempts to show that the grant of a German patent, in spite of real and thorough examination into novelty, does not confer a better title and greater security to the patentee than a British patent. Mr. Abel states that just the same proportion of litigated patents were declared void in Germany as in Great Britain in the year 1896. I desire to point out that quite apart from Mr. Abel's figures the proportion of patents declared void is a matter of no consequence whatever in this connection. The greater security of a German patent lies in the fact that out of about 15,000 applications to the German Patent Office, less than 6000 are granted. This weeding out of 9000 patents, by a careful and searching preliminary examination, carried out by a competent court, enhances the value of, and gives greater security to, a German patent. In this respect, the Act of 1902, although an improvement on the old Act, is still satisfactory neither to inventors nor to industrial interests. Even if it were true, as Mr. Abel suggests, that as many patents are annually declared null and void in the German courts as in our own, there would be more than one good reason to account for this. Let me briefly repeat some of the reasons, from a pamphlet which I published in 1901.

(1) Probably half of our patents are not worth fighting for, as they are not worth the paper on which they are printed.

(2) Patent legislation, in this country, for a man of moderate means spells financial ruin, while in Germany redress is open at a very much smaller expense.

(3) Account must be taken of the difference in the length of life between English and German patents.

But Mr. Abel's figures are misleading. Whether he intentionally took the year 1896 in order to strengthen his case or merely at random, as he says, is of little importance. The fact remains, and this he ought to have known, that fair or trustworthy conclusions cannot be arrived at by statistics of a single year. I took the trouble to point out to Mr. Abel in 1901 that 1896 was an exceptional year, and prepared a table from official sources, which covers not only 1896—Mr. Abel's year—but also four preceding years. This table, being prepared from accurate official sources, was necessarily arranged in a slightly different manner. It did not include patents litigated or patents partially invalidated; as no trustworthy statistics exist, a good deal of patent litigation is carried on without coming into court, or without being published in the official report of patent cases.

Mr. Abel's Table.

Patents 1896	Patents granted	Patents litigated	Patents wholly or partially invalidated
Great Britain ...	14,105	29	13
Germany ...	5,410	102	43

Table Compiled from German Official Sources for 1892 to 1896.

Year	Applications	Patents granted	Patents invalidated, including patents withdrawn
1892	13,126	5,900	10
1893	14,265	6,430	12
1894	14,964	6,280	22
1895	15,063	5,720	18
1896	16,486	5,410	32

It will be seen from this table that thirty-two patents were withdrawn and invalidated in 1896, whilst the average for the four preceding years is only 15·5 per annum. So much about Mr. Abel's figures.

I quite concede that a searching and real preliminary examination is a controversial subject, but from an economic standpoint it must be admitted that the want of conformity existing between our law and that of Germany as to preliminary examination inflicts great injury on our trades. For example, the grant of a British patent to a foreign applicant which his own ccuntry has refused to him benefits the foreign country at our expense, the loss to us being proportionate to the value of the invention.

The compulsory working of foreign patents in this country is, however, a far more serious question than "preliminary examination as to novelty." The Act of 1902 only dealt with compulsory licenses, and, so far as it goes, it is an improvement of the old Section 22, but more stringent measures are wanted to make

our law conform to that of our Continental rivals. We require, in the interests of our home trades and industries, that a patent shall be forfeited if it is worked abroad and not in this country.[1]

The grant of compulsory licenses has many disadvantages. It requires often years of hard work, ingenuity, and the training of an experienced staff before a patented article can be profitably manufactured on the large scale. Is it reasonable to expect that the foreign owner of the patent will impart such knowledge to the applicant for a compulsory license, or afford him any aid beyond the meagre details of the patented process? Quite independently of this, the owner of the patent will cause as much delay as possible before he grants the license, and, in any circumstances, no application for a compulsory license can be made before the lapse of three years from the date of application. In addition, the onus is thrown on the British applicant to show that the non-working of the patent is unfairly prejudicing any existing or the establishment of any new industry. There is thus little inducement to home manufacturers to take out licenses for foreign patents, and thereby to introduce the manufacture of the article into this country. The non-working of foreign patents has inflicted incalculable harm on our trades. There is, in my opinion, only one effective measure with regard to working foreign patents, and this is to make it compulsory to work them on an adequate manufacturing scale say twelve months from the date the invention is worked in foreign countries. We have more reason, or at least our interests demand it in a higher degree than those of any other country in the world, to insist that the onus should be on the foreign owner of a patent to work the monopoly which we have granted to him in this country so long as it has been proved that the patent is workable. The working of patents is an economic question of the highest importance, but it ought not to be discussed from the platform of either the free importer or the protectionist. Its consideration is beyond the present fiscal controversy because the grant of a monopoly to any person, that is, the grant of a sole and exclusive privilege, is in itself the highest form of protection, but our legislature since the time of James I. has established this form of monopoly, and rightly continued to exercise it.

Before James I.'s time, patents were granted to any one—not necessarily an inventor—who introduced a new manufacture into this country, and I think not unjustly. The man who establishes a new manufacture does more good to the community than thousands of patentees who work monopolies which we have granted to them outside of this country.

The first Patent Act, the Statute of Monopolies of James I., introduced so far a change that it confirmed the right of granting patents to the first and true inventor, but on the condition that he introduced a new manufacture in this country. This law has been enforced to this day by every prominent industrial country in Europe except by ourselves, and I will now endeavour to show why no country in the world has a greater interest than our own to insist that the grant of a foreign patent should be on the condition of its being worked in this country always provided that it is worked abroad.

(1) We grant a far larger number of monopolies to foreigners, and on much easier terms, in consequence of a lack of a thorough examination into novelty, than other European countries.

(2) Progress depends on improvements and new inventions; we are, however, as little self-contained as regards the supply of ideas as we are with regard to the supply of food. We must largely rely on foreign inventions for the reason that our population is only a small portion of that of Europe and America.

(3) We have free imports, whilst the foreign patentee is protected by high tariffs. It is therefore, as a rule, not in his interest to work in this country the monopoly which we have granted to him. He prefers to work it in the country which gives him high protection, with the additional advantage of selling to us his patented article, without any restrictions, and at his own price. This is the converse to dumping. Nor has he any other inducement, special circumstances excepted, voluntarily to establish new industries in the United Kingdom. Our patent law does not attract him, nor does our high duty on alcohol, nor do higher wages and shorter hours, nor our rates for transport, which are about twice as high compared with those, for example, of Germany. The want of compulsory working is one of the reasons that for the last twenty years we have established so very few new trades or industries in comparison with other nations.

It is, therefore, of grave importance that our legislature ought only to grant monopolies on the clearly defined condition that such monopoly must be worked within this country. We stand in serious need of finding additional occupation for our people. Employment in our staple industries we do positively know is declining, with one or two exceptions, nor is the total increase in the number of persons employed in all trades adequate to the nett increase of our population. The latter contention may be at least safely assumed by the fact of rapidly increasing emigration, and the increase in the number of unemployed and of those who are working at a starvation wage.

America is the only industrial country of any importance which does not insist on the working of a patent, nor does she require such an enactment. She has protected herself by almost prohibitory tariffs, which in themselves afford the greatest inducement to the owner of a patent to work it or get it worked, instead of paying exorbitant import duties, which, in many instances, may nullify the advantages of the patented improvement. It may be generally said that the higher the import duties the less the necessity for compulsory working, and *vice versâ*, the lower the import duty the more stringent should be the law as to working. There cannot be any doubt that had we amended our patent laws in 1877, when patent laws were first established in Germany, in such a manner as to make them conform to the latter, a large number of industries would have been established in this country which do not exist to-day. The German patent laws have largely stimulated enterprise, and (as Privy Councillor Dr. Otto Witt said a few years ago) "have conferred incalculable advantages on German trades and industries."

Ours have been chiefly instrumental in advancing the industrial and commercial interests of our foreign competition. The whole nation is in arms, for and against, when it is a question to put a shilling tax on corn, but we are content to leave to a few lawyers and patent agents the decision of a question of a purely economic character which largely involves our industrial and commercial future. When is our

[1] At the annual meeting of the Association of Chambers of Commerce of the United Kingdom held in London, the following resolution was passed on March 10, that "whilst welcoming the instalment of reform secured by the Patent Law Amendment Act of 1902, further amendment is needed in order to secure the forfeiture of all foreign patents for inventions workable in this country, which are not so worked within a reasonable limit of time."

legislature to wake up and appreciate the fact that we must, by all legitimate means, encourage the establishment of new industries within this realm?

IVAN LEVINSTEIN.

BIRD MIGRATION IN GREAT BRITAIN AND IRELAND.

THE great inquiry on the migration of birds as observed in Great Britain and Ireland instituted in 1880 by the British Association was brought to a conclusion at the Southport meeting last year, and it may be useful to describe shortly what it accomplished, and to direct attention to some of the results, which practically remain unknown except to a few ornithologists specially interested in the subject.

For eight years, 1880–1887, the committee appointed collected voluminous observations from the numerous light stations, some two hundred in number, around the British and Irish coasts. From the enormous amount of material thus amassed, a digest of the observations was prepared and presented to the Liverpool meeting, and was published in the report of the Association for 1896 (pp. 451–477), affording, in a highly condensed form, the general results of the inquiry in all its aspects, geographical, seasonal, meteorological, &c. This was followed by a series of histories wherein each and every movement (and the very varied conditions under which they are performed) of eight birds carefully selected so as to include every type of British migrant was exhaustively treated.

These histories appeared in the reports for the years 1900, 1901, 1902 and 1903.

Turning now to some of the special results of the inquiry, in the first place it was clearly proved that a considerable proportion of our native-bred song thrushes, blackbirds, skylarks, starlings, rooks, lapwings, and other species which are usually regarded as being wholly resident throughout the year are migratory; indeed, they are as essentially summer visitors to our isles as the swallow and the cuckoo. They leave us before the end of summer for southern Europe, and are the first harbingers of spring to appear on our shores, arriving during February and early March.

As regards the geographical aspect of the subject, perhaps the most interesting of the varied movements investigated, if not actually discovered, are those remarkable intermigrations which take place between the south-eastern coast of England and the opposite shores of the continent by a westerly autumn and easterly spring flight. Day after day in late September and during October, when the weather is suitable, vast numbers of skylarks, starlings, chaffinches, tree sparrows, rooks, and jackdaws rush across the southern waters of the North Sea, proceeding chiefly due west off the mouth of the Thames (the centre of the stream), south-west off the coast of Kent, north-west off Norfolk, and north-north-west off the Humber. Corresponding return migrations, in opposite directions, are witnessed in the spring. A noteworthy feature of these movements is that they are performed during the daytime; indeed, they are the main diurnal flights observed on the British coasts.

During the preparation of the digest and of the various reports, I was so much impressed with the singularity and importance of these movements that I decided to make some further investigations regarding them, and to this end I spent nearly five weeks on the Kentish Knock light vessel, situated thirty-two miles east of the Essex coast and out of sight of land, during the past autumn (see *Ibis*, pp. 112–142). I was previously uncertain as to whence came these hosts of migrants, now I am of opinion that they are emigrants from western central Europe, which, having probably descended the Maas, Rhine, and Schelde, quit the Dutch coast at the mouths of those rivers *en route* for winter quarters. Some of these remain during the winter in England, others proceed to Ireland, and others, again, depart from our southern shores for more southern lands. There can be little doubt that many of those which remain in our islands *winter in latitudes north of their summer homes*!

Turning next to the meteorological aspect of bird-migration, it has been possible to make a careful comparison between the unique data obtained through the inquiry and the reports issued by the Meteorological Office, and thus to establish satisfactorily certain relations between migrational and meteorological phenomena. For instance, it has been found that each great arrival on our shores of migrants from north-west Europe in the autumn is correlated with a certain type of pressure distribution which establishes fine weather over the North Sea between Scandinavia and the British Isles. Such conditions, however, though they may prevail at the all important point of departure, and hence induce migration, do not always extend so far as Britain, and when this is the case the migrants pass into more or less unfavourable weather ere they reach our shores.

During a month's sojourn in the Eddystone Lighthouse (see *Ibis*, 1902, pp. 246–269) in the autumn of 1901, I paid special attention to the weather conditions under which the migrants set out to cross the Channel. I found that no movements were witnessed when the weather was in the least degree unfavourable for the passage, and that the wind is undoubtedly the main factor in migration meteorology. The direction of the wind was of no moment, for the birds flitted southwards in winds from all quarters. It was otherwise when its velocity came to be considered, and no movements were performed when this exceeded about 28 miles an hour. At 34 miles the few stragglers observed were in distress, and the only birds moving when it exceeded this and approached 40 miles were swallows and martins. My subsequent experiences at the Kentish Knock Lightship confirmed these conclusions.

The supposed influence of the *direction* of the wind on migratory movements has been much misunderstood, chiefly because the dependence of the wind upon atmospheric pressure does not appear to have been taken into consideration. We now know that certain types of pressure distribution are favourable for and conducive to migration, and the winds also resulting therefrom have erroneously come to be looked upon as the cause for such movements.

Finally, the investigation of certain movements, namely, the emigrations, has presented exceptional difficulties, due chiefly to the fact that they are habitually performed under conditions which enshroud them in all but complete obscurity, indeed, often in complete obscurity. The reason for this is that, with few exceptions, emigration is undertaken during the hours of darkness, and thus entirely escapes notice at the place of embarkation. It was with the object of investigating this phase in the phenomenon of migration that led me to visit the Eddystone, where it was possible to observe these emigrants immediately after their departure from our shores. There I found that at least 90 per cent. of the various emigrants crossed the Channel during the night. Indeed, night movements are undoubtedly the rule when considerable expanses of sea have to be traversed. To this rule the chief exception has already been mentioned; but both at the lighthouse and at the lightship I found that day migration was confined to a few species only.

WM. EAGLE CLARKE.

NOTES.

THE seventy-fourth annual meeting of the British Association will commence at Cambridge on Wednesday, August 17. The president elect is the Right Hon. A. J. Balfour, and the presidents of the sections will be as follows:—A, mathematical and physical science, Prof. Horace Lamb, F.R.S.; B, chemistry, Prof. Sydney Young, F.R.S.; C, geology, Mr. Aubrey Strahan, F.R.S.; D, zoology, Mr. W. Bateson, F.R.S.; E, geography, Mr. Douglas W. Freshfield; F, economic science and statistics, Prof. W. Smart; G, engineering, Hon. C. A. Parsons, F.R.S.; H, anthropology, Mr. Henry Balfour; I, physiology, Prof. C. S. Sherrington, F.R.S.; K, botany, Mr. Francis Darwin, F.R.S.; L, educational science, the Lord Bishop of Hereford; conference of delegates of corresponding societies, chairman, Principal E. H. Griffiths, F.R.S. On Friday evening, August 19, a discourse on "Ripple Marks and Sand-dunes" will be given by Prof. G. H. Darwin, F.R.S.; and on Monday, August 22, Prof. H. F. Osborn will deliver a lecture on "Recent Explorations and Researches on Extinct Mammalia."

THE King has approved of the award of the Royal Geographical Society's Royal medals for this year to Sir Harry Johnston and Commander R. F. Scott, R.N. The award to Sir Harry Johnston is made for his explorations of Africa and his investigations of African fauna, flora and peoples; that to Commander Scott for the work accomplished by the Antarctic expedition during its first year in the Antarctic, and for his Antarctic sledge journey when he travelled nearly 300 miles farther south than any of his predecessors. The Murchison grant of the Royal Geographical Society has been awarded to Lieut. Colbeck for his services while in command of the Antarctic relief expedition. The Gill memorial is to be presented to Captain Irizar, of the Argentine Navy, for his rescue of the Nordenskjöld Antarctic expedition. The Cuthbert Peek grant has been awarded to Don Juan Villalta for his geographical discoveries to the east of the Andes while in command of a Peruvian exploring expedition; and the Back grant to Dr. M. A. Stein for his geographical work in Central Asia, and especially for his mapping in the Mustaghata and Kuen Lun ranges.

REUTER reports that two rather severe shocks of earthquake were felt on Monday afternoon at Temir-khan-shura, in the province of Daghestan, in the Caucasus.

THE twelfth "James Forrest" lecture of the Institution of Civil Engineers will be delivered by Mr. Dugald Clerk on Thursday, April 21, the subject being "Internal Combustion Engines."

A SEVERE storm was experienced in the island of Réunion on March 21 and 22. The barometer fell to nearly 28 inches. The damage appears to have been very great.

THE *British Medical Journal* announces that Dr. Percival Wright has resigned the chair of botany in Trinity College, Dublin, after thirty-six years' service. He has consented, however, to continue to act as keeper of the herbarium.

GENERAL BASSOT has been appointed director of Nicé Observatory in succession to the late M. Henri Perrotin. General Bassot is a member of the Bureau des Longitudes, and succeeded the late M. Faye as president of the International Geodetic Association last year.

THE following motion was agreed to by the council of the Central and Associated Chambers of Commerce at a meeting held on Tuesday:—"That this Chamber would welcome a measure to facilitate a more practical system of weights and measures than now in use in this country by the introduction of a decimal system, but not by adopting the metric system, which has no affinity to any existing denomination used in trade or commerce in the United Kingdom."

SOME important changes in the constitution and management of the New Zealand Institute were made during the last session of the New Zealand House of Representatives. Under the New Zealand Institute Act of 1867 the institute was controlled by a board of governors consisting chiefly of members nominated by the Government, the different local institutes (now eight in number) incorporated with the institute being represented only by three members chosen by the board from nominations made by these eight incorporated institutes, and the director of the Geological Survey was by the Act made the permanent manager of the institute. This position has been filled for thirty-five years by Sir James Hector, under whose editorship the first thirty-five volumes of the *Transactions* of the new institute have been published. Shortly after Sir James Hector retired, at the end of June, 1903, an Act was passed by the New Zealand Parliament by which the institute was separated from the Geological Survey, the Colonial Museum and other Government departments with which it had been more or less intimately associated in the past, and at the same time the constitution of the board of governors was altered, so that it now consists of the governor, the Colonial Secretary, four members nominated by the Government, two elected by each of the incorporated institutes at Auckland, Wellington, Christchurch and Dunedin, and one by each of the institutes at the smaller centres. The whole control of the institute and of the publication of its *Transactions* is entrusted to this board, which has also the power of electing the president of the institute. The first meeting of this newly constituted board was held in Wellington in January last, when Captain F. W. Hutton, F.R.S., was unanimously elected president, and Mr. A. Hamilton, curator of the Colonial Museum at Wellington, was made editor of the *Transactions*. The board decided to direct the attention of the Government to the urgent necessity of investigating the fauna and flora of the outlying islands of New Zealand and of preserving them so far as possible from destruction. Other matters of more local interest were dealt with, and the board showed that it is likely to be a vigorous body, and will leave no stone unturned in its efforts to advance the interests of science in New Zealand.

REFERRING to a note in the issue of March 17 commenting on an article by him in the *Field Naturalists' Quarterly*, Mr. R. H. Wallace writes to say that the schemes of work in connection with spring flowers to which attention was directed in our note "are schemes that have been actually carried out by their authors in the schools they represent."

THE directors of the Cunard Company have decided to adopt turbines in the new fast steamers to be built under the agreement with the British Government. A committee was appointed by the company last September to consider the question, and its report has been presented to the directors. The work of the committee has been largely experimental. Two series of comparative tests have been carried out, one on shore at the Neptune Bank station of the Newcastle-on-Tyne Supply Company, and the other afloat with the steamships *Arundel* and *Brighton*, of the Newhaven-Dieppe route. The results obtained with the two steamships were exactly comparable, as the *Arundel* and *Brighton* are practically sister vessels. The only difference is in the machinery, the *Brighton* having turbine engines and the *Arundel* reciprocating engines. During the whole

period of the investigations the committee has realised that fitting turbines of the dimensions necessary to propel the new Cunard ships at the speed contemplated involves a very great step in marine propulsion, the largest turbines at present in use afloat being those in the steamship *Queen*, engaged on the Calais-Dover service.

WE have received a copy of *Deutsches Meteorologisches Jahrbuch für* 1902, containing the results of the meteorological observations at the stations under the control of the Deutsche Seewarte. This is the twenty-fifth annual volume of this very valuable publication, and forms, as our readers are aware, but one portion of the useful work that falls to the share of the establishment in question. We need hardly mention how actively the Seewarte is engaged in the prosecution of weather telegraphy and ocean meteorology; it is probably not so well known that, in conjunction with the Danish Meteorological Institute, it publishes a most laborious series of daily synoptic weather charts for the North Atlantic Ocean, in quarterly volumes, which furnish a valuable aid to the study of the cyclonic systems that form so important a factor in the weather conditions of western Europe. The *Jahrbuch* referred to above contains a summary of all the storms which visited the German coasts in 1902, compiled from the registers kept at the storm signal stations in connection with the Seewarte; we think this by no means light compilation is an important appendix to the work.

A COMMUNICATION has been received from Mr. A. Apps in which he desires to point out that the claim of anything new or special can hardly be sustained in respect of the interrupter referred to in our note on p. 470 (March 17). He states that in or about 1858 the late Mr. Ladd made a contact breaker for Mr. J. V. Gassiott, F.R.S., in which the hammer was so arranged as to knock away the contact between the platinum studs very suddenly; this coil gave 12 inch sparks, but when fitted by Mr. Apps with one of his 10 inch contact breakers in 1899 a 14½ inch spark was obtained. Another interrupter on the Gassiott model, made for Mr. Baines in 1868, was discarded after many experiments. About 1866 a coil designed by Cromwell Varley, F.R.S., was fitted with a hammer arranged to produce a very sudden break, and this also was replaced a few years later by one of the Apps form. Mr. Apps further states that for the last thirty years it has been usual for his coils to give a 10 inch spark with 2 cells (4 volts), and that he has now a coil giving 12 inches freely with a 2 cell storage battery. It may be added that our remark as to the new arrangement performing what the inventors claimed referred rather to the length of spark obtained with a given battery power than to its merits compared with other forms, and it should have been stated that while the 10 inch spark was obtained with the greatest ease from two four-volt storage cells, even an electromotive force of four volts was capable of producing a spark of this length.

IN a couple of short printed notes Prof. Moriz Kuhn, of Vienna, describes simple apparatus adapted for class-room demonstrations of Torricelli's theorem, Boyle's and Dalton's laws, and other properties of gases. With a slight modification, a very fair vacuum tube can be obtained with one of the apparatus, or it can be used as an open tube manometer. The whole apparatus is made by Karl Woytaček, 10 Frankengasse, 9th district, Vienna.

MESSRS. VIEWEG AND SON, of Brunswick, have issued a fourth edition of vol. i. part iii. of Dr. Alex. Wernicke's "Lehrbuch der Mechanik." It forms a complete treatise on the theory of elasticity as applied to engineering problems, and deals at considerable length with the statics of loaded beams. In this part of the subject considerable use is made of graphic methods. The book is peculiarly adapted to students of German technical schools, but it also meets the requirements of certain university students and candidates for higher teachers' certificates in that country. It covers a field of study which does not receive the attention which it ought to have in this country; probably no English text-book exists which is written on the same lines. It should receive the careful attention of lecturers on applied mechanics.

A PRELIMINARY report on the lead and zinc deposits of south-western Wisconsin, by Prof. U. S. Grant, has been issued as *Bulletin* No. 9 of the Wisconsin Geological and Natural History Society. In order to render the work useful to the public in general, there is a popular account of the physical features, geology, and genesis of ore deposits, occupying half of this little volume. The lead and zinc ores occur in Cambrian, but mainly in the Trenton and Galena Limestones of the Ordovician. The original minerals of the ore-deposits are the sulphides, galena, sphalerite and marcasite. Smithsonite and iron oxides are secondary minerals, having been formed from the alteration of the original sulphides. The secondary minerals occur in the rocks above the level of ground water, or in the belt of weathering. The original minerals, with the exception of galena, which is closely associated with both the original and secondary minerals, occur below the level of ground water. The order of deposition is noted as (1) marcasite, (2) sphalerite (sometimes with galena), (3) galena. The author points out the method of occurrence of the ores, and explains their origin as due partly to deep-seated or artesian circulation of water, and partly to down water circulation. The methods of mining and the resources of the area are duly considered.

THE March number of the *National Geographic Magazine* deals chiefly with Manchuria and Korea. A good war map, with insets, prepared by the American War Department, is included, and there is a specially valuable account of Russian development of Manchuria by Mr. Henry B. Miller, United States Consul at Niuchwang.

EXCEPT for a note by Mr. D. W. Freshfield on the road to Tibet, the current number of the *Geographical Teacher* is chiefly devoted to reports of the proceedings of the Geographical Association, of conferences on the teaching of geography, and to reprints of papers read. The discussion on the Royal Geographical Society's syllabus, by experienced school teachers of the subject, is of special interest and value.

THE February number of *La Géographie* contains articles on the Lenfant expedition, which has discovered a continuous watercourse between the Logone and the Benoué, *i.e.* between the Tchad and Atlantic basins; on the exploration of Bolivia; on the province of Bathang; and on the country of the Hereros. There is also a number of valuable notes, including one on the utilisation of water-power in la Mayenne and la Manche, and another on the present state of the Russian geodetic and topographic surveys.

WE learn from the *Bulletin* of the Society of Naturalists at St. Petersburg (No. 1) that a new expedition for the exploration of the Caspian Sea is to be sent out early this spring. It is a continuation of the Aral-Caspian expedition which worked some thirty years ago. The party will

include such explorers as MM. Knipovitch and Lebedintseff, well known by their explorations of the White and the Black Seas. The chief aim of the expedition is the hydro-biological exploration of the Caspian Sea and the biology of the Caspian herring

THE *Memoirs* of the St. Petersburg Society of Naturalists (botanical section, vol. xxiii.) continue to bring out new fascicules of the valuable work, "Flora Caucasica Critica," by MM. N. Kuznetsoff, N. Busch, and A. Fomin. The descriptions of the species and varieties are given in Latin, as also all the indexes and the indications concerning the geographical areas of each species; but the remarks added to the above, sometimes extremely interesting, as also the introductory notes to each family, are in Russian.

THE identification of Mexican and Central American plants is receiving special attention from workers in the Gray Herbarium of Harvard University. Mr. J. R. Johnston has contributed to the *Proceedings* of the American Academy of Arts and Sciences a revision of the genus Flaveria, which belongs to the order Compositæ. This genus may be described as Mexican, but is not confined to the country. In a paper published in the *Proceedings* of the Boston Society of Natural History, Mr. B. L. Robinson also deals with plants collected in Mexico and Central America, and describes several new species, amongst others, for the genera Eupatorium, Mikania and Mimosa.

AMONGST the plants forwarded from British New Guinea by the Lieutenant-Governor to Mr. F. Bailey, the colonial botanist in Queensland, to be named by him, the more interesting are a species of Citrus which seems to be suitable for a graft-stock; a euphorbiaceous plant, *Baccaurea papuana*, which, as in the case of other species of the genus, provides edible flowers and fruit; and *Pongamia glabra*, a leguminous plant, of which the leaves and seeds are known to possess therapeutic properties. The recent additions to the flora of Queensland made by Mr. Bailey have either been incorporated into his book direct or have appeared in the *Queensland Agricultural Journal*, but a *Bulletin* was issued last year by the Department of Agriculture which contains a list of newly recorded fungi.

WE are glad to see that Mr. Thompson, who has so long held the office of deputy superintendent and head-keeper in the Gardens of the Zoological Society, has been rewarded with the society's silver medal in recognition of his conspicuous success in the management of the animals under his charge.

NOS. 4 and 5 of the first volume of the *Physiological Publications* of the University of California contain reports of two addresses—one by Prof. W. Ostwald on the relations of biology and the neighbouring sciences, and the other by Prof. J. Loeb on the limits of biological research—delivered at the dedication of the Rudolph Spreckel Physiological Laboratory in August last.

JUDGING from its thirty-seventh report (for last year), that admirable institution, the Rugby School Natural History Society, continues to enjoy a flourishing career, and to be well supported by the members of the school. Among its contents is an illustrated paper by Mr. J. C. F. Fryer on British thrushes, admirable in general plan, but in which the author seems in certain instances to use the term "genus" where he means "group."

THE *Naturalist* for February contains a reproduction (from the *Transactions* of the Entomological Society) of one of Prof. Poulton's beautiful and instructive plates illustrating the colour adaptations of caterpillars to their surroundings under artificial conditions. Among the contents of the March number of the same serial is a description, by Mr. C. T. Trechman, of flint implements of Neolithic age discovered on the coast of Durham.

IN a note on the osteology of some berychoid fishes (the group typified by the members of the family Berychidæ, or slime-heads), published in the *Proceedings* of the U.S. National Museum (No. 1366), Mr. E. C. Starks directs attention to a distinctive feature of the occipital region of the skull. In ordinary percoid fishes the basioccipital forms a concave surface with a deep pit in the centre, while the exoccipitals are small and in most cases separate, and present flat oblique facets for the atlas vertebra. In the berychoids, on the other hand, the exoccipitals are large, extensively in contact in the middle line, and form with the basioccipital a regularly concave surface for the atlas. It may be added that in calling this surface a "concave condyle," the author utterly traverses the etymological significance of κόνδυλος, which signifies a convex knuckle.

WE have received from the secretary the abstract of a paper read at a meeting of the Society for Psychical Research on March 21 by Dr. Albert Wilson. It is interesting as containing an account of a patient who suffered at the age of 12½ years from influenza, followed by meningitis, and in consequence developed a multiple personality. The case appears to be strictly analogous to similar cases already reported (*e.g.* James's "Psychology," p. 383 *sqq.*), except that the "personalities" attained the unusual number ten. Such cases are usually hypnotic; in this instance Dr. Wilson lays stress on the dependence of the various states on the comparative activity of different cortical layers. Dr. Wilson suggests that the brain may be composed of "districts, each district representing a personality or small ego"; we agree with him that "the whole subject requires more extended investigation," and the case he describes is certainly an important datum.

HALF-VOLUME VI. of the "Natural History of Animals," by Prof. J. R. Ainsworth-Davis, has now been published by the Gresham Publishing Company, of London. This part, of what is a very well illustrated publication, deals largely with animal development and animal life-histories.

A NEW catalogue has been issued by Mr. Thomas D. Russell, of 78 Newgate Street, London, E.C., giving full particulars of collections to illustrate lectures and demonstrations in geology, physiography, and mineralogy, as well as of all material required by prospectors and mining engineers. The collections prepared to accompany instruction from well-known text-books of these subjects of natural science should be a great convenience to teachers.

MESSRS. MACMILLAN AND CO., LTD., have published several separate parts of "A School Geometry," by Messrs. Hall and Stevens, already reviewed in these columns. We have received the following volumes:—parts i.–iv., containing the substance of Euclid Books i.–iv., price 3*s.*; parts iii.–iv., containing the substance of Euclid Books ii. and iii., and part of Book iv., price 1*s.* 6*d.*; and parts iv.–v., containing the substance of Euclid Books ii., iii., 35–37, and Book vi., price 2*s.*

WE have received a copy of the new edition of the full catalogue of general testing and scientific instruments manufactured by Messrs. Nalder Bros. and Co., of Westminster. This profusely illustrated volume should prove of real assistance to teachers of science responsible for the equipment of physical laboratories, and, as it is five years

since the last list of Messrs. Nalder Bros. and Co. was published, a number of new instruments used for scientific instruction and research are included in the present catalogue.

A NEW impression of Sir Oliver Lodge's "Pioneers of Science," which originally appeared in 1893 (see NATURE, vol. xlvii. p. 268), has been published by Messrs. Macmillan and Co., Ltd. The book is an interesting narrative of the careers and investigations of great astronomers whose contributions are links in a chain of scientific history. Personal details give living interest to the work, and the essential points of progress are clearly displayed. But why has not Sir Oliver Lodge taken the opportunity which a new issue afforded him of substituting reproductions of astronomical photographs for the caricatures which appear as representations of star clusters and nebulæ? Figs. 43, 48, 80, 87, 89 and half a dozen others could easily have been superseded by pictures from photographs, instead of being left to irritate astronomers who know what beautiful illustrations are available and to mislead students who have not seen the objects depicted or photographs of them. Fig. 47, explaining the phases of the planet Venus, is upside down.

THE first part of the third volume of *Biometrika* has now been issued by the Cambridge University Press. In addition to miscellanea the following papers are published:—on the result of crossing Japanese waltzing mice with albino mice, by Mr. A. D. Darbishire; graduation of a sickness table by Makeham's hypothesis, by Mr. John Spencer; the measurements of 130 criminals, by Mr. G. B. Griffiths, with an introductory note by Dr. H. B. Donkin; a preliminary note on the protective value of colour in *Mantis religiosa*, by Mr. A. P. di Cesnola; a first study of the weight, variability, and correlation of the human viscera, with special reference to the healthy and diseased heart, by Mr. M. Greenwood, jun.; and a paper in Italian, "Sui Massimi delle Curve Dimorfiche," by Signor Da Fernando de Helguero.

IN the *Journal* of the Society of Chemical Industry for February 15 Messrs. R. S. Hutton and J. E. Petavel describe methods for the preparation and compression on a large scale of pure gases for experimental work. The experimental plant required for the production of large quantities of hydrogen, nitrogen, carbon monoxide and ethylene, at a rate of about 100 litres per hour, is illustrated by diagrams, and interesting facts concerning the compression and storage of these gases are communicated.

IN a communication to the *Journal of Physical Chemistry*, vol. vii. p. 557, Dr. J. W. Mellor points out that the theory that water is in many cases essential to chemical change is of much earlier date than is generally supposed. Mrs. Fulhame, in 1794, appears to have been the first to give a clear statement of the influence of water on chemical transformations, and her observations were published in a work entitled "An Essay on Combustion with a View to a New Art of Dyeing and Painting wherein the Phlogistic and Antiphlogistic Hypotheses are proved Erroneous." In many respects Mrs. Fulhame's theory accords with present-day views.

IT has been known for a considerable time that the products obtained in the electrolytic reduction of nitro-compounds depend upon the nature of the kathode plates. By the reduction of nitrobenzene in alkaline solution azoxybenzene is obtained with platinum and nickel kathodes, azobenzene with lead, tin and zinc kathodes, and by using kathodes of copper, aniline appears as the reduction product. In the current number of the *Zeitschrift für physikalische Chemie* Messrs. Löb and Moore show that the essential factor in determining the reduction is the kathode potential, and with a given kathode potential the same products are obtained in approximately constant proportions independent of the nature of the kathode material.

THE experimental determination of the density of fluorine, made by M. Henri Moissan shortly after the isolation of this element, gave the number 1·260, considerably lower than the figure required by the atomic weight of fluorine, 1·319, and on this account the suggestion has been put forward by Brauner that a certain proportion of free atoms was present in the gas, thus accounting for its remarkable chemical properties. In the current number of the *Comptes rendus* M. Moissan has again taken up this question, with minute precautions regarding the purity of the gas, the result of four experiments being 1·298, 1·319, 1·313, 1·312, or a mean of 1·31. The agreement between the experimental and theoretical figures is thus sufficiently close to disprove the existence of any considerable proportion of free atoms in the gas.

THE additions to the Zoological Society's Gardens during the past week include an Otter (*Lutra vulgaris*), British, presented by Mr. Radcliffe Saunders; a Red Fox (*Canis fulvus*) from North America, presented by Mr. E. W. Bishop; a Lesser Sulphur-crested Cockatoo (*Cacatua sulphurea*) from Moluccas, presented by Miss L. Newman; a Bateleur Eagle (*Helotarsus ecaudatus*) from Africa, presented by Dr. W. J. Ansorge; a Jardine's Parrot (*Poeocephalus gulielmi*) from West Africa, presented by Mr. A. Willoughby Osborne; a White-eared Bulbul (*Pycnonotus leucotis*) from North-west India, presented by Mr. G. Dendle; four Common Pheasants (*Phasianus colchicus*), British, presented by the Hon. Walter Rothschild, M.P.; a Hybrid Pheasant (between *Phasianus reevesi* and *Euplocamus nycthemerus*), presented by the Earl of Ducie; two Wharton's Fruit Pigeons (*Carpophaga whartoni*) from Christmas Island, two Yellow-eyed Babblers (*Chrysomma sinense*), two Sepoy Finches (*Haematospiza sipahi*), three Rose-coloured Pastors (*Pastor roseus*) from India, a Purple-capped Lory (*Lorius domicella*) from Moluccas, a Hybrid Duck (between *Metopiana peposaca* and *Fuligula rufina*), a Hybrid Duck (between *Aex sponsa* and *Dafila spinicauda*), European; five Tuatera Lizards (*Sphenodon punctatus*) from New Zealand, fourteen Alpine Newts (*Molge alpestris*), six Marbled Newts (*Molge marmorata*), European; a Red Newt (*Sperlepes rubra*), a Californian Newt (*Molge torosa*) from North America, deposited; three Japanese Pheasants (*Phasianus versicolor*) from Japan, three Bar-tailed Pheasants (*Thaumalea amherstiae*), two Silver Pheasants (*Euplocamus nycthemerus*), two Manchurian Crossoptilons (*Crossoptilon mantchuricum*) from China, purchased.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN APRIL:—

April 5. 4h. Ceres in conjunction with moon. Ceres 1° 1′ S.
7. 10h. 38m. Minimum of Algol (β Persei).
10. 7h. 27m. Minimum of Algol (β Persei).
14. 5h. Jupiter in conjunction with Moon. Jupiter 0° 7′ N.
15. Venus. Illuminated portion of disc = 0·927, of Mars = 0·995.
17. 8h. Mercury 7° N.W. of the Moon.

19. Saturn. Major axis outer ring = 37″·74. Minor axis = 9″·05.
20-22. Epoch of April meteors (*Lyrids*, radiant 271° + 33°).
21. 8h. Mercury at greatest elongation east 20° 11′.
22. 22h. Venus in conjunction with Jupiter. Venus 0° 30′ S.
27. 12h. 20m. Minimum of Algol (β Persei).
30. 9h. 9m. Minimum of Algol (β Persei).
,, 18h. 32m. Transit (egress) of Jupiter's Sat. III. (Ganymede).

STANDARD VELOCITY STARS.—In a communication to No. 2, vol. xix., of the *Astrophysical Journal*, M. A. Belopolsky gives an account of the work which has been done at Pulkowa in connection with the international cooperative scheme for the determination of the radial velocities of certain standard stars.

The 36-inch refractor and a new Töpfer spectrograph, similar to the Potsdam IIIa. spectrograph, have been used, and the details of the methods employed and of the provisional results obtained, for six of the velocity stars, are given in the present paper. The results are not so good as might be expected, but it is hoped that better results will be attained during the next year's work. The spectrum of iron was used for comparison, and control spectrograms of the sun, Mars, Jupiter and Venus were obtained. The results for the first three are discussed in the present paper; those for Venus, which are much more comprehensive, are being reserved for a future communication.

OBSERVED MOTIONS IN THE NOVA PERSEI NEBULA.—Prof. J. M. Schaeberle, in a note to the *Astronomische Nachrichten* (No. 3935), points out the great importance of studying every possible condition which may affect the determination of the parallax of the nebula surrounding Nova Persei, for until the parallax is unquestionably known theories regarding the observed movements can only be of a highly speculative character. In determining the actual parallax only the "absolute" method is available, and Prof. Schaeberle suggests that one of the conditions affecting the results might possibly be a refraction of the rays by some interplanetary medium filling the solar system. He contends that it is only reasonable to suppose that a difference of some kind *may* exist between the space void of heated matter and that surrounding an attracting mass radiating both matter and heat. If any medium (either gaseous or ethereal), such as an extended solar atmosphere, does exist, then any light entering such a space would be refracted, and the hitherto determined negative parallaxes are simply the differences between this refraction and the true parallax, where the latter is less than the former; similarly in cases where the measures indicate no parallax the two may be equal and opposite. Thus if this refraction constant were only 1″ the recorded motions in the nebulosity surrounding Nova Persei would be readily explicable, for with a parallax of 1″ they are about equal in magnitude to those occasionally observed in solar work.

A NEW FORM OF EQUATORIAL MOUNTING.—A new form of equatorial mounting, for which the inventor, Herr A. F. Lindemann, of Darmstadt, claims many advantages, is described and illustrated by a diagram in No. 3935 of the *Astronomische Nachrichten*.

The light from the star is collected by an objective placed at the upper end of the polar axis, and by a system of mirrors is reflected down that axis. By suitable mechanism the movements in R.A. and declination are imparted to tubes inside the telescope (*i.e.* the polar axis), and hence to the reflectors, from clockwork of the usual form.

Among the many advantages claimed for this form of mounting are that the observer may remain comfortably seated in a room of uniform temperature, the instrument is very compact and perfectly balanced, the vibration effects are reduced to a minimum, and no large dome with costly mechanism for revolving it is required.

THE LEONID SHOWER OF 1903.—Further evidence that the Leonid shower of 1903 afforded a fairly rich display is given by the observations made at the Royal Observatory at Lisbon. During a watch of 3h. 28m. (15h. 14·7m. to 18h. 42·7m. G.M.T.) on November 15, Senor Campos Rodrigues counted 165 Leonids. At the maximum of the shower during the five minutes' interval from 16h. 46·7m. to 16h. 51·7m. 22 Leonids were counted (*Astronomische Nachrichten*, No. 3936).

THE INSTITUTION OF NAVAL ARCHITECTS.

THE annual general meeting of the Institution of Naval Architects was held last week in the theatre of the Society of Arts, the president, the Earl of Glasgow, occupying the chair. The meeting commenced on the morning of Wednesday, March 23, and was carried on during the two following days. There was on the agenda a list of fourteen papers to be read and discussed, and these, being all dealt with, made, together with the presidential address and other business, a very full programme for each day, possibly too full, considering the sittings did not commence until noon.

As president of the institution, Lord Glasgow yearly gives a general summary of the condition of the shipbuilding and marine engineering industries of the country in his address, which, though brief, contains a quantity of matter which well illustrates Huxley's apothegm as to the need of knowing a great deal to say a little well. His remarks on the future of the steam turbine, on the prospects of internal combustion engines, and on other matters of a like nature indicate that Lord Glasgow is more than a merely ornamental president.

The chief interest in the meeting was doubtless centered in Sir Edward Reed's paper on the two battleships recently purchased from the Chilian authorities by our own Admiralty. These two ships, now H.M.S. *Triumph* and *Swiftsure*—formerly the *Libertad* and the *Constitucion*—were designed by Sir Edward Reed in conjunction with officers of the Chilian Navy. The debates in Parliament, in which the designs of these vessels were compared with those of battleships of the Royal Navy, raised considerable feeling, and the personal element, which always attracts interest, was not absent. It cannot be said, however, that either the paper or the discussion did much to advance the science of warship design. Sir Edward Reed maintained the superiority of his own designs, whilst Sir William White, who was the chief speaker in the discussion, upheld the superior advantages of the ships for which he was responsible. At present the efficiency of designs for warships is an open question upon which critics may hold conflicting opinions without fear of them being proved erroneous, and this position is likely to continue until practical evidence is obtained by the test of actual warfare. Beyond this, however, it is seldom—in fact one may say never—that particulars sufficient for a full comparison of different ships are made public, and it is for these reasons that the controversies in warship design are so barren.

A paper by Lord Brassey which followed, and dealt with the problem of merchant cruisers and steamship subsidies, pointed out the need that would arise in case of war for more scouts than the navy at present possesses, and advocated the use of merchant vessels for this purpose. Here naval opinion was divided, one authority, Admiral Fitzgerald, maintaining that it would be better policy to devote any money available to the building of regular warships rather than to paying subsidies, whilst another admiral, Sir Edmund Fremantle, said that if he had to send a vessel at full speed across the ocean he would select an Atlantic liner, as our cruisers would not be able to maintain so high a speed for so long a period as the mercantile vessel. The question of portable armour, to be shipped in case of war on merchant vessels, was also brought forward, but this was fully discussed by Prof. Biles at a meeting of the institution held just ten years ago.

On the second day of the meeting Sir William White read a paper in which he advocated the establishment of an experimental tank for testing ships' forms by means of models, on the system instituted by the late William Froude at Torquay. At the Glasgow meeting of the institution held in 1901, Mr. Yarrow brought forward a motion proposing that a tank should be established under the auspices of the institution. As a result efforts were made to raise the necessary funds, but although some ship-building firms promised handsome subscriptions, the proposal was not well

backed up. The reason for the failure was attributed to the fact that it was proposed to try models for different firms, and it was feared that difficulties might arise. Sir William now suggests that what might be called the commercial side of the scheme should be abandoned, and that a tank should be constructed for the sole purpose of research work, and investigation into the general principles underlying the science of naval architecture. This would naturally cut off the income it was proposed should be derived from testing models for firms, and therefore a sufficient sum must be collected, not only to build the tank, but also to endow it. The suggestion is that the tank should be constructed at Bushy, and be incorporated as a part of the National Physical Laboratory. The cost of building would be about 15,000*l.*, and the annual cost of staff, maintenance, &c., would be about 1500*l.* Dr. Glazebrook, who spoke in the discussion, said the management of the National Physical Laboratory welcomed the suggestion most cordially, and it therefore only remains to collect the money. The cooperation of ship owners, as well as of ship builders, was asked for, and the general opinion of the meeting appeared to be that it would argue ill for the enterprise and public spirit of the shipping community if the moderate sum needed were not forthcoming.

The next paper read was doubtless the most valuable presented at the meeting. It was a contribution by Mr. R. E. Froude, and detailed some results on model experiments. It is hardly necessary to remind our readers that Mr. Froude has for many years carried on at Haslar for the Government the work in connection with tank research inaugurated by his brilliant father. The details he now gives are the result of experiments carried through a period of thirty years; in fact, the initial trials were made at Torquay by the late Mr. Froude. The details given were of a purely technical nature, and could not be explained without the advantage of much space and many diagrams of ships' forms, &c. Although the details referred to war vessels, they are applicable to mercantile craft within the limits of form included.

A paper by Prof. Scribanti, of the Royal Italian Navy, on the heeling and rolling of ships of small initial stability, was read in brief abstract, and was not discussed.

A paper by Herr Otto Schlick, on the gyroscopic effect of fly wheels on board ship, was read at the evening sitting of Thursday. The author proposed the installation of an enormous gyroscope for the purpose indicated. The suggestion is not new, but the practical difficulties in the way have generally been considered too great to make the plan acceptable to ship designers. Herr Schlick's paper was, however, acceptable as giving in simple language an admirable exposition of the gyroscopic effect.

Two papers, respectively by Mr. J. E. Thornycroft and Mr. A. F. Evans, gave particulars, chiefly of a historical nature, of the application of oil engines to small vessels. The occasion is perhaps notable from the fact that some members present, connected in a practical manner with marine engineering and ship design, considered the use of gas engines for marine propulsion—with gas producers in place of steam boilers—as a problem that would have to be considered before long.

At the Friday meeting Prof. Plateau, of Paris, gave particulars of vessels fitted with the form of steam turbine he has invented, notably a first-class torpedo boat built by Messrs. Yarrow and Co. This vessel has made a speed of 26·39 knots. The battle of the turbines is likely to be the great feature in the domain of ship propulsion in the immediate future. Whether the impulse type or the reaction type will prove superior is a question that must be settled by experiment, and further information on this subject is anticipated with interest. The adoption of the steam turbine in the two new Cunard liners, after an exhaustive inquiry by a very competent tribunal, has placed the steam turbine on a firm basis as a means of marine propulsion.

A paper by Dr. J. Bruhn, on some points in connection with the transverse strength of ships, dealt with a problem of such complexity that it has often been considered indeterminable; whilst a second paper by Mr. A. W. Johns, on the normal pressure on thin moving plates, is also one that lends itself to abstruse mathematical consideration.

RECENT DISCOVERIES IN BACTERIOLOGY.[1]

THESE are researches towards a fuller knowledge of the morphology and life-history of various orders belonging to Bacteriaceæ. So far the complete life-history of sporogenous forms had only been worked out for a very small number, all belonging to the genus Bacillus. The discovery of spores in the genus Sarcina, and the acquisition of a pure culture of the same by the author, gave him an opportunity of making a complete investigation of this genus. It includes the treatment of spores with various reagents, the germination, the mode of insertion of cilia, the course of development in various media, mode of cell-division, development of spores, and a number of physiological experiments. With appropriate stains the morphology and inner structure of the cell was examined, the cell being differentiated into membrane cytoplasm and nucleus. The results of metabolism fat, glycogen, &c., were not observed, so the products of protoplasm must be dissolved in the cytoplasm, and cannot at present be examined microscopically. The development of the spore is interesting, and requires a very delicate manipulation of stains. It first appears as a vacuole with a central nucleus embedded in it. The vacuole gets denser, until the young spore now dimly outlined stains more deeply than the neighbouring cytoplasm. Then it differentiates a membrane and gradually becomes very strongly refractive, whilst the rest of the cell almost entirely disappears, being only visible when treated with certain stains. This description tallies with Meyer's account of the development of the spore in the genus Bacillus.

Investigation was also carried into the genus Spirillum, the species *Sp. giganteum* being chosen. The variation of size and form, variation, nature, and amount of reserve matter (fat and "Volutans-kugeln"), the ciliation, the course of development in various media, pathogenic structures, &c., were fully examined, so that a complete diagnosis of the species is in our possession. The formation of spores is unfortunately as yet unknown in this species. In this species the most interesting result was the *demonstration* of the origin of the cilia from the inside of the cell. Some investigators had maintained that the cell had no membrane, beng simply naked protoplasm, and that the cilia arose from the periphery, others that there was a membrane, so that the cilia must arise from the inside. The whole question was purely conjectural, but with appropriate staining, which is given in the text, and shown by drawings, the author proves the latter hypothesis to be the true one.

The most important part of the above researches is that dealing with ciliation. Modern classification subdivides according to the possession or non-possession of organs of motion. It is proved that formation of slime in the artificial cultures of the laboratory is the cause of absence of motion. A method is discovered to prevent this formation, with the result that all the supposed non-motile forms were found to be motile, and from everyone the organs of motion were successfully demonstrated. The investigation included 17 forms from the genus Sarcina, 5 forms from the genus Micrococcus, 3 forms from the genus Streptococcus, and 5 from the genus Bacterium, all indiscriminately chosen. Hence the genus Sarcina is absolutely identical with the genus Planosarcina, Micrococcus with Planococcus, and Bacterium with Bacillus (see Migula's "System der Bakterien"). It is therefore obviously necessary that the subdivision of the families Coccaceæ and Bacteriaceæ must be remodelled. A new classification is proposed for these two families, the essence of which is as follows:—

Family Coccaceae. Round cells, ciliated.

(1) Genus Streptococcus. Division in one direction of space.

(2) Genus Micrococcus. Division in two directions of space.

(3) Genus Sarcina. Division in three directions of space.

[1] (1) "Untersuchungen über Sarcina Streptoccus und Spirillum," *Centralblatt für Bakteriologie*, Abt. I. Bd. XXXIII. (1903.) (2) "Der Nachweis der Geisseln bei allen Coccaceen," *Ibid.*, Abt. II. Bd. IX. (1902.) (3) "On the Discovery of Cilia in the Genus Bacterium," *Ibid.*, Abt. II. Bd. XI. (1903.) No. 8/9. By David Ellis, Ph.D. (Marburg), B.Sc. (London).

Family Bacteriaceae. Cylindrical forms, ciliated.

(1) Genus Bacillus. Forms with peritrich cilia.
(2) Genus Pseudomonas. Forms with polar cilia.

It cannot but be interesting to medical bacteriologists to learn that the pathogenic Streptococci are motile. At the conclusion of the third paper the exact method by which successful cilia preparations can be obtained is given.

FLUORESCENT BODIES EXCITED BY RADIUM.

SINCE very active preparations of radium have become available, a steady search has been going on in many quarters for agents which will respond to the radiations and convert them into visible light. The most powerful fluorescer towards the α radiations is Sidot's hexagonal blende, a crystallised form of zinc sulphide, which is especially suited for use with the emanation. The most powerful to the β radiation is willemite, a zinc silicate, which gives a magnificent green fluorescence, and is probably quite free from any phosphorescence after the action of the rays ceases. This if left in the radium emanation steadily increases in brightness as the excited activity, and with it the β radiation, is produced, and reaches its maximum some hours after the emanation has been introduced. The same is true of kunzite, a new variety of spodumene discovered by Dr. Kunz, and supplied by Messrs. Griffin and Sons, Ltd. The colour of the light might be variously described by different observers as salmon-pink, warm orange, or orange-yellow, according to individual opinion. Kunzite is a transparent gem-like crystal, and is one of the most beautiful examples of the fluorescent bodies at present available for demonstrating the luminous effects produced by the radium rays. It is, however, not very powerful compared with willemite or the platinocyanides. Being, like the diamond, transparent, it shines especially well when exposed in a tube to the action of the concentrated radium emanation, as the whole mass of the crystal contributes to the light effect. The growth of the luminosity after the emanation is introduced, owing to gradual production of the excited activity, is more marked than in the case of willemite, as kunzite hardly seems to respond at all to the α radiation. This experiment would be instructive as a lecture illustration to prove that the emanation only gives α rays, and that the β rays are produced only when time has been allowed for some of the emanation to change into the matter causing the excited activity.

The most brilliant and exquisite of all fluorescers for demonstration on a large scale are the platinocyanides in the form of large crystals. Those containing lithium give a beautiful pink, not unlike that of kunzite, but more brilliant. The colour of the latter is doubtless due to the lithium contained in it. The calcium and barium salts are characterised by a deep green, especially the former, whereas the sodium compound shines lemon-yellow. Magnesium platinocyanide, which is so beautiful under the X-rays, hardly responds at all to radium. The feeble γ rays are best shown by a large crystal of the barium or lithium salt. Large crystals of the platinocyanides seem extremely difficult to obtain, and any manufacturer who could produce them would probably find a ready market.

A new fluorescent mineral, which, like kunzite, seems to respond only to the β rays of radium, has been recently discovered by Mr. Armbrecht, a member of the firm of Armbrecht, Nelson and Co., chemists, Duke Street, W. The mineral is sparteite, a form of calcite containing a few per cent. of manganese. It occurs associated with willemite and with zincite, the red oxide of zinc, which contains a trace of manganese. It is pure white in colour, and under the action of the β radium rays fluoresces a very deep orange. The light is not at all powerful, but the colour is very remarkable, and would excite comment merely as a fluorescent phenomenon without reference to the way in which it is produced. One authority described it as exactly similar to the colour given by neon in a spectrum tube. It is rather remarkable that the colour seems to depend on the intensity of the rays, and is of a deeper *tint* when the radium is held near than when it is removed a short distance. The same gentleman has discovered among the fluorites some examples of phosphorescence after exposure to radium which persist for several days, and exhibit marked increase of brilliancy on exposure to the warmth of the hand. He finds that kunzite exhibits a similar behaviour, the after phosphorescence (or thermo-luminescence?) being notably increased if the mineral is held in the hand.

The action of kunzite and sparteite under the kathode rays is of interest. In each case the colour is considerably different from that under the action of radium, being much yellower. Sparteite under these conditions is disappointing, but kunzite is a most beautiful sight. Its colour is a pure deep yellow without a trace of the warmth it exhibits under radium. F. S.

THE PALOLO WORM OF SAMOA.

THE periodical autumnal swarming in the seas around the Samoan Islands of the annelid locally known as the palolo has attracted the attention of residents in those islands and naturalists generally for many years. The swarming takes place in October and November, apparently on the day before the last quarter of the moon, and on this and the following day the sea is absolutely alive with the worms, of which the numbers seem to be greater in the November than in the October swarm. Early dawn is the time for the swarming to commence, and by sunrise the phenomenon is at its height. Not the least curious feature about the swarming is the fact that all the worms are imperfect and headless, and the nature of the complete worm has long been a puzzle to naturalists. Thanks, however, to the investigations of Messrs. Krämer and Friedländer, supplemented by the observations of Mr. W. McM. Woodworth, the solution of the problem has at length been discovered. The results of these investigations have been published in Dr. Krämer's "Die Samoa Inseln" (Stuttgart, 1903), while the original English version of this account, drawn up by Mr. Woodworth, appears in the *American Naturalist* for December last.

Palolo also occur in Fiji and elsewhere. The complete annelid—*Eunice viridis*—burrows into the reef-rock of Samoa, the reef, when prised open with a crowbar, proving shortly before the swarming season to be absolutely alive with palolo. Curiously enough, the Samoan natives, although familiar with the palolo when swarming, are quite unacquainted with it during the period of its rock-boring existence. Owing to the great length of the entire worm, its fragile structure, and its intricate association with the honeycombed reef, the extraction of complete specimens is a matter of considerable difficulty, demanding very delicate manipulation on the part of the operator.

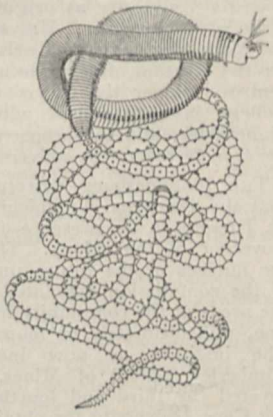

FIG. 1.—*Eunice viridis* (Gray). The narrow posterior epitokal part when detached and free-swimming is known as the "Palolo."

The complete annelid consists of two distinct parts, a broad anterior "atokal" portion, sharply marked off from a slender and much longer "epitokal" portion, which at the swarming season becomes detached and constitutes the free-swimming palolo. The total length averages 40 centimetres, of which about the first fourth is formed by the thick atokal portion. From 250 to 430 is the approximate number of segments in the atokal region, the smaller number occurring in a female and the larger in a male. In the males the colour is reddish brown, and in the females bluish green. These sexual colours are most strongly marked in the epitokal region, where they are due to the sperm and ova, the collapsed integument being quite colourless after the discharge of those elements.

Palolo, as above mentioned, are by no means confined to Samoa. "A similar swarming of marine annelids," writes

Mr. Woodworth, "and at corresponding seasons is known for other islands of the Pacific, though the worms have not everywhere been identified. Powell speaks of them in the Gilbert Islands, where they are known to the natives as *te nmatamata*, and Codrington gives a detailed account for Mota in the Banks Islands, where they are known as *un*. Brown mentions the annual occurrence of a palolo on the east coast of New Zealand, and the *wawo* of Rumphius, which occurs at Amboyna, in the Moluccas, is doubtless the same. Seeman mentions the occurrence of the worm in the New Hebrides, and it is known in Fiji and Tonga. It is reasonable to suppose that a systematic search would show the palolo, or some allied form, to have a wider distribution in the coral-reefs of the Pacific than has been as yet recorded. That the annelid is best known from Samoa and Fiji is accounted for by these groups of islands having been most visited and longest inhabited by whites."

We reproduce Mr. Woodworth's figure of the complete worm.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Glasgow University Court has appointed Mr. Frederick Soddy to be lecturer on physical chemistry for five years from October 1 next.

DR. K. ZINDLER and Dr. J. A. Gmeiner have been appointed ordinary professors of mathematics in the Universities of Innsbruck and Prague respectively.

THE authorities of Yale University announce that, in succeeding Prof. J. J. Thomson as Silliman lecturer, Prof. C. S. Sherrington, F.R.S., will treat of "The Cardinal Features of the Integrative Action of the Nervous System" in a course of ten lectures commencing Friday, April 22.

THE preamble of the Victoria University of Manchester Bill has been found proved by Lord Balfour, acting chairman of committees of the House of Lords, and the Bill will be reported to the House for third reading. The Bill is promoted to give effect, so far as Manchester is concerned, to the decision of the Privy Council dissolving the Victoria University as originally constituted of the Owens College, Manchester, University College, Liverpool, and the Yorkshire College, Leeds, and to the grant of charters for the creation of separate universities in each of the three centres. Under the provisions of the present Bill Owens College is incorporated with the Victoria University of Manchester, and the property and liabilities of the college are transferred to the university.

THE Johannesburg correspondent of the *Times* reports that the Transvaal Technical Institute was formally opened on Tuesday in the presence of the Governor and the Lieut.-Governor of the colony. The institute is intended to be the nucleus of the future university which, in the opinion of the commission appointed by the Government to gauge the needs of the community in the matter of technical education, will ultimately be found necessary for the Transvaal. The institute as now inaugurated has absorbed the Kimberley School of Mines, which for eight years has covered the third and fourth years' courses prescribed by the Cape University for obtaining a degree in this subject. In view of the exceptional opportunities afforded at Johannesburg for mining engineering, arrangements are on foot to enable students of the Royal College of Science and other home institutions to proceed to the Transvaal for a year's post-graduate study.

IN the House of Commons on Monday Sir J. Gorst invited a statement from the secretary to the Board of Education with regard to the physical condition of the children in the elementary schools. In the course of his reply, Sir W. Anson said that the committee of inquiry on physical deterioration began to sit last winter, and they found that the British Association had appointed a committee, of which Prof. Cunningham was chairman, to inquire into the same subject. The committee put itself in communication with the committee of the British Association, which met them in a most cordial spirit. Prof. Cunningham gave evidence, and the scheme already outlined by the British Association committee was sent to the College of Physicians and the College of Surgeons. The College of Surgeons sent back word that they cordially approved of the proposed scheme, that there should be a regular survey of the population of the United Kingdom—of the agricultural and working population and of the children in the schools, and that means should be taken to ascertain their physical condition at the school age. It was hoped that by proper management it might be possible to cover the whole of the United Kingdom in ten years, so that there might be a complete survey of the United Kingdom in the course of every ten years.

LAST week we directed attention to the fact that the Goldsmiths' Company had decided to give up the Goldsmiths' Institute at New Cross at Michaelmas next. The company has now offered to hand over the whole site of the institute (about seven acres), together with its buildings, equipment, and apparatus complete, to the University of London for the purpose of promoting university work in South London. The Senate of the University has resolved, subject to the satisfactory settlement of administrative details, to accept the company's offer. It is estimated that after making due allowance for depreciation, the value of the site, buildings, and equipment cannot be less than 100,000*l*. Some three acres of the site are covered by buildings, leaving four acres uncovered which have been available for recreative purposes. The annual endowment provided by the Goldsmiths' Company, originally fixed at 5000*l*. a year, has grown to about twice that sum. Following so soon upon Sir Donald Currie's splendid gift, of which particulars were given in the last issue of NATURE, there would really seem to be a new era opening for the University of London. It must not, however, be lost sight of that handsome as these two bequests are, they are alone quite inadequate to the great needs of a university equipped and staffed in a manner becoming to the University of London, the metropolis of the empire. It is greatly to be desired that the large minded generosity of Sir Donald Currie and of the Goldsmiths' Company will be immediately emulated by other wealthy individuals and corporations.

A BILL to amend the laws relating to education in Scotland, and for other purposes connected therewith, was introduced in the House of Commons on Monday by Mr. Graham Murray, and passed the first reading. The existing system in Scotland encourages the tendency of educational institutions to overlap, and leads to some waste of resources. In the field of primary education the School Boards have done excellent work, but for secondary and technical education the School Board area is too small. The area which has now been selected for educational purposes is the district area; but the great burghs, Edinburgh, Glasgow, Dundee, and Aberdeen, are to be dealt with exceptionally. There is to be a School Board elected for every district in a county. The number of members which each Board is to have will be fixed by the Scottish Education Department. The boards are to be public authorities for all branches of education, and they are to be elected on the county council franchise and the burgh franchise. In order to foster local interest in education every school is to have local managers, who, however, are not to be allowed to appoint or dismiss teachers or to borrow money. To private venture schools the boards are to be at liberty to give aid out of the rates, if they desire to do so; they are to be absolutely free agents in the matter. With regard to the financial proposals of the Bill, the various Imperial contributions are to be pooled; all the grants will go into one education fund. In order to remove some of the objections to the retention of the Scottish Department in London it is proposed that there shall be constituted by Order in Council four provincial councils which will meet in Edinburgh, Glasgow, Aberdeen, and Inverness. It will be the duty of these councils to deal with any matters referred to them by the department.

THE Military Education Division of the War Office has issued rules which will for the future regulate the appointment to commissions in the army. The rules will not apply to candidates for admission to the Royal Military Academy and Royal Military College until after the competitive examination of June, 1905. In order to show that they have attained a fair standard of general education, all

candidates for appointment to commissions will be required to obtain either a "leaving" certificate or a "qualifying" certificate. A "leaving" certificate is one including the same subjects as a qualifying certificate, and granted by a recognised body to candidates not less than seventeen years of age who have attended three years' continuous teaching, with satisfactory conduct, in a properly inspected school. A "qualifying" certificate is one covering two classes of subjects. All candidates must qualify in the subjects of class i., viz. English, English history and geography, and elementary mathematics. Candidates must qualify in two of the subjects of class ii., viz. science, French or German, Latin or Greek. The expression "science," the rules state, means so far as a leaving certificate is concerned, "such combination of experimental or natural science as the Army Council may approve, provided always that the sciences recognised shall have been taught in a sufficiently extended course, including a due amount of laboratory or field work." Any leaving certificate accepted must certify that the candidate has taken a sufficient course of elementary geometrical drawing and practical geometry, and also an elementary course of practical measurements. Leaving certificates will be accepted from the Oxford and Cambridge University examining bodies, the University of London, the Scottish Education Department, and such universities in Great Britain as undertake to issue a certificate satisfying the required conditions. The same bodies will hold examinations periodically at which candidates who desire to obtain qualifying certificates may present themselves.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 3.—"The Spectra of Antarian Stars in Relation to the Fluted Spectrum of Titanium." By A. **Fowler**, A.R.C.S., F.R.A.S.

The distinguishing feature of the spectra of the Antarian stars (Secchi's third type) is the system of apparently dark flutings, sharp towards the violet and fading off towards the red end of the spectrum. The principal flutings are well seen in Antares, but they are more strongly developed in the spectra of α Herculis and *o* Ceti, in which stars additional details are also seen. These flutings have not hitherto received a definite chemical interpretation, and it has been uncertain, owing to the possibly misleading effects of contrast, whether the spectrum was to be regarded as one consisting wholly of absorption flutings fading towards the red, or as one partly consisting of emission flutings fading in the opposite direction.

The purpose of the present communication is to state the nature of the evidence which indicates that the spectrum is essentially an absorption spectrum, and that the chief substance concerned in the production of the flutings is titanium, or possibly a compound of that element with oxygen.

The flutings in question come out in the arc spectrum of titanium oxide, if the precaution be taken to provide a liberal supply of material and to use a very long arc, taking care also that the image of the "flame" is projected on the slit of the spectroscope. They are also seen in the arc spectrum of the chloride under similar conditions. Numerous lines accompany the flutings produced in this manner, and some of the details are consequently masked or not recognised without careful study of the photographs. So far the flutings have not been very successfully produced in the oxyhydrogen flame; they are visible in the flame spectrum of the fumes from the chloride, but their observation is difficult on account of the bright continuous spectrum. The best representation of the flutings has been obtained by passing a spark, without jar, through the fumes of oxychloride which rise from the chloride of titanium on exposure to air. In these circumstances the lines which appear are not numerous, and some of the secondary flutings which are masked by lines in the spectrum of the flame of the arc are readily detected, in spite of the continuous spectrum which is also present.

The wave-lengths of the heads of the principal flutings are 6162·5, 5604·5, 5447·0, 5241·0, 5167·5, 4955·1, 4761·6 and 4584·3, and it is found that these agree within the possible limits of error with eight of the ten principal bands recorded in the stars by Vogel and Dunér.

The origin of the two outstanding bands at 5862 and 6493 has not yet been ascertained, but in the case of the remaining flutings the evidence for titanium is enormously strengthened by a discussion of their structure and by extending the comparison further into the violet. Photographs of the stellar spectra, especially those of *o* Ceti and α Herculis, show that some of the principal flutings are composite, Dunér's band 10, for example, containing, according to Sidgreaves, four distinct flutings separated by intervals of about 44 tenth-metres, each of which is weaker than the one which precedes it on the more refrangible side. A precisely similar structure is found in the case of the titanium flutings, and a comparison of wave-lengths indicates that the various components occupy the same positions as those in the stars, so far as the available measurements permit the test to be applied.

The table of wave-lengths given in the paper shows that the details of the titanium flutings are reproduced with remarkable fidelity in the stellar spectra, and more especially in *o* Ceti. There is some uncertainty in connection with the complicated groups of flutings and lines extending from 5598 to D, which need further investigation in the stellar spectra with instruments of greater dispersion, but the general agreement is such as to leave no reasonable doubt that titanium is the main factor in the production of the dark flutings which characterise the Antarian group of stars.

This explanation of the dark flutings suggests that the appearance of bright flutings in the Antarian spectrum arises chiefly from effects of contrast. It does not, of course, exclude the possibility of the presence of bright flutings, such as might be indicated by local brightenings which are not exactly in coincidence with the edges of dark flutings.

"An Inquiry into the Nature of the Relationship between Sun-spot Frequency and Terrestrial Magnetism." By C. **Chree**, Sc.D., LL.D., F.R.S.

(1) The formula

$$R = a + bS \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1),$$

where R is some magnetic quantity such as the amplitude of the diurnal oscillation of the needle, *a* and *b* constants, and S sun-spot frequency (after Wolf and Wolfer), was first applied by Wolf to the mean declination range throughout the year.

The present paper is entirely devoted to the connection between sun-spot frequency and terrestrial magnetism. It deals with data from Milan (1836–1901), Greenwich (1841–96), Pawlowsk and Katharinenburg (1890–1900), Batavia (1887–98), and Mauritius (1875–90). It aims at ascertaining wherein the results in my previous paper (*Phil. Trans.*, A, vol. ccii. p. 335) are peculiar to the station or period dealt with.

It investigates what differences may exist between the sun-spot connection on ordinary days and on magnetically quiet days, and what differences arise when one applies (1) to the mean of the differences between the absolutely highest and lowest daily readings, instead of to the range of the mean diurnal inequality. It also considers various measures of the magnetically disturbed character of the year, and their relation to sun-spot frequency.

There seems a general tendency for b/a to increase as we pass from a quantity, such as the range of a diurnal inequality, which is comparatively independent of disturbances, to a quantity such as the mean absolute daily range which is largely dependent on disturbances. Formula (1) becomes, however, less and less strictly applicable, the more disturbed the magnetic quantity to which it is applied. When we consider quantities such as the mean of the twelve monthly ranges (maximum and minimum for the month), or the annual range (maximum and minimum for the year), we find large differences between observed values and those calculated from (1).

In the case of ranges from mean diurnal inequalities for the year, the agreement between observed and calculated values is about equally good at Pawlowsk, Katharinenburg, Batavia, and Kew. In the case of declination, the mean difference between observed and calculated values is about

4 per cent. of the mean value of the range during the period dealt with. On the whole, the agreement is distinctly less good in the case of vertical force than in the case of declination, inclination or horizontal force.

March 17.—"On the Construction of some Mercury Standards of Resistance, with a Determination of the Temperature Coefficient of Resistance of Mercury." By F. E. **Smith**, A.R.C.Sc., Assistant at the National Physical Laboratory. Communicated by R. T. Glazebrook, M.A., F.R.S.

This paper contains an account of the construction and measurement of eleven mercury standards of resistance at the National Physical Laboratory.

A comparison between the international ohm as realised from these standards and the unit of resistance derived from the coils belonging to the British Association shows that

Resistance of 1 int. ohm (as realised at the N.P.L.) − { Resistance of unit derived from B.A. coils (assumed as equal to 10^9 C.G.S. units) } $= 0.00008_5$ ohm.

A very concordant series of observations also indicates that

Resistance of 1 int. ohm (as realised at the Reichsanstalt) − { Resistance of 1 int. ohm (as realised at the N.P.L.) } $= 0\ 00002_0$ ohm.

The methods adopted both for the construction and evaluation of the mercury standards are very different from those which have been previously employed, one of the methods of erection enabling the "end effect" of the tubes to be eliminated. Owing to the increasing accuracy of electrical measurements, it was thought desirable to realise the international ohm with a probable error not exceeding one part in one hundred thousand. The results obtained with the eleven mercury standards of resistance are in very close agreement, the calculated probable error of the determinations being ±0·0008 per cent. only.

The temperature coefficients of resistance of (1) mercury in Jena 16''' glass, of (2) mercury in verre dur glass, and of (3) a constant volume of mercury, have also been determined for a range of temperature 0° C. to 22° C. The results are as follows:—

(1) Mercury in Jena 16''' glass,

$$R_T = R_0[1 + 0{\cdot}000880_{18}T + 0{\cdot}00000105793T^2].$$

(2) Mercury in verre dur glass,

$$R_T = R_0[1 + 0{\cdot}00088036T + 0{\cdot}00000103094T^2].$$

(3) A constant volume of mercury,

Deduced from (1),

$$R_T = R_0[1 + 0{\cdot}00088788T + 0{\cdot}00000105\,64T^2].$$

Deduced from (2),

$$R_T = R_0[1 + 0{\cdot}00088776T + 0{\cdot}00000103\,76T^2].$$

T being the temperature on the hydrogen scale.

"The Specific Heats of Metals and the Relation of Specific Heat to Atomic Weight. Part iii." By Prof. W. A. **Tilden**, F.R.S.

The object of the experiments, of which an account is given in this paper, was to determine whether the atomic heats of the elements entering into combination are preserved in the compound at all temperatures, previous results obtained by the author and others having shown that the specific heats of metals of small atomic weight, such as aluminium, increase very rapidly with rise of temperature.

As it is not possible to determine the specific heat of sulphur throughout a long range of temperature, tellurium was chosen for experiment. Compounds of tin, silver and nickel with tellurium were prepared, and two alloys of silver and aluminium. The average specific heats of all these elements, except tin, which melts at 232° C., were determined over various intervals from the boiling point of liquid oxygen to nearly 500° C. in the case of the less fusible elements, a range of about 680° C. From these mean specific heats the true specific heats at intervals of 100° C. absolute temperature were calculated, and from the specific heats the atomic heats were deduced. The mean specific heats of the compounds, formed by their union, were also determined, and from these data the molecular heats of the compounds calculated. On comparing the sum of the atomic heats of the elements present with the molecular heat of the compound at the successive temperatures, it was found that there is throughout a close concordance. The order of difference may be shown by one example:—

Nickel Telluride, NiTe.

Temperature, absolute	Sum of atomic heat of Ni and Te	Molecular heat of NiTe
100°	9·20	8·38
200°	11·08	11·35
300°	12·22	12·41
400°	13·00	12·92
500°	13·49	13·15
600°	13·85	13·28
700°	14·11	13·35

The results of these experiments show that Neumann's law is approximately true, not only at temperatures from 0° to 100° C., but at all temperatures. They thus support the view that the specific heat of a solid is determined by the nature of the atoms composing the physical molecules, and is not a measure of the work done in thermal expansion.

The paper concludes with a discussion of the relations of specific heat to atomic weight under different physical conditions, that is, in the solid, liquid and gaseous states.

Entomological Society, March 2.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Commander J. J. **Walker**, R.N., exhibited (1) *Hecatesia fenestrata*, Bdv., an interesting Australian moth, the ♂ possessed of a very marked power of stridulation (stridulating organ on longitudinal transparent bar on fore-wing), known in New South Wales as the "whistling moth"; (2) *Dodonidia helmsi*, Butler, a rare satyrid butterfly from New Zealand; and (3) a gigantic species of the Thysanurid genus Japyx, found at Picton, New Zealand.—Mr. C. O. **Waterhouse** exhibited and commented upon a diagram of the mouth of one of the Mallophaga (*Laemobothrium titan*).—Mr. G. C. **Champion** exhibited specimens of the two species of Dorcadion found during his recent journey in Spain, *D. almarzense*, Esc.? from the summit of Montcayo, and *D. neilense*, Esc., from the Sierra de Logroño. He also exhibited numerous examples of *Pyropsyche moncaunella*, Chapm., found by Dr. Chapman and himself on Montcayo.—Mr. A. J. **Chitty**, Mr. **Jennings** and other fellows exhibited specimens of the genus Tropiphorous to determine if possible whether *T. tomentosus* and *T. obtusus* were in reality one and the same species. Various cases of coincident localities for the species were quoted, and it was the general opinion that in the United Kingdom the two were but forms of one species.—Dr. F. A. **Dixey** read a note on the so-called "bugong" moth consumed by some Australian natives for food. He said it was not a Euplœa at all, as supposed by Kirby in his "Bridgwater Treatise," but a Euxoa, and not a butterfly as also stated by Westwood.—The **President** exhibited a specimen of a beetle, *Glenea pulchella* (Thoms.), one of three individuals of the species taken in the Nilgiris by Mr. Leslie Andrewes, which clearly mimics a large ichneumon fly not yet identified.—Mr. L. B. **Prout** exhibited, on behalf of Mr. A. Bacot, long bred series of *Triphaena comes*, Hb., the result of breeding for two generations from a wild ♀ of the *curtisii* form, taken near Forres. In the first generation, rather more than half the progeny followed, to a certain extent, the parent ♀, though varying from rich deep red to almost black. Pairings of these dark specimens resulted in a brood in which the percentage of ab. *curtisii* was slightly increased, although the type forms were still well represented; but it was noticeable that in every specimen the orbicular stigma was filled up with the darker or melanic colour.—*Papers*:—Notes on Australian and Tasmanian Cryptocephalides, with descriptions of new species: A. M. **Lea**.—A revision of the subfamily Pelidnotinæ of the coleopterous family Rutelidæ, with descriptions of new genera and species, by the late F. **Bates**.—On some new species of eastern Australian and African moths in the British Museum: Colonel Charles **Swinhoe**.—An entomological excursion to Montcayo, Spain, with some remarks on the

habits of *Xyleborus dispar*, Fabr., by Dr. Thomas Algernon Chapman: G. C. **Champion.**—Further notes on Hydroptilidæ belonging to the European fauna, with descriptions of new species: K. J. **Morton.**—A note on *Elymnias borniensis*, Wallace: R. **Shelford.**—A discussion on "What is a Species?" was opened by the Rev. F. D. Morice, in which Mr. H. J. Elwes, Prof. F. A. Dixey, Mr. A. J. Chitty, Mr. W. E. Sharp, the president, and other fellows joined.

Geological Society, March 9.—Dr. J. E. M.. F.R.S., president, in the chair.—On the probable occurrence of an Eocene outlier off the Cornish Coast: Clement **Reid**, F.R.S., communicated by permission of the director of H.M. Geological Survey. The evidence suggests that, underlying the western part of the English Channel, an Eocene basin may occur comparable in importance with that of Hampshire.—The Valley of the Teign: A. J. **Jukes-Browne.** The Teign Valley is not a transverse valley preserving a general direction in spite of opposing ridges, nor is it a longitudinal valley running parallel to a dominant ridge, nor is it a simple combination of one with the other, as often happens; but it apparently consists of parts of two transverse valleys linked by a longitudinal one. The Teign runs off Dartmoor through a gorge which takes an easterly direction, as if it were going to join the Exe; it is then deflected southward into what, with respect to the Permian escarpment, is a longitudinal valley; this ends in a low-lying plain, and from this plain it escapes eastward to the sea through a transverse valley, which has been cut across the ridge of Permian and Cretaceous rocks. The theory of the capture of one river by another furnishes an intelligible explanation of the facts when applied to the course of the Teign. The author thinks that some other river-courses and geographical features in Devon can be explained on the theory of an easterly incline modified by a subsequent southerly tilt.

Physical Society, March 11.—Dr. R. T. Glazebrook, F.R.S., president, in the chair.—The whirling and transverse vibrations of shafts: Dr. **Chree.** The paper shows how the mathematical results obtained by Prof. Dunkerley can be derived by a less cumbrous treatment, and how in many instances they admit of great simplification, without sensible loss of accuracy. It is also shown how loaded shafts can be dealt with, without recourse to the hypothesis presented by Dunkerley; at the same time some light is thrown on the relation of this hypothesis to theory. Six main cases are considered, in which the shaft is variously supported; in some of them numerical results are deduced for comparison with Dunkerley's experiments.—Notes on non-homocentric pencils, and the shadows produced by them, part ii., shadows produced by axially symmetrical pencils possessing spherical aberration: W. **Bennett.** This paper deals with the shadows obtained by interposing a straight wire near the focus of a pencil proceeding from a lens or mirror uncorrected for spherical aberration. A method is described for drawing sections of the wave-front in the neighbourhood of the focus. A simple physical explanation of the shadows is given by means of the wave-fronts; it is shown that the real shadow consists in general of two branches, one closed and the other open, with a ϕ-form as a symmetrical special case. The equations of the wave-front are worked out for the special case of the reflection of a plane wave at a spherical mirror, and a method of drawing the shadow-forms is described.

Linnean Society, March 17.—Prof. J. Bretland Farmer, F.R.S., vice-president, in the chair.—An account of the Bryozoa from Franz-Josef Land, collected by the Jackson-Harmsworth Expedition, 1896, 1897 (part ii., Cyclostomata, Ctenostomata, and Endoprocta): A. W. **Waters.** Mr. Waters comments on the confusion that has arisen from attempts to base a classification of the Cyclostomata on almost valueless characters taken from fossils. The bipolar theory of distribution, in his opinion, receives little support from the Bryozoa, in several instances species that are distinct having been united, and in the comparison of opposite areas the terms Arctic and Antarctic not having been used with similar strictness.—Botanic illustration from the fifteenth to the twentieth centuries: B. Daydon **Jackson.**

CAMBRIDGE.

Philosophical Society, February 29.—Dr. Baker, president, in the chair.—On decomposition of hydrogen dioxide under the influence of radium bromide: H. J. H. **Fenton.** These experiments were originally undertaken with the object of studying the conditions of stability in aqueous solutions of pure hydrogen dioxide at the ordinary temperature in absence of light. The observations have been extended so as to include an investigation of the influence exerted by rays from the latter substance on the decomposition of the dioxide. It has been shown by Bredig and his colleagues that the rate of decomposition of hydrogen dioxide under the influence of catalysers, such as colloidal platinum, and in presence of many electrolytes and non-electrolytes, follows the law for a reaction of the first order; in the case of the pure dioxide alone, however, under the influence of platinum, the change is not strictly in accordance with this law, the value of the constant increasing as the concentration of the dioxide becomes smaller. Similar results are obtained in the present instance when the aqueous solution undergoes decomposition either alone or under the influence of radium rays. In the latter case, however, the change is greatly accelerated, the value of the constant in each case being approximately double that calculated from the parallel blank experiment. Further experiments are in progress with the object of ascertaining whether the oxidation of organic substances, either alone or in presence of iron, is influenced by radium.—Exhibition of oribatid mites taken in the neighbourhood of Cambridge: C. **Warburton** and N. D. F. **Pearce.** The Acari have received little attention in this country, and this is the first attempt to investigate the local fauna of any acarine group. In four winter months specimens of forty-seven out of the hundred known British species have been taken in the neighbourhood of Cambridge, and every one of the fifteen British genera is locally represented.—Some observations on the determination of sex in plants: R. P. **Gregory.** The work was carried on in response to Castle's suggestion that sex may be a character inherited in accordance with the Mendelian principles of segregation and dominance. The problem is rendered more complex in plants owing to the occurrence of two distinct generations (the sporophyte and the gametophyte) which regularly alternate in the life-history of the plant. In the flowering plants the alternation is masked by the complete dependence of the gametophyte upon the sporophyte; but in the ferns this is not the case; this group was therefore chosen as the subject for investigation. From the observations it appears that sex in the sporophyte is homologous with that in animals, and may perhaps be inherited in accordance with Mendelian principles. It is to be distinguished from sex (as manifested by the production of antherozoids or of ova) in the gametophyte, the latter being determined by the conditions of nutrition.—On variation in the number and arrangement of the male genital apertures, and on the relative proportion of the sexes, in the Norway lobster (*Nephrops norvegicus*): D. C. **McIntosh.** The results are given of an examination of 656 specimens obtained from the Firth of Clyde. The percentage having an abnormal number of genital apertures was 2·49, or considerably lower than that recorded by Marshall for the Norway lobsters from the Firth of Forth. Among the Clyde specimens the sexes occurred in approximately equal proportions, the females on an average being of considerably smaller size than the males.—On the boiling points of homologous compounds: H. **Ramage.** The relation of boiling point to molecular weight has been studied by means of diagrams drawn with the former as abscissæ and the latter as ordinates. These indicate that Walker's formula for the ten paraffins C_7H_{16} to $C_{16}H_{34}$ only applies to the CH_2 linkage in the molecules, and that the influence of the terminal hydrogen atoms is either a constant in these higher members of the series or it is so small it may be disregarded. The influence of the terminal atoms increases as the chain shortens, and Walker's formula does not, on this account, apply to the lower members. This view has led to a modification which includes all the series up to $C_{16}H_{34}$. The new formula is $T=a\{M(1-2^{-n})\}^{\frac{1}{4}}$, in which T is the boiling point in absolute degrees, a is a number depending on the pressure, M is the molecular weight, and n the number of carbon atoms in the molecule.

PARIS.

Academy of Sciences, March 21.—M. Mascart in the chair.—On hypoabelian groups: Camille **Jordan.**—New researches on the density of fluorine: Henri **Moissan** (see p. 520).—On an African trypanosome, pathogenic for horses: A. **Laveran** and F. **Mesnil.** In the course of their researches on human trypanosomiasis, Messrs. Dutton and Todd have discovered a new trypanosome which is pathogenic to horses, and to which they give the name of *Tr. dimorphon.* A comparison of this trypanosome with *Tr. gambiense* shows that the two species are morphologically distinct. That they are distinct species is also shown by the fact that animals which have acquired immunity for *Tr. gambiense* are still sensible to *Tr. dimorphon*; human serum, which is without action upon *Tr. gambiense,* has a feeble but distinct action upon the other species. The general conclusions of Dutton and Todd are confirmed.—On some formulæ useful in discussing the stability of a vitreous medium: P. **Duhem.**—On the general conditions and unity of formation of combustible minerals of all ages and of all species: M. **Grand'Eury.** The author regards all Coal-measures, of whatever epoch, as being formed under water in a similar manner by the débris of marshy vegetation.—On forms decomposable into linear factors: F. **Hocevar.**—The law of disappearance of the activity induced by radium after heating the substances rendered active: P. **Curie** and J. **Danne.** Plates of platinum, which had been exposed for some time to the action of radium, were heated to different temperatures, and the rate of loss of activity studied at the room temperature. The curves, taking time as the abscissæ and the logarithm of the intensity of radiation as the ordinates, become linear at the higher temperatures.—The study and comparison of the methods of reduction of magnetic hysteresis: Ch. **Moureu.** The hysteresis may be suppressed by the action of an oscillating magnetic field.—The action of magnetism on phosphorescence: Alex. **de Hemptinne.** All phosphorescent substances do not appear to be equally susceptible to the action of a magnetic field.—The application of the electric spark to the chronophotography of rapid movements: Lucien **Bull.** An instrument is described which is capable of taking 1500 images per second.—The study of colloidal solutions: Victor **Henri** and André **Mayer.** It has been generally held that the phase rule cannot serve as a guide in the case of colloidal solutions. The author holds that the phase rule may be applied to the systematic study of the precipitation of colloids whenever the phenomena of precipitation are reversible.—The transformation of oxides and oxygenated salts into chlorides: C. **Matignon** and F. **Bourion.** Further applications are given of the use of a mixture of chlorine and sulphur chloride in the preparation of anhydrous chlorides. The substances studied include tungstic acid, chromic and ferric oxides, the oxides of nickel and cobalt, zinc, manganese and tin, boric anhydride and the sulphates of barium and calcium. In the last two cases the transformation is so complete that the reaction may serve as the basis of a quantitative method.—The lead and silver salts of the monoalkylphosphoric acids: J. **Cavalier.**—Arnisterine, the phytosterine of *Arnica montana*: T. **Klobb.**—On some aminoalcohols with alcoholic function of the type $R.C(OH)(CH_3).CH_2.N(CH_3)_2$: E. **Fourneau.**—*Hyphoene coriacea,* the textile palm of Madagascar: Pascal **Claverie.**—On the persistence of alternate structure in some Labiates: G. **Chauveaud.**—Specific action of some parts of the body on certain phosphorescent screens: Augustin **Charpentier.**—On the colour reactions resulting from the action of tyrosinase: C. **Gessard.**—On the presence of an apparatus for accommodation in the compound eyes of certain insects: Pierre **Vigier.** Proofs are given of the existence in the compound eyes of Aeschna of a real accommodation apparatus, allowing of the adaptation of the sight to different distances.—Study of the law of action of maltase. The influence of the concentration of the maltose: E. F. **Terroine.** The influence of the concentration of the maltose is similar to the cases of invertine, emulsin, amylase and trypsin.—Studies on the action of maltase. The constancy of the ferment: Mlle. Ch. **Philoche.** When maltase from Taka diastase is allowed to act at 40° C. the activity of the ferment undergoes no appreciable change in the first twenty-four hours.—On the duration of the treatment of arterial hypertension in arteriosclerosis by d'Arsonvalisation: A. **Moutier.** Under appropriate diet, the arterial tension in patients suffering from arteriosclerosis can be rapidly reduced to the normal by the use of high frequency currents.—The action of metals in the colloidal state and of artificial oxidases on the evolution of infectious diseases: Albert **Robin** and G. **Bardet.**—The action of formic acid on the muscular system: E. **Clement.** Sodium formate increases the muscular power and also the resistance to fatigue to a marked extent.—The fusion of ice by electricity, and the application of this principle to navigation in Arctic seas: F. Romanet **du Caillaud.**

DIARY OF SOCIETIES.

TUESDAY, APRIL 5.

NATIONAL ASSOCIATION OF MANUAL TRAINING TEACHERS.—Annual Conference at Hastings, at 3.—The Psychological Importance of Manual Training: Sir John Cockburn.

THURSDAY, APRIL 7.

LINNEAN SOCIETY, at 8.—The Morphology and Anatomy of the Stem of the Genus Lycopodium: C. E. Jones.

RÖNTGEN SOCIETY, at 8.30.—Exhibition Evening.

FRIDAY, APRIL 8.

GEOLOGISTS' ASSOCIATION, at 8.—On the Metamorphism of Sediments: G. Barrow.

MALACOLOGICAL SOCIETY, at 8.—Description of apparently New Species of Corbicula, Melania, Vivipara and Lagochilus from Java: Rev. R. Ashington Bullen.—The Hawaiian species of Opeas: E. R. Sykes.—On some Non-marine Hawaiian Mollusca: C. F. Ancey.—Description of a New Species of Ancilla from New Zealand: Rev. W. H. Webster.—Report on a Small Collection of Helicoids from British New Guinea, with Description of a New Species: G. K. Gude.

ROYAL ASTRONOMICAL SOCIETY, at 5.

CONTENTS.