THURSDAY, APRIL 10, 1913.

THE HERITABLE RESULTS OF CHANGED NURTURE.

Das Problem der Vererbung "erworbener Eigenschaften." By R. Semon. Pp. viii+203. (Leipzig: Wilhelm Engelmann, 1912.) Price 3.20 marks.

RETURNING to the much-discussed question of the transmission of acquired characters, Prof. Richard Semon goes over the whole ground. Conclusions—both affirmative and negative—have been based on certain sets of data, but all the facts must be faced if we are to form a sound judgment. This is indeed what many biologists have tried to do. The first chapter, which is historical, includes the commendable suggestion that it is time to stop using inexact terms like "Lamarckism," so often taken as synonymous with the theory of the transmission of acquired modifications. In the second chapter the author formulates the question at issue: A stimulus sets up an excitation in a parental body; the residual effect of this excitation is a change in the reaction-capacity (an "Engramm"); can we say that in favourable circumstances there results a change in the hereditary potency of the germ-cells, and of such a nature that the offspring show a change in the same direction as that exhibited in the parent?

Prof. Semon begins his survey of the evidence by considering language, acquired knowledge, and training; and while he does not claim to prove anything, he refers to cases which suggest that individual experience must count somehow. Why is it, for instance, that a young buzzard, taken from the nest, treats an adder quite differently from a grass-snake? Has experience not counted at all in the evolution of this inborn power of discrimination? The fourth chapter brings together numerous interesting cases which suggest the inheritance of engramms. Young acacias with an "inherited disposition" to a certain rhythm of sleeping and waking will, as it were, try to give expression to this in quite unnatural conditions of illumination and darkness. Braus has shown that if the fore-limb be removed from the larva of a Bombinator, the operculum still shows the thin area, usually with a small hole, through which the limb would press out if it were there. Is this not a reminiscence of a previously established "mechanomorphosis"? The degeneration of the eyes of cave animals, considered in detail and in connection with Kammerer's experiments on Proteus, point to a hereditary accumulation of the structural results of disuse and darkness. In regard to this and similar cases it appears to us to remain a question of interpretation. Which reading of the facts presents least difficulty?

Prof. Semon does not think that we should give up expecting a specific hereditary result of often-repeated injuries, and he refers, for instance, to Kammerer's experiment on the Ascidian, *Ciona intestinalis,* the siphons of which were cut off over and over again. In consequence of the stimulus, the length of the regenerated siphons was excessive, and the uninjured offspring had also excessively elongated siphons. We must, of course, hear more about this interesting case. The sixth chapter marshals the positive evidence which goes to show that parents much modified by peculiarities of nurture may have offspring changed in the same direction, although the peculiar nurture is no longer operative. The evidence includes recent observations on the acclimatisation of plants, Woltereck's experiments on the helmet of Daphnia, and Kammerer's striking work on salamanders and the nurse-frog.

The question then arises: How are the germ-cells affected? Prof. Tower was led by his well-known experiments on potato-beetles to the view that the environmental factors operated on the germ-cells without any induction from the unchanged soma of the parent. But Prof. Semon points out that an adult beetle could not be expected to show much external change, and argues that there is no escape from a theory of somatic induction, the various possible modes of which are carefully and acutely discussed. The author concludes that long-continued functional modifications may by somatic induction exert a specific effect on the germ-cells, and that certain environmental stimuli may also affect the germ-cells by somatic induction. The results depend on three variables: the nature, strength, and duration of the excitations, the general constitution of the organism, and the state of the germ-cells—susceptible or otherwise—at the time. Prof. Semon's latest presentation of the case for the heritability of somatogenic changes is a valuable contribution to ætiology, and one that must be reckoned with by all biologists. The book is written with force and clearness and in admirable scientific temper.

J. A. T.

THE WORK OF G. VON REICHENBACH.

Deutsches Museum Lebensbeschreibungen und Urkunden. Georg von Reichenbach. By Walther v. Dyck. Pp. iii+140+viii plates. (Munich: Deutsches Museum, 1912.)

DURING the last eight or nine years an extremely instructive and valuable collection illustrating the various sections of science and technology has been accumulated at the Deutsches Museum in Munich, and in 1910 the committee of direction decided to publish a series of biographies of men whose work has had a special bearing on these subjects. The first volume to appear deals with the life and work of Georg von Reichenbach, to whom many advances, not only in the construction of astronomical and surveying instruments, but also in engineering, were due. Born in 1771, his education was carried on not only in school, but also in the workshop with his father, where he showed remarkable mechanical aptitude. At the age of twenty he was sent to England to study mechanical engineering, and in the works of Boulton and Watts in Soho he spent some months working at engine construction. While in England he had not had an opportunity of seeing the works of the leading instrument makers, but availed himself of every opportunity to study this industry also. Ramsden, Troughton, Dollond, Cary and others then supplied the greater part of Europe with instruments of the highest grade, but on his return to Munich he founded workshops for constructing instruments of precision, and for accurately dividing circles.

In the latter part of the eighteenth century a large amount of surveying was done, and in 1801 a base-line 21·7 km. long was measured near Munich for the systematic survey of Bavaria, so that von Reichenbach found his opportunity. The work of Laplace, Gauss, Bessel and others introduced a great increase in the precision aimed at and attained, and Reichenbach successfully constructed theodolites for the Bavarian survey with circles up to twelve inches in diameter; he was acquainted with Ramsden's great 36-in. theodolite which was constructed for General Roy, but apparently preferred the smaller instrument.

Throughout his work Reichenbach adhered to the vernier in preference to the micrometer microscope for astronomical as well as for geodetic instruments on the ground that with the former the portion of the circle was directly measured, while the micrometer measured the enlarged figure of the divisions. The circle of his 12-in. theodolite for the Bavarian survey was divided to five minutes and was read by a vernier to four seconds and by estimation to two. The triangulation of northern Bavaria called for the construction of a base-measuring apparatus, and in 1807 von Reichenbach constructed one consisting of iron 4-metre bars to be placed almost in contact, the interval being measured by a thin graduated wedge.

Large astronomical instruments were also constructed for Naples, Genoa, Turin, Mannheim and elsewhere, and are described as being among the best of that time. A very fine range of instruments, both astronomical and geodetic, is included in the collections of the Deutsches Museum. But, as Gauss remarked in a letter written to Bessel from Munich, the construction of astronomical instruments was not von Reichenbach's principal occupation.

Engineering machinery took up more of his time and attention, and in 1808 he constructed water-pressure pumping engines for the salt-works of Riechenhall and Traunstein, and others of improved design were built, and one of these, at Ilsauk, is still working. Iron-bridge construction and steam-engine design and construction also engaged his attention, and in many spheres of activity von Reichenbach showed remarkable originality and brilliant capacity. His family has presented to the Deutsches Museum a large collection of writings, drawings and plans, which have been extensively utilised in the present monograph, wherein Dr. W. von Dyck has produced not only a highly interesting account of a man of exceptional ability and resource, but has also rendered available a large collection of valuable and important documents relating to the construction of instruments of precision and of machinery, and some of these are reproduced in the plates which illustrate the monograph.

PURE AND APPLIED CHEMISTRY.

(1) *Chemistry of the Oil Industries.* By J. E. Southcombe. Pp. ix + 204. (London: Constable and Company, Ltd., 1913.) Price 7*s.* 6*d.*

(2) *Achievements of Chemical Science.* By Dr. J. C. Philip. Pp. vii + 217. (London: Macmillan and Co., Ltd., 1913.) Price 1*s.* 6*d.*

(3) *Le Celluloïd et ses Succedanés.* By W. Main. Pp. 162. (Paris: Gauthier-Villars, 1913.) Price 2.50 fr.

(4) *Ausführing qualitativer Analysen.* By Wilhelm Bilz. Pp. xi + 139. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1913.)

(1) THIS work fulfils in a very satisfactory manner the author's attempt "to fill a gap between the elementary text-books of organic chemistry and the numerous technical treatises and monographs of a highly specialised character." The opening chapter on the chemistry of the hydrocarbons and their derivatives will facilitate the reading of later sections by those not very conversant with organic chemistry, but, in the interest of these readers, exception must be taken to the use of the expression "rests," in reference to unsaturated groups or complexes (pp. 14–15). The adoption of this Germanism is quite unwarranted, inasmuch as the idea can

be accurately expressed in ordinary chemical English.

The next chapter contains much interesting matter concerning the origin and chemical nature of mineral oils, and the principles underlying the commercial methods of oil-refining. Under the heading of saponifiable oils and fats a very judicious selection has been made of the most important members of a very large group of substances derived from both animal and vegetable sources. The analytical methods employed in testing these materials are briefly described, and in several instances illustrations are given of the apparatus employed. The industrial applications of fats and oils are classified, special attention being paid to the various commercial processes of hydrolysis, and to the purification of the higher fatty acids by distillation in superheated steam.

In the section devoted to soap and candle manufacture the author shows how the phase rule and recent discoveries in colloid chemistry can be applied to elucidate the reactions of the soap-pan. Reference is also made to the part played by adsorption complexes in the detergent action of soap.

Looking to the future, the production of petroleum motor spirit by the thermal decomposition of heavier hydrocarbons is suggested as a promising problem for research.

(2) The present volume is one of a series of "Readable Books in Natural Knowledge," the author's theme being the usefulness of the chemist to the community. It is to be hoped that this work will assist in dispelling the deplorable ignorance still existing in the minds of many of the British public in regard to the nature and scope of the chemist's activities. Although on the Continent the difference between "chemiker" and "apotheker" or between "chimiste" and "pharmacien" is well understood, in the United Kingdom the chemist is still usually assumed to be a person who of necessity trades behind a window ornamented with large bottles containing various coloured solutions.

After referring to the work of the pioneers of modern chemistry, the subject of combustion is discussed with the object of showing that this typical chemical change includes not only the burning of ordinary combustibles, but also such phenomena as fermentation, the rusting of metals, and the drying of certain oils. In this connection alone the chemist may with advantage be consulted by the farmer, the coal exporter, the cloth manufacturer and other industrial workers in regard to difficulties arising in the ordinary course of their avocations.

The irrational mode of domestic heating with smoky coal leads the author to recommend "coalite" (semi-coke) or gas-fires. A human note is touched by the remark that the latter are regarded with disfavour because they cannot be poked and nothing can be thrown into them. A more serious objection to gas-fires is suggested under the heading of secondary fuels, namely, the grave risk of poisoning arising from faulty gas-fitting and the high percentage of poisonous carbon monoxide present in modern illuminating gas.

The achievements of inorganic synthetic chemistry receive adequate attention. It is pointed out that by a curious coincidence the year 1828 witnessed not only the synthesis of urea, but also the successful manufacture of artificial ultramarine. The natural pigment from lapis lazuli, which was once worth its weight in gold, is now replaced by the synthetic product sold at less than thirty shillings a hundredweight.

The admirable detective work performed by the analytical chemist in bringing to justice the sophisticator of food is noted with the appreciation which this public service deserves.

(3) This volume, which forms one of a comprehensive series of scientific pocket-books, gives a summary of the manufacture of nitrocellulose and its conversion into celluloid by means of camphor and other adjuvants. The inflammability of this material, which is now employed on an enormous scale in the production of cinematograph films, has led to many processes having for their object the preparation of non-inflammable celluloid substitutes. Viscose (an alkaline solution of viscoid) is now manufactured from wood pulp, soda ley, and carbon bisulphide. Acetocellulose, the product of the acetylation of cellulose, has been placed on a commercial basis in the Elberfeld colour works, after seven years of research. Galalite, prepared by precipitating casein with formaldehyde, can be obtained in a transparent condition by first removing mineral salts from the casein by successive treatment with alkalis and acids. The condensation products of phenol and formaldehyde, when indurated to the desired extent by heating under pressure, give rise to the valuable plastic material "baekelite." The work is of interest as showing the extent to which the celluloid industry has developed in France.

(4) Although this guide to qualitative analysis contains a certain amount of useful information, the matter is not arranged in such a way that it can be readily followed. The group reactions, for example, would be more easily grasped if given in tabular form. Very little attempt is

made to furnish theoretical explanations of the various analytical reactions. A few practical details may be quoted as illustrating modern tendencies in laboratory practice. The difficulty of separating nickel and cobalt is overcome by using dimethylglyoxime to precipitate the former metal, whilst the latter is identified in an ethereal extract with ammonium thiocyanate. There is a reversion to an old process in the removal of phosphoric acid from the precipitable metals by means of tin and nitric acid. Absolute alcohol is used to remove calcium nitrate from the mixed nitrates of the alkaline earths. G. T. M.

THE FLOW OF SUBTERRANEAN WATERS.

Le Principe du Mouvement des Eaux Souterraines. By J. Versluys. Traduit du hollandais par F. Dassesse. Pp. 147. (Amsterdam: W. Versluys, 1912.) Price 7 francs.

CALCULATIONS concerning the flow of subterranean water have almost invariably hitherto been based upon the classical law of Darcy, published in 1856—a law which states that the quantity discharged is directly proportional to the head, and inversely proportional to the thickness of the stratum traversed. The terms are simple, and, for general purposes, are sufficiently close approximations to the truth.

It has been demonstrated more than once that the "law" is not absolutely exact, and, in several cases, the divergency from experimental results has been considerable. The law, in fact, has manifest limitations. Darcy omits all reference to temperature, and, indeed, it is doubtful whether he was acquainted with the experiments of Poiseuille, although these had been published ten years earlier, in 1846. The results obtained by Poiseuille led that investigator to conclude that the mean velocity of the fluid depended, in part, on its specific gravity and also on the temperature.

The object of the author of the brochure before us has been to review the situation in the light of recent research, as exemplified by the work of King, Richert, and others. He investigates, in the first instance, the purely theoretical problem of water-flow in its most general form. Then the various numerical results published in the literature of the subject are collated in a form suitable for comparison with the calculated results, and where pronounced divergences occur, observations and explanations are furnished. Finally, for strictly practical purposes, the author gives a series of numerical coefficients for use in cases where merely general approximations will serve.

The book consists of thirteen chapters and is a most painstaking and valuable compilation of the data at present available on the subject.

OUR BOOKSHELF.

Das Relativitätsprinzip. Zweite vermehrte Auflage. By Dr. M. Laue. Pp. xii+272. (Braunschweig: F. Vieweg und Sohn, 1913.) Price 8 marks.

THE second edition of Prof. M. Laue's book on relativity, though on the same plan as the first edition of 1911, contains several additions. In chapter ii. a short discussion of a second arrangement of the Röntgen-Eichenwald experiments is inserted. The kinematic part of the theory of relativity, chapter iii., shows some slight explanatory extensions in § 6, and an enlarged discussion of the inadmissibility of propagation of any physical effects with a velocity exceeding that of light (§ 7). The "cause and effect" point of view here adopted, which leads to a rejection of any hypervelocity of propagation, seems somewhat too narrow. At any rate, it prevented the author from considering the admirable researches on relativistically rigid bodies of M. Born, and especially of Herglotz. In § 8 we remark a fuller exposition and illustration of the notion of "proper time."

In chapter iv. the vector product of two six-vectors and the four-dimensional "Gauss theorem" are inserted. Chapter v. contains, besides a few minor additions, a considerably extended treatment of the theory of the Trouton and Noble experiment, and a much amplified exposition of four-dimensional potential-theory, following the lines of a paper by Sommerfeld. Chap. vi. contains but a few new lines (on pp. 148–164), while vii. (Dynamics) contains many changes and ample additions, viz., Minkowski's dynamics of a point-mass, remarks on the foundations of the dynamics of continuous bodies (§ 27), and the rotational momentum, with a pair of instructive examples, several minor additions in the following paragraphs, and finally the chief addition to the first edition, namely, relativistic hydrodynamics, giving the general equations of motion, and treating the interesting special case of fluids "of smallest compressibility," both essentially on the lines of a paper by Dr. E. Lamla (*Ann. d. Phys.*, vol. xxxvii., p. 772, 1912).

The Dictionary of Entomology. By N. K. Jardine. Pp. ix+259. (London: West, Newman and Co.) Price 6*s*. net.

THIS useful compilation is a glossary of the technical terms used in describing the structure of insects throughout their several stages. Within the limits which the author has imposed on himself it is likely to be of much service to students of entomology. These limits, it is true, are somewhat narrow; there is no mention of individual species of insects, or of genera or families. The orders, when given, are defined in the briefest possible manner, and frequently there is no indication of the insects comprised in them. The words "Coleoptera" and "Lepidoptera" find a place, but there is no mention of Dermaptera, Odonata, Homoptera, or Heteroptera. Hemiptera and Neuroptera are given, but beyond a bare definition there is nothing to show their content. Some of the terms used in insect bionomics might have been included without greatly adding to the bulk of the work; these are not exclusively applicable to insects, but it is in entomological literature that they are chiefly to be met with. It might also have been well to add references in the case of the less usual terms.

The derivations will be welcomed by many; they are sometimes omitted, as under "coenogonous." Two incompatible derivations are given for "caterpillar," but the author does not help us to decide between them. A few misprints may be noted; "carneous" for "corneous," under "cranium"; "unbra" for "umbra"; "tergum," under "anal angle," probably for "termen," though the latter is insufficiently explained. Other slips occur, but on the whole the book is well suited for its purpose.

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.]*

Antarctic Barometric Pressure.

The reduction of the barometric readings taken during the first year of Capt. Scott's Antarctic expedition has shown what I imagine to be an unprecedented rise of barometer from one month to the next. The mean barometer during November was higher than during October by 0·81 in. at Cape Evans, 0·80 in. at Cape Adare, and 0·87 in. at the Norwegian winter quarters. The rise continued into the next month, and the mean value at all three stations for December was approximately one inch higher than that for October.

The instability of the atmosphere shown by such a change has a melancholy interest in view of the sad disaster caused by the weather, and is further of great meteorological importance. I should therefore be grateful for any information of similar large changes, so that they may be considered in my discussion of the meteorological results of the expedition.

The following table gives the mean height of the barometer at the three stations. The data have been reduced to sea-level and normal temperature and gravity. The large difference between the mean values at Framheim and Cape Evans is being investigated.

	Framheim	Cape Evans	Cape Adare
Lat.	78° 38′ S.	77° 35′ S.	73° 27′ S.
Long.	195° 30′ E.	166° 33′ E.	170° 15′ E.
1911			
February ...	—	29·31	—
March	—	29·21	29·12
April	29·08	29·32	29·25
May	29·02	29·23	29·05
June	28·88	29·11	29·11
July	28·86	29·08	29.01
August ...	28·94	29·19	29·06
September ...	28·90	29·16	28·98
October ...	28·61	28·82	28·76
November ...	29·49	29 63	29·56
December ...	29·66	29·75	29·72
1912			
January ...	29·36	29·43	—

George C. Simpson.

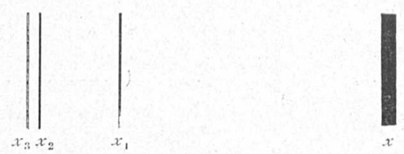
Simla, March 20.

X-Ray Spectra.

We have recently been carrying out some experiments with the object of finding whether spectra of heterogeneous beams of X-rays can be obtained by letting the rays fall on a crystal surface which would serve as a diffraction grating.

A beam of rays from a Röntgen bulb was directed on to the cleavage surface of a crystal of selenite at almost grazing incidence, the beam being made practically parallel by means of suitable lead stops. All the photographs taken of the reflected beam show exceedingly well-defined lines, which are not equally spaced, their number and distances apart varying according to the particular bulb used. These lines are parallel to each other and to the slit. The hardness of the bulb affects the relative intensity of the lines, but apparently makes no difference to their relative positions. Using the same bulb, crystals of different thicknesses all give the same lines.

The accompanying figure represents diagrammatically the lines obtained in one of the photographs. The direct beam strikes the plate at x, and in the reflected beam are seen three well-defined lines, x_1, x_2, and x_3 (in addition to what appear to be interference bands, not shown in the figure). When the bulb was



soft the line x_1 was very intense, whilst the other two lines were comparatively faint. Another photograph taken with the same bulb after it had been hardened shows the line x_1 very much less intense than formerly, whilst the lines x_2 and x_3 have increased in intensity. It appears, therefore, that the line x_1 is due to the softer constituents of the beam, and the lines x_2 and x_3 are due to the harder constituents. That is to say, the rays of longer wave-length are less deviated than the rays of shorter wave-length.

The results suggest that the lines obtained may be spectral lines in the spectra of the beams emitted from the respective bulbs. Further experiments are being carried on.

E. A. Owen.
G. G. Blake.

Teddington, Middlesex, April 7.

X-Rays and Crystals.

On repeating the experiments of Laue, Friedrichs, and Knipping on the transmission of X-rays through crystals, I have found that the transmitted rays may easily be made visible by means of an ordinary fluorescent screen, if we use a sufficiently large pencil of rays, and the crystals are sufficiently transparent to the incident ray.

The X-ray tube used was a Müller-tube of 20 cm. diameter, with water-cooling; the current was supplied by a Toepler influence machine with sixty plates. The diameter of the pencil of rays was 0·5–1·0 cm. The crystals examined were borax, alum, mica, fluorspar, rock-salt, rock-crystal, cane-sugar, &c., the thickness varying from 4 mm. to 1 cm. The transmitted rays show numerous detached fluorescent spots of elongated shape. If we rotate the crystal about an axis perpendicular to the incident ray, the spots move generally across the central spot caused by the incident ray, but we may choose the axis of rotation such that some of these spots remain stationary while the crystal is rotated.

Groups of detached pencils are arranged, as it were, on circular cones, which always touch the incident pencil, and the aperture of which varies continuously with the inclination of the crystal. With a plate of mica, a spot was observed which is situated as if it were the reflected image of the incident ray; but it is doubtful whether we may call it "reflected," because other spots are also seen on the same side of the plate, deviating considerably from the "image." Further experiments in this direction are in progress.

T. TERADA.

Physical Institute, Imperial University, Tokyo, March 18.

Fish-eating Habits of a Spider.

IN a lecture delivered to the Natal Scientific Society on November 22, 1911, the Rev. N. Abraham dedescribed the habits of a spider that he had observed catching and eating fishes. An account of the lecture was printed in *The Natal Advertiser* and subsequently reprinted in *The Agricultural Journal of the Union of South Africa,* but, so far as I am aware, these interesting observations have not appeared in any prominent scientific publication.

When Mr. Abraham's lecture was given the spiders had not been determined, but I have since had an opportunity of examining two preserved examples in his possession, and I have determined them as *Thalassius spenceri,* Picard-Cambridge (Proceedings of the Zoological Society, 1898, p. 28).

The following is an extract from the newspaper account:—"In the year 1905 I was living in Greytown, Natal. One day I was catching small fish and aquatic insects for an aquarium. I was using a small net in a shallow stream. I happened to see on the edge of the water a fine spider, which I captured. On reaching home I placed my specimen in a large aquarium, where I had a number of small fish. The spider measured about three inches when its legs were extended; the body is small, but the legs are long. After being on the rockwork of the aquarium for some time, it took up a very interesting position. It rested two legs on a stone, the other six rested on the water, well spread out, the ends of the six legs commanding a definite and well-defined area of water.

"Being busy, I merely took a note of its attitude, and left it to its devices. After a few minutes my servant boy came into my study to say that the spider I had put into the aquarium was eating one of my pet fish. I at once went to see what had happened, and soon saw the spider on top of the rockwork, holding in its grip a beautiful little fish about four times the weight of its captor. For a moment I was startled into a strange surprise. How could this spider, which has no power to swim, catch a lively, quick-swimming fish? I looked at it in wonder, as it seemed to clutch the fish as a cat clutches a mouse. It soon began to devour its catch, and after some time had passed nothing was left of the fish but its backbone. The spider had eaten it as surely as an otter eats its trout.

"I was now anxious to find out how the spider caught the fish. That night, about 11 o'clock, when I had finished my day's work, I sat down by the aquarium to watch the spider, with the hope that I might see how the fisherman caught his fish. The spider had taken up a position on a piece of stone, where the water was not deep, and had thrown out its long legs over the water, upon which their extremities rested, making little depressions on the surface, but not breaking the 'water skin.' The tarsi of two posterior legs firmly held on to a piece of rock just above water-level, the whole of the body was well over the water, the head being in about the centre of the cordon of legs, and very near to the surface of the water.

"After watching for some little time, I saw a small fish swim towards the stone and pass under the outstretched legs of the spider. The spider made a swift and sudden plunge. Its long legs, head, and body went entirely under the water, the legs were thrown round the fish with wonderful rapidity, and in a moment the powerful fangs were piercing the body of the fish. The spider at once brought its catch to the rocks, and began without delay to eat it. Slowly, but surely, the fish began to disappear, and after the lapse of some time the repast was over."

Recently the Rev. Father Pascalis Boneberg, of the Marianhill Monastery, Natal, has added to Mr. Abraham's observations. Father Boneberg has seen examples of this same spider catching and devouring tadpoles of the toad *Bufo carens,* and adults of the little frog *Rappia marmorata.* It is his intention, I understand, to communicate an account of his observations to a German scientific publication shortly.

That the observations of both these gentlemen are based upon the same species, *Thalassius spenceri,* I have no doubt, for Father Boneberg allowed me to examine an adult male and female, and two immature examples, of his spider. The two latter specimens he kindly presented to the Durban Museum.

E. C. CHUBB.

Durban Museum, Natal, March 15.

A Detonating Daylight Fireball.

THE following may be of interest to some of your readers. On the morning of February 10, at about 6 a.m., the manager and some of the employees of a sheep farm which is situated on the Coyle River, about seventy miles from its mouth, were working close to the settlement when they were suddenly startled by an almost deafening noise which resembled the explosion of a huge gun or a violent peal of thunder close at hand. This was followed by a humming sound, such as would be produced by a motorcar, which lasted for about twenty seconds, after which interval there was another explosion, less violent than the first, which in turn was followed by further hummings and explosions, the latter gradually dying away in about a minute or so.

These men saw nothing to account for the sound, but as the settlement is situated at the foot of a high hill, which rises to the south, it was their impression that the noise came from over the top of this hill. Later in the day Mr. Welsh, the manager referred to, from whom I had most of the facts, met some carters, who told him that they actually saw the object, that it was about twenty-five miles further down along the same river on the top of the high pampa at the same hour, that it resembled a huge ball of fire with a long tail behind, and passed rapidly from east to west; they noticed no explosion.

These facts were corroborated by a sheep farmer (Mr. Ness), who lives about twenty-eight miles above Mr. Welsh, on the same river. Mr. Ness told me that he did not see the object, but that the sound of the explosion shook all the windows in his house and was followed by the same humming sound and secondary shocks.

The servant of a neighbour in this town also informs me that on the same morning at about the same hour she heard what she considered a series of bombs exploding. Now Mr. Ness's house is upwards of ninety miles from here, and as it shook his windows it would probably have been heard another sixty miles further on; this would lead one to believe that the explosions were distinctly audible over an area of at least 150 miles in diameter, and were no doubt produced by a huge exploding fireball. The morning in question was clear and bright. E. G. FENTON.

Rio Gallegos, Patagonia, February 12.

On the Gain of Definition obtained by Moving a Telescope.

Is not the case mentioned by M. E. J. Gheury in NATURE of March 27 (p. 86) but a special case of the familiar fact that an object which is so like its background as to be invisible when at rest is commonly visible when it moves? In this case, as the telescope moved, the signal in its field of view was to the eye fixed to its eyepiece an object moving against the background of misty sky, which it so nearly resembled as to be invisible when at rest. Is not the explanation as follows? Visibility of the object, and in particular of its outline, depends on *contrast* between it and its background. There is commonly *some* contrast, but often so slight as not to attract attention when the object is at rest. When, however, the object moves, the brain receives successive impressions of contrast as the image of the object falls on one part of the retina after another. Thus the brain receives a *cumulative impression of contrast* between the object and the background, and the object becomes "visible."

If this be not, as perhaps it is not, a perfect explanation of this familiar fact, there are probably many others beside myself who will be glad to know what the correct explanation is.

Candahar, Reigate. G. W. BUTLER.

NORTHERN METHODS OF BURIAL IN THE IRON AGE.

MR. SCHETELIG'S excellent memoir[1] describes the recent more precise investigations which correct and elucidate older work. Relics other than from graves are insignificant, and the nominal restriction to Vestland scarcely lessens the interest, for local discoveries are throughout compared with those in other provinces and countries. Neither a *catalogue raisonné* of antiquities, nor a general account of the evolution of Norwegian culture during the Iron Age, the volume serves as a foundation for works of those two different classes. The objective account of the graves themselves, and of the disposition therein of the varied remains, is its endeavour; and its general conclusions relate mainly to the development of burial methods.

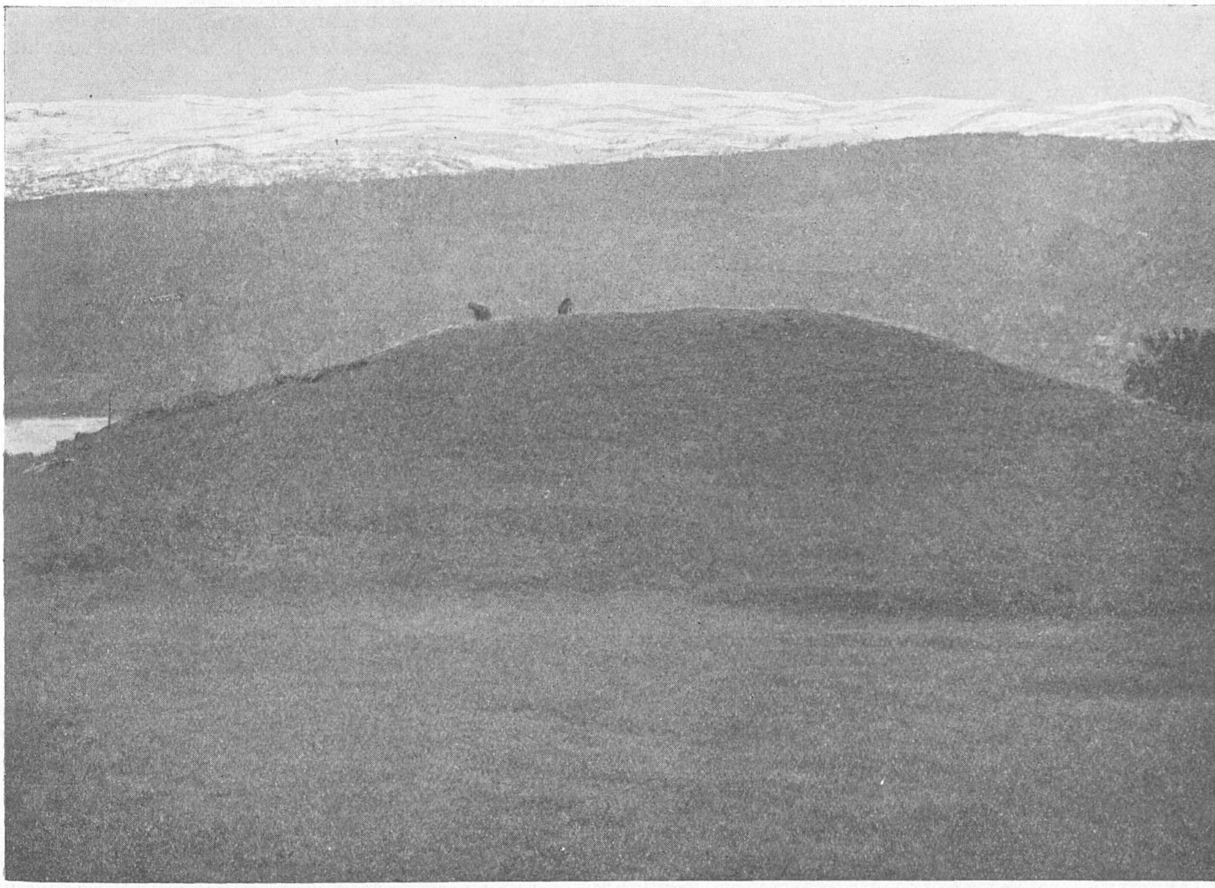


FIG. 1.—The Byrkje grave-mound at the beginning of the excavation. From "Vestlandske Graver fra Jernalderen." Bergens Museums Skrifter.

The third and fourth centuries A.D. are, in Vestland as elsewhere, those most influenced by Roman culture, while during the fifth and sixth centuries more original lines were followed. During the third century, however, a greater change occurred than about the year 400; it was

1 "Bergens Museums Skrifter." Ny Raekke. Bd. ii. No. 1. Vestlandske Graver fra Jernalderen. By Haakon Schetelig. Pp. iii+242. (Bergen: A/S John Griegs Boktrykkeri, 1912.)

also before the latter date that Vestland entered into relations with the West Germanic civilisation on the east coast of the North Sea, and the Anglo-Saxon on its west coast.

Burials without cremation first occurred in the northern countries during the Roman period, and with a broadening of culture the funeral furniture grew more elaborate and diverse. These changes, entering Vestland later than other parts of Scandinavia, affected also the cremation burials, and in the Folk-wandering period (400–800 A.D.) the two kinds tended to fuse. Thus both methods occur in a grave-mound with three graves at Byrkje in Voss (Fig. 1). One of these graves, that of a woman, is further noteworthy as the oldest boat burial in Norway, and approximately contemporary with the sixth-century boat grave in Suffolk. This mode of burial seems to have been the logical outcome of the Charon belief, evidences of which are found about this time in the form of ferry money. Rooting itself naturally and growing exuberantly in the mind of a seafaring folk, this rite bore its richest fruit in the subsequent Viking period, when the gross materialisation of a more primitive symbolism reached its climax. Towards that period there are also observed an increase in the number of weapons, a decrease in the size of the mounds, and a tendency to uniformity of style throughout the whole of the north.

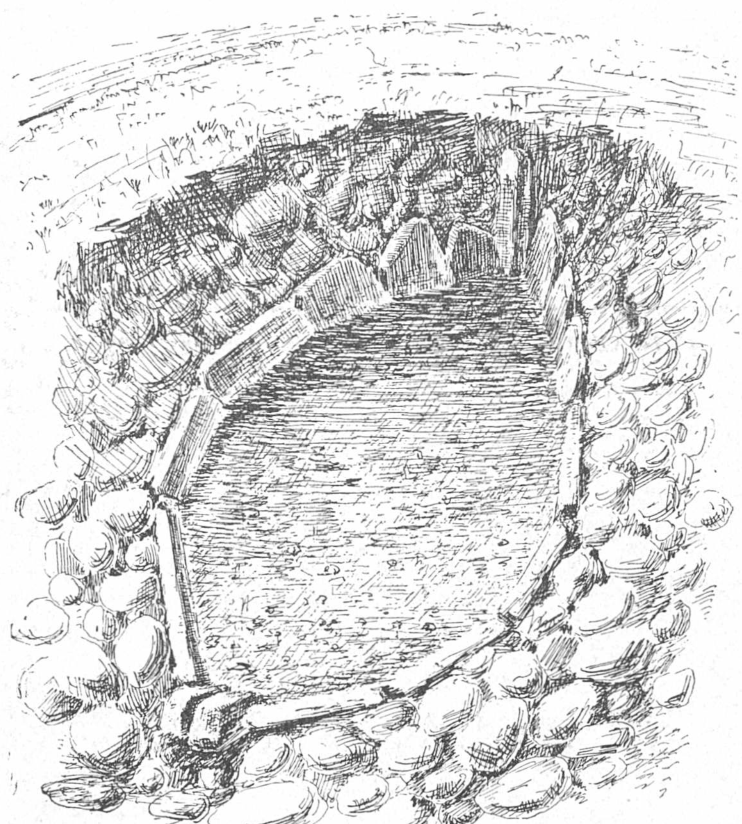


FIG. 2.—A boat-shaped arrangement of stones round a cremation-burial at Ølbør; a wooden boat also formed part of the pyre. (After T. Helliesen, Stavanger Mus. Aarsh., 1902). From "Vestlandske Graver fra Jernalderen." Bergens Museums Skrifter.

Usually in the Viking period there was a funeral pyre on a flat surface, below which the grave was dug and afterwards filled in with large stones, while its position might be marked by one or more gravestones (Fig. 2). The older orientation of head to north was often departed from. This last change and the increased simplicity may betoken Christian customs, if not actually Christian faith. But the halls of the mighty were still homes of heathen worship; their bodies lay when dead with head true to the north of their fathers, and over them, as at Upsala, at Tune, or at Gunnarshaug, were piled the highest mounds with the richest store of goods and the hugest sacrifices known from all Scandinavia.

MIGRATIONS OF BIRDS.[1]

THE volume before us is the seventh of the series of annual reports on migration which we owe to the industry of a committee of the British Ornithologists' Club, which has set itself the task of collecting evidence over a period of ten years, and thereafter of summarising the data thus obtained. The reports have increased progressively both in scope and bulk, and the one before us is a stout volume. It deals mainly with the immigratory movements of birds visiting England and Wales for the purpose of nesting in the summer of 1911. Passage movements are also dealt with, and the autumn movements of 1910 as reported by lighthouses and light-vessels. Summaries of the meteorological conditions are furnished for purposes of comparison.

As the drawing of conclusions is forbidden by the self-denying ordinance of the committee, the volume before us is to be regarded as a summation of facts, and as such it deserves all praise, for everything possible has been done to ensure clearness by condensation, tabulation, and the addition of diagrammatic tables. An immense amount of material has had to be classified and arranged, and we think that the committee has chosen the best course in grouping its facts under the headings of species, although the initial chronological summary is perhaps the most interesting to the casual reader.

The spring migration commenced on March 10 and continued until May 29. During the latter half of April there were three distinct waves of

[1] Report on the Immigrations of Summer Residents in the Spring of 1911; also Notes on the Migratory Movements and Records received from Lighthouses and Light-vessels during the Autumn of 1910. By the Committee appointed by the British Ornithologists' Club. Published as vol. xxx. of the Bulletin of the British Ornithologists' Club. Edited by W. R. Ogilvie-Grant. Pp. 332+20 maps. (London: Witherby and Co., 1912.) Price 6s.

migration—on April 17 and 18, 23, 27 and 28—each of increasing intensity. There was another large influx on May 5. The immigrations of the willow-warbler (probably two races), which lasted from March 11 to May 6, and of the wheatear (two races), from March 19 to May 10, covered the longest periods among the species recorded; while those of the wood-warbler between April 16 and May 13 occupied the shortest time. Notice is drawn to the increasing and now extreme scarcity of the landrail in the south-east of England.

The records which are of most interest merely in themselves are perhaps those to be found in the section dealing with the autumn movements. The autumn of 1910 was noteworthy for the large influx of certain northern species, such as the waxwing, northern bullfinch, mealy redpoll, and continental great tits. Jays were recorded as migrants to the south-east of England, and with them magpies (a flock of twenty), the latter being thus for the first time recorded as migrants to our shores. Great numbers of the little golden-crested wren were on the move round all our coasts between the end of August and mid-November.

LONDON WELLS.[1]

HOW complex and how serious is the problem of maintaining a supply of water suitable to its needs few of the inhabitants of London have any conception. We turn the tap for our morning tub or to fill the kettle for tea and would be surprised and annoyed if the water did not readily flow. During the past few years, however, many large users of water have turned their attention to the provision of private supplies, and the number of wells has greatly increased. The early wells of the city and surrounding area were dug in the superficial gravels and Tertiary formations alone, for in those days they yielded a satisfactory supply without the need of descending further; gradually these shallow wells produced a smaller volume and a deteriorating quality of water, and had to be deepened and sunk into the Chalk.

According to the researches of Mr. A. S. Foord, there were no deep wells either in or near the city till at least the middle of the eighteenth century. It is probable that the difficulty of dealing with the mobile Thanet Sands delayed the introduction of deep wells until the art of overcoming the trouble had been perfected. The yield of many of the older wells was increased by putting a boring at the bottom. Now, the practice of sinking shafts is almost abandoned in favour of boring alone. These borings are lined in the upper portion and are carried as far as necessary into the Chalk. This change has been brought about by the fact that borings are cheaper than dug wells, and that the latter would have to be sunk at least 100 ft. before any water could be reached.

The height of the water level in London wells has been sinking for a long time, but in recent years the fall has been increasingly rapid. This is most clearly brought out in the memoir before us by maps showing the contours of the underground water-surface and by the data supplied with many of the well records. The lowering of the water-level, if continued at the present rate, must seriously affect all wells in the London area, not only as regards quantity, but also quite possibly with respect to quality also. Mr. Barrow has great faith in a remedy for this evil, one which has already proved effective in the hands of Mr. W. B. Bryan in maintaining the level in the waterworks district at Lea Bridge. He recommends that spare water should be conserved in reservoirs in suitable districts and poured as required into dumb wells sunk into the Thanet sand, whence it would permeate into the Chalk; in the introduction to the memoir he brings forward a good deal of evidence in support of this method.

The influence of the Tertiary cover on the quality of the water drawn from the Chalk is remarkable. Water taken from the Chalk beyond the Tertiary outcrop carries a preponderance of lime salts; that from the Chalk beneath the Tertiary is much poorer in lime, which the sodium salts have greatly increased. This change is usually attributed to the influence of the Thanet sand. Dr. Thresh's valuable experiments on the effects of this sand are briefly discussed; but this is a subject of great complexity and requires further study. The work on soils carried out by various agronomic surveys, and that of Cushman and others on the influences of colloids in clays, should have some bearing on the problem.

The well records in this volume are very numerous, and many are published for the first time. They should prove of the utmost value gathered together in this form. Only by complete and accurate records and their careful correlation with geological conditions can an outlook be obtained on the state of the underground water as a whole. If the recording of all borings for water in the United Kingdom were made compulsory, much unnecessary waste would be avoided.

[1] Memoir of the Geological Survey, England and Wales. Records of London Wells, by G. Barrow and L. J. Wills. (H.M. Stationery Office, 1913.) Price 4*s*. 6*d*.

THE LISTER MEMORIAL FUND.

WE are informed that the contributions recently made to the Lister Memorial Fund include the following: Clothworkers' Company, 100*l*.; Grocers' Company, 52*l*. 10*s*.; Ironmongers' Company, 25*l*.; Mercers' Company, 105*l*.; Merchant Taylors' Company, 262*l*. 10*s*.; Skinners' Company, 105*l*.; Society of Apothecaries, 52*l*. 10*s*.; Corporation of the City of Glasgow, 52*l*. 10s.; Royal College of Physicians, 21*l*.; Royal College of Surgeons, 52*l*. 10*s*.; Royal Dublin Society, 50*l*.; Royal Horticultural Society, 52*l*. 10*s*.; the Royal Society, 50*l*.; Harveian Society, 10*l*. 10*s*.; Pharmaceutical Society, 10*l*. 10*s*.; Physiological Society, 10*l*. 10*s*.; Royal Microscopical Society, 5*l*. 5*s*.; Royal Sanitary Institute, 5*l*. 5*s*.; the

Manchester Cooperative Wholesale Society, 21*l*., and many medical societies. Lord Strathcona has sent a donation of 100*l*., and Prof. Ehrlich, of Frankfurt, has sent one of 500 marks.

Committees for the purpose of collecting subscriptions have been formed by the Universities of Oxford, Cambridge, and Durham, and other universities are also making efforts locally to promote the success of the memorial. Arrangements have also been made for the formation of committees in the British Dominions beyond the seas and in foreign countries.

The proposed memorial will be of a threefold character, and consists of (1) a simple marble medallion bearing a sculptured portrait of Lord Lister, to be placed in Westminster Abbey among the monuments of the nation's illustrious dead; (2) a larger and more conspicuous monument, to be erected in some public place in London, and (3) the founding of an International Memorial Fund, from which either grants in aid of researches bearing on surgery or rewards in recognition of important contributions to surgical science will be made, irrespective of nationality. A considerable sum of money is required to carry out these proposals. Donations should be sent to the treasurers of the fund at the Royal Society, Burlington House, London, W.

NOTES.

Sir Oliver Lodge has been elected president of the British Association, in succession to the late Sir William White, for the meeting to be held in Birmingham next September.

The Lord Mayor has given permission for the annual meeting of the British Science Guild to be held at the Mansion House on Wednesday, May 21, at 4 p.m., when he will preside, and Sir William Mather, P.C. (Lord Haldane's successor to the presidentship), will be present. The annual dinner of the guild will be held on Monday, May 26, at the Trocadero Restaurant. The guild has recently been considering the important question of pure milk and the Government Milk Bill, and has drawn up a report in connection with it. A report has also been prepared on national education, and it will be presented to the Government in connection with the contemplated organisation of our educational system.

Lord Burghclere, chairman of the Royal Commission on Historical Monuments, Sir Thomas R. Fraser, F.R.S., professor of materia medica and clinical medicine, University of Edinburgh, and Mr. E. H. Tennyson-D'Eyncourt, Director of Naval Construction, Admiralty, have been elected members of the Athenæum Club, under the provisions of the rule of the club which empowers the annual election by the committee of a certain number of persons of "distinguished eminence in science, literature, the arts, or for public services."

The death is announced, on April 7, at sixty-nine years of age, of Mr. F. G. Smart, fellow of the Linnean and the Royal Geographical Societies.

Mr. G. C. Curtis is starting for Hawaii in order to carry out a commission to construct for the geological museum at Harvard a relief model of the volcano Kilauea.

Prof. Ira N. Hollis, who has been head of the department of engineering at Harvard since 1893, has resigned his chair in order to accept the presidency of the Polytechnic Institute, Worcester, Mass.

The death is announced, in his seventy-sixth year, of Prof. H. Alexan Bezjian, teacher of physical science in the Central Turkey College, Aintab, Turkey-in-Asia, and described by *The Times* as "one of the most distinguished scientific men that Turkey has yet produced."

The medical faculty of the University of Birmingham has suffered a severe loss by the sudden death of Prof. Jordan Lloyd, who had been a member of the University staff since the foundation of the University, having previously occupied the chair of surgery at Mason College since 1891.

The summer meeting of the Institution of Mechanical Engineers will be held in Cambridge, and will begin on Monday, July 28. On the following day the Vice-Chancellor of the University, the Mayor of Cambridge, and the members of the local committee will receive and welcome the president, Sir H. Frederick Donaldson, K.C.B., and the council and members of the institution, in the Senate House of the University. Papers will be read and discussed on that and succeeding days, and there will be visits to engineering works, laboratories, and places of interest in Cambridge, as well as various social functions.

On Tuesday next, April 15, at three o'clock, Prof. W. Bateson will deliver the first of two lectures at the Royal Institution on the heredity of sex and some cognate problems, in continuation of those delivered before Easter, and on Thursday, April 17, Prof. J. Garstang will begin a course of three lectures on the progress of Hittite studies. The Friday evening discourse on April 18 will be delivered by Dr. T. M. Lowry on applications of polarised light, on April 25 by Prof. J. Garstang on Meroë: four years' excavations of the ancient Ethiopian capital, and on May 2 by Mr. H. G. Plimmer on blood parasites.

A joint meeting of the Institution of Electrical Engineers and the Société Internationale des Electriciens will be held in Paris on May 21–24. The inaugural meeting on Wednesday, May 21, will be held at the Conservatoire des Arts et Métiers. The programme includes papers and discussions on the electrification of railways; long-distance transmission of electrical energy; lighting by means of vapour-tube lamps; and wireless telegraphy. There will be a reception and banquet at the Palais d'Orsay by invitation of the Société Internationale des Electriciens; a kinematograph demonstration by M. Gaumont; visit to the aërodynamical laboratory of M. Eiffel at Auteuil; reception by M. Eiffel at the highest platform of the Eiffel Tower, and inspection of the wireless installation, as well as many other social functions.

THE annual meeting of the Iron and Steel Institute will be held on Thursday and Friday, May 1–2. At the opening session the Bessemer gold medal for 1913 will be presented to Mr. A. Greiner, and on May 2 the Andrew Carnegie gold medal (for 1912) will be presented to Dr. J. Newton Friend, and the awards of research scholarships for the current year will be announced. Among the papers that are expected to be submitted are the following:—"Critical Ranges of Pure Iron, with Special Reference to the Point A_2," Dr. H. C. H. Carpenter; "Influence of the Metalloids on the Properties of Cast Iron," H. I. Coe; "Influence of Silicon on the Corrosion of Cast Iron," Dr. J. Newton Friend and C. W. Marshall; "Studies in the Cold Flow of Steel," P. Longmuir; and "Production of Sound Steel by Lateral Compression of the Ingot whilst its Centre is Liquid," B. Talbot.

WE have received the prospectus of an International Ornithological, Entomological, and Botanical Exhibition, to illustrate the economic aspects of ornithology, which is to be held from May 3 to June 1 in the Palais des Beaux-Arts at Liége, under the auspices of three Belgian ornithological societies. The exhibition will be essentially "documentaire," that is to say, based on treatises devoted to the economic aspects of ornithology, and its connections with entomology, but it will also include collections of birds, insects, and such plants as furnish, in the shape of their seeds, a large proportion of the food of birds. To render the show more attractive to the general public, collections of butterflies will be admitted. The object of the exhibition is stated to be entirely for the advancement of science, and not for profit. Exhibits are invited, and intending exhibitors requested to send their communications to L. Cuisinier, 155 Rue de Bruxelles, Ans.

THE death is announced, on April 6, at sixty-three years of age, of Prof. Adolf C. H. Slaby, inventor with Count Arco of the German system of wireless telegraphy. He had a stroke of paralysis about two years ago, and was obliged to retire from the Charlottenburg Hochschule, of which he was at various periods director. A fortnight ago he had a second stroke, and never recovered consciousness. We are indebted to *The Times* for the following particulars of his career:—Prof. Slaby was from 1884 to 1902 director of the electrical laboratory at the Technische Hochscule, and there began the experiments which led to the perfection of the "Telefunken" system. From the Emperor William, who made his acquaintance when the White Hall of the Royal castle in Berlin was fitted with electric light and gave him frequent encouragement and support, he obtained permission to use the Royal gardens on the banks of the Havel for his experiments. Here he worked the whole of the summer of 1897, sometimes ten hours a day, attempting to establish wireless communication between the Pfauen island in Wannsee and the Pfingstberg. In October of that year he established wireless connection between two captive balloons at a distance of 21 kilometres. The range of the German wireless system, of which Siemens Telefunken Company has acquired the monopoly rights for Great Britain, is now said to be 6000 kilometres.

IT is gratifying to learn that the Gypsy Lore Society is now in a flourishing condition, though the number of members is still smaller than it should be. In the second part of vol. vi. of the society's Proceedings Mr. H. L. Williams, of the Indian Police, continues his interesting notes on the criminal and wandering tribes of India. He quotes a current rumour that some of these people in the Punjab and United Provinces of Agra and Oudh are anthropophagous. Two supposed informers are said to have been killed and eaten in a Sánsi camp in the Bhartpur State. The story, as it is recorded, is almost incredible, and seems to be only an instance of the facility with which the settled people in the northern plains are accustomed to accept all kinds of marvellous tales regarding these uncanny and mysterious vagrants.

THE Journal of the Royal Anthropological Institute, of which the final part of vol. xlii. has recently been issued, forms a valuable record of the excellent work in physical anthropology, ethnography, prehistoric archæology, and linguistics which the institute, under its present management, is prosecuting. In its *format* and in the abundant illustrations with which it is furnished, it is equal, or perhaps superior, to the publications of any European society which covers the same field of research. It is scarcely creditable to the Empire that work of this kind does not receive more adequate recognition. In any other country possessing opportunities for the study of anthropology a society like this would be supported by a State grant, and would bear on its rolls a much larger number of subscribers. Funds are urgently required for extending its work. In particular, *Man,* the monthly journal of the institute, does not provide adequate space for a record of current literature, and for the publication of short notes or articles of anthropological interest. The institute is most uncomfortably housed, and its library needs extension and better arrangement before it can meet the wants of students. It may be hoped that when the condition of this important branch of research is brought to public notice the institute may meet with adequate support from the State, from students in this country, and from the large body of English officers working among savage races throughout the Empire.

WE have before us the first part of a new text-book of physiological histology, by Prof. Sigmund, of Teschen, which is being translated into English by Mr. Lovatt Evans, of University College, London. Carl Zeiss, Ltd., is the London firm responsible for the issue. It is beautifully illustrated, and the descriptive text is admirably lucid and up-to-date. The special feature of the work, however, is that it is accompanied by actual microscopical specimens. Thus part i., which deals with the skin, has with it ten specimens to illustrate the structure of the cutaneous organs. We have nothing but praise for the specimens, and these will be highly prized by those who have not the time or opportunity of making microscopic slides for themselves, but nevertheless desire to examine such specimens. We would, however, caution students that pictures, however beautiful, and bought slides, however perfect they may be, can never really teach them histology. The specimens they prepare themselves may not exhibit the same technique, the rough drawings they themselves execute may not be highly artistic, but the educational value of such far transcends that of purchased specimens or highly coloured diagrams.

WE have received from Messrs. Charles Griffin the first number of the sixth volume of *The Quarterly Journal of Experimental Physiology*, which was brought out under the editorship of Prof. Schäfer five years ago. When this new periodical first appeared doubt was expressed in some quarters whether there was room for a new physiological journal. But nothing succeeds like success, and we heartily congratulate its distinguished editor on having justified his expectations in relation to the life and vigour of the journal. The present number contains a noteworthy paper by Prof. Herring on the comparative anatomy and physiology of the pituitary body, a subject which he has made his own; Prof. Schäfer and Mr. Gavin contribute articles on one of the functions of this remarkable gland, namely its influence on the secretion of milk. Dr. Graham Brown continues his studies on the physiology of reflex action. Drs. Cramer and Pringle deal with the much-vexed question of blood-coagulation, pointing out the importance of the platelets in the process, and, finally, Mr. Miller, of Montreal, treats of the nerve centres concerned in the secretion of saliva, and Dr. Grube, of Kansas, on the blocking of nerve impulses. The journal thus deals with many important aspects of physiological progress, and should be on the bookshelves of all working physiologists and others interested in the subject.

PARTS i. and ii. of the ninth volume of *Biometrika* are given up mainly to the consideration of statistical methods. Thus 150 pages are occupied by an article of Prof. Karl Pearson's and Dr. David Heron's on theories of association, which would be more interesting and valuable if it were not merely one stage in a controversy between the authors and Mr. Yule. Four papers treat of methods for obtaining the "probable error" of statistical constants of various kinds, and one on the influence of "broad categories" on correlation. Among those contributions which deal rather with practical results than with statistical theory is a study by Mr. A. B. Emmons, of Harvard, on variations in the pelvis of American Indian squaws. His observations are in conformity with the statement of Engelman that labour is as a rule short and easy among North American Indians who marry within their tribe. He finds that in almost three-quarters of the specimens examined the dimensions of the pelvis would have allowed an easy delivery where the head of the fœtus was about the normal size. Another paper dealing with a subject of considerable importance is that of Mr. E. C. Snow on the intensity of natural selection in man. This is a supplement to his original memoir, which has already been noticed in NATURE.

THE January issue of *Science Progress* (No. 27, 1913) contains an article by Dr. R. R. Armstrong on the mechanism of infection in tuberculosis. Dr. Armstrong expresses the opinion that infection of children from tuberculous milk is of minor importance, and that in their case, as with adults, infection is mainly with the human type of tubercle bacillus by way of the respiratory tract.

A PAMPHLET on the house-fly as a danger to health: its life-history and how to deal with it, by Mr. Ernest Austen, has been issued by the trustees of the British Museum at the price of 1*d*. It gives in simple language the life-history of the house-fly and describes its breeding habits and its dangers to health. The pamphlet is illustrated with two full-page half-tone plates of the house-fly and lesser house-fly and of the house-fly maggots.

WE have received a small volume entitled "Anleitung zur Kultur der Mikroorganismen," by Dr. Ernst Küster (B. G. Teubner, second edition, 1913). It contains a very complete account of the methods and media employed for the cultivation of the protozoa, bacteria, myxomycetes, algæ, and fungi. The matter has been brought well up to date, including, for instance, the work of Bass on the cultivation of the malaria parasite. The price is 8 marks.

TO the March number of *The Zoologist* Prof. Stanley Gardiner contributes a highly appreciative and sympathetic memoir of the late Prof. Adam Sedgwick, with special reference to his early work and associates at Cambridge, and the gradual building up of the modern school of morphology at that University.

IN the *Boletin de la Sociedad Physis*, vol. i., No. 3, Mr. A. Gallardo gives an account of a plague of ants which made their appearance in certain parts of the province of Buenos Aires during 1904–5. The species is the so-called Argentine or New Orleans ant, *Irodomyrmex humilis*, an exceedingly prolific insect, of which colonies have made their appearance during the present century in New Orleans, Madeira, Portugal, and elsewhere. In the opinion of the author this aggressively colonising ant is probably an immigrant into Buenos Aires, and its real home some part of tropical America.

TO the Smithsonian Institution we are indebted for a notice of a complete skeleton of an armoured dinosaur, *Stegosaurus stenops*, which, although discovered near Canyon City, Colorado, so long ago as 1885, has only just been placed on public exhibition in the U.S. National Museum. Alongside is placed a restoration of the reptile as it probably appeared in life. When discovered, the skeleton was lying on its back, in such a manner as to suggest that the reptile had met its death by violence, and the remains have been mounted in the same position, the conformation of the back being displayed by means of mirrors arranged beneath.

IN reference to the recommendation in the "First, Second, and Third Reports from the Committee of Public Accounts" that a periodical stocktaking should be instituted in national museums and galleries, and also that the results of such surveys should be subject to review by the Controller and Auditor-General, it is pointed out in the March number of *The Museums Journal* that in the British Museum alone a small army of officials would be required for a task of this nature. It is added that if the registers in any museum or gallery are not properly kept up to date, the fault is due to the inadequacy of the staff.

The report of the Department of Agriculture of the Union of South Africa has been issued in the form of a Blue-book. Although work has been disorganised by changes in administration, the report contains many interesting accounts of the investigations carried out by the various branches of the service. Amongst these may be mentioned the inquiry as to the cause of lamziekte (lame-sickness) undertaken by Dr. Theiler and Mr. Burtt-Davy, a discussion of which appears in the report of the agrostologist and botanist. Observations already made would appear to indicate that the complaint is not transmissible, and is more or less analogous with the "pica" disease of North Germany and the cornstalk disease of the United States. The view is expressed that the disease is due to the action of a plant poison, which is generated in grasses or other plants normally innocuous. Its development is associated with certain climatic and telluric conditions in which summer drought is an important factor. In this way the conditions responsible for the wilting of grass also favour the formation of the toxin, and this tends to explain the view commonly held that the disease is caused by the consumption of such wilted grass.

To the February issue of the Journal of the Meteorological Society of Japan Mr. J. Otsuki contributes a detailed report, accompanied by a map, of an eruption of Asama-yama on December 14, 1912. The author notes that this volcano has been particularly active in recent years. A violent outburst occurred 130 years ago, but from that time to 1909 the eruptions, though frequent, were of a minor nature. In May of the latter year an alarming eruption occurred, since when the volcano's activity has increased, no fewer than five serious outbursts being recorded in the past four years. The latest manifestation caused considerable consternation over a wide area. The reverberations of the explosion, which are likened to the booming of artillery, had earthquake-like effects on the near-lying villages, and were heard over an area of nearly 16,000 square miles, while a rain of white ash fell during the day of the eruption and the following day, covering ground extending for 2500 square miles. The column of dust and vapour rising above the volcano during the eruption was estimated to have been nearly two miles high.

Some interesting details, accompanied by synoptic charts, relating to the disastrous hurricanes of November last in Jamaica are given in the United States meteorological chart of the North Atlantic Ocean for March, and in a report (No. 411) by Mr. Maxwell Hall, Government meteorologist for the island. Mr. Hall refers to three distinct disturbances: A, an ordinary depression until it curved round the west end of the island; B, a fully developed cyclonic hurricane which struck the south-west coast, travelling in a north-easterly direction; C, a small inland depression which broke the telegraph wires, November 16 and 17. On the morning of November 14 one of several useful warnings issued by the Washington Weather Bureau located a storm 400 miles south-west of Kingston; this storm Mr. Hall refers to by the letter B. At noon on November 17 the storm A was off Negril lighthouse, moving very slowly, and at midnight was overtaken by B. The subsequent action between these storms was very remarkable; Mr. Hall says:—"Every barometric pressure, as well as every direction of the wind, was affected by two or three cyclones, and with the data at hand it is not possible to separate the effects." After A passed out to sea north-east of Montego Bay, it returned rapidly southward, and placed itself between Kempshot on one side and cyclone B on the other. The registered wind velocity reached 120 miles an hour at Negril on the morning of November 18, and at Kempshot (Montego Bay) the same evening a similar rate was estimated. Several towns were entirely destroyed; at Savanna-la-Mar the sea wave was the highest within a century, and the sea was driven half a mile up the principal street.

Almost the whole of the March number of *Terrestrial Magnetism and Atmospheric Electricity* is devoted to a description of the theory, construction, and working of the earth inductor made by the Carnegie Institution of Washington for the determination of dip on board the magnetic exploring ship *Carnegie*. The coil of the inductor rotates about a diameter which can be set at any inclination and in any azimuth. Rotation of the coil will in general produce an alternating current, which only becomes zero if the axis of rotation coincides with the direction of the magnetic field at the place of observation. A telephone in series with the coil would determine the position of the axis for zero current, if the axis could be kept fixed in the proper direction. Since at sea this is not possible, the coil is provided with a two-part commutator, which rectifies the current and sends it through a moving-coil galvanometer. By reading the deflections of the galvanometer when the axis has several positions near the correct one, and the coil is rotated at a constant speed, the dip is determined on the *Carnegie* with an accuracy of about three minutes of arc.

The volume of "Records of the Survey of India, 1910–11," contains discussions on the pendulum and latitude observations made in Sind and Baluchistan, where the arrangement of the mountain masses seems to show marked differences from that found in the vicinity of the main Himalayan region. In the first place, the average deflection of the plumb line is found to be remarkably small, and in general the attraction of the visible mountain masses is much less than could have been anticipated. The geological structure of the whole area is, however, very complicated, and it would appear that far more information, both as to the surface forms and as to the gravity variations, is required before any very definite conclusions can be drawn. Possibly, as suggested by Colonel Burrard, the Eötvös torsion balance might give information which would usefully supplement that derived from other sources. It is to be hoped that the Indian Survey will give a trial to this most interesting instrument. A curious fact elicited is that there seems to be a slow alteration in the vibration periods of a number of pendulums at the same place, Dehra Dun. Thus all four pendulums used showed the apparent force of gravity as highest in January, 1904, and lowest in November, 1909, with a distinct rise since. No cause can be suggested to account for this variation. An investigation as to how far the Indian observations conform to the requirements of "isostacy" promises interesting results, but is as yet only in a preliminary stage.

THE *Alsatian,* which is the first of two quadruple-screw turbine steamers being constructed for the Allan Line, was launched from the yard of Messrs. Wm. Beardmore and Co. on March 22. An illustrated account of this vessel, which is 600 ft. long and of gross tonnage about 18,000, appears in *Engineering* for April 4. A notable feature is the adoption of the cruiser stern, an arrangement which permits of a greater displacement on a given length over-all, with corresponding increase in dead-weight, or, if the displacement be not increased, the lines may be fined down, so that the ship is more easily driven, with corresponding reduction in engine power. Further, the fuller water lines aft which are permissible with this type of stern ensure greater stability, especially at the deeper draughts. It is probable also that this form of stern tends to reduce the vibration due to the propellers. Hitherto the Board of Trade has only required a vessel to be capable of remaining afloat with any two adjacent compartments open to the sea. In the *Alsatian,* the aim of the designers has been to ensure her remaining afloat with four adjacent compartments open to the sea.

WE have received from Messrs. George Philip and Sons, Ltd., of Fleet Street, London, a specimen of a very handy, light terrestrial globe, 6 in. in diameter, showing by bold blue lines the new routes which will be opened when the Panama Canal is completed. "The Panama Canal Route Globe," as it is named, costs only 2*s*. 6*d*. net, and explains easily what a convenience to ocean travel the new canal will be.

MESSRS. CHARLES GRIFFIN AND CO., LTD., announce the following new books and new editions. In *Chemistry*:—The Petroleum Technologist's Pocket Book, by Sir Boverton Redwood, Bart., and A. Eastlake; Roberts-Austen: Addresses and Scientific Papers, together with a Record of the Work of Sir William Chandler Roberts-Austen, K.C.B., F.R.S., compiled and edited by S. W. Smith, illustrated; A Manual on the Examination of Fuel, by J. H. Coste and E. R. Andrews, illustrated; Outlines of Stationery Testing, by H. A. Bromley, illustrated; A Treatise on Petroleum, by Sir Boverton Redwood, Bart., new edition in three volumes, illustrated; A Handbook of Petroleum, by Capt. J. H. Thomson and Sir Boverton Redwood, Bart., new edition, revised throughout and added to by Major A. Cooper-Key and Sir Boverton Redwood, Bart., illustrated; The Synthetic Dyestuffs, and the Intermediate Products from which they are derived, by Dr. J. C. Cain and Dr. J. F. Thorpe, F.R.S., new edition. In *Engineering*:—Coast Erosion and Protection, by E. R. Matthews; The Dock and Harbour Engineer's Reference Book, by B. Cunningham; Electricity in Mining, by Siemens Brothers Dynamo Works, Ltd., illustrated; Griffin's New Guide to the Board of Trade Examination for Marine Engineers, by R. A. McMillan, part ii., Elementaries, Verbals and Drawing; A Manual of Petrol Motors and Motor-cars, comprising the Designing, Construction, and Working of Petrol Motors, by F. Strickland, new edition. In *Geology*:—A Textbook of Geology, by Prof. J. Park, illustrated. In *Mathematics and Physics*:—Electricity and Magnetism, by Prof. J. H. Poynting, F.R.S., and Sir J. J. Thomson, F.R.S., 2 vols., vol i., illustrated. In *Metallurgy*:—Autogenous Welding: a Practical Handbook on the Installation, Working, and Manipulation of Oxy-Acetylene Welding Plant, for the Unition of Metals without Flux or Compression, from the French of R. Granton and P. Rosemberg, translated by D. Richardson, illustrated; Practical Assaying, by Prof. James Park, revised and enlarged from the third New Zealand edition; Rand Metallurgical Practice, vol. i., new edition. In *Technology*:—Engraving for Calico Printing, by W. Blackwood, illustrated; Painters' Colours, Oils, and Varnishes, Hurst's Practical Manual, new edition, revised throughout and re-written by N. Heaton, with a chapter on Varnishes by Dr. M. B. Blackley, illustrated; Painting and Decorating, by W. J. Pearce, new edition, illustrated.

OUR ASTRONOMICAL COLUMN.

NOVA GEMINORUM NO. 2.—In No. 4638 of the *Astronomische Nachrichten* three series of magnitude determinations of Nova Geminorum No. 2 are published. The first, from the University Observatory, Tokyo, commences with the nova's magnitude 5·1, on March 23, and observations were continued until August 17, when its magnitude was 7·89. Both the other sets of observations come from the Observatory of Cracow. The longer list gives the magnitude 3·96 for the nova on March 14; by the time the last determination was made, May 19, its light had dimmed to magnitude 7·60.

LIGHT-CHANGES OF α ORIONIS.—A list of 293 magnitude determinations of α Orionis, made between November, 1901, and August, 1912, by Mr. C. P. Olivier, of the Leander McCormick Observatory, is given in No. 4637 of the *Astronomische Nachrichten*. The table gives, in four columns, the date, Greenwich mean time, determined magnitude, and number of comparison stars used. The values found range from 0·21 (twice) to 1·06 (four times). Under the usual treatment the observations failed to reveal any regularity in the light changes.

PHOTOGRAPHS OF COMET BROOKS (1911*c*).—Dr. Luigi Taffara (*Mem. della Soc. d. Spett. Ital.,* disp. 1^a, vol. ii., ser. 2^a, p. 11) publishes an account of his photographic work on this comet during September, 1911. His observations were made at the Collurania Observatory in Teramo, at the invitation of Dr. Cerulli. The instrument employed was a Cooke triplet of 16·5 cm. aperture and 1·09 metres focal length. This camera was mounted on the equatorial constructed by Salmoiraghi (aperture 13·5 cm. and focal length 1·75 metres), which was used as a finder. In addition to giving a table of positions of the comet for several dates, he publishes a series of photographs of its form, displaying the remarkable changes which the tail underwent.

FRANKLIN ADAMS CHART OF THE SKY.—The Royal Astronomical Society has undertaken the publication of a limited number of reproductions of the Franklin-Adams chart. The 206 sheets form a complete map of the whole sky, the area of each being 15° by 15°. It will be remembered that the original plates were secured with a 10-in. Cooke triplet objective of 45 in. focal length; the negatives show stars down to the sixteenth and seventeenth magnitudes. The reproductions will be on bromide paper, 15 by 12 in., the chart area being 11 by 11 in. The complete price will be ten guineas, and it is expected that the first sets will be ready for delivery in twelve months' time. It is hoped that a sufficient number of subscribers will be enlisted to help to defray the cost of such an expensive undertaking.

A CHEAP FORM OF GRATING SPECTROGRAPH.—In the current number of *Knowledge* (vol. xxxvi., No. 537, p. 142) Mr. A. H. Stuart describes what seems to be a new form of spectroscope in which a transmission grating is used. The instrument is there illustrated by two diagrams, and the principle involved can be easily grasped. The instrument is of the rectangular box form, having the slit and camera at one end of the box. The light, after passing through the slit, falls on an objective, at the back of and nearly in contact with it being placed a replica grating; behind this grating is placed a plane mirror at a distance of a few inches. The beam of light passes through the slit to the objective, and falls normally on the grating. A large portion of the light passes through the grating unchanged, and falls on the mirror. If it meets the mirror normally it will be reflected back to the grating, and a spectrum will pass out obliquely through the object glass and fall on the photographic plate at the camera end to one side of the collimator. In order to avoid the faint reflection spectrum the grating is retained in its position at right angles to the incident beam, but the mirror is slightly twisted. Thus a pure spectrum of considerable dispersion is obtained. Mr. Stuart has constructed such an apparatus by the judicious use of 20*s.*, the achromatic lens, 2 in. in diameter, costing 3*s.* 6*d.*, and the grating 10*s.* 6*d.*

KHEDIVIAL OBSERVATORY, HELWAN.—Two bulletins, Nos. 8 and 9, from this observatory indicate the useful astronomical work that is being accomplished in Egypt. The first gives an account of the method adopted and the results obtained in determining the astronomical positions of El Daba'a, Mersa Malrûh, Baqbaq, Sollûm, and Siwa. The work was carried out by Messrs. E. B. H. Wade and H. Knox Shaw.

The second of the two bulletins contains the results of the first three years (1909–11) of nebular photography with the Reynolds reflector obtained by Mr. H. Knox Shaw. It is stated that during this period the instrument was constantly undergoing alterations and repairs, so that some of the plates are not so good as they might be. Nevertheless, some of them afford considerable information as to the structure of some nebulæ not hitherto photographed. The table gives the new general catalogue numbers, the positions for 1900 and remarks, and four plates, each containing four or more reproductions, conclude the publication. Attention is directed to the advantage of making drawings of the smaller and less brilliant nebulæ from the negatives, a method which is capable of reproducing the general form of the nebula almost as accurately as any photographic reproduction.

THE DEVELOPMENT OF THE PARASITE OF INDIAN KALA-AZAR.

IN a recent memoir with the above title,[1] Captain W. S. Patton gives a detailed account of investigations carried on by him in Madras upon the development and transmission of the parasite of Kala-azar, commonly known as *Leishmania donovani*. As the result of numerous experiments with various blood-sucking insects, the author concludes that the transmission of Indian Kala-azar from man to man is effected solely by bed-bugs of the genus Cimex, and finds that the parasite develops as readily in *C. lectularius*, the species common in Europe, as in the Indian species, *C. rotundatus*. The development observed by the author takes place entirely in the digestive tract of the bug, and is in the main as follows.

The bug takes up the parasite from an infected person in the leishmanial form, that is to say, as the familiar "Leishman-Donovan body," contained either within white blood-corpuscles or in macrophages, in the peripheral blood. After being ingested by the bug, the parasites remain in an unchanged condition for some thirty-six to forty-eight hours. The earliest developmental changes in the gut of the bug may take place while the parasite is still enclosed in a leucocyte or after it has been set free by disintegration of the host-cell, and consist of an increase in the size of the parasite, with enlargement of its trophic and kinetic nuclei. As growth proceeds, the parasites may multiply by binary fission.

The next event in the development of the parasite is the formation of a flagellum, which takes place from the third to the fifth day after the last feed of infected blood. A young, growing parasite may, without dividing, become elongated and spindle-shaped, and acquire a flagellum; or it may first multiply by binary fission, after which each of the two daughter individuals acquires a flagellum; or the parasite may go through a process of multiple fission, in which the two nuclei, trophic and kinetic, divide each into eight or more, and as many flagella grow out, with subsequent division of the body into a number of flagellated daughter-individuals. However the details of the process may vary, the final result is the same, and by the fifth day the parasites, considerably increased in number, have the form of long, actively moving flagellates of the Herpetomonas type, familiar to all those who have studied the development of the parasite in artificial cultures ever since these changes were first discovered and described by Rogers.

About the sixth or seventh day the flagellate parasites are observed to be attaching themselves by their flagella to the intestinal wall of the bug. When thus attached, the body of the parasite slowly rounds up and at the same time it divides; the smaller forms thus produced divide again, and meanwhile the flagellum becomes shorter, and finally disappears altogether. The result of these changes is that the parasite reverts again from the herpetomonad phase to the form of the small, non-flagellate leishmanial body, distinguished by the author as the "post-flagellate" phase, though it does not appear to differ in any essential detail from the initial "preflagellate" leishmanial form, but is described as having a distinct envelope ("periplast"). The post-flagellate stage in the bug begins about the eighth day, and is completed by the twelfth.

According to Captain Patton, this post-flagellate stage represents the final stage of the development of the parasite in the bug. He

[1] Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India. No. 53, "The Development of the Parasite of Indian Kala-Azar." Pp. v+38+1 plate. (Calcutta: Government Printing Office, 1912.) Price 1*s.* 2*d.*

believes that the post-flagellate phase finds its way back again to the human being, when the bug feeds again, by regurgitation from the intestine. Proof of this is as yet lacking, but he hopes in future experiments to solve this part of the problem once and for all. He states that if the bug takes a fresh feed of blood when the parasites in its intestine are in the flagellated phase, they are all destroyed, and cannot develop further. "Human blood has some body in it which not only prevents the process of flagellation, but also destroys the flagellates. This substance is in all probability the complement, and it is known that it is itself destroyed in about two days, when blood is drawn from the human body. This fact further explains why the parasite only begins its development in the bug on the second day. . . . Though many bugs may become infected, only those which do not feed again till the parasite has passed back to its post-flagellate stage are infective." He believes that only in its "post-flagellate" leishmanial form can the parasite resist the destructive action of fresh blood and re-infect the vertebrate host.

The author's conclusion that a non-flagellate leishmanial stage is the final phase in the development of the parasite in the insect-host is based largely on a comparison with the herpetomonad parasites of insects; that is to say, on an analogy with species which are parasitic in invertebrate hosts alone and have no alternate vertebrate host in their life-cycle. In such species, however, the infection of new hosts is effected (apart from the possible occurrence of "hereditary" infection) by the contaminative method; that is to say, by means of resting, non-flagellate phases, usually encysted, which pass out of the host in the fæces, and are accidentally swallowed by another insect-host. On the other hand, in all known cases where a flagellate parasite has an alternation of hosts, vertebrate and invertebrate, and where the vertebrate host is infected by the inoculative method, that is to say, by the parasite being injected into it through the mouth-parts of the invertebrate in the act of sucking blood; in all such cases that have been investigated accurately up to the present, the final stage of the parasite in the invertebrate host is an active flagellate. Further, it has been frequently observed in, for instance, the development of trypanosomes in their alternate invertebrate hosts that the active, flagellate forms, usually crithidial or herpetomonad in type, may pass temporarily into a resting, non-flagellate, leishmanial phase during hunger-periods, when the ingested blood is digested and absorbed, and become active flagellate forms again when the host takes in a fresh supply of food.

From these considerations the possibility is not to be excluded at present that Captain Patton's observations may be capable of an interpretation different from that which he places upon them. It may well be that his "post-flagellate" stage represents a resting phase upon which the parasite enters when the blood taken up by the bug is digested, and that when the bug feeds again these resting forms will become active once more, and give rise to a final flagellate stage, yet to be discovered, which will be inoculated ultimately into the human being. It must, however, be borne in mind that it has not yet been proved definitely that the parasite passes from the bug into the human being by inoculation through the proboscis; if, as is at least possible, the parasite is destined to pass out of the bug in its fæces, it is then probable in the highest degree that the final stage in the development in the bug would be a resting, non-flagellate phase.

The final decision, however, with regard to the transmission of the parasite of Kala-azar will rest, not upon analogies with other parasites, but upon facts demonstrated with regard to this parasite itself, and if Captain Patton establishes his statements, he will have added a new type of development and transmission to those known already to occur in flagellate parasites of vertebrates transmitted by blood-sucking invertebrates. However this may be, the author is to be congratulated on having brought forward very strong evidence to show that, as suggested originally by Rogers, the spread of this very deadly human disease is to be attributed to the agency of the bed-bug, a discovery of immense practical importance.

E. A. MINCHIN.

NEW ZEALAND VEGETATION.[1]

IN a brief general account, contributed to the "New Zealand Year-book, 1912," Dr. L. Cockayne, F.R.S., who has done so much floristic and ecological work in New Zealand, points out that owing to its long isolation and diverse elements (Malayan, Australian, subantarctic, and endemic), the flora of New Zealand is of special interest.

The vascular plants in this flora—ferns, fern-allies, and seed-plants—number, so far as at present known, about 1700 species, of which about three-fourths are endemic. Of the lower plants—algæ, fungi, lichens, liverworts, and mosses—many hundreds have been described, including many remarkable genera and species, but there can be no doubt that hundreds more remain to be described. The ferns and fern-allies form a striking feature in the vegetation in some areas, but are not of such great relative importance in the New Zealand flora as has sometimes been supposed; still, about 160 species of these plants are known.

Among the seed-plants, the daisy family is the largest, as might be expected, having more than 230 species; the sedge, grass, and figwort families follow with more than 100 species each, while between thirty and seventy species belong in each case to the orchid, carrot, buttercup, bedstraw, epacrid, willowherb, pea, rush, and forget-me-not families.

Among genera which contain many species and are marked by great variability, making them difficult to define and classify, Dr. Cockayne mentions Veronica, Carex, Ranunculus, Senecio, Epilobium, and Myosotis. The genus Veronica, with more than 100 species, is remarkable for its variability and for the almost endless variety of habit assumed by the various species, some of the New Zealand speedwells (mostly endemic and largely alpine in habitat) being small trees, while the majority are shrubby and often dwarf, frequently simulating cypresses and other conifers owing to their reduced and appressed leaves. Apart from variability in the adult plants, about 100 New Zealand species, belonging to different genera, have juvenile forms which are quite distinct from the adult forms, and may retain their juvenile characters for many years; this is seen in various trees, such as lace-bark, lancewood, and ribbonwood.

Among the multitudinous growth-forms, characteristic of diverse life conditions, the more remarkable are the climbers with woody rope-like stems, resembling the lianas of the South American tropical forests; shrubs with wiry interlaced branches forming close masses; the curious cushion-plants, sometimes of immense size, as in the vegetable sheep (species of Haastia, Raoulia, and Psychrophyton); leafless shrubs with round or flattened stems, and so on. The woody plants are almost all evergreen, only some twenty species being deciduous or semi-deciduous; herbs that

[1] The Flora of New Zealand." By Dr. L. Cockayne. Extract from the "New Zealand Year-book, 1912.'

die to the ground in winter are rare, as are bulbous plants.

The plant associations of New Zealand, on which Dr. Cockayne has written so extensively,[2] are of surpassing interest; to find an equal variety a continent extending to the tropics would have to be visited. The northern rivers and estuaries display a mangrove vegetation—a unique and unexpected occurrence outside of the tropics. The lowland and montane forests are of the tropical rain-forest type, and are distinguished by the abundance of filmy ferns, tree-ferns, woody climbers, massive perching plants, deep carpets of mosses and liverworts, and trees with buttress-roots. The high-mountain forests are subantarctic in character, and are usually dominated by the southern beech (Nothofagus). Wide areas are covered by shrub heath, fern heath of tall bracken, and moorland with bogs, while grass-land with tussock grasses is a great feature of the volcanic plateau of the North Island and of the east of the South Island; species of Poa and Festuca form the chief tussocks of the lowlands and lower hills, but at higher altitudes species of Danthonia are dominant.

The alpine vegetation contains, excluding lowland plants which ascend to the mountains, about 550 species, most of which never descend below 1500 ft. altitude, while some are confined to the highest elevations. The most beautiful of New Zealand flowers, with but few exceptions, belong to this mountain flora—the great white and yellow buttercups, the marguerite-flowered celmisias, and the variously coloured ourisias, eyebrights, forget-me-nots, and many more. The growth-forms are often striking—cushion-plants, rosette-forming plants, stiff-branched shrubs, mat-forming plants, and other xerophytes are much in evidence, showing the usual xerophilous leaf-characters (hairiness, leathery structure, rigidity, needle-points, &c.).

The floras of the Kermadecs, Chatham Islands, and the Subantarctic Islands (Snares, Auckland, Campbell, Antipodes, Macquarie)—island groups far distant from the mainland—are distinctly part of that of New Zealand. The Kermadecs contain 114 species of vascular plants, only twelve of which are endemic, while seventy-one belong to New Zealand proper; the largest island (Sunday Island) is covered with forest in which *Metrosideros villosa*, a near relative of the pohutakawa (*M. tomentosa*), is the dominant tree. The Chatham Islands have 235 species, twenty-nine of which are endemic, while the remainder of the flora is found on the mainland. The chief plant associations are forest, moor, and heath; on the moors are great thickets of the purple-flowered shrub *Olearia semidentata*, while there are two remarkable endemic genera, Coxiella (an Umbellifer) and Myosotidium (a giant forget-me-not)—both now almost extinct, unfortunately. The Subantarctic Islands have a dense vegetation consisting of 194 species, of which no fewer than fifty-two are endemic, the rest occurring in New Zealand, but chiefly in the mountains. Forest is found only on the Snares and the Aucklands, the dominant trees being an Olearia and a Metrosideros respectively. Very dense scrubs occur on the Auckland and Campbell Islands, and moors are characteristic of all the islands, owing to the enormous peat-deposit and the frequent rain. The Cook Islands, though forming a part of the dominion, have a Polynesian flora quite distinct from that of New Zealand, and are therefore not included in Dr. Cockayne's notice, while, on the contrary, the flora of the Macquarie Islands, though belonging to Tasmania, is a portion of that of New Zealand.

[2] See, for instance, the papers reviewed in NATURE, vol. lxxxviii., pp. 51, 590.

The indigenous flora has been invaded by an important introduced element, consisting of about 540 species, mostly European, which has followed in the wake of settlement. Dr. Cockayne points out that although these aliens are in active competition with the true native plants, the widespread opinion that the latter are being eradicated in the struggle is quite erroneous. Where the vegetation has never been disturbed by man, there are no foreign plants at all, but where man has, by farming operations, stock-raising, and burning, brought about European conditions, the indigenous plants have given way before artificial meadows with their economic plants and accompanying weeds. On the tussock-grass areas, however, invaders and natives have met, and though the original vegetation has changed, there is no reason to consider the one or the other as the victor. On the contrary, it appears likely that both will persist, and in course of time a new flora and vegetation will be evolved.

F. C.

PALÆOZOIC AND OTHER ECHINOIDS.[1]

THE Echinoidea afford probably greater opportunities for accurate phylogenetic study than any other class of animals. This is due to the fact that a fossil Echinoid is, when well preserved, often as complete for morphological, and even ontogenetic, examination as a recent specimen. No work on recent Echinoids could be adequately carried out without reference to the fossil forms, while any classification of the group based on structures other than skeletal would exclude more than half the available material.

There could be no better proof of the absolute interdependence of zoology and palæontology than the volume before us. The work aims primarily at a revision of the known Palæozoic Echinoids, but before the characters and relations of those highly specialised forms can be well understood, an exhaustive general survey of the morphology of the whole class is necessary. Conversely, it is surprising, but none the less gratifying, to find that the fullest account of the lantern of a recent Echinoid yet published is included in a work mainly concerned with Palæozoic types.

In the introduction a valuable summary of the methods of research (based largely on those of Hyatt) is given, together with useful technical hints for the preservation and development of recent and fossil Echinoids.

The first section of the work is devoted to a detailed account of the comparative morphology of the class. Beside the study of the lantern already mentioned, three features stand out preeminently in this part. Teratological and other irregularities of development are here systematised for the first time, and their value in the interpretation of normal conditions is clearly established. The apical system, considered biometrically, is found to yield important evidence of the direction of evolution in species, especially among the regular Echinoids. But perhaps the most noteworthy conclusion reached concerns the actual composition of the test. It is shown that the only parts of the Echinoid skeleton that occupy an interradial position are the genital plates and the braces of the lantern. Each interambulacrum is really composed of two separate halves, each half having its origin in the same ocular plate as the contiguous ambulacrum.

The systematic classification contained in the second section of the work is concerned chiefly with the regular Echinoids. The only striking novelty is found

[1] Memoirs of the Boston Society of Natural History. Vol. vii., "Phylogeny of the Echini," with a Revision of Palæozoic Species. By Robert T. Jackson. Pp. 491+76 plates. (Boston: Printed for the Society, 1912.)

in the subdivision of the Centrechinoida (*olim* Diademoida). Here the characters of the jaws are used as the guiding features in the separation of three suborders.

The final part of the paper gives a complete survey of all Palæozoic Echinoids hitherto described, and, naturally, includes the description of several new genera and species. The completeness of the revision may be gauged from the fact that figures are given of all but four of the known species. The seventy-six plates accompanying the paper are partly photographic and partly diagrammatic, both alike admirably clear. A full bibliography and an adequate index bring to a fitting conclusion a work that must always remain a classic to echinologists, and a model to workers on other groups. H. L. H.

CHEMISTRY OF THE SUGARS.

PROF. EMIL FISCHER'S latest paper in the final part of the Berlin *Berichte* for 1912 brings another chapter in the chemistry of the sugars to a close. His welcome return to the subject has been attended with the same brilliant experimental dexterity which led to his former successes in this remarkable group of compounds, and it is to be hoped that he will yet succeed in conquering the still unsolved problem of the synthesis of the disaccharides. Fischer now describes the conversion of ordinary glucose into a methyl pentose, and is enabled to clear up the constitutional formulæ of the stereoisomeric methyl pentoses and effect their complete synthesis from the elements.

The methyl pentoses are a somewhat remarkable group of compounds; they represent sugars of the type of glucose in which one hydroxyl group is reduced so that $CH_2.OH$ is replaced by CH_3. At first their occurrence was rare and limited to a few coloured glucosides. Many more of these have been described recently, but the group is most widely represented amongst the seaweeds, the investigation of which we owe to Votoček. As a result of his work, several isomerides of rhamnose, the methyl pentose which was first discovered, are known.

Fischer started from a dibromo-derivative of glucose, discovered by Fischer and Armstrong ten years previously. The one bromine atom in this substance is attached to the carbon atom at one end of the chain of carbons which constitutes the skeleton of glucose; it is easily replaced by methoxyl and a glucosidic compound formed. The position of the second bromine was uncertain; there were reasons for considering it as attached to the other end of the chain. This position is now confirmed by the fact that when the bromine atom is reduced the glucoside of a methyl pentose is formed from which the methyl pentose is in turn obtained. The new sugar proves to be identical with a compound described by Votoček, and receives the name isorhamnose. Its configuration formula must be the same as that of glucose, and it is easy to deduce the formula of rhamnose and other members of the group.

A side issue of the research, which, however, possesses the very greatest interest, is the behaviour of the new glucoside of isorhamnose towards enzymes. Like the β-methyl glucoside, from which it is derived, it is hydrolysed by emulsin, though somewhat more slowly. Apparently the substitution of CH_3 for $CH_2.OH$ is not sufficient to put the compound out of harmony with the enzyme; this is what might be expected in view of Irvine's proof that tetramethyl-β-methyl glucoside is likewise hydrolysed by emulsin. It is therefore all the more remarkable that β-methyl xyloside, which differs only in that the CH_3 group is replaced by H, is not acted on by the enzyme in the very least.

A more striking proof of the selective nature of enzyme action could not well be desired, and the moment is opportune to emphasise this fact, since it is fundamental to the interpretation of vital phenomena. E. F. A.

GYROSTATS AND GYROSTATIC ACTION.[1]

WE are accustomed in daily life to handle non-rotating bodies, and their dynamical properties excite little attention, though it cannot be said that they are commonly understood. It is different, however, with rotating bodies. These, when handled, seem to be endowed with paradoxical, almost magical properties. I have here an egg-shaped piece of wood. I place it on the table and it rests, as we expect it to do, with its long axis horizontal. Our experience tells us that this is the natural and correct position of the body. But I set it spinning rapidly on the table, as you see, with the long axis horizontal, and you observe that after an apparently wobbling motion it erects itself so that its long axis is vertical. It was started spinning about a shortest axis, but the body has of itself changed the spin, and it is now turning about the long axis. In taking this position it has actually raised itself against gravity, through a height equal to half the difference between the lengths of the long and short axes. This seems paradoxical, but the man who is in the habit of spinning tops knows that this is the proper position of the body, that it must stand up in this way when spinning rapidly on a rough horizontal plane.

This experiment may be performed at the breakfast table with an egg as the spinning body. But the egg must be solid within—that is, it must be hard-boiled; a raw or soft-boiled egg will not spin. Perhaps this was why Columbus did not adopt this method for his celebrated experiment; there may, of course, have been other reasons.

It is thus made clear that by causing a body to rotate rapidly we endow it with new and strange properties. Between a top when spinning and the same top when not spinning there is a difference which reminds us of that between living and dead matter; and this will strike us still more forcibly when we consider some more complicated cases of rotational motion. The top, the ordinary spinning-top of the schoolboy, stands on its peg and "sleeps" in the upright position, in contempt of all the laws which govern statical equilibrium.

The experimental study of spinning-tops is carried on by very small boys and a few more or less aged people. Somehow, but I think quite wrongly, a top is regarded as a toy suitable only for a child, and that kind of amusement is scarcely encouraged by the benevolent despots who so completely direct the games of boys at school. Among older boys there used to be a regular game in Scotland of "peeries," and some of you may have read Clerk Maxwell's poetical description of the Homeric contests which distinguished the sport.

The top as a plaything is depised; nevertheless it is a most important contrivance. The earth on which we live is a top, and a considerable range of astronomical phenomena are most easily explained by reference to the behaviour of ordinary spinning-tops. It is a top that directs the dirigible torpedo, that controls the monorail car, which may soon rise from the posi-

[1] Discourse delivered at the Royal Institution on Friday, February 14, by Prof. Andrew Gray, F.R.S. The motor-gyrostats described are the invention of Dr. J. G. Gray and Mr. G. B. Burnside. The gyrostatic tops and combinations used in the latter part of the lecture are due to Dr. Gray.

tion of a small model to that of an important affair of practical railway engineering, and that in the gyrostatic compass gives a direction-pointer unaffected by the iron of the ship, or the rolling and pitching of the vessel. Its properties (summed up in what we call gyrostatic action) have to be reckoned with in all swift-running machinery, such as fast-speed turbines, and rotary engines of all kinds, especially if these drive flywheels or propellers. They affect very seriously the stability of aëroplanes, and even of submarines, and I am very doubtful if aviators have yet become in sufficient degree instinctively alive to the dangers of sudden turnings, such as those which are encouraged by the promoters of aviation displays in alighting competitions.

The man who has spun and studied tops and gyrostats appreciates as no one else can the extreme importance of properly balancing rotating machinery, and of avoiding gyrostatic action where such action is likely to interfere with the running of the machine as a whole.

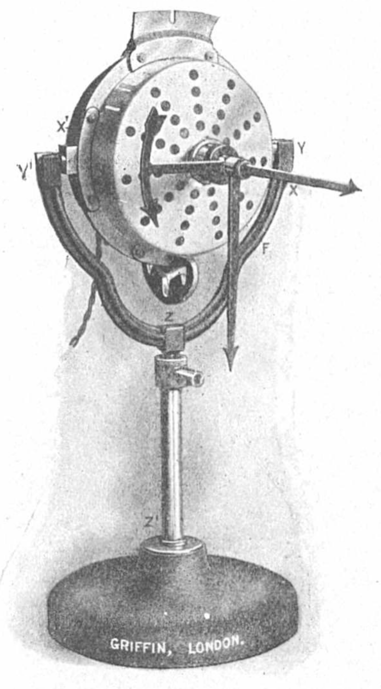


FIG. 1.—Motor-gyrostat in "fork and pedestal" mounting.

The properties of a top are best studied in the gyroscope, or gyrostat, as it is better called. Here is a simple gyrostat, of the ordinary form sold in the toyshops, but with some important modifications to enable it to run for a long time at a high speed. It consists, as you see, of a heavy-rimmed metal disc, or flywheel, capable of rotation with but little friction on pivots held in sockets attached to a metal frame. Thus the flywheel may, by the quick withdrawal of a string wound round its axle, or in some other way, be set into rapid rotation in the frame, which in turn is mounted in various ways to show gyrostatic effects. But this ordinary form, as well as some others of a more pretentious character, suffers from the great disadvantage of having no means of maintaining the spin, and the continual renewal of the spin is a great nuisance.

I have here a gyrostat (Fig. 1) in which this drawback has been overcome by the simple and effective device of making the flywheel itself the rotor of a high-speed continuous-current electric motor. The ordinary gramme-ring armature is well adapted for this. It gives a wheel of great moment of inertia, or, as I call it, "spin inertia" (that is, the matter of the wheel is distributed so as to be on the whole as distant from the axis as possible), which can be run at high speed for a long time without trouble of any kind from bearings or contacts.

For my first experiments the motor gyrostat is set up with the axis of the flywheel horizontal, in this mounting, which consists, as you see, of a fork perched on a pillar. Notice the possible motions, the freedoms, I may call them, of the arrangement. The flywheel can turn about its axle, the case can turn about the line of the pivots which carry it in the fork, and the fork about a vertical axis provided in the pillar. These three axles, which we shall number (1), (2), (3), are mutually at right angles and meet at the centre of gravity of the movable system or gyrostat proper. When thus set up the gyrostat is said to be freely mounted.

With the flywheel at rest I push down on one side of the case, and immediately turning takes place, as we should expect, about the axis (2). Pushing down the other side of the case causes the instrument to turn about the axis (2) in the opposite direction. I grasp the fork in my hands and turn it about the axle (3) in either direction. Nothing unexpected happens; the gyrostat turns with the fork, its axis remaining horizontal throughout. Again, I grasp the pillar in my hands and turn it on the table, and you see that the friction of the axle (3) is sufficient to cause the fork and gyrostat to move round with the pillar. As before, the axis of the flywheel remains horizontal.

My assistant now causes a current of electricity to flow in the coils which form part of the flywheel and in the coils which surround the soft iron core of the magnet which is stationary within the ring. So far you can only tell that the flywheel is turning by the faint hum which its motion sets up. But when I repeat the operations which I have just performed on the non-rotating gyrostat, the behaviour of the instrument is quite startlingly different. I push down on one side of the case as before; a resisting force is experienced, and the gyrostat turns, not visibly about the axle (2), but about (3), the vertical axis. So long as I maintain the tilting force so long does the resistance and this turning about the vertical persist. I withdraw the tilting force, and the turning motion ceases.

Now I would direct attention to these rods with arrow-heads, which are screwed to the gyrostat case. This curved one shows the direction in which the flywheel is spinning. The straight rods are intended to represent the spin-momentum and the tilting action respectively. Both are completely known when their amounts and their planes are known. The spin-momentum is got by multiplying two numbers together, one representing the spin-inertia of the wheel (which is greater the more the mass is placed in the rim), the other the speed of turning. The turning action or "couple" is also got by multiplying the force with which I push by the arm or leverage of the force about the axis. So then we represent these two by lines drawn at right angles to the two planes, making the lines of lengths to represent the two products. Standing on one side of the plane of the flywheel, you see it turning against the hands of a clock; standing on one side of the plane of the turning action I apply you observe that action tending to turn the body also against the hands of a clock. The two lines representing the two products drawn towards you from the two planes represent also the directions of the turning actions of the couples. For example, the direction of rotation of the flywheel being that shown by the curved rod, the line representing the spin-momentum points outwards from the side of the gyrostat to which the rods are attached. I call this the *spin-axis*. The other line representing the turning action which I applied I call the *couple-axis*.

Now observe that I set the couple-axis so as to point toward your left. I push down the side of the gyrostat nearest me, and you see that the spin-axis turns towards the left. Again, I turn the couple-axis so as to point to your right. When so placed it represents a turning action tending to depress the end of the axle of the flywheel that is nearest you. I apply such an action and the spin-axis turns towards your right. In both cases the spin-axis turned towards the instantaneous position of the couple-axis.

Now I set the couple-axis vertical, pointing up. It

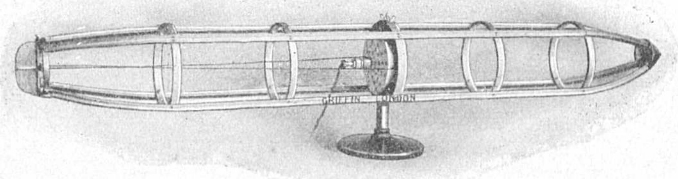


FIG. 2.—Motor-gyrostat mounted to demonstrate the principle of the dirigible torpedo.

represents a turning action tending to produce horizontal turning in the counter-clock direction as seen from above. I apply such an action to the fork, when you see that the gyrostat turns the spin-axis towards the upward direction. Finally, I set the couple-axis vertical but pointing down, as in Fig. 1. It now represents a turning action tending to produce clockwise rotation as viewed from above, counter-clock rotation as seen from below. I apply the action represented and the gyrostat turns the spin-axis towards the downward direction.

These experiments may be summed up as follows:—The flywheel is spinning about axis (1). Any attempt to tilt the gyrostat about axis (2) produces turning about (3); an attempt to tilt it about (3) produces turning about (2). This response of the body seems paradoxical, but in point of fact, and this is the secret of the whole affair, *this turning of the body as a whole amounts to the production of spin-momentum about the couple-axis at exactly the proper rate.* It is quite easy to prove this by the consideration, in the most elementary way, of the accelerations of the different particles composing the wheel.

The turning of the spin-axis towards the couple-axis is called a precessional motion, from a similar motion of the earth which produces the astronomical phenomenon called the precession of the equinoxes. The turning action, or couple, as I shall now call it, may be said to cause the flywheel to "precess" towards the couple-axis. This relation of directions is very important, and should be kept always in mind.

If this turning response of the body, about an axis which we shall call (3), is prevented when turning about an axis (2), at right angles to (3), is changing the direction of the axis of a rotor—an axis (1), say, at right angles to (2) and (3)—a preventing couple, usually called *gyrostatic,* about the axis (3), must be applied by the bearings to the axle of the rotor, and therefore an equal and opposite couple by the axle to the bearings. This couple, it is easy to prove, is equal to the product of the spin-momentum and the angular speed at which the direction of the axis of the rotor is being changed. Thus the greater the moment of inertia of the rotor, or its angular speed, or the angular speed of the change of direction of the axis, the greater is the gyrostatic couple.

For example, the rotor of a dynamo, mounted on one of the decks with its rotor-axis athwart ship, applies, when the ship rolls, a couple to the bearings, the plane of which is parallel to the deck, and which consists of a forward force on one bearing and a sternward force on the other. These forces are reversed with reversal of the direction of rolling, so that an alternating force is applied to each bearing tending to shear it off the deck. Thus if the bearings are at all loose, the axle will knock alternately on the front and back of each bearing.

Similarly the axle of the rotor of a fore-and-aft turbine, when the ship pitches, applies a force to port to the bearing at one end, and a force to starboard at the other end, which forces are reversed when the direction of the pitching motion is reversed. When the course is being changed the forces of the gyrostatic couple are applied to the top of one bearing and the bottom of the other.

Now, returning to the pillar-gyrostat, and putting the flywheel in rapid rotation, I turn the pillar round on the table. I have turned, as you see, the base round through one revolution, and throughout the turning motion the axle of the flywheel has remained pointing in the same direction. The friction at the axle about which I have turned the pillar, which, you will remember, was sufficient to carry the gyrostat round when there was no spin, is now quite insufficient to cause any serious change of position of the gyrostat. Only a very small couple producing precession acted.

This experiment illustrates the principle of permanence of direction of the axis of rotation, in the absence of a couple producing precession, the principle on which depend the gyrostatic compass and the self-directing torpedo. Carried within the body of the torpedo is a fast-spinning gyrostat, and at the instant at which the torpedo leaves the impulse-tube this gyrostat is mounted freely with its axis coincident with that of the torpedo—that is pointed, so to speak, exactly along the "cigar." Any turning of the torpedo body sideways brings about a relative shift between the gyrostat and torpedo axes, and this shift brings into operation a vertical rudder at the stern of the torpedo. If the nose of the torpedo turns to port, the rudder steers the craft to starboard, and *vice versâ.*

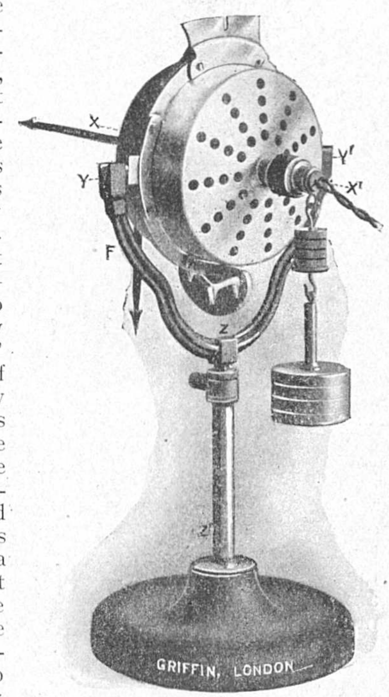


FIG. 3.—Motor-gyrostat in pedestal, with weight attached.

Here (Fig. 2) is a skeleton frame representing a torpedo. It is mounted on a vertical axle, and carried on pivots within the structure is one of our motor-gyrostats. At the stern of the frame is a small rudder, and this is connected by means of cords to the gyrostat. I set the flywheel in rotation. When, as I do now, I turn the nose of the torpedo to port, the rudder steers to starboard; when I turn the nose to starboard the rudder steers the craft to port.

The case of the pedestal gyrostat is provided with a hook at one extremity of the axis (see Fig. 3). The effect of hanging a weight on this hook is to apply a couple tending to cause turning about the axis (2)—that is, which would produce such turning if the flywheel were not spinning. But the wheel is spinning, and the visible actual turning is about the axis (3). Observe also that the wheel is rotating comparatively slowly, and that the precessional motion is great. I increase the speed of the flywheel and the gyrostat precesses more slowly. I replace the weight by a larger one, and for the same spin the precessional motion is greatly increased. Thus for a given applied couple the faster the spin the slower the precessional motion, and for a given spin the greater the couple the faster the precessional motion.

Now while the weight is in position and the gyrostat precessing about the axle (3) I attempt to hurry the precessional motion, and immediately the gyrostat turns about the axis (2) so as to *rise* against gravity. I try to delay the precession, and again the gyrostat turns about the axis (2), but now so as to descend under gravity.

Without being aware of it people are constantly meeting with examples of gyrostatic action in daily life. A child expert in trundling a hoop causes it to turn its path to the right or left, by striking it a blow at the top with the hoop stick, the effect of which the ordinary person would suppose, if he thought about it, should be to make the hoop to fall over to the right or the left. A bicyclist riding without holding the handles leans over to the right if he wants to steer the bicycle to the right, and to the left if he wants to steer to the left. And if he feels himself falling over to right or left he turns the handles instinctively so as to turn the bicycle to that side, when the machine resumes the upright position. In the bicycle, however, the spin of the wheels is not the most important action to be taken account of.

The gyrostatic action in the bicycle is much more marked in a motor machine, for in that a massive flywheel rotates in the same direction as the wheels. As the bicycle turns a corner it is constrained to precess, and a couple is needed to produce this precession of the rotating parts quite apart from that required to turn the rest of the machine. This the rider applies by leaning over to the *inside* of the turn, and leans over more than he would have to do if the flywheel were not there or were not rotating.

Good examples of gyrostatic action are given by paddle and turbine steamers. A paddle steamer is steadier in a cross-sea than a screw steamer of the same size. This is due in part to the gyrostatic action of the paddle-wheels, which, but for their comparatively slow speed of rotation, would form a compound gyrostat of considerable power. For this gyrostat the spin-momentum may be conveniently represented by a line drawn from the steamer towards the port-side. A couple tending to tilt the steamer over to starboard is represented by a line drawn towards the bow, and a couple tending to tilt the steamer to port by a line drawn towards the stern. Hence, if the steamer heels over to starboard, her bow, in consequence of gyrostatic action, precesses to starboard, but the starboard wheel, becoming somewhat more deeply immersed, uses more power and exerts a turning influence to port. Thus the steersman has less difficulty in keeping the vessel on a straight course.

But if the vessel be turned by the rudder, say to port, the vessel will by gyrostatic action be slightly heeled over to starboard, and the starboard wheel, being more deeply immersed, will assist the turning action of the rudder.

Though the gyrostatic action of the wheels is not very great, calculation shows that it is enough to produce an appreciable variation in the immersion of the wheels.

The gyrostatic action of the flywheel in a motor-car is of some practical interest. The flywheel is placed with its plane athwart the car—that is, with the axis, so to speak, fore and aft. It rotates in the clockwise direction as viewed by an observer behind the car. The effect of turning a corner to the left gives a gyrostatic couple, throwing the weight of the car more on the back wheels; turning to the right throws the weight more on the front wheels. The forces applied by the ground to the front wheels are diminished in the former case and increased in the latter. There is danger, therefore, of the steering power of the car being interfered with, if the corner is taken at too great a speed.

As a final example, we take an aëroplane. Here the rotor of the engine and the propeller together form a compound gyrostat of considerable power. As the bearings are fore and aft, the action is similar to that of the flywheel of the motor-car. Turning horizontally in one direction gives rise to a gyrostatic couple tending to make the aëroplane dive, turning the

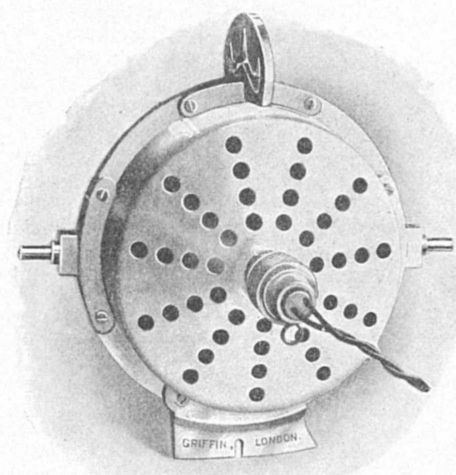


FIG. 4.—Motor-gyrostat balancing on a skate.

opposite way sets up a couple which makes the aëroplane rear up in front. If the aëroplane is kept horizontal such couples have to be balanced by stresses in the framework. These considerations show that sudden turning of aëroplanes should, if possible, be avoided. Manœuvres calling for such turning are accompanied by very considerable danger. No doubt aviators are aware of the existence of gyrostatic action, but there is considerable haziness in people's minds as to its direction in the various possible cases. The peculiar properties of rotating bodies need not, of course, be understood theoretically by aviators, though it is well to know something about them. But the aviator, like a person walking or swimming, must know instinctively what to do in an emergency, and what motions must be avoided. The gyrostatic action he has to contend with lies hid, as it were, until he tries some new and violent manœuvre; and then it brings him to grief.

I now pass on to some special experiments which can be carried out with these motor-gyrostats. First take one or two old experiments (see Thomson and Tait's "Natural Philosophy," § 345^{x} *et seq.*), which are more effectively performed with these fast-running instruments. Here is a skate attachment (Fig. 4) on which I place the gyrostat after its speed has been adjusted to the moderate value of about 6000 revolutions per minute. The plane of the flywheel is inclined to the vertical, and you see that the top does not fall down, but precesses round on the table. I increase the inclination and the precession becomes more rapid. Now I attempt to hurry the precession, and the gyrostat stands up erect; I try to resist the precession and the gyrostat falls over.

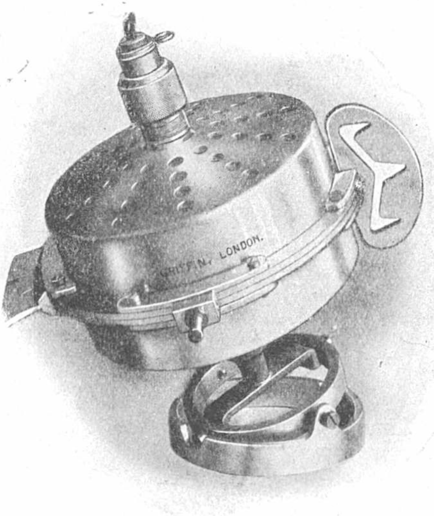


FIG. 5.—Motor-gyrostat on gimbals

I mount the gyrostat with its wheel horizontal over a flexible support, in the present case a universal joint (Fig. 5). Without rotation the instrument would fall over at once, but you see that it stands stably erect when the flywheel is spinning, and has a precessional motion when disturbed from the upright position.

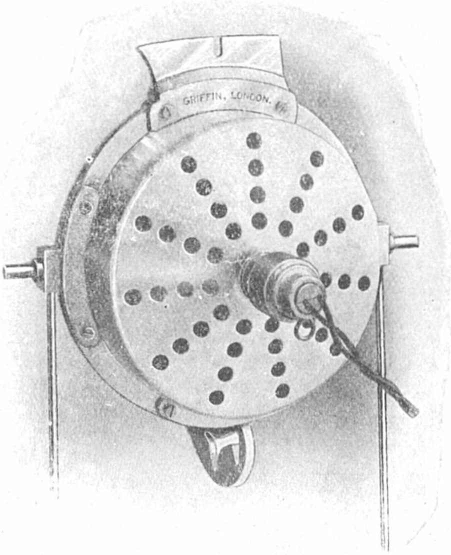


FIG. 6.—Motor-gyrostat balancing on stilts.

Again, here is a two-stilt support (Fig. 6). One of the stilts is held by a long socket, at one side of the case, and may be regarded as rigidly attached. The other stilt is simply a bit of wire pointed at both ends; one end rests on the table, the other, the upper end, rests loosely in a hollow in the under-side of this projecting piece attached to the case. The gyrostat is thus supported between two stilts, one fixed the other quite loose, and its axis is at right angles to the plane of these when the arrangement stands upright. It would be hard to devise a more unstable support. You see that there is no possibility of making the arrangement stand up without spin. But you see, on the other hand, that there is a fair amount of stability with the flywheel spinning if the arrangement is allowed to oscillate, or, as one might say, wriggle, backwards and forwards, horizontally.

In the next experiment (due originally, I have been told, to the late Prof. Blackburn) the gyrostat is rigidly clamped to this metal bar, which, as you see, is hung by two chains attached to its ends. The chains have been crossed by passing one through a large ring in the middle of the other. I turn the gyrostat so that the chains and the rim of the case are in the vertical plane. You observe that the arrangement is one of instability. The gyrostat has perfect freedom to fall over towards you, or towards me. Further, in consequence of the crossing of the chains the gyrostat is unstable as regards motion about a vertical axis. The arrangement is thus doubly unstable without rotation.

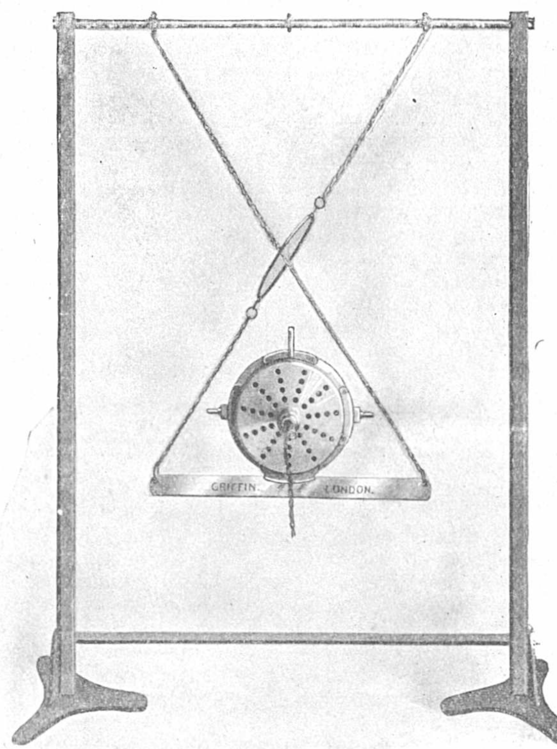


FIG. 7.—Motor-gyrostat on crossed bifilar support.

I now set the flywheel into rapid rotation, arrange the instrument as before, and leave it to itself, when, as you observe, it balances with great ease.

I now repeat the experiment with the chains uncrossed. Here there is only one instability without rotation, and you observe that the gyrostat falls over. An important point to be observed here is that the rotation will completely stabilise two non-rotational instabilities but not one. In point of fact, a system possessing non-rotational freedoms, all of which are unstable, can be completely stabilised if the number of freedoms is even, but not if the number is odd.

A general explanation of the experiment just performed may be given, as follows. Starting with the bar, gyrostat rim, and chains (crossed) in one vertical plane, we may suppose the gyrostat to fall over slightly. In consequence of the tilting couple introduced the gyrostat precesses so that its axis turns in a plane which is nearly horizontal. The chains now get slightly out of the vertical, and at once a couple hurrying the precessional motion is brought to bear on the gyrostat, which, in consequence, erects itself into the vertical position. The couple does not retard but hurries the precession because the chains are crossed. This holds for both directions in which it is possible for the gyrostat to fall over. Again, suppose, starting with the rim, bar, and chain in the same vertical plane, the chains get out of the vertical. There is now a couple brought to bear on the gyrostat tending to turn its axis in a horizontal plane. In consequence the gyrostat tilts over on the bar—in other words, it has a precessional motion about a horizontal axis in the plane of the flywheel. This brings into action a couple due to gravity, which is such as to hurry the last-mentioned precessional motion; the horizontal motion is opposed and reversed, and with the reversal the gyrostat regains the upright position. This holds for both directions in which the bar tends to turn in consequence of the crossed chains. The result is complete stability.

Similar explanations are applicable to the other cases of motion you have seen.

(To be continued.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE foundation-stone of the new building of the agricultural department at Armstrong College, Newcastle-upon-Tyne, was laid on April 5, by Dr. C. Stephenson, of Newcastle, whose gift of 5000*l*. enabled the college council to cooperate with the Board of Agriculture in a scheme proposed by the Development Commissioners. The new block of buildings has three floors, and includes administrative offices, class-rooms, laboratories for botany and zoology, a museum, research laboratories, &c.

IT is proposed to hold a short spring holiday course in science at the University of Leeds on Thursday, Friday, and Saturday, April 24, 25, and 26. The course is designed primarily for teachers who wish to keep in touch with modern scientific work, but it will also afford an opportunity for all who are interested to meet and discuss among themselves, and with members of the University staff, the problems which arise in their teaching and research. In the department of physics Prof. Bragg will give three lectures on radioactivity and its lessons, Dr. N. R. Campbell two lectures on the electron theory, Mr. A. O. Allen one lecture on modern technical optics, and Mr. S. A. Shorter one lecture on capillarity. In the department of chemistry Dr. H. M. Dawson will give three lectures on recent work in physical chemistry. The fee for the course is 10*s*., but graduates of the University of Leeds will be admitted free.

A DEPUTATION urging the views expressed at the recent Eugenic Education Conference was received by Mr. Trevelyan, Parliamentary Secretary of the Board of Education, on April 2. Among the speakers were Major L. Darwin, president of the Eugenics Education Society, and the Headmaster of Eton. The deputation presented the following resolution, which was passed at the conference:—"That the Minister of Education be asked to receive a deputation requesting an inquiry as to the advisability of encouraging the presentation of the idea of racial responsibility to students in training, and children at school." It was indicated that there is no idea of advocating the addition of "eugenics" as an extra subject in the curriculum, or of requiring it to be taught by unwilling teachers. It was urged that if the idea of individual racial responsibility were inculcated by means of presenting the eugenic ideal, and the subject approached from the evolutionary point of view, it would both assist the teachers and tend to strengthen the moral tone of the country; and also that the training-college curriculum should be adapted to include the necessary biological and physiological knowledge on which the eugenic ideal can be based. Mr. Trevelyan expressed his sympathy with the general objects which the deputation put before him. He said the Board of Education has no wish to discourage any experiments in teaching on these lines, and recognises the importance of the matter, and will consider carefully the representations made by the deputation.

AT a meeting of the Society of Engineers (Incorporated), held on Monday, April 7, Mr. W. Ransom read a paper on how to improve the status of engineers and engineering, with special reference to consulting engineers. He pointed out that the civilisation of to-day has become possible only because of the efforts of the engineer, but that the public does not sufficiently appreciate the advantages it has gained or the men whose work has secured these advantages. Engineers have many lessons to learn from the legal and medical professions, both of which exclude unqualified men and exercise a benevolent professional control over their members; and the State should recognise the engineering profession by giving it an official standing equal to that of other professions. Admission to the profession requires to be carefully guarded, and the number of pupils allowed to an engineer should be regulated by the extent of his practice, while the climax of the period of pupilage should be a State examination. Much more may be done to make examinations of practical value to those who prepare for them, but no other form of test is possible. When State recognition is obtained for engineers, the members of the profession will constitute one great society, amalgamating the existing societies into one body, which should have the control of professional matters and be the mouthpiece of the profession. Such a society would necessarily have subsections dealing with special branches of the profession. While the growth of specialisation must be recognised, it is essential for those who are training for the profession to acquire a sound general scientific knowledge before beginning to specialise.

THE following are among the courses of advanced lectures upon scientific subjects announced in the *London University Gazette of April* 2:—Six lectures on the activities of plants in relation to light, at Bedford College, by Harold W. T. Wager, F.R.S., on April 28, May 5, 19, 26, June 2 and 9; three lectures on geological problems of the desert, at University College, by Dr. J. Walther, professor of geology in the University of Halle, on April 23, 24, and 25; eight lectures on surface tension and physiological processes, by Prof. A. B. Macallum, F.R.S., at the

University, beginning on May 13; eight lectures on the physiology of photosynthesis and respiration in plants, by F. F. Blackman, F.R.S., at University College, beginning on April 23; four lectures on the physiology of absorption, by Prof. T. G. Brodie, F.R.S., at King's College, beginning on May 21; four lectures on the supposed physical basis of life and mind, by Dr. J. S. Haldane, F.R.S., at Guy's Hospital, beginning on May 8; eight lectures on the factors concerned in the volume and form changes of cells (growth and movement), by Dr. H. E. Roaf, at St. Mary's Hospital Medical School, beginning on May 5; three lectures on growth and form, by Prof. D'Arcy W. Thompson, C.B., at King's College, on May 26, 28, and 30; four lectures on recent advances in the metallurgy of copper, gold, silver, and lead, by Prof. W. Gowland, F.R.S., at the Old Royal College of Science Building, South Kensington, on April 21, 25, 28, and May 2. The lectures are for advanced students of the University and others interested in the various subjects. Admission to all the lectures except those on physiology is free, without ticket.

The report of the Admiralty Committee appointed to inquire into the education and training of naval officers shows that the Admiralty policy of watching the results of its great educational experiment with the view of readjusting its procedure to meet any defects that may be revealed, is being consistently and carefully carried out. The recommendations of the Committee that are of most general interest may be thus summarised:—(1) That to increase the number of candidates for entry and so raise the standard of ability among those selected, a system of bursaries or reduced fees shall be established, which for not more than 20 per cent. of any entry would reduce the annual cost of the four years of training at Osborne and Dartmouth from about 110*l*. per annum to about 59*l*. per annum. (2) That the subsequent training of cadets in special seagoing cruisers before joining the fleet be reduced from eight months to four. (3) That all sub-lieutenants shall serve six consecutive months in the engine-room department and obtain an engine-room watch-keeping certificate. (4) That officers who volunteer for the engineering branch shall pass through a course of study lasting six months at Greenwich, followed by a practical course of about one year's duration at Keyham. (5) That for the higher technical and administrative engineering appointments at the Admiralty and dockyards a selection be made of a limited number of those who have qualified for the engineering branch. These officers will undergo a further two years' training at Greenwich, followed by not less than one year at sea, after which they will be eligible for special shore appointments, but will not be eligible to take military command. Changes in the training of specialists in navigation, torpedo, and gunnery are also recommended with the view of securing earlier practical efficiency in the duties to be actually performed at sea.

SOCIETIES AND ACADEMIES.

Edinburgh.

Royal Society, March 17.—Dr. B. N. Peach, F.R.S., vice-president, in the chair.—Dr. W. S. **Bruce**: Measurements and weights of Antarctic seals taken by the Scottish National Antarctic expedition.—Dr. S. F. **Harmer** and Dr. W. G. **Ridewood**: The Pterobranchia of the Scottish National Antarctic expedition. The paper contained the description of a new species of Cephalodiscus (*C. agglutinans*), in which the colony is massive and branching, the pieces of the colony being 115 mm. in greatest length, and 55 mm. in greatest breadth. The specimens were obtained in one haul in 56 fathoms off the Burdwood Bank, south of the Falkland Islands. The Zooids, which are deep brown or black in colour, are 4·5 mm. long, and have usually nine pairs of arms, *i.e.* a greater number than in any species hitherto known. Buds are present in large numbers, being formed in the usual way on a disc at the end of a stalk of a full-grown individual.—Prof. J. **Stephenson**: Intestinal respiration in Annelids, with considerations on the origin and evolution of the vascular system in that group. The occurrence of antiperistalsis and ascending ciliary action in the intestine of aquatic Oligochæta points to the intestine being a respiratory organ in those worms. The exceptional case of the genus Chætogaster is explained by assuming the descent of existing species (which are carnivorous) from endoparasitic ancestors, the antiperistalsis and the ascending ciliary action being given up on the assumption of the parasitic habit. From a consideration of the cryptozoic habits, the nature of the vascular system, and the occurrence of intestinal respiration, the author holds that the existing Polychæts are to be regarded as more primitive than the errant forms.—Dr. J. **Ritchie** and A. J. H. **Edwards**: The occurrence of functional teeth in the upper jaw of the sperm whale. In two of seven sperm whales examined about a score of maxillary teeth, with worn crowns, projected from the surface of the gum and were clearly used in masticating. Each of the whales had an enormous pre-oral rostrum sharply truncated at the extremity.

Paris.

Academy of Sciences, March 25.—M. F. Guyon in the chair.—Gaston **Darboux**: Minimal surfaces engendered by a variable circle.—A. **Laveran** and M. **Marullaz**: Concerning some toxoplasms of the rabbit and gondi (*Ctenodactylus gondi*). Splendore described a new protozoa (*Toxoplasma cuniculi*) affecting rabbits, and Nicolle and Manceaux have isolated a very similar organism (*T. gondi*) from the gondi of Tunis. The experiments on rabbits described by the author lead to the conclusion that the two protozoa are probably identical, although this is not yet conclusively proved.—The president announced the death of Louis Henry, correspondant for the section of chemistry.—R. **Jonckheère**: New double stars discovered at the Observatory of Lille. Since 1906 thirteen lists have been given describing the positions of 1002 new double stars of an average magnitude of 9·19.—Jules **Andrade**: New experimental researches on double spiral balance springs.—L. **Décombe**: The electronic theory of gravitation.—Mlle. Paule **Collet**: The electrical conductivity of tellurium. The direction of the crystalline axes was without effect on the resistance. The influence of pressure, of the time of passage of the current, and of the applied electromotive force has been studied, and also the residual electromotive forces in the tellurium.—H. **Buisson** and C. H. **Fabry**: The wave-lengths of the krypton lines. The krypton lines are extremely fine and permit interferences up to the order of 600,000, or even of 950,000 if the tube is cooled in a bath of liquid air, corresponding to a difference of path of 53 cm. The green and yellow krypton lines have been compared with the red cadmium line, and, taking the data given by Benoit, Fabry, and Perot for the latter, the krypton lines are evaluated as 5570·2908 and 5870·9172, with an approximation of some units in the last figure. The krypton tube has the advantage of working without heating, and the two lines can be separated without the use of any apparatus for dispersion by the use of suitable absorbing solutions (didymium chloride for the yellow ray, eosin for the green ray).—M. **Dussaud**: The separation of the lighting and heating effects produced by a source of light. Instead of concentration by single lenses, a group of optical systems arranged to succeed each other automatically is used. During displacement out of the path of the rays, the system cools. In this way a separation of the heating and lighting effects is produced. Numerous applications are suggested.—Mlle. L. **Chevroton** and M. F. **Vlès**: Kinematography of the vocal chords and their laryngial annexes.—G. **Lafon**: The formation of fat at the expense of the albuminoid materials in the animal organism. The formation of fat from albuminoid material, although theoretically possible, is physiologically difficult. The nutritive value of albumin, considered as a source of energy, must be measured, not by the total energy it contains, but by the energy contained in the amount of glucose which can be derived from it.—P. **Chaussé**: The conditions of respirability of the virulent particles obtained by liquid polarisation. In experimental infection by the inhalation of liquid tuberculous virus, it is only the dried particles which are effective.—Em. **Bourquelot** and Em. **Verdon**: The reversibility of ferment actions: emulsin and β-methylglucoside. The action of emulsin upon β-methylglucoside and upon a mixture of glucose and methylglucoside shows that the reaction is reversible, the final state of equilibrium being identical in both systems.—R. **Goupil**: Researches on the phosphorus compounds formed by *Amylomyces rouxii*. — L. **Launoy** and K. **Oechslin**: Concerning secretin (Bayliss and Starling) and vasodilatine (Popielski). By repeated precipitation with absolute alcohol secretin can be obtained possessing no depressive action on the blood pressure; a depressor substance has also been isolated from the alcoholic solutions, for which the name depressine is proposed. These results are in agreement with the views of Bayliss and Starling, and opposed to those of Popielski.—Louis **Gentil**: The structure of the coast line of western Algeria.

March 31.—M. F. Guyon in the chair.—Gaston **Darboux**: Minimum surfaces engendered by a variable circle.—Emile **Picard**: A class of transcendentals generalising elliptic and Abelian functions.—J. **Boussinesq**: The existence of a superficial viscosity in the thin transition layer separating a liquid from another fluid.—MM. **Leclainche** and **Vallée**: Vaccination against anthrax. Details of a method of obtaining with certainty attenuated races of the anthrax bacillus. More than 345,000 successful inoculations have been made with this virus during the last three years.—The secretary announced the death of V. Dwelshauvers-Dery, correspondant for the section of mechanics.—M. **Amann**: Observations of the mutual occultations of the satellites of Jupiter.—Léon **Lichtenstein**: The fundamental functions of linear differential equations of the second order and the development of an arbitrary function. Application of the theory of quadratic forms to an infinity of variables.—Georges **Pólya**: A theorem of Laguerre.—M. **Barré**: A series of surfaces of which a family of lines of curvature is constituted by indeformable helices.—Henri **Bénard**: The zone of formation of alternate vortices behind an obstacle.—Ernest **Esclangon**: The motion of the support in pendulum observations.—J. **Chaudier**: The magnetic rotatory polarisation of liquefied oxygen and nitrogen.—M. de **Broglie**: The multiple images produced by Röntgen rays after traversing crystals.—Victor **Henri** and René **Wurmser**: The energy absorbed in photochemical reactions. In the three cases examined experimentally the energy necessary for the destruction of a molecule is less than the quantum of energy of Einstein.—L. **Gay**: The pressure of expansibility of normal fluids.—M. **Barre**: Combinations of cerium chloride with ammonia gas. Five definite compounds are described, all of which are decomposed by water. —A. **Saint-Sernin**: The estimation of calcium as tungstate. The determination of calcium as tungstate possesses some advantages, especially as regards its separation from magnesium.—E. **Chablay**: The preparation of the primary alcohols by reducing the esters by means of absolute alcohol and sodammonium. The ester R.CO.(OR′) is converted by this reaction into the alcohol $R.CH_2.(OH)$. Examples of the generality of the reaction are given.—A. **Duffour**: A new crystalline form of potassium bichromate.—L. **Blaringhem**: A remarkable case of heredity in hybrids of barley, *Hordeum distichum nutans* × *H. distichum nudum*.—Albert **Berthelot** and D. M. **Bertrand**: Researches on the intestinal flora. The possible production of ptomaines in acid medium. In the intestinal flora of subjects showing symptoms of enteritis or of mucocolitis, together with fœcal matter possessing an acid reaction, an organism is frequently found (*B. aminophilus intestinalis*) capable of removing the carboxyl group from histidine even in a slightly acid medium. —M. **Mansuy**: Limestones of Indo-China containing Productus.—Gustave F. **Dollfus**: The use of drainage wells. The attempt to modify the flooding of the Seine valley by borings is useless, and likely to aggravate the trouble it is intended to alleviate.

BOOKS RECEIVED.

Paläobotanisches Praktikum. By Prof. H. Potonie and Dr. W. Gothan. Pp. viii+152. (Berlin: Gebrüder Borntraeger.) 4 marks.

Modern Geography for High Schools. By R. D. Salisbury, H. H. Barrows, and W. S. Tower. Pp. ix+418+vii plates. (New York: H. Holt and Co.) 1.25 dollars.

Der Mensch und seine Kultur. By Neophilosophos Tis. Pp. 101. (Konstanz: E. Ackermann.) 3 marks.

Theorie der Erdgestalt nach Gesetzen der Hydrostatik. By Clairaut. Edited by P. E. B. Jourdain and A. v. Oettingen. Pp. 162. (Leipzig: W. Engelmann.) 4.60 marks.

Die Druckkräfte des Lichtes. By P. Lebedew. Edited by P. Lasareff. Pp. 58. (Leipzig: W. Engelmann.) 1.80 marks.

Dispersion und Absorption des Lichtes in ruhenden isotropen Körpern. By Dr. D. A. Goldhammer. Pp. vi+144. (Leipzig u. Berlin: B. G. Teubner.) 3.60 marks.

Ministry of Finance, Egypt. Survey Department. Meteorological Report for the Year 1910. Part ii., Climatological and Rainfall Observations. Pp. 199+ii plates. (Cairo: Government Press.) 15 P.T.

Examples in Algebra. By H. S. Hall. Pp. viii+168+xxxvii. (London: Macmillan and Co., Ltd.) 2*s*.

Elementary Biology: Plant, Animal, Human. By J. E. Peabody and A. E. Hunt. (London: Macmillan and Co., Ltd.) 5*s*. 6*d*. net.

Die Vererbung und Bestimmung des Geschlechtes. By C. Correns and R. Goldschmidt. Erweiterte Fassung. Pp. viii+149+plates. (Berlin: Gebrüder Borntraeger.) 4.50 marks.

Tracks of the Sun and Stars, A.D. 1900 to A.D. 37900. By T. E. Heath. Pp. 17+vi. (London: W. Wesley and Son.) 5*s*. net.

Are the Planets Inhabited? By E. W. Maunder. Pp. iv+166. (London: Harper and Brothers.) 2*s*. 6*d*. net.

The Age of the Earth. By A. Holmes. Pp. xii+196. (London: Harper and Brothers.) 2*s*. 6*d*. net.

Service Chemistry. By Prof. V. B. Lewes and

J. S. S. Brame. Fourth edition, revised. Pp. xvi+576+vii plates. (London: E. Arnold.) 15*s*. net.

Canada. Department of Mines. Mines Branch. Pyrites in Canada. By Dr. A. W. G. Wilson. Pp. xi+202. (Ottawa: Government Printing Bureau.)

The Sling. By W. L. Jordan. Second edition. Pp vi+431. (London: Simpkin and Co., Ltd.) 7*s*. 6*d*. net.

Mimikry und verwandte Erscheinungen. By Dr. A. Jacobi. Pp. ix+215. (Braunschweig: F. Vieweg und Sohn.)

The Geology and Mining Industry of the Kinta District, Perak, Federated Malay States, with a Geological Sketch Map. By J. B. Scrivenor. Pp. viii+90+20 plates. (Kuala Lumpur: F.M.S. Government Printing Office.) 3 dollars.

Annals of the South African Museum. Vol. vii., part 6, pp. 353–366. Vol. xi., part 5, pp. 321–463. (London: West, Newman and Co.) 1*s*. and 15*s*. respectively.

Cours de Chimie Organique. By Prof. F. Swarts. 2e édition. Pp. 754. (Gand: A. Hoste; Paris: A. Hermann et Fils.) 15 francs.

Leçons sur les Hypothèses Cosmogoniques. By H. Poincaré. Seconde édition. Pp. lxx+294. (Paris: Hermann et Fils.) 12 francs.

Cours de Physique Générale. By H. Ollivier. Tome second. Pp. 295. (Paris: A. Hermann et Fils.) 10 francs.

Principia Mathematica. By Dr. A. N. Whitehead and B. Russell. Vol. iii. Pp. x+491. (Cambridge University Press.) 21*s*. net.

The Carnegie Foundation for the Advancement of Teaching. Seventh Annual Report of the President and of the Treasurer. Pp. vi+194. (New York City.)

Ministry of Finance. Survey Department, Egypt. The Geography and Geology of South-Eastern Egypt. By Dr. J. Ball. Pp. xii+304+xxviii plates. (Cairo: Government Press.) 40 P.T.

DIARY OF SOCIETIES.

THURSDAY, APRIL 10.

ROYAL SOCIETY, at 4.30.—The Effect of Lability (Resilience) of the Arterial Wall on the Blood Pressure and Pulse Curve: L. Hill and M. Flack.—The Nature of the Toxic Action of the Electric Discharge upon *Bacillus coli communis*: Prof. J. H. Priestley and R. C. Knight.—Some Investigations on the Phenomena of "Clot" Formations. I. The Clotting of Milk: S. B. Schryver.—(1) Morphology of Various Strains of the Trypanosome causing Disease in Man in Nyasaland. II. The Wild Game Strain; (2) Morphology of Various Strains of the Trypanosome causing Disease in Man in Nyasaland. III. The Wild *Glossina morsitans* Strain; (3) Infectivity of *Glossina morsitans* in Nyasaland: Surg.-General Sir D. Bruce, Majors D. Harvey and A. E. Hamerton, and Lady Bruce.

ROYAL INSTITUTION, at 3.—Colour in Flowers: Dr. E. Frankland Armstrong.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Self-synchronising Machines (Self-starting Synchronous Motors and Rotary Converters): Dr E. Rosenberg.

CONCRETE INSTITUTE, at 7.30.—Structural Engineering: E. F. Etchells.

FRIDAY, APRIL 11.

ROYAL INSTITUTION, at 9—The Winds in the Free Air: C. J. P. Cave.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Observations of the Variable Star 97.1910 Cygni: E. E. Barnard.—A Discussion of the Empirical Terms in the Moon's Longitude: E. W. Brown.—Some Types of Prominences associated with Sun-spots: Mrs. M. A. Evershed.—*Probable Papers*: The Short Period Variable SW Draconis: C. Martin and H. C. Plummer.—Preliminary Discussion of Galactic Motions of Bright Stars of Type I, with Some Additional Material (Stellar Motions, No. 5): H. C. Plummer.—Sun-spots and Terrestrial Magnetic Phenomena, 1898–1911; Sun-spot Areas, Magnetic Storms, and the Sun's Corona: Rev. A. L. Cortie.—The Distribution in Space of the Stars of Carrington's Circumpolar Catalogue (Second Paper): F. W. Dyson.—A Suggested Substitute for Bode's Law: Miss M. A. Blagg.

PHYSICAL SOCIETY, at 8.—Some Errors in Magnetic Testing Due to Elastic Strain: A. Campbell and H. C. Booth.—Note on Kathodic Spluttering: Dr. G. W. C. Kaye.

MONDAY, APRIL 14.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.

ROYAL SOCIETY OF ARTS, at 8.—Aëronautics: Prof. J. E. Petavel.

TUESDAY, APRIL 15.

ROYAL INSTITUTION, at 3.—The Heredity of Sex and Some Cognate Problems: Prof. W. Bateson.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Standard Clauses for Inclusion in a Specification of Street-lighting: A. P. Trotter.

ROYAL STATISTICAL SOCIETY, at 5.—Gleanings from the Census of Production Report: A. W. Flux.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Coastal Sand-travel near Madras Harbour: Sir F. J. E. Spring.

WEDNESDAY, APRIL 16.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—The Vertical Distribution of Temperature in the Atmosphere, and the work required to alter it: W. H. Dines.—Report on the Phenological Observations for 1912: J. E. Clark and R. H. Hooker.—Meteorological, Electrical and Magnetic Observations during the Solar Eclipse, April 17, 1912: R. Corless, G. Dobson, and Dr. C. Chree.

ROYAL SOCIETY OF ARTS, at 8.—The Physical Properties of Clay: W. C. Hancock.

THURSDAY, APRIL 17.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Luminosity Curves of Persons having Normal and Abnormal Colour Vision: Dr. W. Watson.—A Fluorescence Spectrum of Iodine Vapour: Prof. J. C. McLennan.—The Relation between the Crystal-symmetry of the Simpler Organic Compounds and their Molecular Constitution. I.: Dr. W. Wahl.—The Purification of Phosphorus Pentoxide for Use in High Vacua: J. J. Manley.

ROYAL INSTITUTION, at 3.—The Progress of Hittite Studies. I. Recent Explorations: Prof. J. Garstang.

INSTITUTION OF MINING AND METALLURGY, at 8.

ROYAL SOCIETY OF ARTS, at 4.30.—The Burma Oil Fields: N. G. Cholmeley

FRIDAY, APRIL 18.

ROYAL INSTITUTION, at 9.—Applications of Polarised Light: Dr. T. M. Lowry.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Presidential Address.—*Discussion*: Volute Chambers and Guide-passages for Centrifugal Pumps: Prof. Gibson.

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