THURSDAY, DECEMBER 13, 1888.

THE ZOOLOGICAL RESULTS OF THE "CHALLENGER" EXPEDITION.

Report on the Scientific Results of the Voyage of H.M.S. "Challenger" during the Years 1873-76, *under the command of Captain George S. Nares, R.N., F.R.S., and the late Captain Frank T. Thomson, R.N.* Prepared under the superintendence of the late Sir C. Wyville Thomson, Knt., F.R.S., &c., Director of the Civilian Staff on board, and now of John Murray, LL.D., Ph.D., &c., one of the Naturalists of the Expedition. Zoology—Vol. XXVII. Published by Order of Her Majesty's Government. (London: Printed for Her Majesty's Stationery Office, and sold by Eyre and Spottiswoode, 1888.)

THE first Report in this volume is by Prof. J. R. Henderson, M.B., on the Anomura. Some time after the return of the *Challenger*, the collection of Anomura was placed in the hands of Dr. Jules Barrois; but, not finding time sufficient for their investigation, Dr. Barrois was compelled to return them, and they were placed in Dr. Henderson's care towards the end of 1884.

This group of Crustacea, taken in the sense of Dana, is intermediate between the Brachyura and the Macrura, but in the classification adopted in this Report the author has, to a certain extent, followed the arrangement of Boas, though retaining the Dromidea and Ranidea within the limits of the group—this latter not without some hesitation.

The Anomura are found in all seas, but much more abundantly in those of tropical or temperate climates; some few forms are terrestrial or fluviatile. The greater number inhabit shallow water or moderate depths; two groups, however, the Pagurids and the Galatheids, are numerously represented in the great ocean depths. The collection contained 161 species or well-marked varieties, referable to fifty-two genera, and of these, over one-half of the species (eighty-six) and seven of the genera are described as new. While some of the common shallow-water forms are absent from the collection, still it adds very considerably to our knowledge of the distribution even of this section.

The main interest, however, is in the deep-sea forms, and these chiefly belong to the Paguridea and the Galatheidea, more than four-fifths of the species taken belonging to these groups, and the latter contains the greater proportion of the species.

While the structural modifications met with in the deep-sea species of the Paguridea are comparatively few and unimportant, in the species of Galatheidea the abyssal forms are blind, and the eyes have undergone a process of degeneration which is tolerably uniform in all. In the majority of the species—with the exception of those belonging to the genus Munida—the eggs carried by the females were found to be few in number and of remarkably large size, leading to the inference that their enemies were but few. No facts in reference to their coloration were observed, as the strong alcohol in which the specimens were preserved reduced them all to a dull white colour. Thirty-one plates accompany this Report.

The second Report is by Prof. P. Pelseneer, on the anatomy of the deep-sea Mollusca. The material for this Report could not be placed in Dr. Pelseneer's hands until the systematic Report on the species had been completed, and it consisted exclusively of Gastropoda (not including Isopleura or Amphineura) of Scaphoda, and of Pelecypoda; there was no great wealth of either species or of specimens. Of certain forms there were but single specimens, and in the case of others the soft parts had been injured in removing them from the shells; still, many new and very interesting facts have been noted and recorded, the chief conclusions from which, so far as the special sense-organs are concerned, are as follows. The organ of vision may atrophy and disappear, in consequence of the absence of sufficient light, in great depths; correlatively, the organs of general sense may multiply, and acquire a high degree of development, such as the labial palps of *Trochus infundibulum*, the siphonal tentacles of varied structure in the deep-sea Anatinacea and in Malletia; and, lastly, the respiratory activity may diminish, and the gills become rudimentary in various ways, or these may retain a great simplicity of structure. Four plates accompany this memoir.

The third Report is by Prof. W. C. McIntosh, F.R.S., on *Phoronis buskii*, n. sp. The genus Phoronis was established in 1856, by Dr. Strethill Wright, for a minute Polyzoan, about 1½ millimetre in length. Since this species (*P. hippocrepia*, St. Wright) was described, other species, also of more or less small size, have been described by various authors, from the coasts of Scotland, the Mediterranean, and Eastern America. One, from Australia, is of considerable length. The species dredged by the *Challenger* in shallow water at depths varying from 10 to 20 fathoms (Station 212) south of the Philippine Islands, measures 52 millimetres in length, with an average diameter of about 2 millimetres at the anterior region, and of 4 to 5 millimetres at the enlarged posterior end. The tentacular or branchial region is from 6 to 7 millimetres in length. There has always been a great deal of interest taken in the species of this genus, owing to their strange metamorphosis, and to the uncertainty that seemed to attach to their position in the animal kingdom; this now is settled to be in Ray Lankester's section "Vermiformia," of the Polyzoa. In this Report the minute structure of the *Challenger* species, called after the late George Busk, is given in detail, and figured on four plates. The history of the development of this fine species remains to be written.

The fourth Report is by Prof. W. A. Herdman, on the Tunicata. The first part of this Report, published in 1882, treated of the Simple Ascidians, while the second part, published in 1886, was occupied mainly with an account of the Compound Ascidians, with a supplementary account of some Simple Ascidians which had been found after the publication of the first part. The present part treats of the "free-swimming" Ascidians, which, however, fall into three very distinct groups, less allied to one another than the Simple Ascidia are to the Compound Ascidia. One of these is the group of Salpiform Ascidia; the other two are the Thaliacea, including

such genera as Doliolum and Salpa, and the Larvacea, containing the Appendicularia.

By far the greater number of the pelagic Tunicata collected during the voyage of the *Challenger* belonged to the genus Salpa. Of these, vast numbers were taken at the various stations, so that a great deal of labour was spent in a critical examination of these before it could be determined that they were all the same or different species.

The collection of pelagic Tunicata contained about twenty-six species, of which nine are new to science. No new genera are established, but a new family, the Octacnemidæ, has been formed for the reception of the remarkable deep-sea genus described by Moseley as Octacnemus.

Prof. Herdman gives in some detail, at the close of his account of the species and of their geographical and bathymetrical distribution, the conclusions at which, after a prolonged study of this group, he has arrived, as to their relationship and phylogeny; this is accompanied by a graphic representation of the phylogeny of the Tunicata. This important Report is illustrated by eleven plates.

THE BRITISH FARMER AND HIS COMPETITORS.

The British Farmer and his Competitors. By W. E. Bear. (London: Cassell and Co., Limited, 1888.)

THIS small volume of 160 pages is in some respects a reprint of articles published in the *Quarterly Review*, revised and brought down to date. The first chapter is devoted to the condition of British agriculture, in which the somewhat Radical doctrines of the Farmers' Alliance (an organization which has never succeeded in winning the confidence of the farmers) are promulgated. "Before this country will be cultivated to the best advantage, those who cultivate it must be either the owners of their farms, or tenants who are entitled to sell their improvements to the highest bidder, and who are free to crop the land as they please, provided that they be liable for actual damage done to the property of the owner." "Our farmers must have complete security for their capital invested in improvements, and freedom of enterprise as well, if they are to do the best they can with the land." This is the panacea for agricultural distress, and yet we may well ask why it is that Britain is exceptionally well cultivated, and that farmers as a rule farm as well or better than landlords? Landlord farming has, in fact, for the most part not been satisfactory, either when carried out on the large or on the small scale, and whether any advantage would accrue from its extension is exceedingly doubtful. Allotments, too, are put forward as amongst the requirements of our time, and small farming is also advocated, although condemned by experience.

Mr. Bear is more happy as a statistician than as a politician, and his chapters upon foreign competition and the prospects of the wheat-grower, and the breeder and feeder of live stock, are deeply interesting. The first welcome truth is that in almost all articles of agricultural production the crisis of injurious foreign competition appears to have been passed about the year 1883 or earlier. Such was the case up to date, with regard to wheat, barley, oats, and cattle. The maximum importation of sheep, hops, and potatoes, took place in 1882; of bacon, hams, and preserved meats in 1880; of pigs and cheese in 1878; and of beans in 1877. It must be understood that quantities in quarters and hundredweights, and not values, are indicated; and so considerable has been the shrinkage that the present imports of meat fall short of the maximum reached some eight years ago by about one million hundredweights, chiefly bacon.

Taken in connection with this diminution of foreign supplies of grain and meat, is to be noted the increase in population, not only at home and in Europe, but throughout our colonies and in the United States. In the last-named country alone, population has increased from 38,500,000 in 1870 to 62,500,000 at the beginning of the present year, and it is estimated that it will have reached 66,000,000 by 1890. During the five years ending with 1884 the average annual consumption of wheat in the United States was nearly 324,000,000 bushels, and the average export was 140,000,000 bushels. If the production in the five years ending with 1894 does not become greater, all but 43,000,000 bushels, or less than 5,500,000 quarters, will be required for home consumption, and the surplus will not suffice for the increased population of the next five years. Thus, unless the area of wheat-growing is greatly extended, the United States must cease to be a wheat-exporting country before the close of the present century! There is certainly a somewhat large "if" to swallow in accepting this statement, but it seems pretty evident that wheat-growing is not profitable at present prices, and that American farmers are becoming tired of it. Higher prices can alone cause the necessary increased supply, and the influence of such higher prices would be found in Europe to the advantage of the farmers. Considerable space is devoted to show that American and Canadian farmers grow wheat at a direct loss. It appears that the average gross money return from an acre of wheat in the United States is £1 13*s*. This figure is based on official information, and is arrived at by a yield of 12·2 bushels per acre, and a price of 68·1 cents. the bushel. As, however, the farmers have been often obliged to sell at 48 cents. per bushel, and the yield is in one State, not 12·2 but, 5 bushels, and in another 7 bushels, and in eight States it is below 8 bushels, the gross value of an acre of wheat must in many cases fall much below the average. It is held that unless 20 to 25 bushels can be secured no profit is possible. The cost of growing an acre of wheat in the States cannot, it appears, be placed under 14·11 dollars per acre, *i.e.* about or near £2 18*s*.; and if these figures are even approximately correct, the wheat-growers of the Far West must be in a worse plight than our own. Although nominally rent free, the Western farmers have generally been obliged to mortgage their farms at an interest of from 8 to 10 per cent. per annum, and according to one authority, "teams, tools, stock, and grain, all are being rapidly mortgaged." It is generally admitted that the American farmer's life as a rule is one of "excessive and almost incessant toil, and the scantiest reward—in money, at any rate; while his wife is held up in America as a common object of pity." With such encouragement, Mr. Bear does not expect wheat-growing to spread in America unless prices generally rise.

The second part of the book is devoted to our meat supply and dairy produce. The greatest scare among home meat-producers has been occasioned by the increasing imports of frozen meat—chiefly mutton. The future of this trade is, however, very dubious, and exportation completely collapsed when prices fell in 1886 and 1887. A New Zealand colonist, writing to the *Otago Witness*, says:—"The producer, when he sends his meat to London, realizes about 4½*d*., perhaps only 4*d*., per pound; and when he deducts expenses, say 2½*d*., he has only about 1½*d*. per pound for the choice of his flock. Now, this will not pay him, and some of our largest exporters of meat have decided that it will not pay them to send home their meat."

Mr. Bear's views on the future of English farming are, on the whole, hopeful, but he is accused by some of his critics of being an optimist. He has also brought down the wrath of the Canadian Press upon him for decrying the climate of Manitoba as a wheat-growing area, and discounting the reports of its fertility. As published under the auspices of the Cobden Club, the bias of the work is in favour of free trade, if we may except the trade in live stock, where contagious diseases are involved. Some political or economical bias ought to be accepted as inseparable from a book so issued. The reader will no doubt exercise judicious discrimination in accepting all the deductions, but will not fail to see that Mr. Bear's arguments are well supported by facts and official figures. The book is, in fact, a valuable contribution towards the solution of a question of vast importance—the future of our agriculture.

COLEOPTERA.

Biologia Centrali-Americana—Zoology: Coleoptera. Vol. I. Part II. By David Sharp, M.B., F.Z.S., &c. (London: R. H. Porter, 1882–87.)

ALTHOUGH nearly six years have been required for the completion of this volume, entomology has received a valuable contribution, which is at the same time an evidence of the untiring industry of its author and of the great liberality and enterprise of its editors. The volume covers about 840 pages, illustrated by nineteen plates, including in its scope nine divisions of the Coleoptera, called families, as follows: Haliplidæ, Dytiscidæ, Gyrinidæ, Hydrophilidæ, Heteroceridæ, Cyathoceridæ, Parnidæ, Georissidæ, and Staphylinidæ, in dealing with three of which Dr. Sharp had already shown a rare combination of analytical power and synthetic skill.

While the arrangement of the families in the order indicated above might be criticized as somewhat unnatural, it is to be presumed that the convenient division of labour among the different authors, and the approximation of the labours of each in one volume, had more to do with the sequence than the desire to indicate affinities.

The family *Haliplidæ* presents no point worthy of special mention; there are three new species in a total of six.

The *Dytiscidæ* is represented by 168 species, of which about seventy-one are new, nearly all small species, while the thorough analytical study previously given to the family by Dr. Sharp has left but one generic division to be indicated.

The *Gyrinidæ*, represented by twenty species, of which four are new, presents nothing of note, except the evident tendency of Gyretes to replace Gyrinus in the warmer parts of America.

The *Hydrophilidæ* contains 141 species, four-fifths of them new, requiring the indication of thirteen new genera. In the study of this family, Dr. Sharp gives evidence of the close attention he has devoted to it from the commencement of his career as an author, and he has shown how much new work may be done even in those families moderately well studied. The point seems well taken that the Hydrophilidæ constitute a family, and not a complex equivalent to the Adephaga. While no new arrangement of the family is proposed, the inaccuracy of our present method is shown, and numerous structural differences are indicated, which may form the basis of a better system when more is known of the genera from other regions than Europe and North America.

The next four families, Heteroceridæ, Parnidæ, Georissidæ, and Cyathoceridæ are all of small extent, containing between them but fifty species. While these are closely related among themselves, their position in mass between the Hydrophilidæ and Staphylinidæ is unnatural, and obscures their evident relationship with the Byrrhidæ and certain Dascyllidæ.

The greater portion of the volume is occupied with the treatment of the Staphylinidæ, in which more than 1400 species are enumerated, seven-eighths of them new; of the remaining eighth a fair proportion had already been described by Dr. Sharp elsewhere. The mere numerical statement will give but an inadequate idea of the labour expended in this part of the volume. Those who have had occasion to deal with the Aleocharinæ will realize the amount of minute examination required, almost ruinous in its effects on the eyesight. It is evident that the Staphylinide fauna of Mexico is far from being exhausted, and had as enthusiastic collectors as Mr. G. C. Champion collected in other parts as he did in his regions, it is safe to believe that the number of species would have been more than doubled. In a notice like the present it seems unnecessary to enter more deeply into details. Although much has been done in Staphylinidæ, our knowledge of the fauna of Europe is the only one approximately complete, and it gives a very narrow basis for comparison.

As a whole, Dr. Sharp's work will receive the recognition due to careful, conscientious, and erudite labour. It is to be regretted that the descriptions are at times too brief; and how much difficulty future students may find in following them may be inferred from the experience of Dr. Sharp with the longer and very able descriptions of Erichson.

The volume concludes with nineteen plates, with about 450 figures, which will prove useful in the identification of the species. The omission of details is to be regretted, although their representation would have given Dr. Sharp an amount of labour which he could hardly be expected to undertake.

G. H. H.

OUR BOOK SHELF.

A Sequel to the First Six Books of the Elements of Euclid. Fifth Edition. By J. Casey, F.R.S. (Dublin: Hodges, 1888.)

THIS handy book has been a decided hit, and has supplied something that was really needed. The main body of the work is little altered in the present edition, but corrections have been made of slips which we had occasion to point out. The special part, *i.e.* the supplementary chapter on the recent elementary geometry, continues to grow. In the last edition, pp. 165–222 were devoted to it; in this, pp. 165–248. Additional articles are devoted to Taylor's circle (Mr. Taylor's paper in the *Messenger of Mathematics*, vol. xi., appeared before his article in the Mathematical Society's Proceedings, vol. xv., and some of the properties of it were given in a Trinity College, Cambridge, examination paper (*l.c.*); see, however, Simmons, "Recent Geometry," in "Milne's Companion," p. 181). Much of Section vi., on "The Theory of Harmonic Polygons," has been rewritten, and indebtedness to Messrs. Neuberg and Simmons is admitted. The impression conveyed to a reader is that the latter's important article, referred to above, has not been seen by Dr. Casey, for, if it had been seen by him, frequent reference must, we should suppose, have been made to it, whereas the only reference is to a note in the Mathematical Society's Proceedings, April 1887. We now commend the article in question to Dr. Casey's notice. Section vii., on the "General Theory of Associated Figures," is for the most part new to the volume,[1] and there are additional exercises. We would point out that Questions 76, 77 (p. 217, fourth edition, and p. 241, fifth edition) are not consistent. 76 is right; in 77 read, for "*orthocentre* of pedal triangle," "symmedian point," as in the author's "Conics," p. 325.

Elementary Theory of the Tides. By T. K. Abbot, B.D. (London: Longmans, Green, and Co., 1888.)

FULL discussions of tidal action and its effects have hitherto been confined to treatises which employ higher mathematics, and any successful attempt to simplify matters ought therefore to receive a hearty welcome. The book before us is an attempt at this, and although it only consists of some forty pages, it simplifies many points. The proofs of the various theorems require no special knowledge beyond that of the resolution of forces, but the quantitative determinations necessarily demand a little mathematical knowledge.

There is a common notion that without friction there would be high water under the moon, but Mr. Abbot easily demonstrates that it would occur at quadratures. A simple construction is given and proved for the determination of the amount of the disturbance at any point on the equator. The influence of tides upon the length of the day is also discussed. Airy's analytical method is given in an appendix.

The book is mainly a compilation of papers by the author which were published in 1871-82 in the *Philosophical Magazine* and other journals.

Pictures of Native Life in Distant Lands. Depicted by H. Leutemann. With Explanatory Text by Prof. A. Kirchoff; translated from the German by George Philip, Jun. (London: George Philip and Son, 1888.)

TWELVE coloured plates, illustrating what are called the typical races of mankind, are brought together in this volume. The subjects have been well selected, and the workmanship of the pictures is sufficiently good for the artist's purpose. The letterpress, by Prof. Kirchoff, contains much valuable information, and it has been translated by Mr Philip into clear and simple English. The work will both amuse and instruct any young readers who may be fortunate enough to obtain a copy.

[1] M. Torry's paper reached the author as his fourth edition was in the press, see pp. 221, 222 of that edition.

The Zoo. By the Rev. J. G. Wood. (London: Society for Promoting Christian Knowledge, 1888.)

MR. WOOD is so well known as an expounder of the facts of natural history that it is unnecessary to say much about the present volume. His object is to interest children in some of the animals which they may see in the course of a visit to the Zoological Gardens. He begins with an account of monkeys, and then goes on to talk about lions, tigers, leopards, the chetah, the jaguar, the lynx, wolves, foxes, hyænas, the Aard wolf, bears, and the racoon. In each section he contrives to say something that is worth remembering, and perhaps a good many of his descriptions will be at least as interesting to older readers as to the young people for whom they are primarily intended. The book is prettily illustrated.

Alpine Winter in its Medical Aspects. By A. Tucker Wise. Fourth Edition. (London: J. and A. Churchill, 1888.)

THE present edition of this work contains all the subject-matter of previous publications of the Alpine climate series, with extracts from Dr. Wise's papers read at the Harveian Society of London, the Royal Meteorological Society, and the International Medical Congress held at Washington in September 1887. The writer knows his subject thoroughly, and he has too ardent a belief in the treatment of chest disease in the mountains to wish to make extravagant statements about it. In his representations of Alpine climate he has not forgotten to include those unpleasant details which are generally somewhat vaguely described as "drawbacks." The work contains a series of careful notes on Davos Platz, Wiesen, St. Moritz, and the Maloja.

Animal Physiology. By William S. Furneaux. (London: Longmans, Green, and Co., 1888.)

IF the necessity be granted that a separate text-book should be published to meet the requirements of every examination body in each department of learning, Mr. Furneaux may be said to have met his share of that necessity, and with more success than many of those who have recently set to themselves a similar task. The book covers a slightly wider field than that indicated by the "Elementary" Syllabus of the Science and Art Department for human anatomy and physiology; it is clear and well arranged, and the illustrations are good and carefully selected. Such loose statements as that "bone is produced by the gradual hardening of cartilage" (p. 34) appear to be almost a necessity in works of this stamp, but with Mr. Furneaux they are unusually rare. The volume forms one of Messrs. Longmans' series of "Elementary Science Manuals."

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.*]

Hailstones.

A SEVERE hailstorm occurred here yesterday evening, between 6 and 7 o'clock, and lasted for about a quarter of an hour. The hailstones being fairly large, I was able, by the aid of a good lens, to examine them somewhat carefully. The result of this examination I give shortly in the following statement.

All the hailstones were pyramidal in form, and the pyramids were nearly all four-sided. Their bases were in almost every instance more or less rectangular in outline, the contours of a few only being triangular, and the surface of each base was convexly curved. The general length from the centre of the base to the apex was about a quarter of an inch; the longer diameter

of the base was nearly three-sixteenths of an inch, while the shorter basal diameter was about a sixteenth less. Of course, the above measurements are merely general, and were necessarily taken in a rather rough fashion.

The figures 1, 2, 3 below, although diagrammatic, will give a better idea of the usual shape of the hailstones than could be readily furnished by any further detailed description.

When sixteen hailstones, all of which were practically of the same size, were placed closely together side by side, so that all their apices terminated at the same point, a half spheroid was constructed, the curved basal surfaces of the pellets running neatly into one another to form the external globular surface. It

FIG. 1.—Magnified.

FIG. 2.—Magnified.

FIG. 3.—Basal view; magnified.

is evident, therefore, that those particular hailstones, at least, were originally portions of spheroids, each hailstone being a segment (the 1/32nd in this case) of a globe. How the icy globes were formed, and what was the cause of their breaking up into segments, are problems, I believe, that yet await serious investigation.

When the substance of any of the hailstones was observed closely by means of a lens magnifying four times, it was seen to be a transparent mass of ice, and fairly homogeneous in texture, having apparently little or none of the fibrous structure which has been previously noticed in other cases, and recorded by myself and other observers (see NATURE, vol. xxxv. pp. 413, 438,

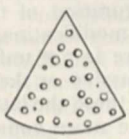


FIG. 4.—Showing numerous liquid cavities in a hailstone; magnified six times.

536). Each icy mass, however, contained scattered about in its substance numerous small cavities, round, oval, or elliptical in form, which were filled wholly or partially with water (see Fig. 4).

In some cases these liquid cavities were so numerous and so crowded together as to interfere seriously with the diaphaneity of the hailstone and to give it quite a clouded or granulated appearance. I may add that the convex basal surfaces of the hailstones were not quite smooth and glassy, but exhibited a rather grainy appearance, and were slightly but distinctly rough to the feel.

ALEXANDER JOHNSTONE.

Edinburgh University, November 29.

The Renaissance of British Mineralogy.

THE following passage occurs on p. 116 of NATURE of November 29, in an article on the above subject:—

"Crystallography should be taught as a special subject; and a knowledge of it should be required not only of the mineralogist but of the chemist, and even of the physicist. Hitherto, at least, the chemists of this country have been too content either to leave the crystalline forms of their artificial products undetermined, or to impose the task of their determination on the already sufficiently occupied mineralogist. It seems obvious, that in a satisfactory system of education every chemist should be taught how to measure and describe the crystalline characters of the products which it is his fate to call into existence. On various occasions expression has been given to this view, but the only chemist who has yet seen his way to act upon it is Prof. Henry Armstrong, who I am happy to say, has introduced the subject into the educational course of the City and Guilds Technical Institute. I trust that before another generation passes away his excellent example will be followed throughout the country. A knowledge of the elements of crystallography, including the mechanics of crystal measurement, ought to be made a *sine quâ non* for a degree in chemistry at every University."

The views thus expressed are shared by many chemists, and are, I believe, generally known. It is, however, not exactly correct that "the only chemist who has seen his way to act upon it is Prof. Henry Armstrong."

Long before the City and Guilds Institute was established or thought of, mineralogy, including crystallography, was a part of the curriculum in the Department of Engineering and Applied Science in King's College, London.

Until the year 1879, mineralogy and crystallography were studied in the Royal College of Science, Dublin, by students in the Faculty of Mining only, but at my suggestion these subjects mere made compulsory on the students in all Faculties.

Furthermore, this subject was introduced into the course pursued in this College by the candidates for the Associateship of the Institute of Chemistry, the Council of the Institute accepting attendance at the course of mineralogy as equivalent to an equal number of hours in the chemical laboratory. This arrangement was carried out in 1881. It will be seen that mineralogy and crystallography are subjects which have by no means been neglected by chemists, though it is quite true that, like many other science subjects, they have not taken their proper places at the Universities. To chemists generally, there are without doubt more important subjects of study than crystallography which are not adequately taught; I refer to the use of the microscope, polarimeter, and spectroscope. These instruments are employed, and are absolutely indispensable, in certain methods of chemical analysis and research.

In how few laboratories are any accurate measurements of spectra made, or is the spectroscope used for any other observations than for detecting the alkalies and alkaline earths!

We have as yet no Professor of Spectrum Analysis, though it is undoubtedly a fit subject for a distinct Professorship, and this fact has, I believe, been recognized in Germany. If the advances in chemistry made respectively by students of crystallography and of spectroscopy be compared, it will appear that we owe very much more to the latter than to the former. W. N. HARTLEY.

Royal College of Science, Dublin, December 1.

"Weather Charts and Storm Warnings."

I HAVE just been reading Mr. Allan Broun's review of Mr. Robert H. Scott's "Weather Charts and Storm Warnings," in NATURE, vol. xiv. p. 566, and note that the reviewer says:—

"Why, in all the disquisitions on fluid equilibrium, are the constant low (barometric) pressures in the Antarctic regions south of 60° neglected? How shall we account for the permanent depression in the neighbourhood of Iceland referred to by the author (p. 64)? And, to come to our own country, how will cyclonic winds explain the fact that the pressure of the atmosphere diminishes, on the average of the whole year, at the rate of one-tenth of an inch of mercury for 4° of latitude as we proceed northwards?"

I have no suggestion to offer respecting the depression near Iceland, but the other two—the depression about the South Pole, and the diminution of pressure going northwards in Great Britain—are parts of one general fact—namely, the diminution of pressure in going from about lat. 30° to either Pole, which, however, is most marked in the southern hemisphere. This, I think, admits of a simple explanation. The zones on each side of the equator are occupied by the trade-winds, blowing from the east: their cause is too well known to need statement here. But, by the law of reaction, they necessitate the existence of winds of equal total force from the west, and those west winds are formed in the regions between the trade-winds and the Poles. Winds blowing continuously round the Poles, in the same direction as the earth's rotation, constitute vortexes, and the pressure at the bottom of the vortex—that is to say, at the earth's surface—necessarily diminishes towards the centre—that is to say, towards each Pole. The diminution of pressure towards the Pole is much greater in the southern than in the northern hemisphere, because in the latter the unequal heating of continents and oceans produces currents of wind which, though on a large scale, are local currents in respect to the entire hemisphere, and tend to break up the vortex.

The cause I have assigned is a *vera causa*—that is to say, it is known to exist, and its effect must be of the nature of the effect actually found. Perhaps some of your mathematical correspondents will discuss the question whether it is of sufficient magnitude to account for the effect.

Belfast, December 2. JOSEPH JOHN MURPHY.

The Philippine "Tamarao."

In 1878 I reported in a letter to Dr. Sclater, the existence of a species of *Anoa* in the Island of Mindoro, on the strength of an example of the *Tamarao* labelled *Anoa depressicornis* in a Museum at Manilla. Having since seen living specimens of the Celebean *Anoa*, I have no hesitation in affirming that the latter animal has not even a superficial resemblance to the *Tamarao* which I saw at Manilla. I have now no doubt that the *Tamarao* of the Manilla Museum is a buffalo,—not, however, an immature example of the common buffalo, as has been suggested, but a distinct species, with short flattened horns sloping directly backwards.

A. H. Everett.

41 York Terrace, Regent's Park.

A Pheasant attacking a Gamekeeper.

As the keeper was walking home, a distance of half a mile, through the plantations near his cottage, a pheasant flew at him three times, attacking his legs in a most savage manner. The keeper got to his cottage with the pheasant after him, and called his wife out to witness the incident.

The keeper was able to secure the pheasant and return it to the cover. I should be glad to know if such conduct is exceptional on the part of game birds.

M. H. Maw.

Walk House, Barrow, Hull, November 30.

THE MORPHOLOGY OF BIRDS.[1]

I.

This magnificent work, consisting of two folio volumes, with more than 1700 pages of closely printed text, and illustrated by more than thirty artistically executed plates, is the latest of the "Bijdragen tot de Dierkunde" ("Contributions to the Knowledge of Animals"), published by the Royal Zoological Society, *Natura Artis Magistra*, of Amsterdam, on its fiftieth anniversary. It is the parting gift to that Society of its grateful author, who, one of Prof. Gegenbaur's ablest pupils, now fills the Chair of Anatomy in the University of Jena; and it is needless to say that the publication of so monumental a work reflects the highest credit upon the Society of Amsterdam. It is monumental not merely from its bulk, but chiefly from the enormous amount of information it contains, much of it bearing upon some of the most deeply-rooted questions of importance to the general morphologist, and above all on the natural affinities—that is to say, the phylogeny—of birds both living and extinct.

In what follows I make no attempt at a critical review, but give as complete a summary as possible of Prof. Fuerbringer's work, which I trust will be acceptable to English readers, for few of them will have the opportunity of seeing these costly and weighty volumes, or the perseverance to master their contents, and yet it cannot be but that many would like to know the results at which the author's investigations have led him to arrive.

The whole work consists of two parts.

The special part comprises the first 837 pages, and is devoted to a minute and most comprehensive description of the bones, nerves, and muscles of the avian shoulder-girdle in the widest sense. The investigations extend over many hundreds of birds of all orders and families; frequently numerous specimens of the same species have been examined in order to ascertain the extent of individual variability.

The author justly asks himself if it is not too much to offer such a bewildering mass of mere detail to the public; but he considers it indispensable that the reader, who may not easily yield acceptance to the generalizations, should be offered the fullest opportunity to re examine the facts in detail, and to follow step by step the road which has led the author to his conclusions.

[1] "Untersuchungen zur Morphologie und Systematik der Vogel, zugleich ein Beitrag zur Anatomie der Stuetz- und Bewegungsorgane." Von Max Fuerbringer, Professor der Anatomie, und Direktor des anatomischen Instituts und des Museum Vrolik der Universitaet zu Amsterdam. Mit 9 Tafeln. (Amsterdam: T. van Holkema, 1888.)

At the same time, it must be borne in mind that the first part of the work is not merely descriptive, but that it contains a series of complete essays on the morphology of the organs under consideration. The treatment of the structure, development, and modifications of the sternum, for instance, takes up not less than 78 pages. In the myological part particular attention has been bestowed upon the proper naming and homologizing of the muscles.

The descriptive detail deposited in the special part has been used in the *second or generalizing part* as the material for reflections. These lead (*a*) to morphological results, which are important chiefly for the phylogenesis of the skeletal, nervous, and muscular systems; (*b*) they form a basis for a new systematic arrangement of birds. Physiological questions are less dwelt upon, but there are numerous contemplations on the theory of flight, and a remarkable chapter on cold- and warm-bloodedness.

The author remarks that the study of the morphology of birds well repays the labour bestowed upon it, not so much because of the great or fundamental variety which this class of vertebrates exhibits, but rather because several organic systems have reached a height of development which they have not attained in any other class of animals. We often find a richness of organic differentiations within the limits of small groups of birds. It is therefore possible to form a judgment, approaching almost to certainty, as to the primary or secondary significance of these differences. It is interesting to follow the steps which lead to such astonishing heights of specialization.

Pp. 839-996 are devoted to results and reflections of general morphological importance. For instance, the changes in the configuration of the sternum which are brought about by the modifications of the muscles of the pectoral girdle. There is not unfrequently an apparent discord between the passive or skeletal and the active or muscular elements; of these the latter are by far the more progressive, so that the more conservative skeletal parts have not always kept step with the newly introduced changes of the muscles. An example of this is afforded by the wings. By the reduction of the wing, beginning at the distal end, those muscles are first affected which arise from the wing bones, next are affected the bones themselves, and lastly those muscles which are inserted on the same (p. 855).

Syndesmology receives much attention, chiefly by an extensive treatment of the shoulder-joint. Joints are certainly not formed by the action of the muscles during embryonic life, but they are phylogenetically preformed, and only during the post-embryonic stages can the finer configuration of the joints be modelled and influenced by the muscles.

P. 862.—Questions of the greatest importance are involved in the transformation of mere ligamentous connections into symphyses and joints, with the accompanying neoblastic appearance of cartilage. This new cartilage is either homoblastic or heteroblastic. It arises from latent cartilaginous cells, as is the case with the addition of new vertebræ at the end of the Ophidian tail, and probably with the multiplication of the Cetacean phalanges; or the cartilage is due to transformation of periosteal cells, like the patella ulnaris. In such cases the original ligament can be supplanted by bone. On the other hand, the clavicle is sometimes transformed into a ligamentum claviculare.

Fasciæ are often strengthened into aponeuroses and into tendons; they are used as such, not only by their own muscle, but also by neighbouring ones, and this leads to the formation of paratenons or tendinous slips. Birds afford numerous instances in which muscles have gained extra support by "anchoring" themselves to neighbouring fasciæ.

Pp. 877-82 treat of *sesamoid* bodies, of which the author recognizes three sorts. (1) Skeletogenous sesamoids, like the pisiform bone, are, strictly speaking, not

sesamoids, as they are retrograded skeletal parts, which in most cases have been preserved by the surrounding muscles. (2) Arthrogenous sesamoids, like the os humero-scapulare, are derived from the capsule of a joint. (3) Tenontogenous or desmogenous, like the patella, are formed heteroblastically inside of a tendon.

The eighth and ninth chapters (pp. 894–947), form a critical essay on muscles with regard to their connection with the nervous system. After having exhaustively criticized the neuro-muscle theory of Kleinenberg, the various views of Huxley, those of the brothers Hertwig with reference to the cœlom theory, and, lastly, the theory of the secondary connection of muscle- and nerve-fibres as promulgated by Claus and Chun, the author considers the ontogeny, degeneration, and regeneration of muscles and nerves. Lastly, he proceeds to attempt a decision (pp. 920–41).

In connection with this attempt stands a discussion of the inheritance of acquired faculties, and the continuity of germinal and somatic plasma. Fuerbringer believes in Haeckel's law of accumulative adaptation through inheritance. What the individual has acquired during and through its incessant contact with the world can greatly influence its descendants; hence the great importance of the investigation of post-embryonic developmental changes. Throughout the whole book, Fuerbringer, without denying the importance of the ontogenetic features as a recapitulation of the ancestral history, lays more stress upon the study and comparison of the adult forms. In almost every chapter, we come across instances in which the embryonic development does not help to explain certain organs; the recapitulation of their previous stages is too much hurried or condensed, and at the best only that is repeated which had last been acquired.

Fuerbringer accepts Kleinenberg's neuro-muscle theory as the most probable solution. The whole apparatus, which consists of a ganglionic cell, a nervous and a muscular fibre, has been developed from one and the same cell, and is therefore to be looked upon as one organ. The muscle is the end-organ of its nerve, consequently the innervation of the muscles forms the most trustworthy means for the determination of their homologies.

Chapter x. (pp. 947–72) deals with the variability of muscles. Neither the point of the origin, nor that of the insertion, of muscles is a safe guide to their homologies. This shows why muscles are almost valueless for the determination of the homologies of skeletal parts.

Pp. 972–91, on the shifting or migration of the extremities with their girdles along the vertebral axis. This shifting has reached its highest degree in birds. Even individual and one-sided variations are frequent. As a rule, the shifting has been directed backwards, resulting in an increase of the length of the neck. Large birds show a greater amount of shifting than the smaller ones of the same family. A retrograde or secondary shifting towards the head seems to stand in correlation with the degradation of the wings. Hand in hand with the changes of the relative position of the limb and girdle goes a change of the whole thorax. Thoracic vertebræ are turned into cervical, and lumbar into thoracic vertebræ. In most cases, but not always, the number of thoracic ribs remains the same. It looks as if, roughly speaking, the whole trunk with all the organs inclosed in it, did slide along the vertebral axis. The accompanying metamerical transformation of the plexus brachialis is not effected by inter- or excalation of nervous segments, but by the diminution and reduction of one anterior nerve-stem, and the contemporary formation and addition of a nerve nearer to the posterior end of the plexus. The peripheral parts of the plexus retain their configuration in spite of all the changes, and since the only trustworthy safeguard in the homologies of spinal nerves is their number in the series of metameres, two plexuses may be homodynamous, although, strictly speaking, not homologous. This is expressed by the term "imitatory homodynamy," more happily by "parhomology."

The same considerations apply to the muscles. They, together with the nerves, undergo metameric changes until they likewise are only parhomologous. The various muscles of the shoulder-girdle of a bird with thirteen cervical vertebræ may present, in shape, position, and distribution of the nerves, features identical with those of a bird with fifteen cervical vertebræ, but still they are only parhomologous to each other.

This metameric transformation cannot, of course, be watched on those muscles which arise from the shoulder-girdle, but on those which, like the mm. rhomboidales et serrati, arise from the trunk, and are inserted into the girdle. The migration of the whole anterior extremity tailwards necessitates first elongation, then a thinning out, and even total reduction, of those muscles which extended from the neck to the anterior end of the shoulder-girdle. In this way the m. levator scapulæ of the reptiles has become lost by the birds.

Of course the whole problem of the metameric transformation and new formation of muscles and nerves cannot be considered as solved without an explanation of the histological changes which are involved in the question of the parhomology of the muscles together with their nerves. Such an explanation Fuerbringer has not been able to present, but he tries to suggest one by showing how we may imagine those changes to take place.

Most muscles, Fuerbringer argues, are polymetameric, *i.e.* they receive nervous fibres from two or more spinal roots. Moreover, the nerves of the more proximal muscles belong chiefly to the pre-axial or anterior, whilst those of the distal or more peripheral muscles receive their nerves mostly from the post-axial roots of the plexus. The author discards the idea that nerve-fibres can send out buddings into neighbouring new muscles, but thinks that in many cases the formation of new muscles and nerve-fibres is initiated by a splitting. This splitting begins peripherally with the muscle-fibre, is followed by that of the nerve-fibre, and perhaps leads to a division of the ganglionic cell. Ganglionic cells with two axial cylinders of motory nerves are known to occur.

Another possible explanation of the increase of the number of fibres of one nerve and those of one muscle is their derivation from cells which had remained latent in an embryonic or primordial condition between the fully formed muscle- and nerve-cells. Traces of such primordial elements Fuerbringer has found between the fibres of motory nerves, and between the fibres of fully developed muscles; in the latter case they may be identical with the myoblasts of other authors.

Everywhere in nature, in the organism, there is superfluity of material. Tissues and organs seem to be trained by the struggle for existence in such a way that they produce at their beginning an abundance of formative germs and cells, of which under ordinary circumstances only a small part becomes developed into specifically functional tissue-cells. The rest remain in their primitive embryonic condition. They form stored-up plastic material, which may or may not be called upon to meet such extraordinary requirements as may arise from the necessity for the organism to adapt itself to new conditions.

Still greater is the difficulty when the neomorphism (by which word the reviewer has on a previous occasion tried to render into English the meaning of the German term "*Neubildung*,"—new formation not being exactly identical with it) is not confined to the same, but takes place in the next following metamere. For instance, when a muscle, which previously was innervated by the fibres from the 15th and 16th spinal nerves, now receives its supply from the 15th, 16th, and 17th nerves, the explanation given above will be of no avail. The permanent continuity of the two later components of the original neuro-muscle

cells forbids the assumption of a secondary junction; in our case the junction of fibres of the 17th spinal nerve with those fibres of the old muscle which, by migration or by increase in number, have come to be situated on the 17th metamere.

Fuerbringer explains these changes by an ingenious hypothesis, viz. by a peculiar mode of growth, which he terms "growth by metameric opposition or reduction of the muscles and nerves." The primordial extremity was perhaps somewhat broader, and extended over a greater number of metameres. This surplus of locomotory elements was reduced by the following concentration of the limb, but not so completely that those metameres did not in later generations retain *vi inertiæ* the faculty of reproducing some of the nearly lost elements in a primitive condition. The reduction of these germs, that are not called upon, would become complete, they would be lost, but for the particular stimulus which they and their metameres receive from the extremity. The real nature of the interdependence between a stimulus and its effect is still an obscure problem; but we can imagine that the shifting limb exercised a stimulating influence upon the newly overlaid metameres, and that this stimulus awakened the latent nerve-muscle germs, which then joined the already existing apparatus of the approaching limb. Such latent germs, when once started into activity, may well be required to fully develop in order to make up for the reduction of the motory elements at the opposite end of the limb. As a support for this speculation, Fuerbringer alludes to the fact that the anterior limb of birds now tends to shift backwards, and it is the last root of the brachial plexus which contains relatively the greatest number of those immeasurably fine elements that he is inclined to consider as latent germs. The absolutely gradual mode of growth, which this metameric apparition postulates, makes it less perplexing that parts which are only parhomologous should be the very counterfeits of each other.

Pp. 984–91. What has caused the backward shifting of the anterior extremity? To inquire into the causation of the length of the neck means the same problem in a different form. A correlation between the length of the neck and that of the legs is not always there, *e.g.* swans. The assumption of intercalation of vertebræ is still unjustifiable, being quite unsupported by proofs. There remain lengthening of the single vertebræ and the shifting of the extremity along the axis.

In stretching our neck, we bring into play chiefly two sets of muscles, viz. the extensors of the neck and the depressors of the shoulder and anterior limb. There is no reason for assuming that the ancestors of recent birds did not effect the stretching of their necks in the same way. Continued habit results in permanent conditions. In a well-extended neck the vertebræ are in more perfect equilibrium and in conditions more favourable to their nutrition and growth than if the neck were much curved and doubled up. The pectoral girdle, the sternum, and the whole anterior limb of birds are *in toto* retracted by the incessant pulling of the mm. rhomboides, serrati, latissimus dorsi, and the abdominal muscles, the latter so far as they are attached to the sternum. Many of the thoracic muscles show a pronounced tendency to extend their origin tailwards. As a rule, large birds possess more cervical vertebræ than smaller birds, and they are noteworthy for their soaring and more lasting mode of flight. During the time that the wings are not moved, but are kept in a spread-out position, they offer a greater resistance to the air than the far smaller but heavier bulk of the body. The momentum gained by the body will therefore tend to move the latter forwards with more velocity than the resisting wings. In other words, the wings will remain behind the body, and the strain produced by this difference in equilibrium will act upon the ribs, since these form the weakest connection of the sternum + shoulder-girdle + wing with the rest of the body. The anterior thoracic ribs will lose their sterno-costal character, and be transformed into cervical ribs, *i.e.* the neck is lengthened, and the whole pectoral girdle, with the whole apparatus of flight, will be shifted backwards. The reduction of thoracic into cervical ribs can be proved on grounds independent of this question. The long necks of the Ratite birds seem to offer a serious objection to the view just explained, but Fuerbringer pleads in another part of his work (p. 1504) for their being descendants of birds which possessed well-developed power of flight.

Pp. 991–95 contain some remarkable observations about the size of birds. On the whole, small birds show more primitive and simpler conditions of structure, whilst the larger members of the same group exhibit a more one-sided development, and consequently greater deviation from the common stock. The first birds were probably smaller than Archæopteryx. Reptiles and mammals show likewise in their earlier and smaller types more primitive features than do their larger descendants. It is therefore the study of the smaller members within given groups of animals which promises the best results as to their phylogeny.

H. GADOW.

(*To be continued.*)

STATISTICS OF THE BRITISH ASSOCIATION.

IT may prove instructive to see, in diagram-form, some statistics connected with the history of the British Association. We go back only to 1850 (the Association, it is known, dates from 1831), and our curves relate to the total attendance in each year to the present, to attendance of ladies, and to grants in aid of scientific research.

As regards attendance, it will be seen that the maximum is that of the Manchester meeting in 1887, the figure 3838 having been then reached. Newcastle, in 1863, comes next, with 3335; then Manchester again, in 1861, with 3133. The curve reaches high points also in the case of Liverpool in 1870, Glasgow in 1876, Southport in 1883, &c.

On the other hand, we find the curve reaching its lowest, in this period, at Ipswich, in 1851, with 710; while Hull, in 1853, Swansea in 1880, Cheltenham in 1856, Cambridge in 1862, and Plymouth in 1877, furnish other low points, in rising series.

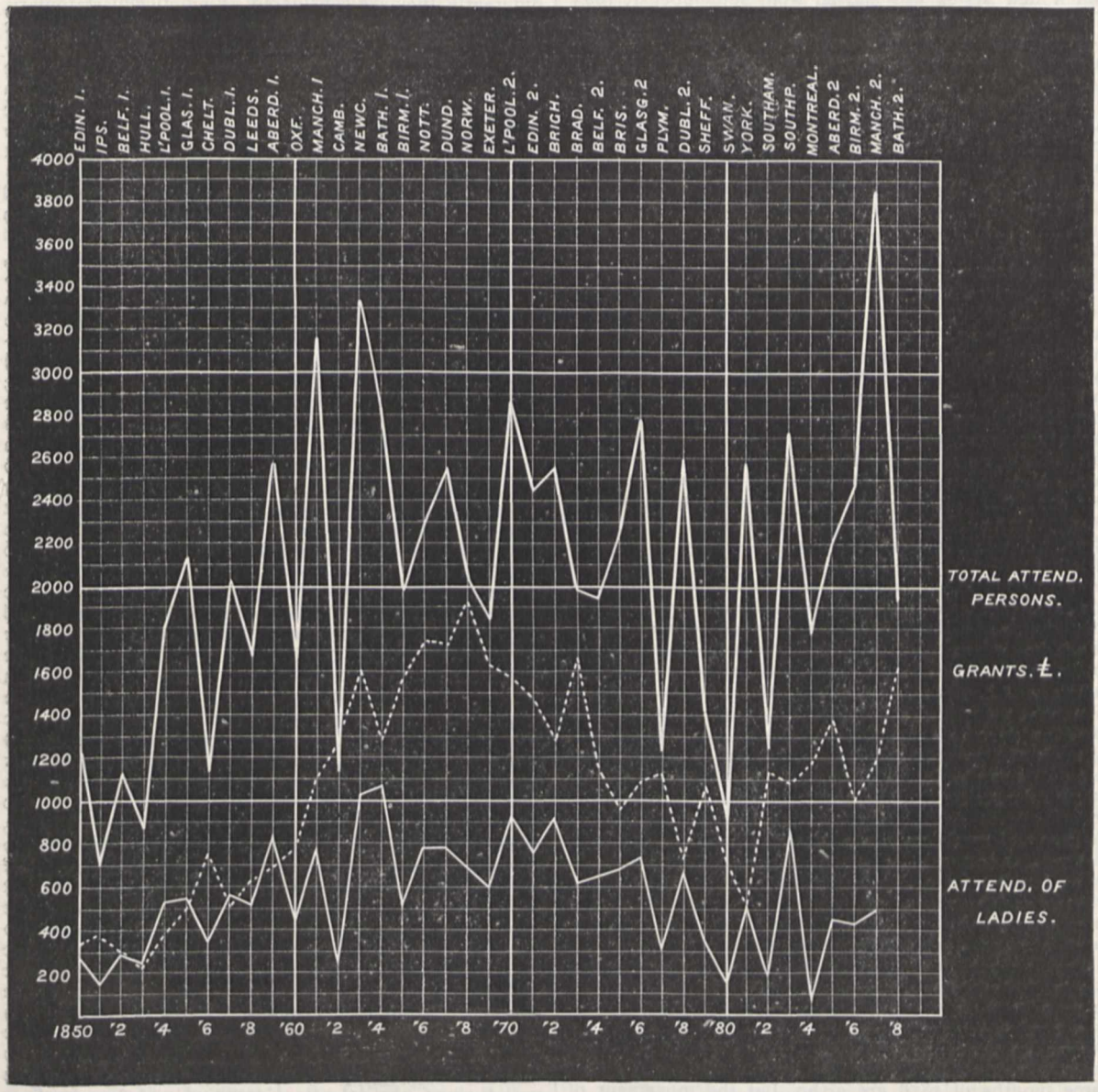
The general course of the curve seems to be that of rise to a maximum at Newcastle in 1863, then descent to Swansea in 1880, followed by another rise to the peak representing Manchester in 1887. The meeting at Montreal (in 1884) it will be seen, takes a fairly good position as to numbers (1777).

Several places had a second visit *in the period considered* (not necessarily second in the whole series); these are indicated by figures after the abbreviated names. How do those repeated visits compare with the earlier? In general, the second visit considerably exceeds the first in numbers. But in the case of Aberdeen the second figure (2203) is less than the first (2564); and the same holds for Bath, 1950 this year, as against 2802 in 1864. The former Bath meeting had no doubt exceptional attractions in the visit of Livingstone, &c. The earlier Aberdeen meeting was presided over by the Prince Consort.

Of the total number, something like one-half are usually associates for the year (paying £1), the others annual or life members, ladies, and foreigners. These groups do not call for special remark here; but we have given a curve of ladies' attendance, as there is room for it, and it is somewhat curious. It seems to have a

slightly downward tendency from the maximum of 1058 at Bath in 1864. Whether this has any significance as revealing change of character in the Association (deterioration or otherwise) we cannot say. Subjects of discussion within the range of average feminine comprehension and interest, have not, we think, been growing in scarcity of late, but rather the reverse.

We might note the much smaller attendance of ladies at Manchester in 1887 (viz. 493) than in 1861 (viz. 791), though the general attendance was much larger in the later year. Again, more ladies attend the meetings in a place like Bath than in one like Newcastle, while the total attendance is greater at the latter: this is only natural. In Brighton, as compared with Liverpool, similarly, there is a larger proportional attendance of ladies. And further discrepancies between the two



curves will be found on examination. The minimum attendance of ladies was at Montreal in 1884, viz. 74.

In the dotted curve showing grants of money for research, we find a rapid rise to a maximum in 1868, when £1940 was paid; then a rapid fall to £476 in 1881; after which the curve mounts again to £1645 this year. In 1872 the grant to Kew Observatory fell from £620 to £300, and the following year it disappears.

A curve of the yearly income corresponds, in the main, with that of the attendance.

The history of an institution, clearly comprehended, should furnish hints as to how the welfare of the latter may best be promoted in the future. Should the teaching of our diagram in this relation be educed through discussion in the columns of NATURE, it may serve a good purpose.

THE MOVEMENTS OF CYCLONIC AREAS.[1]

THE Meteorological Council having undertaken a special discussion of the weather over the North Atlantic and adjacent continents for the thirteen months ending with August 1883, the period agreed upon for the international circumpolar observations, the preparation of the synoptic charts for the same area originally commenced by Captain Hoffmeyer, and since his death carried on conjointly by the Institute at Copenhagen and the Seewarte at Hamburg, was suspended for the time, and a new series was started from September 1, 1883. The charts are issued in quarterly volumes, and the "Vierteljahrs-Wetter-Rundschau" is a carefully-prepared summary of the principal meteorological features in each volume, to which is added a critical examination of the routes followed by sailing-ships from Europe to and from America, and to and from the equator, with tables showing the time occupied by each ship in sailing between certain latitudes and longitudes. Passage tables have always been a favourite study with mariners. Here there are hundreds of voyages tabulated in order of date, so that the sailing qualities of several ships are comparable from being under the same conditions of weather, and the value of the tables is therefore greatly enhanced.

The novel point in the work, however, is the introduction by Dr. Köppen of a new system of discussing the paths of storms. For some years past, meteorologists have been slowly coming round to the opinion that anticyclonic areas exercise a very important influence on the movements of cyclones; indeed, it may be safely asserted that the latter are almost entirely dependent upon the former for every stage of their progress. But although this is daily becoming more manifest, little has been done in the way of improving our mode of tracking cyclones. Ordinary track-charts represent the paths of storms during fixed periods of a calendar month, as if those of the early days were comparable with those of the end of the month—that the tracks, in fact, were regulated by time rather than by changing circumstances. A month's storm-tracks are so numerous, the direction of translation so varied, disturbances travelling in every conceivable direction—north, south, east, and west—and twisting round and round within a small radius, that to trace an individual disturbance is a work of no small difficulty. Even when the tangle is unravelled, there is nothing on the chart to show why one storm travels direct across the Atlantic to Europe in two or three days, another takes ten or eleven days, while others dart off through Davis Strait or by the east coast of Greenland to the Arctic regions; and the consequence is that we are left entirely to theorizing to explain the different movements, and theory has generally sought for the cause within the cyclones themselves. The more we examine synchronous weather-charts the more patent is it that cyclonic areas are strictly limited in their movements, both in rate and direction, by the surrounding conditions.

In NATURE, vol. xxxiii. p. 206, a diagram is given showing the track of a low-pressure system and its influencing anticyclone, the position of the lowest and of the highest barometer being indicated for each day. In the volume for 1880 of "Aus dem Archiv der Seewarte," the daily positions of the cyclonic centres for the first three months of 1878 are given, but the movement of maximum pressure is shown by a simple line without any indication of the position every twenty-four hours. Dr. Köppen has considerably improved on these plans. He has before him the daily charts for several weeks, and finds that for a number of consecutive days there is a general resemblance in the distribution of high and low pressure areas, the former almost stationary, the latter travelling along on the edges of the anticyclones. He selects the ruling type for the whole area of the charts, and then proceeds to represent the period of the type on one chart, the number of such periods in the twelve months ending with August 1884 being fifty-seven, ranging from three to eleven days each. The movements of the cyclones during the type are represented by lines joining the ascertained positions each day, and by a simple arrangement the lowest pressure and the force of the wind are represented daily. The anticyclones are treated differently, they are considered as practically stationary, and the isobar of 765 mm. (30·12 inches) being found on the charts every day, it has been adopted as the representative of the high-pressure systems. This isobar for the several days of the type produces a mean line which shows the average position of the anticyclone during the period. The maximum barometric values are shown near the centre, and also the direction in which the highest pressures moved, as in the volume already alluded to.

An examination of the results as shown by this method indicates that the question of storm tracking has been greatly simplified. Instead of twelve monthly charts full of tangled curves exhausting our patience to unravel them, we have about five for each month, the paths of disturbances during the prevalence of a type not varying greatly, and individual cases are followed without difficulty. The question of expense in lithographing the charts has apparently compelled Dr. Köppen to represent two, and even three, types on one chart, which tends to confusion; and if more of this kind of work is to be done, it will be well to strain a point to give each period by itself, so as not to perplex those who only occasionally deal with such charts. There are, however, several single periods to which a chart has been devoted, and a study of these only will suffice to convince us that an advance in the right direction has been made. Take the sixth and seventh charts representing the conditions between October 26 and November 1, and November 2 to 10, 1883, and the importance of the work is at once apparent. In the former the permanent anticyclone over the ocean is well south, while the European anticyclone covers all but the most northern parts of Scandinavia and Russia. The cyclones follow a well-marked path from America to Iceland and the White Sea. In the second case the Atlantic anticyclone is further north, and the European area has moved away to the eastward, and in keeping with these changes, the disturbances have also modified their directions. Speaking very generally, storm areas run parallel with the edge of the anticyclone. According to the position of the latter so do the cyclones advance, recede, or stand still. We see that land does not seem to offer any resistance to the advance of a storm area, the changes of direction in mid-ocean being quite as frequent as near the land. Tropical storms may either march due north, curve round by the American coast, or proceed to the western side of the Gulf of Mexico, and then cross the American continent to the Atlantic; but in each case we find the position of the anticyclone to govern the course followed. From a similar cause the rate of movement is also affected, varying quite as much on the level surface of the sea as in the midst of mountainous continents. In the chart for March 30 to April 11, 1884, the anticyclones over Europe, the Atlantic, Greenland, and America form a barrier allowing no means of escape for the disturbance which is seen to wind about from Davis Strait to the coast of Ireland and back again to the neighbourhood of its starting-point. The question of direction and rate, therefore, depends largely upon the position and stability of the anticyclones; and if we can in any way discover the resisting power of the latter we should no doubt greatly increase our ability to forecast changes. For the purposes of storm-warnings, it seems to be quite as necessary to know the conditions over Eastern as over Western

[1] "Vierteljahrs-Wetter-Rundschau an der Hand der täglichen synoptischen Wetterkarten für den Nordatlantischen Ocean des Dänischen Meteorologischen Instituts und der Deutschen Seewarte." Parts 1 to 5, September 1883 to November 1884, with 41 Charts. (Berlin: Mittler und Sohn, 1887-88.)

Europe, because it is on the existence or non-existence of anticyclonic areas over Russia that bad weather may either steer clear of our coasts, or pass clean over us and cause enormous damage to life and property.

Dr. Köppen's adaptation of composite portraiture for anticyclones will, when fully developed, doubtless lead to the discovery of principles which must be of considerable practical importance in our every-day life, and meteorologists should direct their attention to the discovery of some law which will indicate the approach of a change in the distribution of high barometer readings. At present we know absolutely nothing of what is taking place over the Atlantic out of sight of our own coasts, and the ordinary weather-charts cover such a small extent of North-Western Europe that they do not give us a fair idea of what the conditions are to the eastward. As the facts indicated become more fully known, we shall probably see an extension of the Weather Report area, and a corresponding improvement in forecasting.

The "Vierteljahrs-Wetter-Rundschau" appeared originally in various numbers of the *Annalen der Hydrographie und Maritimen Meteorologie*, the official publication of the Deutsche Seewarte, and are now reprinted in separate form.

NOTES.

THE members of the "Provisional Committee" appointed at the International Geological Congress in London, with reference to preparations for the next meeting of the Congress at Philadelphia, met at New Haven on Thursday, November 15. All were present except Dr. T. Sterry Hunt, who was confined to New York by illness. By vote, twenty-four members of the Permanent or Organizing Committee were appointed, as follows:—C. A. Ashburner, J. C. Branner, T. C. Chamberlin, G. H. Cook, J. D. Dana, W. M. Davis, C. E. Dutton, G. K. Gilbert, James Hall, A. Heilprin, C. H. Hitchcock, Joseph LeConte, Dr. J. Leidy, J. P. Lesley, O. C. Marsh, J. S. Newberry, J. W. Powell, J. R. Procter, N. S. Shaler, J. J. Stevenson, C. D. Walcott, R. P. Whitfield, H. S. Williams, Alexander Winchell. The Committee has power to add to its number. Dr. J. S. Newberry was appointed temporary Chairman. With this action, the duties of the Provisional Committee ended. The first meeting of the Permanent Committee will be held in Washington in the month of April. One of the publications presented to the recent session of the Congress in London was a voluminous Report on some important questions in American stratigraphical geology. We learn from an article in the December number of the *American Journal of Science*, by Prof. Dana, that, in his opinion, the views of the great majority of American geologists are not fairly represented in that Report. The Committee now appointed will certainly be regarded by geologists in Europe as a thoroughly representative one, which will, no doubt, take good care that the general body of geological opinion in the United States shall be adequately put before the world at the Philadelphia meeting.

ON Tuesday the completion of the ninth edition of the "Encyclopædia Britannica" was celebrated by a dinner given by Dr. W. Robertson Smith, the editor, in the hall of Christ's College, Cambridge. Upwards of a hundred contributors were present, and among them were many eminent men of science. Responding for "Science," Dr. Archibald Geikie said the old limits within which culture was confined had proved to be altogether too small for the progress of the present day. The soldiers of the republic of science had sometimes been accused of a strong desire to attack University culture and carry it by storm. For his part he wished that it might stand, but that no barrier should be interposed against the freest communion between the people inside and the newer and wider city around their borders.

AN Anthropological Congress is to be held at Vienna during August next.

AN important paper by Prof. Virchow, on "Land and People in Ancient and Modern Egypt," appears in the current number of the Transactions of the Berlin Gesellschaft für Erdkunde. It embodies some of the results of Prof. Virchow's ethnological researches during his recent visit to Egypt. It has hitherto been thought that the fellaheen of to-day are of exactly the same physical type as that of the most ancient known Egyptian population. Prof. Virchow, however, holds that the evidence afforded by the oldest sculpture, as well as by the skulls of the earliest period, tends to show that the primitive type in Egypt was brachycephalic, whereas the types which exist at the present time, and have existed for ages, are dolichocephalic and mesocephalic. Whether the change was produced by the influence of environment, or by the influx of new races, cannot, according to Prof. Virchow, be definitely determined by the evidence at present at our disposal; but, of the two views, the latter, he thinks, is the more probable.

THE inaugural lecture delivered before the University of Glasgow by Prof. Max Müller, as Lord Gifford's Lecturer in Natural Theology, has just been published by Messrs. Longmans, Green, and Co. In this lecture, Prof. Müller presents a most interesting account of the ideas which have regulated the work of his life. His conception of "the science of religion" will serve as the test, and, he hopes, the confirmation, of his theories relating to language, mythology, and thought.

THE New England Meteorological Society proposes to have a Loan Exhibition of Meteorological Apparatus, Photographs, &c., at the Institute of Technology, Boston, in connection with its fourteenth regular meeting in January 1889. The Society has issued a request for contributions.

THE Report of the Norwegian party of the International Polar Investigation contains the results of the observations which were made according to the programme decided upon at the Polar Conference at St. Petersburg, in August 1881. The observations were made at Bossekop in Alten, in lat. 69° 58′ N. and long. 23° 15′ E. of Greenwich. The first volume, issued in 1887, contains the astronomical and meteorological observations, and the second volume (Christiania, 1888) gives the results of the magnetic determinations and observations of auroræ. In the meteorological section, tables are given of the hourly readings of the temperature and humidity of the air, height of barometer, direction of winds and nature of clouds, extending from August 1882 to August 1883 inclusive, and concluding with monthly averages. In vol. ii. are given the records of the determinations of the magnetic declination and horizontal and vertical intensity. These were made fortnightly during the year, at intervals of five minutes during the day, so that the carefully-executed curves expressing the results of the observations are very detailed and convenient for comparison with the complete descriptions of auroral displays, the records of which are also contained in this volume. No doubt these results will be of great service in correlating auroræ with magnetic disturbances.

THE Royal Meteorological Society has published its "Meteorological Record" for the first quarter of this year, containing the monthly results of observations made at its stations, with remarks on the weather by Mr. W. Marriott. The Society commenced the organization of stations on a uniform plan in 1874, and these were supplemented by another class of stations, termed climatological, in 1880. Since 1881 the results have been published in a separate form under the above title. A map of the stations is issued annually, and shows that they are fairly well distributed, except in Wales. In addition to the monthly results, tables of daily rainfall are given for a number of stations, and of the

daily temperature and sunshine in London and the suburbs. The monthly values published by the Registrar-General are also appended, and the whole forms a valuable record of the meteorological statistics of England and Wales, issued well up to date.

AT the meeting of the French Meteorological Society on November 6, M. Lemoine presented a summary of the rainfall observations of the basin of the Seine in 1887. He stated that the rainfall was everywhere below the average; in the Department of the Seine-Inférieure the totals for the year were the lowest in a series of twenty-one years. M. Renou stated that the late M. Hervé-Mangon having expressed the wish that his observations made at Ste.-Marie-du-Mont should be published, Mme. Mangon had handed them over to him for publication at her expense. M. Renou presented a note on the temperature of October at Paris since 1757. He pointed out that during the last 130 years the month of October presented either a low or a high mean every twenty or twenty-five years. Means as low as that for October 1887, viz. 44°·1, were very rare. Since 1757 the lowest averages for October had occurred in 1784 (45°·3), and 1817 (45°·1).

BIOLOGISTS will be glad to learn that the posthumous works of the late M. Severtsoff are being issued by M. Menzbier, at Moscow, and that a new part has been added this year to the part which appeared in 1886. Severtsoff not only was a first-rate zoologist and explorer of unbeaten tracts in Turkestan; he was also a powerful thinker, and everything he wrote about the philosophy of zoology deserves attention. Unhappily, his frequent expeditions to Central Asia rendered it impossible for him to bring to an end the works of a general character which he was preparing. He had begun an "Ornithology of Turkestan," based upon his exceedingly rich collection of birds, which contains no less than from 12,000 to 13,000 specimens. This work will be completed by M. Menzbier, and it could not have been put into better hands. As for the two parts of his "Posthumous Works" (*Mémoires de la Soc. des Natur. de Moscou*, vol. xv. fascs. 3 and 5), they consist of two papers: one in German, on two insufficiently known species of Russian hunting hawks (*Hierofalco grebnitzky*, n. sp., and *Hierofalco uralensis*, Sev. et Menzbier); and the other, in French, on variations due to age of the Palæarctic *Aquilinæ*, and the taxonomic importance of those variations. The former contains, besides the description of the two species (with coloured plates), a sketch of the geographical distribution of the Icelandian, Norwegian, Uralian, and Labradorian species of *Hierofalco*. The second paper contains, first, a discussion of some principles of zoological classification, being an answer to Dr. Sharpe's reproach of having "too closely followed the steps of the elder Brehm," and of having aimed at "hitting the happy medium between 'lumpers' and 'splitters.'" This is followed by a discussion of the natural extent of the family of *Aquilinæ* (which, according to Severtsoff, must include only the three genera, *Aquila*, *Haliaëtos*, and *Milvus*); the geographical distribution of all known species of the *Aquilinæ*; and finally, the description of those species which Severtsoff had himself studied closely in the field,—special attention being given to the variations of coloration dependent upon the age of the individuals. Seven beautifully coloured plates accompany the work.

WE have received the twelfth volume of the systematic Catalogue of the Museum of Natural History of the Netherlands. The present volume deals with Mammifers, and has been compiled by F. A. Jentink. No fewer than 5379 individuals, representing 900 species of Mammifers, are enumerated in this Catalogue. M. Jentink hopes that his work may be of service to zoologists by enabling them to see what rare or interesting species are to be found in the National Museum, the value of which, in this particular branch, has not hitherto, apparently, been sufficiently appreciated.

A PAPER on "Energy and Vision," by Prof. S. P. Langley, was read by abstract before the American National Academy of Sciences on April 19 last. This paper was printed in the November number of the *American Journal of Science*, and has now been separately issued. The writer does not profess any competence in physiological optics, and points out that his observations, and the conclusions reached from them, are both to be understood from the purely physical point of view. This being premised, he summarizes the paper in the following conclusions:—"The time required for the distinct perception of an excessively faint light is about one half-second. A relatively very long time is, however, needed for the recovery of sensitiveness after exposure to a bright light, and the time demanded for this restoration of complete visual power appears to be the greatest when the light to be perceived is of a violet colour. *The visual effect produced by any given, constant amount of energy varies enormously according to the colour of the light in question.* It varies considerably between eyes which may ordinarily be called normal ones, but an average gives the following proportionate result for seven points in the normal spectrum, whose wave-lengths correspond approximately with those of the ordinary colour divisions, where unity is the amount of energy (about $\frac{1}{10000}$ erg) required to make us see light in the crimson of the spectrum near A, and where the six preceding wave-lengths given correspond approximately to the six colours—violet, blue, green, yellow, orange, red.

Colour.	Violet.	Blue.	Green.	Yellow.	Orange.	Red.	Crimson.
	μ	μ	μ	μ	μ	μ	μ
Wave-length	·40	·47	·53	·58	·60	·65	·75
Luminosity (visual effect).	1,600	62,000	100,000	28,000	14,000	1200	1

Since we can recognize colour still deeper than this crimson, it appears that the same amount of energy may produce *at least* 100,000 times the visual effect in one colour of the spectrum that it does in another, and that the *vis viva* of the waves whose length is 0·75μ, arrested by the ordinary retina, represents work done in giving rise to the sensation of crimson light of 0·0000000000003 horse power, or about 0·001 of an erg, while the sensation of green can be produced by 0·0000000 of an erg."

A NEW and highly interesting method of obtaining gaseous carbon oxysulphide, COS, perfectly pure and in large quantities, has been discovered by M. Armand Gautier. The methods of preparing this gas already known are somewhat difficult to carry out, and the only effectual means of purifying it from the persistent presence of carbon disulphide vapour with which we have been hitherto acquainted, is by utilizing the fact that carbon disulphide is absorbed by triethyl phosphine, a most costly reagent. M. Gautier's new method is extremely simple. A large porcelain tube is partially filled with calcined kaolin, the purest variety of natural silicate of alumina, and heated to whiteness in a good furnace. The air having been first expelled by means of a current of carbon dioxide, a gentle stream of dry carbon disulphide vapour is allowed to slowly pass through the tube. The mixture of gases which issues from the tube is found to consist of a little over 60 per cent. of carbon oxysulphide, and about 35 per cent. of carbonic oxide, together with traces of carbon dioxide and sulphuretted hydrogen, and a slight excess of vapour of carbon disulphide. This mixture is now passed (1) through a flask half filled with iced water, in which is deposited the greater portion of the excess of carbon disulphide; (2) through a wash-bottle containing potash solution, which absorbs carbon dioxide and sulphuretted hydrogen; (3) through a solution of cuprous chloride in hydrochloric acid, which removes the carbonic oxide; (4) through an alcoholic 12 per cent. solution of aniline, which

takes up the last traces of carbon disulphide, with formation, according to Hofmann, of sulpho-diphenyl-urea, $CS(NH.C_6H_5)_2$; and finally (5) through an ordinary drying tube containing pumice and sulphuric acid. The gas which issues from the apparatus thus arranged is found on analysis, provided the most ordinary precautions are taken not to allow the passage of too rapid a stream, to consist of chemically pure carbon oxysulphide. As regards what happens in the kaolin tube, on allowing it to cool in contact with the mixture of gases and afterwards carefully breaking it, at the end from which the gas issued a quantity of brilliant white needles of silicon sulphide, SiS_2, are found partially obstructing the tube. In place of the kaolin is found a graphitic mass studded with very hard tolerably large crystals of a substance which evolves sulphuretted hydrogen in contact with moist air, and is decomposed by water with precipitation of gelatinous aluminic and silicic hydrates. This most interesting substance is in reality a sulpho-silicate of alumina, or a kaolin in which oxygen has been replaced by sulphur, thus opening up the wide prospect of the formation of a whole series of sulpho-silicates in which the oxygen of natural silicates is replaced by sulphur.

A WORK on the telephone, by Mr. W. H. Preece and Dr. Julius Maier, which has long been in preparation, will be published in the course of a week or two by Messrs. Whittaker and Co., as a volume in their "Specialists' Series." A work on manures will be published shortly in the same series. Its author is Dr. A. B. Griffiths, Principal of the School of Science, Lincoln. Mr. G. R. Bodmer has in the press a practical treatise on hydraulic motors, which will also form a volume of the "Specialists' Series."

THE Carpathian Club in Transylvania, which was founded in 1880, has now about 1600 members. Its object is to investigate the Transylvanian Alps, and to construct good roads and refuges. The Club intends to erect at Hermannstadt a Museum for its library, and for maps, plans, photographic views of the Carpathians, and ethnological and natural history objects.

THE Liverpool Science Students' Association has issued its Report for the session 1887–88. According to the Committee, the condition of the Society, as regards both the number of its members and the character of its work, is eminently satisfactory. The papers read at the evening meetings were, we are told, "of a high character, evidencing much careful observation and patient investigation."

A REPORT from Elba states that the whole of the island is infected by Phylloxera. In Toscana the efforts to check the plague have as yet proved unsuccessful. The insect has also made its appearance at Parmi, in Calabria, at Novara, and at Cervo in Liguria. Reports from the neighbourhood of San Remo and from Lombardy state that the infected areas are constantly increasing.

DURING the last summer, Washington and other eastern cities of the United States were exceptionally free from the attacks of "shade-tree pests." Elm-leaf beetles were not nearly so numerous as usual. In recording this fact in *Insect Life*—a useful publication lately started by the United States Department of Agriculture—the writer refers to "an occurrence which shows how careful one must be in drawing conclusions from experiments to destroy insects." "Counting," he says, "upon the ordinary appearance of the elm-leaf beetle, we sprayed the trees in our garden with London purple early in the summer, and as no damage was done, we were quite of the opinion that the spraying had been a success until, later, we noticed that unsprayed trees were quite free also. In the same way a gentleman came to us toward the end of the season and informed us that he had completely protected his trees, by spraying the grass under them with Paris green, his trees for the first time in several years having retained the verdure of their foliage."

AT a recent meeting of the Linnean Society of New South Wales, Mr. C. W. De Vis read a paper presenting "A Glimpse of the Post-Tertiary Avi-fauna of Queensland." He described such bird-remains as can with confidence be referred to known genera, from the Chinchilla deposits, Darling Downs, Queensland. The fossiliferous beds, which have been exposed by floods in the banks of the Condamine River, have yielded the remains of mollusks, fresh-water fishes, alligators, turtles, and terrestrial vertebrates; whence it may be inferred that the locality was once the site of a densely populated water-course or basin. In keeping with this it might have been anticipated that the birds whose remains have so far come to light would belong for the most part to tribes which haunt the margins or explore the waters of lakes and rivers. And this turns out to be the case, for, with one or two more or less doubtful exceptions, the nine species described are referable to birds of no higher grade than the old order Grallatores, the majority of them belonging chiefly to the Anseres and Rallidæ.

THE last issue of the *Mittheilungen* of the German Asiatic Society of Japan (Heft 39, Band iv.) contains a long account of the remote Chinese province of Kansu, by Herr von Kreitner, who is known to many readers as a member of the Szchenyi Expedition to the borders of Tibet about twelve years ago, and the author of an account of the explorations then made, entitled "Im Fernen Osten." The writer describes the geography of the province in three sections: (1) North-Western Kansu, belonging to the Gobi and Shamo deserts; (2) the central and north-eastern districts, which are drained by the Hoang-ho or Yellow River; and (3) Southern Kansu, belonging to the Yang-tsze drainage area. One feature of the paper is a picturesque account of the loess districts of the province. Prof. Fesca describes briefly two works of his on Japanese agriculture, and the agricultural capacities of the country, which have recently appeared. A third paper, also short, contains the results of an investigation into the chemical changes produced in tea by the process of firing," a species of roasting which the leaf undergoes after it is picked, and before shipment to Europe.

IN the signature of the letter entitled "The Pasteur Institute," printed in NATURE last week, for Parky*er* read Parky*n*.

THE additions to the Zoological Society's Gardens during the past week include two Philippine Paradoxures (*Paradoxurus philippensis*) from the Philippine Islands, presented by Mr. G. P. Ogg; a Brazilian Tapir (*Tapirus americanus* ♂) from the Province of Parana, South America, presented by Mr. Anthony Taafe; a Long-fronted Gerbille (*Gerbillus longifrons*) from Western Asia, presented by Mr. Lionel Hanbury; a Meyer's Parrot (*Pœocephalus meyeri*) from East Africa, presented by Dr. Hugh Eaton, F.G.S.; two Common Quails (*Coturnix communis*), European, presented by Mr. W. H. St. Quintin, F.Z.S.; a Common Guillemot (*Lomvia troile*), British, presented by Mr. E. Hart, F.Z.S.; a Moorish Gecko (*Tarentola mauritanica*) from the South of France, presented by Mr. J. C. Warbury; an Indian Crocodile (*Crocodilus palustris*), a Hawks-billed Turtle (*Chelone imbricata*) from the Philippine Islands, presented by Captain J. Sommes; a Black Salamander (*Salamandra atra*), European, presented by Mr. G. A. Boulenger, F.Z.S.; a Bald-headed Chimpanzee (*Anthropopithecus calvus* ♀) from the Gaboon, three Dwarf Chameleons (*Chamæleon pumilus*) from South Africa, deposited; a Molucca Deer (*Cervus moluccensis*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

COMET 1888 *e* (BARNARD, SEPTEMBER 2).—The following ephemeris for this comet for Greenwich midnight is in continuation of that given in NATURE, vol. xxxix. p. 114:—

1888.	R.A.	Decl.	Log Δ.	Log *r*.	Brightness.
	h. m. s.	° ′			
Dec. 15	1 4 21	7 41·2 S.	0·1390	0·2810	8·7
17	0 56 52	7 43·1			
19	0 49 59	7 43·4	0·1654	0·2776	7·8
21	0 43 38	7 42·4			
23	0 37 47	7 40·1	0·1916	0·2744	7·0
25	0 32 24	7 36·9			
27	0 27 29	7 32·8 S.	0·2170	0·2715	6·3

The brightness on September 2 has been taken as unity.

The spectrum of the comet presents no very interesting feature, as it is mainly continuous, with but little evidence of the bright hydrocarbon bands.

Y CYGNI.—Although it is only just two years since Mr. Chandler discovered this variable, and but comparatively few minima have therefore yet been observed—the fewer that the star seems to have been unaccountably neglected by European observers—yet some strange and strongly-marked anomalies have already been observed in its period. Although the light-curve is of such a shape as to enable the minima to be determined with much precision, the variations in brightness proceeding with relatively great rapidity, and Mr. Chandler had therefore believed that the period he had deduced from his 1886 and 1887 observations could not be more than a second or two in error, he found, when the star came again under observation in the spring of 1888, that the ephemeris required a correction of four or five hours, and this difference increased until, in the October just past, it had amounted to nearly seven hours. Dividing all the observations into five groups, they give the following values for the period:—

d.	h.	m.	s.
1	11	56	31·8
		57	45·3
		58	19·5
		58	30·9

The observations from which these periods have been deduced include five minima determined by Mr. Sawyer, three by Mr. Vendell, and thirteen by Mr. Chandler himself. Using his own observations alone, he has roughly represented them by the following elements: 1889 January 25, 5h. 39·6m. (G.M.T.), + 1d. 12h. 0m. 0·12s. (E − 519) + 0·24s. (E − 519)²; the elements being referred to epoch 519 on account of the convenience of the period at that time being so nearly commensurate with a solar day. But these elements leave residuals far too large to be regarded as errors of observation, whilst the lengthening of the period, half a second between two successive recurrences, is entirely unparalleled in amount by the irregularities in other Algol variables. Mr. Chandler considers that this change is far more likely to be periodic, and of short period, than secular, and it is therefore specially to be desired that observers will follow it with all attention, for the complete knowledge of its changes must throw much light on the whole subject of variation of the Algol type. At present the minima occur soon after sunset, for England, on December 17, and every third following day, and shortly before sunrise on December 19, and every third following day. It is to be hoped that English observers will give a most persistent attention to this star, now so clearly a most important one.

RECENT SKETCHES OF JUPITER.—Vol. xlix. of the *Mémoires couronnés* of the Royal Academy of Sciences of Belgium, contains a valuable series of observations of Jupiter by Dr. F. Terby, of Louvain. This series, which contains his observations from 1882 to 1885, is in continuation of a former memoir, which appeared in vol. xlvii. of the same publication, and is soon to be followed by a third containing the results of his work in 1887. In this present memoir Dr. Terby has made some first efforts towards the identification of details on the surface of Jupiter in successive rotations, a work which he considers he has been able to carry on more successfully in his third series. The present memoir is illustrated by 100 sketches of the planet, which, if of no great beauty or minuteness of detail, are very creditable when the smallness of the telescope used—only 3½ inches aperture—is borne in mind, and are valuable from their number and the completeness of the series which they form. The 1887 observations were made with Dr. Terby's new telescope of 8 inches aperture, which has given excellent proof of its good quality.

On one occasion (1884 February 16) Dr. Terby was fortunate enough to watch the shadow of the first satellite pass over a bright white spot. The shadow lost none of its blackness in the transit, showing that the white spot was in no perceptible degree self-luminous.

85 PEGASI.—Some recent observations which Mr. Burnham has obtained of this close and difficult double, discovered by him in 1878, have enabled Mr. Schaeberle (*Gould's Astronomical Journal*, No. 185) to compute an approximate orbit, from which it appears that the star has a period of 22·3 years, and an eccentricity of 0·35, and that it passed through periastron at the beginning of 1884. The other elements are—

$$\pi - \Omega = 70°{\cdot}3 \quad \ldots \quad i = 68°{\cdot}6$$
$$\Omega = 306°{\cdot}1 \quad \ldots \quad a = 0''{\cdot}96$$

From observed position-angles and distances of the third star, C, the following result has been obtained for the relative proper motion of 85 Pegasi, viz. annual motion being 1″·305 and its direction 140° 20′·4, or in R.A. and Decl., $\Delta\alpha = +0''{\cdot}833$; $\Delta\delta = -1''{\cdot}005$. The comparison star, C, would appear to have a slight proper motion also, as these values differ somewhat from those obtained for 85 Pegasi by Argelander, Mädler, and Brünnow.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1888 DECEMBER 16–22.

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on December 16

Sun rises, 8h. 3m.; souths, 11h. 56m. 7·7s.; sets, 15h. 50m.: right asc. on meridian, 17h. 38·3m.; decl. 23° 22′ S. Sidereal Time at Sunset, 21h. 33m.

Moon (Full on December 18, 11h.) rises, 15h. 3m.; souths, 22h. 48m.; sets, 6h. 43m.*: right asc. on meridian, 4h. 32·5m.; decl. 18° 23′ N.

Planet.	Rises.	Souths.	Sets.	Right asc. and declination on meridian.
	h. m.	h. m.	h. m.	h. m. ° ′
Mercury..	7 34	11 26	15 18	17 8·0 ... 23 34 S.
Venus ...	10 38	14 45	18 52	20 27·5 ... 21 16 S.
Mars ...	10 50	15 14	19 38	20 56·5 ... 18 36 S.
Jupiter ...	7 32	11 30	15 28	17 12·5 ... 22 36 S.
Saturn ...	20 24*...	3 51	11 18	9 31·5 ... 15 44 N.
Uranus...	2 14	7 38	13 2	13 19·4 ... 7 43 S.
Neptune..	14 26	22 10	5 54*...	3 53·8 ... 18 32 N.

* Indicates that the rising is that of the preceding evening and the setting that of the following morning.

Variable Stars.

Star.	R.A.	Decl.		
	h. m.	° ′		h. m.
U Cephei	0 52·4	81 16 N.	Dec. 19,	22 44 *m*
V Tauri	4 45·6	17 21 N.	,, 17,	*M*
R Canis Majoris ...	7 14·5	16 12 S.	,, 18,	21 24 *m*
		and at intervals of		27 16
U Monocerotis ...	7 25·5	9 33 S.	Dec. 16,	*M*
R Crateris	10 55·1	17 43 S.	,, 18,	*M*
S Virginis	13 27·2	6 37 S.	,, 17,	*M*
U Coronæ	15 13·6	32 3 N.	,, 18,	6 9 *m*
β Lyræ... ...	18 46·0	33 14 N.	,, 20,	7 0 m_2
S Vulpeculæ ...	19 43·8	27 1 N.	,, 17,	*m*
η Aquilæ	19 46·8	0 43 N.	,, 21,	6 0 *M*
S Sagittæ	19 50·9	16 20 N.	,, 20,	17 0 *m*
R Sagittæ	20 9·0	16 23 N.	,, 21,	*m*
T Vulpeculæ ...	20 46·7	27 50 N.	,, 22,	2 0 *M*
Y Cygni	20 47·6	34 14 N.	,, 16,	5 40 *m*
		and at intervals of		36 0
δ Cephei	22 25·0	57 51 N.	Dec. 22,	0 0 *M*

M signifies maximum; *m* minimum; m_2 secondary minimum.

Meteor-Showers.

	R.A.	Decl.	
Near Pollux	115°	32° N.	... Rather swift.
	195	67 N.	... Swift ; streaks.

GEOGRAPHICAL NOTES.

GREAT activity is still being displayed by German explorers in the interior of Togo-land. Captain C. von François has brought to a successful termination his journey into the country confined within the great bend of the Niger. The route taken by him was as follows: viz. Kpandu, Salaga, Jendi, Gambaga, and then across the upper course of the Volta at Bupere (the river at this spot, though more than 80 yards broad, is no longer navigable). From this point he arrived on April 19 last at Surma (11° 28′ N. lat.) in the country of Mosi. He afterwards made an excursion from Gambaga to the south-west by way of Nantong to the River Volta, and returned to the coast through Adeli. In the latter place he met Dr. L. Wolf, who founded a station there on the Adado Mountains in the beginning of May, having travelled to Adeli through the eastern part of Togo-land. Dr. Wolf has, with the aid of a mercurial barometer, been able to determine numerous altitudes with greater accuracy than any measurements previously made in this part of Africa. It appears from his results that Dr. Henrici has considerably over-estimated the height of the Agome Mountains. Herr von Puttkamer, the Imperial Commissioner, made in March an excursion into the region of the French Protectorate as far as the lower course of the Mono, and then explored the country of Agotime up to the foot of the mountains. All these travellers agree in stating that the prospects of the interior of Togo-land are very favourable, both as regards agriculture and commerce. The climatic conditions of these uplands are much more favourable than those of the coast.

THE last issue of the *Bollettino* of the Italian Geographical Society, which is a double number for October and November, publishes an account by Dr. Leopoldo Travesi of an expedition he made last November to the almost unknown district of Jimma (Jimma-Kakka, Jimma Abba-Jifar) on the debatable borderland between Abyssinia and Kaffa. Jimma constitutes a petty Mohammedan State tributary to Menelek, King of Shoa, in the Upper Valley of the Ghibeh, which is an important head-stream of the Gugsa, and which had hitherto been crossed only by one European, Travesi's fellow-countryman, Cecchi. Through fear of "annexation" or "protection," Europeans are jealously excluded, and Travesi only succeeded in penetrating into the country by joining the suite of its ruler, Abba-Jafir, who was returning from a visit to his suzerain, King Menelek. Jimma forms a deep upland valley over 6000 feet above sea-level, about 40 miles long and 10 broad, and inhabited by an extremely mixed population, in which the Abyssinian, Galla, and Negro elements are intermingled in diverse proportions. Hence the great variety of types, and colours ranging from the relatively fair and regular Hamitic to the dark and nearly pure Negro, as well illustrated by the numerous photographs Travesi succeeded in obtaining, and eight of which are here reproduced. The penal code of Jimma is remarkable for its simplicity, most offences being punished by "banishment," which is here a euphuistic expression for "slavery." Hence to the traveller's question, "What do you do with your thieves and other criminals?" the prompt reply invariably was "We drive them from the country," meaning "We sell them." Had Travesi been allowed to penetrate a little further south, he would have solved the problem of the Juba and Sobat (White Nile) water-parting. As it was, he was able, from native report, almost to satisfy himself that the Gugsa, here called the Uma, and elsewhere the Abula, flows, not west to the Nile basin, but south-east to Lake Abbala, which is known to be in the Juba basin. Consequently the Gugsa may be regarded as the chief head-stream of that river. He also heard of d'Abbadie's Mount Wosho, here however called *Woso*, which lay away to the south-east, and to describe the altitude of which the natives exhausted the language of hyperbole. They could not exactly say where it was, except that the country was called Am'ca (?), but they knew quite well it was the highest mountain in the world, lost in the skies, &c. The Wosho, whose existence was lately imperilled by certain vague reports, seems thus, at all events, "rehabilitated."

ELECTRICAL NOTES.

THE magnetic elements for Paris for 1888 are—

Declination	15° 52′ 1″
Dip	63° 14′ 7″
H	0·19480
V	0·42245
Total force	0·46520

SORET (*Arch. des Sciences*, April 1888) has reproduced Oliver Lodge's experiment on the dissipation of fog on a small scale by placing a platinum cup, containing water in a boiling condition, by a Bunsen flame in connection with one pole of an influence machine and a point above the water in connection with the other pole. When the machine is not at work, so-called steam ascends undisturbed, but when the machine is excited the clouds whirl and move about in a flame-like fashion, until the vapour disappears entirely. The experiment is made in a dark room, and the cup is illuminated by a beam of electric light.

C. L. WEBER (*Ann. Wiedemann*, xxxiv. p. 576) has made some interesting observations on the variation of the resistance of alloys of tin-lead and tin-bismuth at their period of fusion. A considerable and rapid increase of resistance is observed as the fusing-point is reached, and it is the more marked the simpler the composition of the alloys. Pb_2Sn behaves like pure tin. The tin-bismuth alloys are very irregular, for the specific resistance of bismuth falls as the point of fusion is reached.

VON OETTINGEN (*Ann. Wiedemann*, xxxiv. p. 570) has been repeating his old experiments on the oscillatory discharges of Leyden jars, and he has obtained some admirable photographs of sparks. They give periods of oscillations varying from 19 to 39 millionths of a second.

THE use of Gassner's dry cell is making great progress in Germany. In the latest form hydrated ferric oxide is used as the depolarizer. Ferric oxide is said to abandon all its oxygen in presence of sal ammoniac.

A NOVEL trial is about to commence in Philadelphia. It is to decide the question whether electricity is a condition or a thing, and whether it is something which is manufactured.

A CONGRESS OF ELECTRICIANS will be held in Paris, in 1889, under the presidency of M. Mascart, and under the auspices of the International Society of Electricians. It is proposed to hold the meeting in September, but the British Association meeting in Newcastle will prevent many English electricians from being present.

THE term "therm," in place of *calorie*, for the unit of heat in the C.G.S. system has not met with general approbation, as the other names applied to the e units have done. It was, perhaps, hastily accepted ; but has it occurred to the dissentients that it might be dispensed with altogether, and that the unit of work "Joule" answers all the purpose of a unit of heat? There are 4·2 *Joules* in a *therm*. They are of the same dimensions, and really indicate the same physical quantity, viz. the mechanical equivalent of heat. Calorie will, however, perhaps hold its own, now that the C.G.S. system is so generally adopted. The only reason that led to the acceptance of the therm was the confusion arising from the kilogramme-degree, as well as the gramme degree, being called a calorie, but the former is fast going out.

THE ANNIVERSARY OF THE ROYAL SOCIETY.[1]

IN the month which intervened between our last anniversary and the end of the year, the Society lost four of its Fellows. In addressing the Fellows last year, I referred to the loss which science had sustained through the death of the illustrious Kirchhoff, and before three weeks were out, one followed him to the grave whose researches on the connection between the emission and absorption of radiant heat and light were closely akin to those of Kirchhoff. I refer to Balfour Stewart, who, shortly after landing in Ireland, whither he had gone to spend the Christmas with his family, was suddenly carried off after only a few hours' illness, shortly after he had entered on his sixtieth year. His name is widely known on account of his scientific work in heat, magnetism, and solar physics. He has been a member of the Council, and the Rumford Medal of the Society was awarded to him for the particular research to which I alluded at the outset. The other three of our ordinary Fellows

[1] Address of the President, delivered at the Anniversary Meeting, on November 30.

who died before the month was out were all far advanced in years. Two of them were eminent in the medical world, Sir George Burrows and Dr. Arthur Farre, both of whom served on our Council. Early in the year we lost one of our Fellows, who, while not a man of science, was eminent in literature and jurisprudence. While our ranks are mainly recruited from men of science, we gladly welcome among us men who, like Sir Henry Sumner Maine, have proved their ability and earned their distinction in other branches of knowledge; whose connection with us we look on as honourable to the Society, while, as the very fact of their joining us shows, they regard the Fellowship as honourable to themselves. Admiral Sir Cooper Key, who was highly distinguished as a naval officer, and was at one time Director of the Royal Naval College at Greenwich, was another who served on the Council. Philip Henry Gosse, who died at an advanced age, is well known for his charming popular works on natural history. These are some of the Fellows on the home list who died since the last anniversary; but, besides these, we have lost no less than three of our foreign members. Prof. Anton de Bary, so well known for his researches on the Cryptogams, and the eminent naturalist, Prof. Asa Gray, who not very long ago was over in this country, both died in January. Comparatively recently we have lost Prof. Clausius, so eminent as a physicist, especially in the department of thermodynamics.

The year of the Society which terminates to-day has shown no flagging in scientific activity. Since the last anniversary, thirty-three memoirs have been published in the Philosophical Transactions, containing a total of 1010 pages and 91 plates. Of the Proceedings, nineteen numbers have been issued, containing 1008 pages and 17 plates. In addition to this, a monograph of the Horny Sponges of Australia, by Dr. R. von Lendenfeld, which was accepted for publication by the Council, and which when completed will extend to about 1000 pages, is now nearly through the press.

A large amount of work connected with the Library has been done since the last anniversary. A special effort has been made to complete imperfect series of scientific periodicals; and by means of exchange, or by the generosity of our corresponding Societies, some hundreds of deficient numbers have been obtained. The Lists of Institutions entitled to receive gratis the Philosophical Transactions and Proceedings have also been carefully revised by the Library Committee.

In December last, Mr. Arthur Soper was engaged as a special Assistant to continue the formation of the Shelf-Catalogue, and the revision of the Catalogue of MSS., and other work. The Shelf-Catalogue of the Upper Library is now completed—a work involving the rearrangement or removal to the lower stories of several thousands of volumes. Considerable progress has been made in collating and cataloguing the Archives and other manuscripts belonging to the Society, and an instalment of slips have been written towards a Catalogue of the Miscellaneous Literature in the Library.

In the course of this work many duplicate scientific books, and literary works of little value to the Society, have been thrown out, and these have been presented, by order of the Council, to the libraries of the Universities and some of the chief scientific Societies.

The cataloguing of the titles of scientific papers for the decade 1874 to 1883 is now complete, and the work is ready for the press. The amount of matter is estimated to require, if printed, three quarto volumes of the usual size. The extraction of the title, the preparation of the work for the press, and the correction of the proofs of this work, which is really of international importance, has all along been done at the sole charge of the Royal Society; but the printing of the volumes which have already been published has been done at the Stationery Office, by the authority of the Lords of the Treasury, and the proceeds of the sale have been paid in to the Treasury. The Council have applied to the Lords Commissioners of Her Majesty's Treasury to sanction the printing of the last decade in a similar manner, and it is hoped that the application may be favourably entertained.

In the year 1882 a change was made in the amount and mode of administration of the grant which for a considerable time before had been voted annually by Parliament for scientific research. Since that year the annual grant has been one of £4000, which has been administered by the former Government Grant Committee, with the addition of certain *ex-officio* members, mostly the Presidents of certain scientific Societies. Meetings of this large Committee, consisting usually of about fifty members, have been held twice a year, and the various applications for aid from the grant to enable the applicant to carry out investigations explained by him, have been previously discussed in meetings of three, or latterly two, Sub-Committees, into which the whole Committee was divided, and then submitted to the General Committee for confirmation or modification.

In the discussion of these grants, the Government received the benefit of the gratuitous services of a large number of men of the highest distinction in science. In the large Sub-Committees, however, it necessarily happened that of the members present only a fraction would be likely to be conversant with the particular branch of science to which any particular application belonged; and the Council thought that the time of the members might be economized, and at the same time a more efficient discussion of the grants secured, by arranging the applications under a number of subdivisions, and assigning the discussion of these to a corresponding number of Boards formed out of the General Committee. It was thought that a good deal of the discussion of the applications in the several branches might be carried on by correspondence among the members of the respective Boards, so that one or two meetings of each Board might suffice. If some trouble were thus saved to the members of the Committee in regard to personal attendance at long meetings, there would probably be more expenditure of time in the way of correspondence, and it was thought that one meeting of the General Committee in the year would in most cases suffice. To meet pressing cases in the interval, it was suggested that a limited sum might be placed by the General Committee at the disposal of the Council of the Royal Society. There are further provisions for forming a reserve fund of not more than £2000 to meet special objects involving unusual expenditure, and for holding in reserve out of the money available for any one year enough to meet annual grants of limited amount made for a period not exceeding three years, the future grants being contingent on the receipt by the Committee of satisfactory evidence of progress in the inquiry. The new regulations, of which I have merely given a slight sketch, have been communicated to the Treasury, and will come into operation next year.

The Krakatão Committee have now completed their work, and the volume which is the outcome of their labours is in the hands of the public. The Society is much indebted to those Fellows and other gentlemen who discussed and reported on the different subjects into which the whole inquiry was divided, and to Mr. Symons, who was the first to propose that the materials should be collected, and to whose unwearied labour as Chairman of the Committee, director of the correspondence, and editor of the volume the successful accomplishment of the undertaking is largely due. The work has been favourably noticed in more than one quarter. A comprehensive and digested account of that extraordinary volcanic explosion, remarkable both for its magnitude and the striking disturbances and other phenomena attending or following it, is now placed within easy reach of the ordinary reader, and will go down to posterity; whereas, had the various accounts remained in their is lated form, they would many of them have perished, and the remainder could not have been brought together without a most laborious search. It must be a great satisfaction to my predecessor in this chair to remember that he urged upon the Council the importance of collecting the facts before the materials should have become dissipated, and while the freshness of men's recollection of the event kept up a lively interest in all that belonged to it.

The Royal Society is in possession of some important standards for the safe keeping of which we are responsible. Parliamentary copies of the standard yard and standard pound have been intrusted to our custody; and we have also a standard measure of length known as Sir George Schuckburgh's scale, with reference to which the length of the seconds pendulum for Greenwich has been determined by Kater and Sabine. This length, as determined by experiment, has been defined with reference to the interval from the 0 to the 39- and 40-inch graduations on the scale; but no exact comparison has hitherto been made between the length of this portion of the scale and the national yard, and such a comparison is no easy matter. It happens that Commandant Deforges has been engaged in determining the length of the seconds pendulum at Greenwich with reference to the French standard metre, and just before his return to Paris he came to our meeting, and offered to take charge of the scale, bring it with him to Paris, and there determine the length of the part of the scale used by Kater and Sabine with reference to the metre, for doing which he has all the requisite appliances; and as we know the ratio of the metre to the yard,

the length of the seconds pendulum as determined by Kater and Sabine would thus be known accurately with reference to the standard yard. It seemed to me that so important a scale should hardly be sent away, even though in the care of so experienced a physicist, without the authority of the Council, and without an outer case being made for its box, which there was no time to get ready. The authority of the Council has since been obtained, and it fortunately happens that one of the assistants at the Greenwich Observatory is going to Paris, who will take charge of the scale. Thus by the kind proposal of Commandant Deforges, we may shortly hope to have an authentic comparison of the length of the seconds pendulum as measured by Kater and Sabine with the standard English yard.

At the time of the anniversary last year, some of the reports of the observers who went to Grenada to observe the total solar eclipse of August 1886 had been seen in, and I mentioned that it seemed desirable, for convenience of reference at a future time, that the different reports should come out together, instead of being published in a scattered form, provided at least that the waiting for the later reports should not cause too much delay. I regret to say that the completion of the reports has been delayed in part by the illness of one of the observers, but I have every hope that they will all be in by Christmas, and I do not anticipate that any long time will elapse before they will be in some form in the hands of the public.

The time is well within our recollection when the occurrence of the solar prominences seen in total eclipses first attracted the attention of astronomers, and when for observations bearing on their nature we had to wait for the rare and brief glimpses which, clouds permitting, were afforded by total eclipses. Now, however, thanks to the method of observation devised independently by Lockyer and Janssen, they may be studied at any time. It would obviously be a great advantage if a similar study could be made of the corona; for though we cannot expect to obtain a picture of it equal to that which may be got during a total eclipse, yet, if a fairly good picture could be obtained from time to time, we might thereby be enabled to learn more about the history of its changes than could be got by observations extending over a lifetime if restricted to total eclipses. Some observations were made during the partial phases of the last total eclipse with the view of throwing light on the prospect of success. Notwithstanding the unpromising nature of the results obtained, I have reason for hoping that the desired object may yet be accomplished.

In addressing you last year, that year which will be memorable as the Jubilee of the reign of our beloved Sovereign, I alluded briefly to the progress which science had made in the last half-century, and ventured to indicate one or two directions in which it seemed to me possible that a very great addition to our physical knowledge might some day be reached. I will not to-day venture to look so far ahead; but the mention of a total eclipse leads me to refer to some theories now before the scientific world which are likely to undergo full discussion and further examination in the near future, with the probable result of a pretty general agreement as to their acceptance or rejection.

It is now many years since Dr. Huggins discovered the peculiar character of the spectra of the nebulæ, spectra which he found to consist mainly of bright lines, indicating that what we see is an incandescent gas. The natural supposition to make at the time was that those distant masses of matter consisted of incandescent gas, of which the luminosity was in some way kept up, probably as a result of condensation. But the researches of Mr. Lockyer, as described by him in the Bakerian Lecture which he delivered last spring, and in part in a previous paper communicated shortly before the last anniversary, have led him to take a different view of the constitution of nebulæ. According to the theory advanced by him, the mass of a nebula consists mainly of meteorites, which are constantly coming into collision here and there; and the glowing gas the existence of which the spectroscope reveals, is merely a portion of the matter, volatilized by the heat of collision. According to the former view therefore, the nebula consists of glowing gas, not yet condensed into a solid or liquid form, possibly in a condition even more elementary than that of the so-called elements that we know on earth; according to the latter it consists mainly of discrete portions of solid matter, and the glowing gas does not consist of the same matter permanently glowing, but is continually supplied afresh by fresh collisions.

A similar theory is applied to explain the self-luminosity of the nucleus, and sometimes the very root of the tail, of comets. A comet is regarded as a swarm of meteorites, moving in orbits not greatly differing from one another; and as the swarm approaches the sun collisions become more frequent, and individually more potent, from an increase in the velocities, differential as well as absolute; and a portion of matter is volatilized and rendered incandescent. As to the tail, the theory long ago suggested by Sir John Herschel has always seemed to me by far the most probable of those that have been advanced—namely, that it is due to the propulsion of excessively attenuated matter, owing to a repulsive force, probably of electrical origin, emanating from the sun. This view seems to be adopted both by Mr. Lockyer and Dr. Huggins; and the latter gentleman, in an earlier Bakerian Lecture, has suggested a new theory of the corona—the corona as distinguished from the prominences—namely, that it is not projected from the sun by molar forces due to the tremendous state of turmoil in which we have very strong reason for believing that the matter composing the sun exists, but of matter actually propelled from the sun by a repulsive force in the manner of the tails of comets.

Daring as some of these speculations may appear to be, there seems a great deal to recommend them, and the whole subject is one of extreme interest at the present day.

But I must not take up your time longer by dwelling on so special a subject; I proceed to matters more particularly connected with the occasion on which we are assembled.

The Council have awarded the Copley Medal of the year to my predecessor in this chair, Mr. Huxley, for his investigations on the morphology and histology of vertebrate and invertebrate animals, and for his services to biological science in general during many past years. These subjects lie so entirely out of the range of my own studies that I need hardly say that in attempting to give some idea of the more salient features of his investigations I am dependent upon the kindness of biological friends.

During the fifteen or twenty years which preceded the publication of Darwin's famous work, the "Origin of Species," the views and methods of comparative anatomists underwent a most marked change. Without that change, biologists would have been far less prepared to accept Mr. Darwin's work, and, what is even more important, would have been unprepared to make use of that work as a light enabling them to carry on the remarkable researches which have so brilliantly characterized the progress of biology during the last quarter of a century. That change was effected chiefly by the labours first of Johannes Müller, and subsequently of Huxley in this country, and of Gegenbaur in Germany. The labours of these men opened out the right road of morphological inquiry. It is not, perhaps, too much to say that Mr. Huxley's treatment of his subject in his "Morphology of Cephalous Mollusca" was to many young morphologists little short of a revelation, and all his other works of the same period, such as that on the Hydrozoa and on Tunicates, and, later still, his treatment of the Vertebrate skull and skeleton, and Arthropoda, produced in varying degree a like effect.

Closely allied to, or rather forming part of, his morphological labours, are his numerous palæontological researches, carried out for the most part while he was Palæontologist to the Geological Survey, researches characterized by the same clear morphological insight, researches which have been as profitable to animal morphology as useful to the geologist. The most important are perhaps those on the remarkable reptiles of the Elgin Sandstones and on the Dinosauria; but many others have great value, and his anniversary address to the Geological Society, in 1870, made its mark.

Though his career has been in the main that of a morphologist, he has through the common ground of histology given considerable help to physiology. An early paper by him "On the Cell-Theory," did much to clear away erroneous notions concerning the relations of structure to the actions of living beings. His article on "Tegumentary Organs" was a great step onward as regards both morphology and histology, and still remains a classical work; while, by other papers and in various ways, he has contributed to the progress of histology and physiology.

But, however important Mr. Huxley's original contributions to the advancement of our scientific knowledge have been, we should form a very inadequate idea of his benefits to the cause of science if we did not bear in mind also his singular ability and effectiveness as an expositor of science to the people, and the powerful influence he has exerted in the improvement of the teaching of

biology in its widest sense in this country. Indeed, it is not too much to say that the remarkable improvement which has taken place within the last few years must be ascribed either directly or indirectly to his influence, and has been in many cases due to his initiation.

The Rumford Medal has been awarded to Prof. Pietro Tacchini for important and long-continued investigations, which have largely advanced our knowledge of the physics of the sun.

Prof. Tacchini occupies a foremost place among those who have paid special attention to the physics of the sun. Since 1870 he has unceasingly observed, first at Palermo, and afterwards at Rome, the solar prominences. The information at our disposal at the present time, both as regards their distribution, their spectra, and the changes which take place in them, and their connection with other solar phenomena, rests to a large extent upon his individual efforts. His memoirs on this subject are very numerous. He has been engaged in the observation of four total solar eclipses, and from some of the phenomena therein observed has drawn the important conclusion that many of the so-called prominences are really descending currents.

A Royal Medal has been awarded to Sir Ferdinand von Mueller for his long services in Australian exploration, and for his investigations of the flora of the Australian continent.

For more than forty years von Mueller has been working, without intermission, at scientific botany and its practical illustrations. As a botanical traveller and collector, he has, to quote the words of Sir Joseph Hooker, "personally explored more of the Australian continent than any other botanist, except Allan Cunningham." No one has investigated the Australian flora and the geographical distribution of its components with so much perseverance and success, and no one has enriched our herbaria, laboratories, and gardens with materials for study to so great an extent. The eleven volumes of the "Fragmenta Phytographiæ Australiæ" contain the descriptions of a great series of new plants, and the unrestricted communication of his collections and observations to the late Mr. Bentham rendered possible the preparation of the "Flora Australiensis," in seven volumes, the only account of the vegetation of any large continental area which has at present been completed.

He has especially devoted himself to the elucidation of the most difficult though most characteristic groups of the Australian flora; and as a result of his labours in this direction, his "Eucalyptographia" may be more particularly mentioned, a work which will always be the standard of nomenclature for the intricate genus *Eucalyptus*. Of a similiar character are his descriptions and illustrations of the "Myoporineous Plants of Australia," and his "Iconography of the Genus *Acacia*." To him is also due the foundation of the Government Herbarium at Melbourne, the first great botanical collection formed in the southern hemisphere, and the future centre of all scientific work on the Australasian flora.

A Royal Medal has been awarded to Prof. Osborne Reynolds for his investigations in mathematical and experimental physics, and on the application of scientific theory to engineering.

Prof. Reynolds was among the first to refer the repulsion exhibited in that remarkable instrument of Mr. Crookes's, the radiometer, to a change in the molecular impact of the rarefied gas consequent upon the slight change of temperature of the movable body due to the radiation incident upon it; and in an important paper published in the Philosophical Transactions for 1879, he deduced from theoretical considerations the conclusion that similar phenomena might be expected to be observed in bodies surrounded by a gas of comparatively large density, provided their surfaces were very small. He verified this anticipation by producing on silk fibres, surrounded by hydrogen at the atmospheric pressure, impulsions similar to those which in a high vacuum affect the relatively large disks of the radiometer.

In an important paper published in the Philosophical Transactions for 1883, he has given an account of an investigation, both theoretical and experimental, of the circumstances which determine whether the motion of water shall be direct or sinuous, or, in other words, regular and stable, or else eddying and unstable. The dimensions of the terms in the equations of motion of a fluid when viscosity is taken into account involve, as had been pointed out, the conditions of dynamical similarity in geometrically similar systems in which the motion is regular; but when the motion becomes eddying it seemed no longer to be amenable to mathematical treatment. But Prof. Reynolds has shown that the same conditions of similarity hold good, as to the average effect, even when the motion is of the eddying kind; and moreover that if in one system the motion is on the border between steady and eddying, in another system it will also be on the border, provided the system satisfies the above conditions of dynamical as well as geometrical similarity. This is a matter of great practical importance, because the resistance to the flow of water in channels and conduits usually depends mainly on the formation of eddies; and though we cannot determine mathematically the actual resistance, yet the application of the above proposition leads to a formula for the flow, in which there is a most material reduction in the number of constants for the determination of which we are obliged to have recourse to experiment.

There are various other investigations of Prof. Reynolds's which time would not allow me to enter into, and I therefore merely mention his investigation of the relation between rolling friction and the distortion produced by the rolling body on the surface on which it rests, that of the effect of the change of temperature with height above the surface of the ground on the audibility of sounds, and his explanation of the effect of lubrication as depending on the viscosity of the lubricant.

The Davy Medal has been awarded to Mr. Crookes for his investigations on the behaviour of substances under the influence of the electric discharge in a high vacuum.

Mr. Crookes's remarkable series of researches which conducted him to the invention of the radiometer led him to work with excessively high vacua. In connection with this he found that an electric discharge in such vacua is capable of exciting effects of phosphorescence apparently quite different in their origin from those produced in the ordinary way by such discharges. The latter are clearly referable to the action of the ethereal undulations which are propagated from the seat of the discharge. But the former involve in some way the effect of the actual transference of the molecules of ponderable matter. These phenomena in the hands of Mr. Crookes opened up a new means of discrimination between different bodies, and he has applied them as a test for the discrimination of groups of rare earths, not yet fully investigated. The test went hand in hand with processes of chemical separation. But here a great difficulty presented itself. So very closely allied in their chemical properties are the members of the groups, that it was only by an excessively tedious and laborious system of fractional precipitation that Mr. Crookes was able to effect a pretty fair separation. Even still, the separate existence of some members of the groups is more or less problematical. It is for these most painstaking researches that the medal has been awarded.

The existence, or apparent existence, of so many earths of such close chemical relationship led Mr. Crookes to speculate on the possibility that after all the molecules of what is deemed a chemical element may not be absolutely alike, as chemists have almost universally believed, but only very approximately so, and that what is deemed the molecular weight of the substance may really be that of the average of its molecules. Should such groups exist, it is conceivable that by processes of very delicate chemical separation they might be split up again into sub-groups, the molecules of which still more nearly match one another; so that according to this view the number of groups into which an element, or what is deemed such, might be split up, not, be it observed, by any dissociation, but merely by a sorting of the molecules which are very nearly alike, may be somewhat indefinite.

Chemists will not probably be disposed to give up the idea of the perfect similarity of the individual molecules of elementary bodies; but it is surely legitimate for one who has worked so assiduously at these difficult separations to suggest, merely as a matter for chemists to think about, a possible view of the nature of elements different from that to which they have been accustomed.

MOTIONS OF THE SOLAR SYSTEM.[1]

NO other hypothesis has been suggested which offers such direct and complete answers to most of the questions which relate to the origin, structure, and unity of the universe, as Newton's law of gravity. It is but natural, therefore, that the

[1] Abstract of an Address before the Section of Mathematics and Astronomy of the American Association for the Advancement of Science, at Cleveland, O., August 15–22, 1888, by Ormond Stone, Vice-President of the Section.

majority of the problems which arise in regard to the motions of the solar system should have their origin in an effort to confirm that law.

The first attempt to apply Newton's law to all the motions of the solar system was made by Laplace. When, however, Lindenau and Bouvard undertook to compute their tables of the motions of the planets, a complete revision of Laplace's theory was found necessary. So enormous is the labour involved, that there exists, besides those mentioned, only one other complete set of theories and tables of the motions of the principal planets —that of Leverrier. Leverrier's tables of the inner planets are now nearly thirty years old. His tables of the outer planets are much later, having employed his attention almost to the day of his death. His tables of Jupiter and Saturn were published in 1876, and those of Uranus and Neptune in the year following. Newcomb's tables of Neptune were published in 1865 ; those of Uranus, in 1874. Hill's theory of Jupiter and Saturn, which has for years occupied his attention, has at last been completed, and he is now engaged in preparing tables therefrom. These are intended to form a part of a complete series of tables of the principal planets now being prepared under the direction of Prof. Newcomb at Washington. Another such series is also being prepared by Prof. Gyldén at Stockholm.

The values of the coefficients of the terms of short period in the motions of the principal planets are now pretty well known ; and the same might be said of the secular variations, were it not for the difference between theory and observation which exists in regard to the motion of the perihelion of Mercury, which was discovered by Leverrier, and has been confirmed by Newcomb, in a discussion of the observations of the transits of Mercury extending over a period of more than two centuries. The cause of this difference still remains unknown. The completion and comparison with observations of the new theory of the four inner planets, now being prepared under the direction of Prof. Newcomb, will be awaited with interest, with the hope that it may throw new light on this interesting subject.

The only recent original tables of the moon's motions are those of Hansen. These, like Leverrier's tables of the inner planets, are now more than thirty years old. These tables have been compared with observations, and agree fairly well with those made during the century preceding their publication, but not with those made before or since that time. The theoretical value of the acceleration of the moon's longitude is 6″ ; that found by Hansen from accounts of ancient total eclipses of the sun, 12″. Newcomb, however, considers these accounts as unreliable, and, limiting himself to the Ptolemaic eclipses of the "Almagest" and the Arabian eclipses of the "Table Hakémite," obtains the value 8″·3, or, from the Arabian eclipses alone, 7″ —a value but little greater than the theoretical value. Dr. Ginzel, from an extended examination of accounts of ancient and mediæval total eclipses of the sun, concludes that Hansen's value requires a change of only a little over 1″. His solution, however, in reality depends upon the ancient eclipses alone. The only other theory of the moon comparable with Hansen's is that of Delaunay. This theory, however, is limited to a determination of the inequalities in the motion of the moon due to the action of the sun, on the hypothesis that the orbit of the earth is a pure ellipse, and differs from that of Hansen in that the inequalities determined are not expressed numerically, but only symbolically in terms of arbitrary constants.

While the coefficients of the inequalities upon which Hansen's tables are based seem to be pretty well known, I am not aware that the tables themselves have been sufficiently checked, except by comparison with observations. Apparently the great desideratum now is a set of tables computed from Delaunay's theory in a completed form, or computed in some other way entirely independently of Hansen's. Until Hansen's tables are thus checked, it is questionable whether it can be safely said that the motion of the moon cannot be completely accounted for by the law of gravity.

The detection of the two satellites of Mars by Prof. Hall may be considered the most interesting recent achievement in pure discovery. It was not till the discovery of these satellites that a means was offered for the accurate determination of the mass of that planet. No satellites of Venus and Mercury have as yet been detected, and the values at present assumed for the masses of those planets are very uncertain.

In 1788, just one hundred years ago, Laplace published his theory of Jupiter's satellites. This theory is still the basis of the tables now in use. Souillart's analytical theory of these satellites appeared in 1881. The numerical theory was completed only within the last year, and the tables therefrom remain still to be formed.

Bessel made a careful investigation of the orbit of Titan ; but the general theory of the Saturnian system which he commenced, he did not live to finish. Our knowledge of the motions of Saturn's satellites, with the exception of Titan, was very meagre until the erection of the great equatorial at Washington. A difficulty in the determination of a correct theory of the motions of Saturn's satellites is the fact that there are a number of cases of approximate commensurability in the ratios of their mean motions. The most interesting case is that of Hyperion, whose mean motion is very nearly three-fourths that of Titan. In this case there is the additional difficulty that their distance from one another is only about one-seventh as great at conjunction as at opposition.

Our knowledge of the motions of the satellites of Uranus and Neptune depends almost entirely on the observations made at Washington. Quite accurate determinations of the masses of these two planets have been obtained. The large secular motion of the plane of Neptune's satellite, to which Marth has called attention, needs confirmation.

The number of the asteroids is so great that they have been the frequent subject of statistical investigation. The systematic grouping of the nodes and perihelia which exists was shown by Newcomb to be the effect of perturbation. Glauser finds that the grouping of the nodes on the ecliptic is a result of a nearly uniform distribution on the orbit of Jupiter. Prof. Newton had previously found that the mean plane of the asteroid orbits lies nearer to the plane of Jupiter's orbit than to the orbit plane of any individual asteroid. Eighty-five per cent. of the asteroids have mean motions greater than twice and less than three times that of Jupiter ; and the mean motions of none approximate closely either of these, the two simplest ratios possible. The next simplest ratios lie beyond the limits of the zone ; that is, there are no asteroids having mean motions nearly equal to or less than one and a half times that of Jupiter, and none nearly equal to or greater than four times that of Jupiter. The labour of determining the general perturbations and computing tables of an asteroid is as great as in the case of a major planet. It is no wonder, therefore, that tables have been prepared for scarce a dozen of these small bodies, and that these are already out of date.

Of well-known comets of short period, Encke's, which has the shortest period of any, possesses the greatest interest to the student of celestial motions, since it was from a discussion of the orbit of this comet that Encke detected evidence of the existence of a resisting medium which produces an acceleration in the comet's mean motion. This acceleration has been confirmed by the investigations of Von Asten and Backlund. The investigations of Oppolzer and Haerdtl indicate that there is an acceleration also in the mean motion of Winnecke's comet.

We have thus glanced briefly at the present condition of our knowledge of the motions of the principal bodies of the solar system. Only four cases have been found in which we cannot fully explain these motions, so far as known, by Newton's law of gravity. The unexplained discordances are the motion of the perihelion of Mercury, and the accelerations of the mean motions of the moon and the two periodic comets just named.

If we go beyond the solar system, we cannot tell whether Newton's law does or does not apply without modification to all parts of the universe. It is principally in the hope of answering this question that double-star observations are carried on ; and, in the case of the many binary systems already detected, Newton's law is satisfied within the errors of observation. Nevertheless, this evidence is purely negative, and its value, it seems to me, not at all commensurate with the labour expended upon it, unless it be in the case of such objects as Sirius, whose observation may assist in the solution of the problem of irregular so-called proper motion. The angles subtended are in general so small that relatively large personal errors are unavoidable ; so that, even though their motions be controlled by a law or laws of gravity widely different from that of Newton, it is not likely that such differences can be proved with any degree of certainty. It is rather to the study of the proper motions of the fixed stars and of the nebulæ, and then only after a lapse of hundreds and perhaps thousands of years, that we must look for a solution of this question.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—It is proposed to alter the system of papers in the second part of the Natural Sciences Tripos, which has lasted for many years, according to which questions in each subject are set in every paper. Formerly one question in each subject was so set; latterly at least two questions in each have been set. It is considered that under the present system candidates with an extensive knowledge of one subject may not have time to show such a competent knowledge of a second as is required to gain a first class. It is now proposed to set four separate papers in each of the eight subjects, and to combine them in groups of two subjects, so as to get the examination over in eight days. Probably this may remedy the evil complained of, which can only affect a minimum of candidates; but it will re-introduce the evil which the present system was intended to obviate—namely, it will give an opportunity for taking a number of subjects by means of cramming. It is also proposed to make the change next June, an altogether insufficient length of notice.

Prof. W. G. Adams, F.R.S., has been approved for the degree of D.Sc.

Mr. Francis Darwin, M.A., F.R.S., Reader in Botany, has been elected to a Fellowship at Christ's College.

Dr. Hill, Master of Downing College, has been appointed University Lecturer in Advanced Human Anatomy, and Mr. Walter Gardiner, Fellow of Clare College, University Lecturer in Botany, for five years in each case.

Dr. Guillemard has resigned the University Lectureship in Geography owing to ill-health, and a fresh election will take place in January, for the remainder of the term of five years, ending midsummer 1893. The stipend is £200 per annum. Candidates must send their names, with brief statements of their qualifications, and the methods they propose to adopt, to the Master of Caius College on or before January 8 next.

SCIENTIFIC SERIALS.

The Quarterly Journal of Microscopical Science for October 1888 contains the following:—On the structure of three new species of earthworms, with remarks on certain points in the morphology of the Oligochæta, by Frank E. Beddard (Plates xii. and xiii.).—This paper contains an anatomical description of *Acanthodrilus annectens*, n. sp., and *Deinodrilus benhami*, nov. gen. et. sp., from New Zealand, and *Typhæus gammii*, n. sp., from Darjeeling. Among the more important anatomical facts detailed, are the independence of the vasa deferentia and atria in Acanthodrilus; the independence of the single vas deferens and its atrium in Typhæus; the occurrence of six pairs of setæ in each (setigerous) somite of Deinodrilus; the completely double dorsal blood-vessel of Deinodrilus in a separate cœlomic space; and the presence in *Moniligaster barwelli* of an atrium consisting of a thick glandular covering of peritoneum, of a layer of muscular fibres, and finally of a single layer of columnar epithelium; the atrium being similar to that of Rhynchelmis.—On the development of the fat-bodies in *Rana temporaria*; a contribution to the history of the pronephros, by Arthur E. Giles (Plate xiv.). The fat-bodies in the frog are formed by a fatty degeneration, not of the anterior end of the genitalia, but of the pronephros or head kidney; it seems highly probable that the structure described by Balfour in the Ganoids and Teleostei as lymphatic tissue is the persistent but structurally and functionally modified pronephros.—On two new types of Actinaria, by Dr. G. Herbert Fowler (Plate xv.). In a bottle of corals, which had been collected from the reefs off Papieté during the expedition of H.M.S. *Challenger*, three small Actinaria were found, which would seem to differ markedly from all hitherto described types; so much so as to possibly necessitate the formation of a new tribe, of equal value with the Edwardsiæ, &c. The name proposed is *Thaumactis medusoides*, gen. sp. nn. The animal is flattened in shape, and almost medusiform; it appears to be free-swimming, for the aboral is like the oral ectoderm, and there is no trace of any attachment. Fourteen true tentacles surround the stomodæum, and peripherally to them are the pseudo-tentacles; the true tentacles with the stomodæum are drawn downwards and outwards into the cœlenteron; in the largest specimen twenty-one pairs of mesenteries, and in the smallest eleven pairs were present; no generative organs were met with. The second form was found attached to a piece of Millepore and is called *Phialactis neglecta*, gen. sp. nn. In this new genus the tentacles are replaced not by stomidia—slight elevations of the oral disk, surrounding the large opening which is homologous with the pore at the tip of some normal Actinarian tentacles—but by what the author calls "sphæridia," *i.e.* ampullate diverticula of the inter- or intra-mesenterial chambers, devoid of an opening to the exterior, and homologous, therefore, with the imperforate tentacles of many genera.—Morphological studies, ii. The development of the peripheral nervous system of Vertebrates; Part i, Elasmobranchii and Aves, by Dr. J. Beard (Plates xvi.–xxi.). This important memoir has appended to it a *résumé* of its chief results.

Revue d'Anthropologie, troisième série, tome iii. fasc. 6 (Paris, 1888.)—On the conversion of the cephalic index into a cranial index, by M. P. Topinard. This paper gives the author's reply to the objections raised by M. Houzé, of Brussels, against his method of determining comparative cephalic and cranial measurements. He explains the various methods employed by Broca and others, and points out the sources of error dependent upon the varying length of time in which skulls have been preserved owing to the gradual drying up of the cranial substance after prolonged preservation in our museums. Thus the craniometric determinations made under the latter conditions must be different from those obtainable immediately after death, or on removal from a damp humus.—Continuation of M. Boule's essays on the stratigraphic palæontology of man. The relations between the Pliocene and the Glacial formations of North America are here considered at length. In concluding his summary of the results yielded by the valuable labours of American palæontologists, M. Boule expresses his assent to the opinion advanced by Mr. Putnam, that recent discoveries afford conclusive evidence that a portion of North America from the Mississippi to the Atlantic was occupied by man contemporaneously with the mastodon and the mammoth, at a period when all the north of the continent was covered by vast glaciers. The closing part of the paper treats of the French classical beds at Chelles, Saint-Acheul, &c., from which date the earliest researches regarding fossil man in France.—On the concurrence in certain crania of divergent characteristics as exemplified in a series of Burmese skulls, by M. Hovelacque.—Kashgar and the passes of the Tian-shan Range, by Dr. Seeland. This is the first of a series of papers communicated by the doctor appointed by the Russian Government to institute proper measures for preventing the advance into the provinces of Semiretche and Ferganah of the severe epidemic of cholera, which had broken out in the Kashgar dominions in 1886. These provinces, which remained in a savage and uncultivated condition till they were brought under Russian dominion in 1862, are necessarily almost a *terra incognita*; and hence Dr. Seeland's narrative of his travels from Vierny to Ak-su in Kashgar, by way of Naryne, which compelled him to cross the colossal range of the Tian-shan range, is a valuable addition to our geographic knowledge of this portion of the Russo-Chinese frontier-lands, while his descriptions of their natural products, and his remarks on the habits and character of the Kirghis hordes, now being thrust back by the Russians, supply much information that is new to science.—Palæontology in Switzerland, by Dr. Victor Gross. This is a useful summary of the large and important mass of materials accumulated by recent Swiss palæontologists. After treating of the various periods of cave and lacustrine habitations, and of the later pile-dwellings, or *crannoges*, he considers at length the character and importance of the various finds belonging to the several stations. Of these, the Lakes of Bienne and Neuchâtel are remarkable, as having already yielded more than 19,500 complete bronze objects, of which fully three-fourths were of a decorative or domestic character, rings and pins numbering 4000. Important investigations are at present being carried out at the La Tène station, where the finds have hitherto been so exclusively connected with weapons of offence and defence as to lead to the inference that its pile constructions marked the site of some primitive fort. The search for lacustrine graves, successfully begun in 1876 is also being vigorously prosecuted.

Memoirs of the St. Petersburg Society of Naturalists, vol. xix.—*Geology and Mineralogy*:—*Dactylodus rossicus*, a new species of fish from the Moscow Coal-measures, by A. Inostrantseff.—The diabase deposits of Olonets, by F. Levinson-Lessing, being an elaborate work which contains a general geological and geographical description of the region, and a detailed

petrographical description of the rocks and their metamorphoses. A sketch-map and five plates of microscopical sections accompany the paper, which is well summed up in German.—Geological observations on the Yug River, by B. Polyenoff.—On the *Spaniodon barbotii* deposits of Crimea and the Caucasus, by N. Andrusoff (also summed up in German).—*Zoology and Physiology*:—Notes on the ichthyology of the basin of the Amur, by N. Warpachowski and S. Hertzenstein, being an elaborate description of forty species, and their connection with kindred species in neighbouring regions (diagnoses in Latin, and the whole summed up in German).—On the Vertebrate fauna of the Balkhash depression, by M. Nikolsky. The most interesting conclusions of the author as to the recent geological history of the Balkhash depression have already been mentioned in NATURE. Now we have a full description of the fauna (39 mammals, 226 birds, 21 reptiles, 3 amphibians, and 16 fishes), together with an elaborate inquiry into the connection of this fauna with those of the neighbouring regions.—The *Percarina* and *Benthophilus* of the Sea of Azoff, by J. Kuznetsoff.—The minutes of proceedings contain several papers of great interest—namely, on a journey to Dutch India, by A. Korotneff; on the ornithology of Caucasus, by K. Rossikoff; on the fossils of the Nijne-udinsk cave, by I. Tcherski; on a journey to Turkestan and Bukhara, by S. Lidsky, &c.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 22.—"On the Magnetization of Iron and other Magnetic Metals in very Strong Fields." By J. A. Ewing, B.Sc., F.R.S., Professor of Engineering in University College, Dundee, and William Low.

The large magnet of the Edinburgh University, kindly lent by Prof. Tait, was used throughout the experiments, and allowed the authors to effect a high concentration of the magnetic force by using bobbins, the necks of which had a cross-sectional area of (in some cases) only $\frac{1}{15\cdot00}$ of the cross-sectional area of the magnet cores. By this means the induction $\mathfrak{B}$ was raised to the following extreme values:—

	C.G.S.
In wrought iron	45,350
,, cast iron	31,760
,, Bessemer steel	39,880
,, Vickers's tool steel	35,820
,, Hadfield's manganese steel	14,790
,, nickel	21,070
,, cobalt	30,210

The induction was measured by means of a coil consisting of a single layer of very fine wire wound upon the central neck of the bobbin. Outside of this coil, at a definite distance from it, a second coil was wound, and the magnetic force was determined in the annular space between the two. In a paper communicated to the Manchester meeting of the British Association, the authors showed that if the force so measured could be proved to have the same value as the magnetic force within the metal neck itself, it would follow that the intensity of magnetism $\mathfrak{I}$ had begun to diminish under the action of excessively strong fields, in the manner which Maxwell's extension of the Weber-Ampère theory of molecular magnets anticipates. In the present paper the authors discuss at some length the question of how far the magnetic force within the metal is fairly measurable by the magnetic force in the ring of surrounding air, and they show that, with the form of cones originally used, the force within the metal must have been less than the force outside, by an amount probably sufficient to explain the apparent decrease of $\mathfrak{I}$. The form of cone suited to give a uniform field of force with sensibly the same value in the metal neck and round it is investigated; and experiments are described in which the condition necessary for a uniform field was satisfied. The results of these experiments are conclusive in showing that no considerable change takes place in the value of $\mathfrak{I}$ (in wrought-iron) when the magnetic force is varied from about 2000 to 20,000 C.G.S. units. Throughout this range of force, the intensity of magnetism has a sensibly constant value of about 1700 C.G.S. units, which is to be accepted as the saturation value for wrought iron. The term saturation may be properly applied in speaking of the intensity of magnetism, but there appears to be no limit to the degree to which the magnetic induction may be raised.

The following are probable values of the intensity of magnetism when saturation is reached in the particular metals examined:—

	Saturation value of $\mathfrak{I}$.
Wrought-iron	1700
Cast-iron	1240
Nickel (with 0·75 per cent. of iron)	515
Nickel (with 0·56 per cent. of iron)	400
Cobalt (with 1·66 per cent. of iron)	1300

Experiments were also made with specimens of Vickers's tool steel, and other crucible steels, Whitworth's fluid-compressed steel, Bessemer steel, Siemens steel, and Hadfield's manganese steel. This last material, which is noted for its extraordinary impermeability to magnetic induction, was found to have a constant permeability of about 1·4 throughout the range of forces applied to it—namely, from 2000 to nearly 10,000 C.G.S.

Physical Society, November 24.—Prof. Reinold, President, in the chair.—Captain Abney read a paper on the measurement of the luminosity of coloured surfaces, which was illustrated by experiments. In a communication to the Royal Society, General Festing and the author have described a method of comparing the intensity of the light of different parts of the spectrum, reflected by various pigments, with that reflected from white, and luminosity-curves have been constructed, the areas of which give comparative measures of the total luminosities. This method of comparison is accurate, but requires considerable time, and the author has devised a more rapid process. The coloured surface whose luminosity is to be compared with white is placed beside a white patch within a dark box. A direct beam of light passes through an aperture in the box, and a black rod casts a shadow on the coloured patch; another beam from the same source is reflected at an angle, and forms a shadow of the same rod on the white patch, the junction of the two shadows coinciding with that of the two surfaces to be compared. In the path of the direct beam is placed a rotating disk with angular openings, adjustable whilst rotating by a simple lever, and by this means the white patch can be made to appear too light and too dark in rapid succession. By gradually diminishing the range of oscillation of the lever, a position of equal luminosities can be found. The coloured surface is now replaced by a white one, and the adjustment again made; and from the angular apertures required in the two cases the relative luminosities are determined. Comparisons made in this way (the numbers relating to which are given in the paper) with emerald green, vermilion, French ultramarine, &c., gave results in close agreement with those deduced from the luminosity-curves obtained by the spectrum method. In reply to questions, Captain Abney said the spectrum method was the more accurate, and could be relied on to 1 per cent. The new method gave results within 2 per cent., showing that the eye is very sensitive to small changes of luminosity when such changes take place in rapid succession.—Prof. Rücker made a communication on the suppressed dimensions of physical quantities. In arranging a system of dimensional equations for thermal quantities, the question arises as to what are the dimensions of temperature. A degree of temperature, as measured by the ordinary arbitrary method of the mercurial thermometer, is not affected by changes in the units of length, mass, and time; but the numerical values of thermal quantities (J, for instance) depend on the scale of temperature adopted, say Centigrade or Fahrenheit. Two courses seem open, either of which renders a complete system of thermal dimensional equations possible: (1) temperature may be considered as a measure of energy, as in the kinetic theory of gases, and may be expressed as the energy of translation of a standard number of molecules (say that number contained in 1 cubic centimetre of air at standard pressure and temperature); or (2) temperature may be considered as a secondary fundamental unit. If the first be adopted, the dimensions of specific heat become M^{-1}, and the temperature of 0° C. is expressed by $1\cdot5207 \times 10^6$ ergs. If a practical unit corresponding to $\frac{10^5}{18}$ ergs be adopted, this new unit of temperature will coincide with the Centigrade degree to about 1 part in 3000. The chief objection to such a definition of temperature is that the above relation between temperature and energy is not yet proved to hold for liquids and solids. If the second course be adopted, the dimensions of all thermal quantities may be expressed in terms of M, L, T, and θ, where θ is the unit of

temperature. Attention was directed to the difficulties students generally experience on finding the dimensions of the same electrical quantities to be different, according as they are expressed in electro-static or electro-magnetic measure, and that different quantities may have the same dimensions. The anomalies are shown to be due to the suppression of the dimensions of specific inductive capacity and permeability, each being called unity in air. By retaining K and μ in the dimensional equations, the author thinks that many difficulties will be avoided, the methods of transformation of units will be generalized, and the limits of our knowledge kept more clearly in view. Though the dimensions of K and μ cannot be determined, it is easily shown that those of the product $K^{\frac{1}{2}} \mu^{\frac{1}{2}}$ are $L^{-1} T$. Mr. Blakesley, in commenting on thermal units, strongly protested against the use of the word "*therm*" as a name for the unit of heat. If used at all, it should be reserved for the unit of temperature. Referring to the choice of fundamental units, he reminded the Society that the dimensions of quantities expressed in the electro-static or electro-magnetic systems become identical if the unit velocity be the velocity of light, and by choosing the unit of time as a suitable decimal part of a day, the relation between electrical and practical mechanical units could be simplified. Prof. Carey Foster, after discussing the effect of defining specific heat as a ratio, or as a quantity of heat as the dimensions of temperature, pointed out that, as quantity of heat = temperature × entropy, the dimensions of temperature would be determinate if those of entropy were found. Prof. S. P. Thompson considered that part of the difficulties of dimensional equations arose from the fact that no distinction was made between *scalar* and *vector* quantities. Thus the dimensions of work and moment of a force are given as ML^2T^{-2}, whereas the true representation for the latter would be $ML^2T^{-2}\sqrt{-1}$, because the line by which the force is multiplied is at right angles to the force. By similar considerations, Ampère's rule for the force between two parallel current elements can be derived from the magnetic equation $\frac{m \cdot m'}{r^2} = f$, for, replacing m and m' by equivalent current elements, $i \cdot ds$ and $i' \cdot ds'$, the equation becomes—

$$f = \frac{\sqrt{-1}\, i \cdot ds \cdot \sqrt{-1}\, i' \cdot ds'}{r^2}$$

$$= \frac{-i^2 ds \cdot ds'}{r^2}.$$

Referring to the use of "therm," Dr. Thompson concurred with the remarks of Mr. Blakesley, and thought the word "calorie" answered all requirements. He also considered that thermal equations were greatly simplified by always expressing specific heat in ergs. Prof. Ayrton was of opinion that students experienced much greater difficulty in dealing with electrical units than with thermal ones, and thought part of this was due to the vague way in which some of the standard text-books treated the subject. With reference to the force exerted by quantities of electricity, Prof. Perry and himself had pointed out that specific inductive capacity must be taken into account, for, contrary to Faraday, they had found it to be different in different gases. In reply, Prof. Rücker said he often explained the identity of the dimensions of work and moment of a force, by considering moment as measured by the work done in rotating through unit angle, the dimensions of angle being zero as regards L, M, and T. He also pointed out that, in Bayne's "Thermodynamics," specific heats are always expressed in ergs. In thanking Prof. Rücker for his interesting paper, the President expressed his conviction that, by paying attention to the points considered, the difficulties arising from the two systems of units would be considerably diminished.

Chemical Society, November 15.—Mr. W. Crookes, F.R.S., in the chair.—The following papers were read:—The principles of thermo-chemistry, by Mr. S. U. Pickering. The author rejects the thermo-chemical principles enunciated by Thomsen, Naumann, and Berthelot, not only on special grounds, but on the more general ground that they depend on an impossible distinction between chemical and physical actions. A satisfactory explanation of all known thermo-chemical facts is derived from the recogni ion of the laws of dissociation and the hydrate theory of dissolution. Every act of combination must be accompanied by the evolution of heat, and in interactions where heat is absorbed this absorption must be due to the fact that, one or more of the agents being partially dissociated at the temperature of the interaction, the removal of one of the products of the dissociation necessitates a further decomposition of the agent. The heat evolved must also be a direct measure of the affinities saturated; and, of two possible interactions, that which evolves more heat must occur to the exclusion of the other. The cases of endothermic changes which present difficulties are those in which liquids and solids are concerned. The heat absorbed when many solids are dissolved in liquids cannot be explained by the fusion, but only by the volatilization of the solid. A mass of water contains some fundamental molecules possessing an energy of 10,000 cal greater than the average molecular aggregates constituting the mass. These can therefore combine with the salt, and effect its volatilization with an evolution of heat, even if the heat of volatilization be nearly 10,000 cal.; other water aggregates then dissociate to supply the place of the free molecules thus removed from the sphere of action. From theoretical considerations the author arrives at the conclusion that Berthollet's theory as to the division of a base between two acids is correct, and argues that the facts observed are in accordance with these conclusions, and are entirely opposed to the existence of the so-called "avidity" or "affinity" constants advocated by Ostwald and others. In the discussion which followed the reading of the paper, Prof. Ramsay, F.R.S., said that he did not believe in the universal presence of complex molecules in liquids and solids, nor did he exclude the existence of such; the researches of Prof. Young and himself, he thought, conclusively established the absence of a complex molecular structure in such liquids as ethyl alcohol and ether, whilst, on the other hand, Henry's arguments testified to the complexity of the molecules of certain oxides, such as silica. With regard to water, which specially formed the subject of Mr. Pickering's remarks, it was to be noted that, whilst the vapour-density pointed to molecular simplicity, other arguments drawn from its behaviour when examined by Raoult's method were in favour of moderate molecular complexity. Prof. Armstrong, F.R.S., remarked that by taking into account the action of water, Mr. Pickering had advanced what appeared to be a rational explanation of many facts which hitherto had appeared paradoxical.—Note on the mixture of propyl alcohol and water, by Prof. Ramsay, F.R.S., and Prof. Young. The authors have determined the vapour-pressures of a mixture of propyl alcohol and water in the proportions $C_3H_8O : H_2O$, and like Konowalow, arrive at results adverse to the conclusion that a definite hydrate exists. Chancel found that this mixture distils over to the last drop at 87°·5 under 738 mm. pressure, but the authors find that the composition of the mixture of constant boiling-point varies with the pressure under which distillation takes place.—Note on the action of nitric acid on ammonium chloride, by Dr. F. E. Matthews. The principal gaseous product of the action of nitric acid on ammonium chloride in solution is nitrous oxide, and not nitrogen, as has been previously stated; the gas is mixed with small quantities of chlorine and oxychloride of nitrogen.—Ethylic cinnamyldiethacetate, by the same.—The isomeric sulphonic acids of β-naphthylamine, by Mr. A. G. Green. Three acids—the α-, β-, and γ-acids—are known to be formed when β-naphthylamine is sulphonated with ordinary sulphuric acid at 100°, but the author finds, as was to be expected, that the δ-acid is also present. The analogous behaviour of hydroxy- and amido-compounds makes it probable that β-naphthol on sulphonation gives four isomeric sulphonic acids, although two only have hitherto been isolated, and the author's experiments confirm this view, inasmuch as he has succeeded in isolating a third acid—corresponding to the β-naphthylamine-δ-sulphonic acid—from the product formed on sulphonating β-naphthol at 100°. In the discussion which followed, Prof. Armstrong, F.R.S., and Mr. Wynne pointed out that the formula adopted by Mr. Green as representing the constitution of the β-naphthylamine-α-sulphonic acid was at variance with the views put forward by Cleve and others, and could not be accepted; Mr. Green, in reply, defending his view that the α-acid is an ortho-compound, mainly on the ground that it and the corresponding β-naphtholsulphonic acid differed so greatly in properties from their isomerides.—The constitution of the dichloronaphthalenes, especially the αβ-compounds, by Prof. Armstrong, F.R.S., and Mr. W. P. Wynne. The three possible αα- and the two possible heteronucleal ββ dichloronaphthalenes are known, and formulæ have been ascribed to them which almost certainly are correct expressions of their constitutions. The authors point out that the four possible αβ-dichloronaphthalenes are also known, and draw attention to the somewhat discrepant statements on record relating to the so-

called θ-modification, melting at about 61°. The authors have found (Brit. Assoc. Report, 1887, p. 231) that under this designation two distinct dichloronaphthalenes have been regarded as one, and now bring forward evidence showing that one of these, melting at 61°·5, is a homonucleal, and the second, melting at 64°, is a heteronucleal αβ-derivative. They confirm Cleve's view that the dichloronaphthalene, melting at 34°, is a homonucleal αβ-compound, the dichloronaphthalene melting at 48° being the remaining heteronucleal αβ-derivative. With regard to the constitution of the two homonucleal αβ-dichloronaphthalenes, the authors show that that melting at 61°·5 must be the *meta*-compound (that melting at 34° being, by exclusion, the ortho-derivative), since their experiments prove that so-called α-dichloronaphthalene, melting at 38°, and obtained by treating naphthalene tetrachloride with alcoholic potash, is a mixture of two homonucleal dichloronaphthalenes—namely, the αβ-derivative melting at 61°·5, and the αα-derivative melting at 68°. Sufficient data have not yet been obtained to determine the constitution of the heteronucleal αβ-dichloronaphthalenes.—Piazine derivatives, by Dr. A. T. Mason. A continuation of the author's work on a class of compounds formerly known as ketines, and more recently as pyrazines.

Anthropological Institute, November 27.—Francis Galton, F.R.S., President, in the chair.—The President exhibited a gold breastplate from an ancient Peruvian grave.—Mr. F. W. Rudler exhibited a collection of ethnological objects from the Jivaros of the Upper Amazons, and the Arawaks and the Acaways of the interior of British Guiana.—Mr. G. F. Lawrence exhibited two Palæolithic implements from the valley of the Thames, near Erith.—Mr. Osbert H. Howarth read a paper on the survival of corporal penance, and exhibited specimens of the "*disciplinas*," or scourges, which are still used, in public penance, in the village of Fenães d'Ajuda, a remote community on the north coast of St. Michael's, Azores.—The Secretary read a paper by the Rev. Benjamin Danks on marriage customs of the New Britain Group.

PARIS.

Academy of Sciences, December 3.—M. Daubrée in the chair.—Observations of the minor planets made with the great meridian instrument of the Paris Observatory during the first half of the year 1888, by M. Mouchez. The right ascension and polar distance, with correction of ephemerides, are tabulated for Diana, Danaë, Athamantis, Astrea, Parthenope, Flora, Sappho, Hebe, Cyrene, Germania, and five other minor planets.—On the satellites of Mars, by M. H. Poincaré. The paper deals with M. Dubois's recent hypothesis (*Comptes rendus*, August 20, 1888), that Phobos and Deimos were originally small planets, which a few years ago passed within the attraction of Mars. This hypothesis, which is based on the fact that the two satellites were never observed before 1877, is shown to be inadmissible by a consideration of the eccentricity of the orbit of Mars, and on other grounds. Although the eccentricity of Mars is about six times greater than that of the earth, it can be demonstrated that the elements of its moons cannot have perceptibly varied during the last hundred years.—On the preparation of the phosphorescent sulphides of calcium and strontium, by M. Edmond Becquerel. The author, who has lately resumed the study of these sulphides, now finds that some of the added substances, when employed alone, fail to produce any appreciable effect, and that the simultaneous presence of several is sometimes necessary for the preparation of strongly luminous bodies. The modifications depend not only on the nature of the mixed substances, but also on that of the phosphorescent sulphide itself.—On the invariants of differential equations, by M. E. Goursat. Since M. Halphen's researches on linear differential equations, M. Appell and others have extended the notion of invariants to differential equations of a more or less general form for certain special categories of transformations, without, however, determining in a general way the existence of these invariants. The determination is here effected by a demonstration based on Herr Lie's *Theorie der Transformationsgruppen*, (Leipzig, 1888).—On the dark waters of the equatorial regions, by MM. A. Muntz and V. Marcano. For the purpose of ascertaining the cause of the dark colour so characteristic of numerous affluents of the Amazons and Orinoco, the authors have analyzed some specimens from the upper course of the latter river. They conclude that the discoloration is due to the free humic acids held in solution, and derived from the decomposition of vegetable matter on a granite soil free from lime. The liquid is thus in some respects of the nature of bog-water, and the colour persists because, in the absence of lime, the phenomena of nitrification, and consequently the combustion of the organic matter, cannot take place, as shown by the complete absence of nitrates. The waters themselves are perfectly limpid, wholesome, and palatable, for although the discoloration is primarily due to their chemical composition, its intensity must be attributed to phenomena of reflection produced by the great depth of the liquid masses.—On the benzoic acetals of mannite and its homologues; decomposing action of benzoic aldehyde, by M. J. Meunier. The acetal of mannite is readily obtained by dissolving it in hydrochloric or sulphuric acid, adding a corresponding quantity of benzoic aldehyde and shaking; the mixture is rapidly transformed to acetal and solidifies. When a benzoic acetal, and doubtless others also, is completely freed from the excess of aldehyde, it resists the action of the acids as well as of the alkalies, and is not decomposed by prolonged boiling with acidulated water. In the presence of the aldehyde, on the contrary, decomposition takes place very rapidly by boiling, and all the more rapidly the greater the excess of aldehyde, even if the liquid be but slightly acidulated, containing, for instance, not more than 1 per cent. of sulphuric acid. Benzoic aldehyde thus influences the hydration of the acetal and the consecutive formation of mannite.—Action of the sulphide of carbon on clays; production of the oxysulphide of carbon, by M. Armand Gautier. During his researches on the mineralizing elements of thermal waters, the author has been led to attempt the synthesis of the oxysulphide of carbon by causing the vapours of the sulphide of carbon to act at red heat on the natural silicates, and especially on the argillaceous earths. These essays have been successful, and a method is here described which alone can furnish the oxysulphide of carbon, COS, in a pure state and in large quantities.—Transformation of terpilene into a menthene, by MM. G. Bouchardat and J. Lafont. By exposing terpine, $C_{20}H_{16}.2H_2O_2$, for fifteen hours at 100° C. to twenty times its weight of aqueous hydriodic acid saturated at 0°, the authors have produced a dihydriodate of crystallized terpilene, $C_{20}H_{16}.2HI$, identical with the dihydriodate of the essence of terebinthine. From their further researches they conclude that natural menthol should perhaps be grouped with the terpilene series.—On a spermaceti whale taken in the Azore waters, by Prince Albert of Monaco. Photographs are given of the head of a large spermaceti whale harpooned last summer in the neighbourhood of the Azores. It measured from the eye to the upper extremity of the mouth 1·90 metre, and from the under jaw to the lip 1·16 metre.—Papers are contributed by M. G. Saint-Remy on the brain of the spider family; and by M. A. Giard on *Peroderma cylindricum*, Heller, a parasite of the sardine.

BERLIN.

Physical Society, November 16.—Prof. du Bois-Reymond, President, in the chair.—Prof. von Bezold made a further communication on the thermo-dynamics of the atmosphere, in continuation of a statement made to the Society earlier in the year. After briefly recapitulating the processes which occur during the adiabatic expansion of a mass of air as it rises, he introduced into thermo-dynamic considerations a new idea, brought forward by Helmholtz, and found to be extremely convenient. The idea is that of "potential temperature," or in other words the absolute temperature assumed by a mass of air when it comes adiabatically under normal pressure. The speaker then propounded the following as a general law: "Whenever a mass of air changes its condition adiabatically, the potential temperature is never diminished, it is usually increased, and sometimes is unchanged." This law was proved from a number of examples. During the adiabatic alterations of pressure and volume in the currents of air as they rise and fall, the temperature should fall, on the average, about 1° C. for a height of 100 metres; as a matter of fact, the fall is really less than 1° C. This is due to the fact that under natural conditions the processes do not occur adiabatically, since near the earth's surface and above the level of the clouds warming and cooling influences are brought to bear on the air. In an anticyclone the powerful radiation from the earth leads to a cooling of the lower strata of air, and to this is due the fall of temperature observed at all stations which are situated on a height, a phenomenon which, according to the speaker, must also make its appearance at lower levels during maximal pressures of the air in winter and during the night. In cyclones the fall of temperature with increasing altitude similarly differs from its theoretical value, since warm air from the neighbouring anti-

cyclone becomes mixed with the colder air as it is rising, owing to the whirling motion : as a result of this, the formation of clouds must be most dense in the centre of the cyclone, and thinner towards its periphery. The latent heat liberated during the condensation accompanying cloud-formation is only obvious in the anticyclone, since it merely slows the rate of cooling in the rising current of air ; on the other hand, the cold rain-drops as they fall cool the lower layers of air in a cyclone, so that as a result of the above a mixed convection of heat takes place from the cylone in the direction of the anticyclone. These thermo-dynamic con siderations explain in general a large number of meteorological phenomena of which the speaker was only able to enumerate a few.—Dr. Budde made some remarks in connection with Janssen's communication to the last meeting of the British Association on the double spectrum of oxygen, of which one is proportional to the density of the gas, the other to the square of that density. He showed that on the supposition that one of the spectra is due to separate free molecules, the other to molecules which are impacting, the result must follow which Janssen has found experimentally.

Physiological Society, November 23.—Prof. du Bois-Reymond, President, in the chair.—Prof. Moebius spoke on the nests which are constructed by the marine stickleback (*Gasterosteus*). As early as 1829 the fact that this animal constructs a nest was described by an English observer. The speaker had had frequent opportunities of examining these nests in the Baltic, and found that they are constituted not only out of Fuci, Algæ, and other marine plants, but also out of the leaves of terrestrial plants which have fallen into the water, and even sometimes out of bits of wool. The male, who is constantly circling round the nest, knows how to find it again, even if it is lifted and lowered again into the water at a distance of five hundred paces from its first position. In an aquarium the speaker was able to observe that the male is continually spinning new fibres round the nest which proceed from out of the urinary bladder. The fibres are, as shown by chemical reactions, composed of mucin, which is not, however, secreted in the bladder, but by the kidneys. Sections through a kidney, treated with osmic acid and stained with hæmatoxylin, showed that only a few of the cells lining the uriniferous tubes are concerned in the elaboration of mucin, the others undergoing no such change. Out of the breeding-season none of these mucigenous cells are to be found in the kidneys, which are then less swollen. A case analogous to the above, of nests constructed of mucin derived from temporarily modified gland-cells, is found in Salangane, which produce the edible nests ; these birds make use of a glutinous material for the construction of their nests, which is at times secreted by a gland, in this case the salivary gland. A comparative physiological-chemical analysis of these two secretions would be very interesting.—Prof. Munk gave an account of his researches on the physiology of the thyroid gland. It has long been known that in cases of excision of this gland in man the patients suffer from severe cachexia, to which they speedily succumb, with symptoms indicative of serious disease of the central nervous system ; this fact has led to a long series of physiological researches, from which it appears that this small organ is of the greatest importance to life. It was assumed, in accordance with Schiff's views, either that it produces some substance which, passing into the blood, upsets the normal function of the central nervous system, or that it is concerned in the destruction of some injurious products of cerebral activity. Two years ago, as the speaker began his researches on the physiology of this gland, with a view to the discovery of the above remarkable substance, he observed solitary cases in which the dogs were only slightly ill, and then completely recovered, notwithstanding that the thyroid was completely extirpated ; one dog showed no signs of any illness at all. Similarly in the literature of this subject, solitary cases are mentioned in which extirpation had no effect on the dog's health. The speaker had next changed his method of operating, merely isolating the gland from the surrounding structures, ligaturing the hilus, and replacing the isolated lobes in their original position. Some of the dogs with the gland thus isolated lived on in perfect health ; in these the gland was found to have degenerated and become completely converted into connective-tissue. Others of the dogs became ill and died, and in these the gland had healed and recovered its vascular supply. From these experiments it followed that the thyroid is not an organ of absolute importance for life, inasmuch as animals can live in perfect health without it. It thus remained to determine what is the cause of the serious pathological condition and ultimate death which ensues when the thyroid is excised in man and other animals. A careful study of the symptoms showed that the normal functions of respiration, cardiac activity and nutrition, and of the nervous system, are upset, resulting in dyspnœa with powerful expirations, palpitation of the heart, relaxation of the arteries, derangement of the movements of deglutition, accompanied by vomiting, clonic and tonic cramps, resulting in epileptic attacks. It was further found that the dyspnœa and palpitation are primary symptoms, the cramps are secondary, and that death ensues during the latter. The dyspnœic attacks with the resultant conditions are undoubtedly due to the stimulation of nerves lying in the inflamed tissues after the extirpation of the gland, viz. the superior laryngeal, recurrent laryngeal, vagus, and sympathetic nerves. This is clearly shown by the fact that when the gland is simply isolated by a ligature the dogs live in good health, the gland at the same time degenerating, whereas in cases where the surrounding tissues inflame and lead to a renewed adhesion and vascularity of this organ the dogs became ill and died. The speaker was obliged to defer to the next meeting, owing to the lateness of the hour, the further description of his experiments, and of the conclusions to be drawn from them.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

The Mining Manual for 1888 : W. R. Skinner.—The Speaking Parrots, parts 7 and 8 : Dr. K. Russ (L. U. Gill).—British Dogs, Nos. 25 and 26 : H. Dalziel (L. U. Gill).—A Text-book of Elementary Metallurgy : A. H. Hiorns (Macmillan).—Mental Evolution in Man : G. J. Romanes (Kegan Paul).—Die Stämme des Thierreiches (Wirbellose Thiere), vol. ii. : M. Neumayr (Temsky, Wien).—Essai d'une Théorie Rationnelle des Sociétés de Secours Mutuels : P. de Lafitte (Paris, Gauthier-Villars).—Cours d'Astronomie Pratique ; Application à la Géographie et à la Navigation, 2me partie : E. Caspari (Paris, Gauthier-Villars).—The Agreement of Colour Theories with Practical Experience : G. H. Morton (Liverpool).—The Proposed Chemical Laboratory at the University of Sydney : A. Liversidge (Sydney).—Journal of the Chemical Society, December (Gurney and Jackson).—Proceedings of the Linnean Society of New South Wales, vol. iii. part 1 (Trübner).

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