THURSDAY, OCTOBER 3, 1895.

RITTER'S "ASIA": RUSSIAN ADDENDA.

Eastern Siberia, including Lake Baikal and the Mountains on its North-Western Shore. Vol. II. By P. P. Semenoff, I. D. Cherskiy, and G. G. von Petz. Pp. 630. (Russian: St. Petersburg, 1895.)

THIS new volume, edited by P. P. Semenoff, from the MSS. of I. D. Cherskiy, and containing 630 pages of text, in lieu of the three paragraphs of Ritter's work, is even more interesting than the preceding volume, which was noticed in these columns a short time ago (NATURE, vol. l. p. 471). It covers Lake Baikal and the mountains along its north-western shore, and embodies explorations either entirely new or quite unknown even in Russia itself. Moreover, all that has been said concerning the preceding volume, as regards the masterly treatment of the subject and a strict adherence to Ritter's excellent methods—a combination of a minute description of details with broad generalisations drawn out of them—fully applies to this new instalment of the great work undertaken by the Russian Geographical Society. A third volume, containing Transbaikalia and the Gobi, will soon follow—the invaluable collaboration of M. Obrucheff having been secured for this purpose by the editor.

When we cast a glance upon a good orographical map of Asia (*e.g.* Petermann's, in Stieler's "Hand Atlas," or even in the miniature "Taschen Atlas" of the same publishers), we see that the two great plateaus of West and East Asia are fringed along their north-western borders with a chain of great lakes: the Caspian Sea, Lake Balkhash, Ala-kul and Zaisan, Ulungur, Baikal, and Oron; while a succession of large post-Tertiary lakes, now desiccated, which formerly filled the valleys of the Tian-shan, the Altais, the Sayans, and the Muya ridges, complete this chain of depressions along the outer border of the plateaus. Lake Baikal is one of the lakes of this chain—a small remainder only of the great mass of water which formerly filled up the valley of the Irkut, and the lower parts of the eastern tributaries of the present lake, and discharged its waters, as we now learn from the volume under review, through the narrow gorge pierced by the Irkut through the Tunka Alps, by means of which it now joins the Angara at Irkutsk. At that time, *i.e.* during the post-Tertiary period, its level stood, as shown by the lake deposits and terraces explored by Cherskiy, at least 928 feet above the present level of Lake Baikal, which now lies 1561 feet above the sea level.[1]

However, even in its present limits, Lake Baikal occupies the sixth place among the largest lakes of the globe (after Lake Tanganika), and the first place among the Alpine lakes. Sufficient to say that it covers 15,300 square miles, and that the two extremities of the crescent which it makes on a map are 380 miles distant from each other. As for its depth it stands foremost. Already Kononoff's soundings, in 1859, indicated a depth of 5621 feet, and when the Polish exiles, Dr. Dybowski and Godlewski, made, in 1867 and 1871–76, a series of very accurate soundings, they revealed the existence of several valleys in its bottom, attaining depths of 2197, 4460, and 4503 feet, the greatest depths being located in the proximity of the north-western shore, so that a depth of 1935 feet (374 feet below the level of the ocean) was found within a thousand metres from the coast.

Both in its position at the foot of, and the manner it penetrates at its southern extremity into, the plateau, Lake Baikal offers a striking analogy with the Caspian Sea. The same analogy appears in its relations to the surrounding mountains. It is divided about its middle by a submerged ridge, which appears on the surface in the Olkhon Island, and in the promontory of Svyatoi Nos; and of the two basins thus formed, and named respectively the "Great Sea" and the "Small Sea," the southern, that is the one which lies nearest to the plateau, is the deepest. In older works, and in some recent ones as well, Lake Baikal used to be described as a longitudinal valley between two parallel chains of mountains; but it is evident, from what has just been said, how false this view is. The next step would be to consider it as originated from two lakes which once occupied two longitudinal valleys, and joined together after the dividing ridge had been partially destroyed by geological agencies; and this hypothesis, too, has been advocated. Things appear, however, to be much more complicated than that. When I was working out a general scheme of the orography of Siberia, I was compelled to recognise that even the two-valleys-hypothesis could not interpret the real features of the region, and although at that time (1872) we knew next to nothing about the geological structure of the Baikal mountains, I was induced, by considerations about the structure of the plateaus, their border-ridges, and the Alpine chains parallel to the latter, to draw two chains across the northern part of the lake. From the volume under review, we now learn the real state of affairs. In all his explorations in Siberia, Cherskiy used to pay a great deal of attention to the orographical features as they *now* appear to the explorer, and tried to discriminate in how far they were a result of structural features—foldings of the rocks and so on—and in how far they were derived from subsequent erosion which has been going on in these parts of Siberia since the Silurian and Cambrian periods, when the mountain ridges and plateaus received their first shape. As regards the Baikal mountains, it now appears that there is, on the north-western shore, a real ridge running parallel to the shore, and separated by a valley from the mountains lying further west; but that both this ridge and the deep hollow of the Baikal are due, not to structural, but to erosion processes. The ridge consists of slates and gneisses *crossing* it in a diagonal direction, and these strata cross also the northern part of the lake in the same direction—the direction I had indicated on the orographical map on merely theoretical grounds—so as to reappear in the same succession on the eastern shore. The foldings of the Baikal Mountains date from the Silurian, Cambrian, or perhaps even the Laurentian period (Devonian red sandstones lie undisturbed at the outer footings of the Baikal Mountains), but subsequent

[1] There is still a certain uncertainty, perhaps of over 100 feet, concerning the altitude of the level of Lake Baikal. A levelling across Siberia had been made a few years ago; but the death of the person who undertook the calculation of the results brought about some confusion, and Russian geographers suppose that some considerable error may have crept in in the levelling between the Yenisei and Irkutsk, and consequently in the above figure.

erosion and denudation have modified the primary features on a gigantic scale; and a valley so deep as the northern part of Lake Baikal is, has been dug out *across* the former direction of the chains. The lake is thus an immense erosion valley which only partially has been determined by the structural valleys at the foot of the plateau, but has received its final shape through erosion, which made several parallel lakes coalesce as the mountains once separating them were pierced through and obliterated.

This instance will already give an idea of the interest which attaches to the volume now published, and the wealth of data which will be found in it. We sincerely desire, in the interests of geography, that at least these new volumes of the series should be rendered accessible to West European geographers.

The described region is very thinly populated, and contains but few explored remains of the past. As to its flora, it has been properly explored only on the Olkhon Island. The little, however, which is known in these two directions is well summed up, and will give a sound basis for ulterior exploration. We hope to find in the forthcoming volume a summary of all that is known about the fauna of the lake. P. K.

APPLICATIONS OF BESSEL FUNCTIONS.

A Treatise on Bessel Functions and their Applications to Physics. By Andrew Gray, M.A., and G. B. Mathews, M.A. (London: Macmillan and Co., 1895.)

THIS book, like the kindred work of Prof. Byerly on "Fourier's Series and Spherical Harmonics," marks the modern system of mathematical treatment, and may be contrasted with Dr. Todhunter's "Functions of Laplace, Lamé, and Bessel," of twenty years ago. At that time it was considered desirable to develop the purely mathematical analysis quite apart from the physical considerations to which it owed its life and interest; keeping the pure and the mixed mathematics in separate water-tight compartments, so to speak, with an impenetrable bulkhead between.

But as the Bessel function, like every other function, first presented itself in connection with physical investigations, the authors have done well to begin, on p. 1, with a brief account of three independent problems which lead to its introduction into analysis, before entering upon the discussion of the properties of the Bessel functions.

These three problems are: the small oscillations of a vertical chain, the conduction of heat in a solid cylinder, and the complete solution of Kepler's problem by expressing radius vector, true and excentric anomaly in terms of the mean anomaly.

It is very extraordinary that Kepler's problem should, as a general rule, be still left unfinished in the ordinary treatises, considering that the Bessel function is implicitly defined in the equation; but we need go back only twenty-five years, and we find Boole's "Differential Equations" ignoring the Bessel Function and the solution of the general Riccation equation which it provides. In those days it was customary to speak of any solution, not immediately expressible by algebraical or trigonometrical functions, as "not integrable in finite terms"; an elliptic integral was skirted round with the remark that it was "reducible to a matter of mere quadrature," and even the homely hyberbolic functions were tabooed.

String is the favourite material of the mathematician for illustrating catenary properties; but it is a relief to find that the authors have provided a *chain* for the discussion of the oscillations when suspended in a vertical line. The banal word *string* turns up accidentally two or three lines lower down (line 10, p. 1), but if a piece of string is used by the side of a length of fine chain, such as is now purchasable, the unsuitability of the string, by reason of its lack of flexibilty and its kinkiness, for the representation of catenaries and their oscillations, is at once manifest.

The small plane oscillations of the chain about its mean vertical position are of exactly the same character as the slight deviations from the straight line due to spinning the chain from its highest point of suspension; and this procedure has the advantage of showing a permanent figure, similar to that given for $J_0(\sqrt{x})$ on p. 295 of Lamb's "Hydrodynamics"; with a little practice the knack of producing one, two, three or more nodes at will is easily attained. Thus with a piece of chain 4 feet long, the number of revolutions per second should be 0·54, 1·24, 1·95, 2·65, &c.

The Bessel function was first introduced by the inventor for the complete solution of Kepler's problem, namely, to express the variable quantities in undisturbed planetary motion in terms of the time or mean anomaly $\mu = nt + \epsilon - \varpi$.

The authors avoid the awkward integration by parts employed by Todhunter in determining the excentric anomaly ϕ by means of a differentiation. Another procedure will give a/r, where a denotes the mean distance and r the radius vector, more directly, from the relation

$$\phi = \mu + e \sin \phi.$$

For differentiation with respect to μ gives

$$\frac{d\phi}{d\mu} = \frac{1}{1 - e\cos\phi} = \frac{1 + e\cos\theta}{1 - e^2} = \frac{a}{r} = 1 + \Sigma B_r \cos r\mu,$$

suppose, when expressed in a Fourier series, and then

$$B_r = \frac{2}{\pi}\int_0^\pi \cos r\mu \frac{d\phi}{d\mu} d\mu = \frac{2}{\pi}\int_0^\pi \cos r(\phi - e\sin\phi) d\phi = 2J_r(re),$$

according to Bessel's definition.

An integration now gives

$$\phi = \mu + 2\Sigma \frac{J_r(re)}{r} \sin r\mu$$

and

$$\sin\phi = \frac{\phi - \mu}{e} = 2\Sigma \frac{J_r(re)}{re} \sin r\mu; \text{ &c.}$$

Chapters ii.–ix. are devoted to the purely analytical development of the Bessel function, considered as the solution of a differential equation, as an algebraical or trigonometrical series, or as a definite integral; these are the earlier chapters for which the authors apologise in the preface as appearing to contain a needless amount of tedious analysis. In Prof. Byerly's treatise the requisite analysis is introduced in small doses, and only as required; but the ordinary mathematician loves to strew the path at the outside with difficulties best kept out of sight; thus, as Heaviside remarks, the too rigorous mathematician tends to become obstructive. It is of

course reassuring to know that the functions employed in the physical applications, rest on a sound analytical basis, and that the convergency of the series has been carefully examined. But there is no compulsion to follow these demonstrations, tedious to all but pure mathematicians; so we can pass on direct to Chapter x., where the physical interest is resumed, under the head of "Vibrations of Membranes," for instance the notes produced on a circular drum-head. Lord Kelvin's oscillations of a columnar vortex, Lord Rayleigh's waves in a circular tank, and Sir George Stokes's investigation of the drag of the air in pendulum vibrations, make up an interesting Chapter xi. on Hydrodynamics.

Chapter xii. deals with the steady flow of electricity or of heat, and Chapter xiii. with the fascinating and novel phenomenon of Hertz's electromagnetic waves, when propagated along wires, in which problem the Bessel function assumes an essential importance.

The Diffraction of Light, considered in Chapter xiv., contains important applications of the Bessel functions; the hydrodynamical analogue would be the investigation of the effect of a breakwater in smoothing the waves which bend round behind into its shelter; for instance, the effect of the Goodwin Sands on the safe anchorage in the Downs.

Newton rejected the Undulatory Theory of Light, partly because he could not understand the existence of shadows on this hypothesis, a curious effect of Newton's early ideas as a country boy; had he been brought up on the sea coast, this apparent difficulty could not have troubled him.

It would be a needless complication to consider any but straight waves in the case of the breakwater; and similarly in the Diffraction problem, the authors might have made a simplification by parallelising the incident light by passing it through a lens; or at least this special case, which is the one of practical importance in the subsequent discussion of the resolving power of a telescope, might receive separate treatment as the analysis now becomes almost self-evident. This chapter concludes with a discussion of Fresnel's integrals, required in the diffraction through a narrow slit; the integrals are expressed by a series of Bessel Functions of fractional order, half an odd integer, and are represented graphically by Cornu's spirals.

The problem of the stability of a vertical mast or tree, considered under the head of Miscellaneous Application in the last chapter, may well be amplified by examining the effect of centrifugal whirling on the stability, as in the case of the chain on p. 1; for the number of revolutions required to start instability is exactly equal to the number of vibrations which the mast or tree will make when swaying from side to side. A differential equation of the fourth order, with a variable coefficient, now makes its appearance, the solution of which will express the oscillations of the bullrushes in a stream, or the waving of cornstalks in a field. The curious appearance of permanence in the waves on a cornfield gives an illustration, analogous to Prof. Osborne Reynolds's disconnected pendulum, of a case of zero group-velocity; and by some intuitive deductions from the appearance of these waves the farmer can judge the time suitable for harvest.

The authors have been fortunate in securing an original collection of numerical tables, including those of Dr Meissel, who did not live quite long enough to see his valuable calculations published in this book.

A collection of examples adds greatly to the interest of the treatise, and will probably form the nucleus of a still larger list in the future.

Altogether the authors are to be congratulated in bringing their task to such a successful conclusion; and they deserve the gratitude of the mathematical and physical student for their lucid and interesting mode of presentment.

A. G. GREENHILL.

OUR BOOK SHELF.

Protoplasme et Noyau. Par J. Pérez, Professeur à la Faculté des Sciences de Bordeaux. (Bordeaux: Imprimerie G. Gounouilhou, 1894.)

EXPERIMENTAL work in recent years has repeatedly shown that in plants as well as in animals the physiological *rôle* of the nucleus in the cell is one of great importance. It has been demonstrated that non-nucleated fragments of protoplasm, whether of a *Spirogyra* or an Infusorian, are incapable of growth and reproduction; while, on the other hand, fragments containing a portion of nuclear material are capable of complete recrescence. Impressed by these facts the writer of the essay before us has been led to doubt whether protoplasm can be properly regarded as the "physical basis of life," since it cannot retain its life when removed from the influence of the nucleus. Consistently with this position the writer throws doubt upon the existence of non-nucleate organisms in general. The presence of nuclei has been demonstrated in many forms once believed to be destitute of them—*e.g.* Mushrooms, marine Rhizopods, and plasmodia. There remains only Haeckel's group of Monera in which the presence of a nucleus may still be disputed. M. Pérez considers in turn each of Haeckel's subdivisions of this most artificial group. In the Lobomonera (*e.g. Protamœba*) he believes that the nucleus has been overlooked. In the Rhizomonera the nucleus has been observed in various species of *Vampyrella;* and it probably exists also in *Protomyxa*, since this form produces zoospores; the zoospores of those Myxomycetes which most resemble *Protomyxa* have been shown by Zopf to be nucleated. In the Tachymonera (Schizomycetes) the greater part of the body seems to consist of nucleoplasm, while the zoogloœa may perhaps be compared with the undivided protoplasm of a plasmodium.

M. Pérez concludes that non-nucleated organisms or cytodes are creations of the imagination; that protoplasm, by which our author means cytoplasm, is not the primitive living matter, but a product of nucleoplasm; and that nucleoplasm, and not protoplasm, is the most primitive living substance known to us.

Analytical Key to the Natural Orders of Flowering Plants. By Franz Thonner. Small 8vo. pp. 151. (London: Swan Sonnenschein and Co., 1895.)

THE author's apology for his little book is that few "Exotic Floras" contain artificial keys to the natural orders, even such as contain keys to the genera and species. But we imagine few persons would attempt working with a flora, exotic or native, without some preliminary knowledge of botany, and especially of the natural orders. Indeed a considerable acquaintance with the subject would be necessary to enable a person to use the present key to advantage. For example, the author begins with "ovules naked," and "ovules enclosed in an ovary," &c. Now, to be able to decide this point means a great deal, for a person who could do it would most likely know his gymnosperm without looking at the ovule

—even better without, perhaps. The next alternative is between isolated vascular bundles, and vascular bundles in a cylinder, connected with other characters, entailing previous teaching and study, which should largely consist of acquiring a knowledge of natural orders. Nevertheless this book may prove useful, especially to the collector desirous of determining the natural orders of his plants in the field or at home. So far as we have tested it, it is carefully compiled and edited, and we can conscientiously recommend it to those who know the characters of many natural orders in advance.

W. B. H.

LETTERS TO THE EDITOR.

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Attempt to Liquefy Helium.

I HAVE received a letter from Prof. Olszewski, of Krakau, in which he informs me that having exposed a sample of helium which I sent him to the same treatment as was successful in liquefying hydrogen—namely, compressing with a pressure of 140 atmospheres, cooling to the temperature of air boiling at low pressure, and then expanding suddenly—he has been unable to detect any sign of liquefaction.

The density of helium being, roughly speaking, twice that of hydrogen, it is very striking that its liquefying point should lie below that of hydrogen. It may be remembered that argon, which has a higher density than oxygen, liquefies at a lower temperature than oxygen; and it was pointed out by Prof. Olszewski that this behaviour was not improbably connected with its apparently simple molecular constitution. The similar fact now recorded for helium may therefore be regarded as evidence of its simple molecular constitution. I use the word "its" instead of "their," although further research may corroborate Prof. Runge's contention that what is termed helium may in reality be a mixture of two, if not more than two elements. If this contention is true, both, or all, must have extraordinarily low boiling-points. WILLIAM RAMSAY.

September 23.

Helium and the Spectrum of Nova Aurigæ.

IN the paper on the constituents of the gas in cleveite that we read before the British Association, we said that in the first spectrum of Nova Aurigæ the principal lines 5016 and 4922 of the lighter constituent were far more intense than those of the other constituent. But we were puzzled at the line 6678 not having been observed, as it is also a strong line in the spectrum of the lighter constituent. On inquiry, Dr. and Mrs. Huggins were kind enough to give us better information. Dr. Huggins writes:

"I think there is no doubt that we did see the red line at 6678 in Nova Aurigæ. We were unable to measure in that part of the spectrum, but on three nights we saw a bright line a little below C. This was a pure estimation under difficult circumstances. In the map we put the line, as a mere guess, at a little over 6700. On the first night we put the line in a rough diagram, made at the time, a little nearer C, almost exactly at 6678. On a subsequent night, we made the estimation a little below 6700, but the line was not then so bright."

London, September 27. C. RUNGE AND F. PASCHEN.

Latent Vitality in Seeds.

THERE is no doubt, as M. Casimir de Candolle has recently shown in his paper on latent life in seeds, that all the functions of seeds can remain completely quiescent for a long period; probably in some cases this period may be indefinitely ong. In 1878 I published a paper[1] on the resistance of seeds, especially of *Medicago sativa*, or lucerne, to the action of gaseous and liquid chemical reagents. An abstract of my experiments was published in NATURE, vol. xxv., 1882, p. 328.

Recently I have examined portions of the seeds used in the experiments of 1877 and 1878, to see if after the lapse of so many years, during which the seeds have remained constantly surrounded by special gases, or immersed in different solutions, they had retained their vitality. The results have been remarkable, for in some cases a large proportion of the seeds have maintained their vitality after a lapse of 15, 16, and nearly 17 years of special external chemical conditions. I summarise the results of some of my experiments.

(*a*) *Experiments in Gases.*

In all these experiments the gases were *dry*, for in these conditions moisture is rapidly fatal to the seeds. The seeds were introduced into small bulbed tubes, into which the dry gas was made to pass for some time, after which the tubes were rapidly sealed at a spirit-lamp flame. The tubes were then kept in the dark.

In the following summary I give the dates of the sealing and opening of the tubes:—

Hydrogen.—Lucerne seeds, from September 15, 1877, to August 5, 1894, a period of 16 years, 10 months, and 20 days. Out of 51 seeds sown, none germinated. Seeds of wheat, vetch, *Cynara cardunculus* and coriander, kept in hydrogen, gave the same negative results. There is some suspicion that the hydrogen had not been originally well dried.

Oxygen.—Lucerne, from May 19, 1878, to August 4, 1894, 16 years, 2 months, and 15 days. Out of 293 seeds sown, 2 germinated, or 0·68 per cent. The seeds were not thoroughly dry.

Nitrogen.—Lucerne, from April 12, 1878, to August 21, 1894, 16 years, 3 months, and 22 days. Out of 320 seeds, 181 germinated, or 56·56 per cent.

Chlorine and Hydrochloric Acid Gas.—Lucerne, from April 28, 1878, to August 3, 1894, 16 years, 3 months, and 5 days. Out of 342 seeds, 23 germinated, or 6·72 per cent. Originally these seeds had been put into pure chlorine; but the gas had acted on the seeds, carbonising a portion of them, so that at the end of the experiment the seeds were in an atmosphere composed chiefly of hydrochloric acid gas, mixed with carbon dioxide.

In a second experiment with lucerne seed, kept in chlorine, and then hydrochloric acid, during the same period, out of 167 sown, 10 germinated, or 5·98 per cent. In this experiment the tube was carefully opened *in vacuo*, to protect the seeds from the moisture condensed by the hydrochloric acid gas at the moment when it is brought into contact with common air.

Sulphuretted Hydrogen.—From October 14, 1877, to August 5, 1894, 16 years, 9 months, and 22 days. After the opening of the tube, filled with the strongly smelling gas, the seeds were left in contact with the air for 24 hours, before sowing them in the moist sand of the germinator. Out of 101 lucerne seeds, one germinated, or 0·99 per cent. Out of 50 seeds of wheat, none germinated.

Arseniuretted Hydrogen.—From April 4, 1878, to August 4, 1894, 16 years and 4 months. On opening the tube the garlic smell of AsH_3 was strongly evident. Out of 255 lucerne seeds sown, 181 germinated, or 70·98 per cent. In a second experiment with seeds kept in arseniuretted hydrogen, out of 247 lucerne seeds 170 germinated, or 68·82 per cent.

Carbon Monoxide.—From April 3, 1878, to August 4, 1894, or 16 years and 4 months. Out of 266 lucerne seeds, 224 germinated, or 84·2 per cent.

Carbon Dioxide.—From September 8, 1877, to August 5, 1894, or 16 years, 11 months, and 27 days. The same tube contained seeds of lucerne, wheat, vetch, *Cynara*, and coriander. None germinated. Perhaps the large number of seeds contained in a relatively small tube rendered the carbon dioxide damp, and therefore noxious.

Nitric Oxide.—From May 2, 1878, to August 4, 1894, or 16 years, 3 months, and 2 days. On opening the tube, abundant red fumes were produced by contact with air. Before sowing, the seeds were left dry for 24 hours. Some of the seeds were brownish, the rest retained their natural colour. Out of 309 lucerne seeds, 3 germinated, or 0·97 per cent. In a second experiment, the tube containing the lucerne seeds was opened *in vacuo:* out of 320 seeds, 2 germinated, or 0·62 per cent.

[1] Italo Giglioli. "Resistenza di alcuni semi all' azione prolungata di agenti chimici, gasosi e liquidi," *Gazzetta Chimica italiana*, ix., 1879, p. 199; and *Giorn. delle staz. sper. ital.* viii., 1879, p. 199.

(*b*) *Experiments with Liquids and Solutions.*

I give only the results obtained with alcohol and alcoholic solutions. In other liquids, such as ether and amyl alcohol, the liquids had gradually evaporated, so that the exact period of their action could not be ascertained, and the seeds, covered with a moist oily varnish, had lost all vitality. Lucerne seeds kept in chloroform for 16 years and 4 months, were completely lifeless. In all the recorded experiments the seeds were completely immersed in a relatively large volume of liquid.

Strong Alcohol.—From March 26, 1878, to August 6, 1894, or 16 years, 4 months, and 13 days. The alcohol was originally absolute, but in contact with the seeds, and during so many years must have absorbed a small proportion of water. Before being sown, the lucerne seeds were carefully air-dried on a filter for 12 hours. Out of 60 seeds sown, 40 germinated, or 66·6 per cent.

Concentrated Alcoholic Solution of Corrosive Sublimate.—The alcoholic solution was originally prepared with alcohol nearly absolute, and saturated with mercuric chloride. From May 23, 1878, to August 17, 1894, or 16 years, 2 months, and 25 days. On taking the seed from the mercuric solution, they were very carefully washed with alcohol at 97 per cent. until every trace of the mercuric compound was washed away. The seeds were dried at the ordinary temperature, and then sown. Out of 79 lucerne seeds, 16 germinated, or 20·2 per cent.

Alcoholic Solution of Sulphur Dioxide.—From November 10, 1878, to August 24, 1894, or 15 years, 9 months, and 14 days. Originally the alcohol was of 93 per cent. strength; the solution preserved a suffocating odour of sulphurous acid. The lucerne seeds were mixed with minute sulphur crystals; the seeds were well washed with strong alcohol, dried and sown. Out of 645 lucerne seeds, one alone germinated, or 0·15 per cent.

Alcoholic Solution of Sulphuretted Hydrogen.—From November 10, 1878, to September 4, 1894, or 15 years, 9 months, and 15 days. The alcohol, originally 93 per cent. strength, had been repeatedly saturated with sulphuretted hydrogen gas. The liquid emitted a marked mercaptanic smell. Sulphur crystals were formed, and sedimented with the lucerne seeds. The latter were washed with 97 per cent. alcohol, and then air-dried. Out of 583 seeds, 41 germinated, or 7·03 per cent.

Alcoholic Solution of Nitric Oxide.—From November 10, 1878, to September 4, 1894, a period equal to that of the last described experiment. The alcohol, 93 per cent. strength, had been repeatedly saturated with NO. Before sowing, the seeds were washed with alcohol and dried. Out of 288 seeds, 12 germinated, or 4·16 per cent.

Alcoholic Solution of Phenol.—The lucerne seeds preserved in the solution for over 15 years, showed no signs of vitality. In washing the seeds, previous to sowing, with alcohol, they could not be completely purified from the phenol.

Many of the germinating lucerne plants developed from the seeds used in these experiments, were transplanted from the germinator into flower-pots. The plants grew well, and have flowered and seeded normally.

At the beginning of these experiments, in 1877 and 1878, I was not aware of the noxious action of even small proportions of moisture. It is probable that if in all these experiments special care had been taken at the beginning to exclude as much as possible moisture, both from the seeds and from the gases or liquids, a much larger proportion of seeds would have retained their vitality. The difficulty of preserving the vitality of large seeds must be chiefly caused, in all probability, by the difficulty of thoroughly drying them.

These experiments are of interest in showing that seeds may retain their vitality in conditions when all respiratory exchange is completely prevented for a long series of years. They fully confirm the results of the late G. J. Romanes, who proved that seeds may preserve their vitality for 15 months when kept *in vacuo*, or when transferred from the vacuum tubes to other tubes, charged with sundry gases or vapours.[1]

My experiments encourage, moreover, the suspicion that latent vitality may last indefinitely when sufficient care is taken to prevent all exchange with the surrounding medium. There is no reason for denying the possibility of the retention of vitality in seeds preserved during many centuries, such as the mummy-wheat, and seeds from Pompei and Herculaneum, provided that these seeds have been preserved from the beginning in conditions unfavourable to chemical change. The original dryness of the seeds, and their preservation from soil moisture or moist air, must be the very first conditions for a latent secular vitality.

In experimenting with seeds from Pompei and Herculaneum, I have not as yet been able to find among them any living grain. The greater part of these seeds are too much carbonised and changed to permit the entertaining of much hope as to their possible vitality. Especially among the seeds of Pompei, the carbonisation must have been caused by the slow action of moisture, which would speedily destroy all life in the seeds. Among the Pompeian wheat the destruction of organic matter has been so great as to leave in the seed, in its present condition, a proportion of ash as high, in some cases, as 4·2 per cent., and even 8·4 per cent.

On the other hand, some of these seeds, as those found in the granaries of the *Casa dell' Argo*, at Herculaneum, in 1828, seem to have been in conditions favourable to a prolonged preservation of latent vitality; the millet seeds, especially, were found unchanged in outer aspect. Unfortunately, no test was made at the time of their discovery, and since then the action of moist air, and exposure to changes of temperature and to light, must have impaired fatally any remnant of vitality still lurking amongst the seeds.

All researches on latent life are of great interest in ascertaining the nature of living matter. The present researches have established that, for some seeds at least, respiration, or exchange with the surrounding medium, is not necessary for the preservation of germ-life. It is a common notion that life, or capacity for life, is always connected with continuous chemical and physical change. The very existence of living matter is supposed to imply change. There is now reason for believing that living matter may exist, in a completely passive state, without any chemical change whatever, and may therefore maintain its special properties for an indefinite time, as is the case with mineral and all lifeless matter. Chemical change in living matter means active life, the wear and tear of which necessarily leads to death. Latent life, when completely passive, in a chemical sense, ought to be life without death.

It may be finally remarked that the proof of the resistance of seeds to vacuum, of the non-necessity of a respiratory exchange with outer air, together with the proof of the resistance in some seeds to very low temperatures, are facts encouraging the belief that the origin of life on our globe may be due to the introduction of germs that have travelled, embedded in aerolites, from other planets where life is older than upon the earth.

ITALO GIGLIOLI.

Regia Scuola Superiore d'Agricoltura,
Portici, near Naples.

[1] NATURE, December 7, 1893, p. 140.

To Friends and Fellow Workers in Quaternions.

SINCE the publication of Hamilton's "Elements of Quaternions," in which the great mathematician developed his new calculus with admirable skill and clearness, more than thirty years have passed away, without it finding the adequate recognition which it so highly deserves. The circumstance is still the more deplorable as the calculus has since been further developed by Prof. Tait and others.

There is, in truth, no question as to the importance of the use of vectorial quantities in physics, but on account of their apparently preponderating importance, various physicists have been led to invent new forms of vector-theory excluding the idea of quaternions. But, as far as we see, they are founded on definitions which are established by quaternions, and are systems of notation rather than logical developments of a mathematical idea.

On the other hand, many who are prejudiced against the calculus of quaternions maintain the opinion that it is hard to understand, and that it contains a great deal which is useless in addition to things immediately applicable. To the latter charge there need be no answer, since all forms of mathematics are exactly alike in this respect, and since in the very combination of the pure and the applied lies the potentiality of further development. In regard to the former objection, quaternionists need only say that if the objectors approach the calculus of quaternions with proper care and meekness, they will ere long assuredly rejoice in having at their disposal an instrument of research mightier far than they had the slightest notion of so long as they were in the domain of cartesian coordinates. Certainly it would be a blessing to science if they could accept these assertions, and their endeavours would find a

sure reward in its advancement wherever this method might be applied. So much for these objections.

New notations in the calculus of quaternions must needs be invented from time to time. But since they are becoming complex (though far simpler than in cartesian coordinates) as the problems are getting more complicated, it is highly desirable already at this stage of development, to exchange opinions on the selection or adoption of new symbols.

By these and other considerations we have been led to believe that the time has come for those who are interested in vector analysis to come to the fore and join hands. In order to further this purpose, we venture to suggest the establishing of something like an "International Association for Promoting the Calculus of Quaternions." The following would be amongst its principal objects:—

(1) That the members should be informed of the publications of all important papers and works respecting either the theory of quaternions or its applications; and if possible to have these made accessible to them.

(2) That the members should be afforded the means of exchanging opinions on the introduction and adoption of new notations.

In these few lines we have tried to point out the important task of the Association, but shall be obliged for any suggestion or improvement. All we desire is to assure to the calculus the place it deserves, and consequently to see it fully developed in its various aspects by the combined efforts of able mathematicians and physicists. It is almost needless to say that we are only preparing the way; and once the Association has been started, we shall be ready to place it in the hands of persons much more competent than ourselves to further its best interests.

We earnestly hope that all friends will appreciate our endeavours and show us at once some token of approval. We would ask those who are in Europe to communicate with the first of the names below, and those in America with the second.

P. MOLENBROEK, The Hague, Holland.
SHUNKICHI KIMURA, Yale University, U.S.A.

August 7.

P.S.—It has been suggested by friends interested in this matter to enlarge the scope of the proposed Association so as to include all systems allied to quaternions and to Grassmann's "Ausdehnungslehre." This suggestion we are in full sympathy with. The name of the Association might then be "The International Association for Promoting the Study of Quaternions and Allied Systems of Mathematics." P. M.

September 17. S. K.

Artificial Human Milk.

IT is stated in NATURE of September 19, that "so far, according to Dr. Backhaus, no satisfactory substitute has been produced in the place of human milk"; and a method is then described by which he has "quite recently" succeeded in supplying the deficiency. It appears to differ little from the process first employed and made known by me in 1854, and afterwards published in my "Experimental Researches" in 1877; except that, in omitting to add the necessary amount of milk-sugar to make up for the deficiency in the cow's milk, Dr. Backhaus fails to obtain an artificial milk closely resembling the human in chemical composition.

My recipe has, since its first publication, been advantageously used in private and hospital practice by the late Prof. W. C. Williamson, by Dr. W. Playfair, and others, but it has probably not come under the notice of Dr. Backhaus.

My process is based on the fact that by the removal of one-third of the casein from cow's milk, and the addition of one-third more milk-sugar, a liquid is obtained which closely approaches human milk in composition. The following is the mode of preparing the milk, and it is so simple that any intelligent mother or nurse can easily carry it out.

"Allow one-third of a pint of new milk to stand for about twelve hours, remove the cream, and add it to two-thirds of a pint of new milk, as fresh from the cow as possible. Into the one-third of a pint of blue milk left after the abstraction of the cream, put a piece of rennet about one inch square. Set the vessel in warm water until the milk is fully curdled, an operation requiring from five to fifteen minutes, according to the activity of the rennet, which should be removed as soon as the curdling commences and put into an egg-cup for use on subsequent occasions, as it may be employed daily for a week or two. Break up the curd repeatedly and carefully separate the whole of the whey, which should then be rapidly heated to boiling in a small tin pan placed over a spirit- or gas-lamp. During the heating, a further quantity of casein separates, and must be removed by straining through muslin. Now dissolve 110 grains of powdered milk-sugar in the hot whey, and mix it with two-thirds of a pint of new milk to which the cream from the other third of a pint was added, as already described. The artificial milk should be used within twelve hours of its preparation; and it is almost needless to add, that all the vessels employed in its manufacture and administration should be kept scrupulously clean."

In this process only one-third of the milk was sterilised; but, in the light of modern bacteriology, it is desirable to sterilise the whole by finally heating it to boiling.

The Yews, Reigate, September 29. E. FRANKLAND.

The Elements of Architecture.

HAVING been for some weeks out of the way of seeing papers, I have only just seen the review of "Architecture for General Readers" in NATURE of August 15. I ought to thank you for devoting so much space to a book which deals rather with art than "nature," and there are one or two criticisms on special points which I think are just, and which will have attention in the second edition of the book. But there are three remarks of the reviewer's on which I should like to have a word.

(1) He refers the reader to Perrot and Chipiez' work on "The Arts of Primitive Greece" for proof of the derivation of the Greek entablature from a wooden origin. In my opinion, Messrs. Perrot and Chipiez prove nothing whatever but their own ingenuity. They argue in a circle. Assuming the probability of a wooden origin for the Greek entablature, they proceed to construct out of their own inner consciousness a series of wooden structures, quite possible but entirely imaginary, in which the origin of all the features of the stone entablature is carefully provided for, and then produce an engraving of the stone (or, rather, marble) entablature to show triumphantly the result which they have been consciously leading up to all the way. You may prove anything on that kind of principle. I do not deny that the Greek entablature appears to be of timber origin. I only say it has not been proved to be so, and I am sure Messrs. Perrot and Chipiez have not proved it.

(2) The reviewer thinks I am captious in objecting to Wren's double cupola at St. Paul's as a sham, and that I might as well object to the vault which hides the interior of the tower over the crossing in a mediæval cathedral. But he misses the main point of my objection, which is that the exterior timber dome of St. Paul's is made to appear, to the eye, to carry a ponderous stone lantern which would, in fact, crush it at once, and which is really the termination of a concealed masonic construction thrusting itself through the timber dome. At Florence and St. Peter's the stone lantern is really carried by the visible dome which appears to carry it; at St. Paul's it is not, and could not be. I consider St. Paul's by far the more beautiful design of the three, but it cannot be denied that it is a constructional falsehood in that respect. (See the block section of it given on p. 99 of the book.)

(3) The reviewer objects that I have denied to Italy any specimen of true Gothic, and yet that Milan is one of the most impressive Gothic interiors in existence. This may be true as to general effect; but the detail of Milan is wretched; and it is by detail that purity of architectural style is chiefly to be judged.

H. HEATHCOTE STATHAM.

(1) MR. STATHAM objects to Perrot and Chipiez' work, on primitive Greece being cited for proof of the derivation of the Greek entablature from a wooden origin.

It seems to me that in this matter possibly the main difference between Mr. Statham and the reviewer lies in the meaning to be attached to the word *proof*. Absolute mathematical proof is seldom to be looked for in archæological or historical descriptions, and we must be often contented with a sufficiently high probability. Taking the word in that sense, it seems to me that the circle in which Perrot and Chipiez are said to argue, cannot be made to re-enter into itself.

Mr. Statham allows that the Greek entablature "appears to be of timber origin." Vitruvius (iv. cap. 2) says distinctly that it

was so. The remains of primitive architecture in Greece—particularly at Tiryus—show that wood must have entered largely into architectural constructions; amongst other evidences, the traces of wooden door-cases cannot be explained away. Perrot and Chipiez, with whatever amount of fancifulness there may be (and there is no doubt much which is altogether hypothetical) in their restorations, do come legitimately to an explanation of the Doric guttæ both under the triglyphs and beneath the mutules, as typical of the ends of wooden pegs or trenails in timber construction, which is sufficient for the argument in the review, in which there was no intention to approve Perrot and Chipiez' restorations and deductions any further than that.

(2) As to the second objection taken to the review—the remark respecting the cupola of St. Paul's. The remark in the review had reference to the objection that the external outline of the dome was distinct from the internal, and not to the question of support of the lantern; but with reference to the latter point, when the lantern of St. Peter's is quoted as supported by a more legitimate construction than that of St. Paul's, it may be asked: Why the construction of St. Peter's dome, which is absolutely dependent for its safety on the iron chains by which it is hooped together, is preferable to that of St. Paul's, where the lantern has a much securer, and therefore not less legitimate, support in Sir Christopher Wren's cone?

(3) One remark only on the objection raised to the style of Milan Cathedral. The detail is said to be wretched. That it does not conform to the canon of Northern Gothic can be readily conceded, but that the shafts of the magnificent forest of pillars which support the interior are wretchedly designed, and unsuitable to the intended effect, is not so easy to admit.

THE REVIEWER.

Do the Components of Compound Colours in Nature follow a Law of Multiple Proportions?

THIS question, put by Mr. F. Howard Collins in NATURE (p. 438), may be answered in the negative.

In practical work there is no indication of such a law. It is found that the two rays, which together produce a compound natural colour, may be in any proportions; when there is a multiple proportion, and in some cases there must be, it is only as forming part of a series of variations, such as are frequently found within the limits of a single popular colour term. How wide these proportions may be, can be illustrated by comparing them to the varying proportions of two irregular curves towards each other.

The examples of foliage quoted can only be taken as representing individual instances. Variations of climate, age, cultivation, and aspect alter the colour proportions of a given variety of leaf; indeed, such variations are sometimes found in the same leaf.

JOSEPH W. LOVIBOND.

Salisbury, September 23.

IN view of the letters, recently printed in NATURE, by Mr. H. H. Pillsbury and Mr. Herbert Spencer, it may be well to state that Chevreul published an "Exposé d'un moyen de définir et de nommer les couleur d'après une méthode précise et expérimentale" (Paris, 1861, also *Mem. de l'Acad.* xxxiii.), in which elaborate charts are given showing the colours defined by a decimal system and in ten degrees of saturation.

Recently Prof. W. Hallock, of this College, has painted discs with standard colours, and determined their wave-lengths with the spectroscope. These discs were then used to study 6000 samples of coloured objects, and formulæ were determined for some 500 named colours. These formulæ have been used for defining the names of colours in the new "Standard Dictionary" (Funk and Wagnall's, New York).

J. MCKEEN CATTELL.

Columbia College, New York, September 20.

A Problem in Thermodynamics.

IT may interest some of your readers to know that the problem in thermodynamics, propounded by Mr. Blass in your number of August 29, has actually been put to the test. I pointed out Mr. Blass's letter to my brother, who is a freezing engineer, and he showed me a copy of the *Zeitschrift für die Gesammelte Kälte-Industrie* (Munich) for August, in which an account is given of a machine on exactly the principle Mr. Blass suggests, by which Herr Linde has succeeded in liquefying air. It would appear, therefore, that the "theoretical minimum of temperature produced at c" would be determined by the point of liquefaction of the gas employed; with a perfect unliquefiable gas it would, I suppose, theoretically, be absolute zero.

EDWARD T. DIXON.

Cambridge, September 22.

THE NEW MINERAL GASES.

OUR knowledge of the spectra and other conditionings of the new mineral gases has received an important addition in the communication from Drs. Runge and Paschen which appeared in last week's NATURE. The employment of exposures extending over seven hours has given a considerable extension in the number of lines, and the bolometer has been called in to investigate lines in the infra-red; better still, they have employed well-practised hands in searching for series of lines. Operating, by chemical means, upon a crystal of clèveite free from any other mineral, they have obtained a product so pure that from these series there are no outstanding lines. Very great weight, therefore, must be attached to their conclusions, and there are several points of contact with the work upon which I have been engaged from a slightly different stand-point since last April, when Prof. Ramsay made his fortunate discovery of a terrestrial source of helium.

I will touch upon some of these points *seriatim*.

In the first place, there has never been the slightest doubt in my mind that it was a question of gases and not of a gas. The spectroscopic evidence in the laboratory alone was complete, and the case was greatly strengthened when the behaviour of the various lines in the sun and stars was also brought into evidence. Drs. Runge and Paschen also declare that the gas given off even by a pure crystal of clèveite is not simple, but consists of two constituents. To the one containing the line D_3, which I discovered in 1868, the name helium remains; the other for the present, we may call "gas X." The chief lines of these two constituents are as follows, according to Runge and Paschen:

Helium.	Gas X.
5876	6678
4713	5048
4472	5016
4026	4922
3889	

Last May I wrote as follows[1]:—

"The preliminary reconnaissance suggests that the gas obtained from bröggerite, by my method, is one of complex origin.

"I now proceed to show that the same conclusion holds good for the gases obtained by Profs. Ramsay and Clève from clèveite.

"For this purpose, as the final measures of the lines of the gas as obtained from clèveite by Profs. Ramsay and Clève have not yet been published, I take those given by Crookes, and Clève, as observed by Thalén.

"The most definite and striking result so far obtained is that in the spectra of the minerals giving the yellow line I have so far examined, I have never once seen the lines recorded by Crookes and Thalén in the blue. This demonstrates that the gas obtained from certain specimens of clèveite by chemical methods is vastly different from that obtained by my method from certain specimens of bröggerite, and since from the point of view of the blue lines, the spectrum of the gas obtained from clèveite is more complex than that of bröggerite, the gas itself cannot be more simple.

"Even the blue lines themselves, instead of appearing

[1] *Proc.* Roy. Soc., vol. lviii. p. 114.

en bloc, vary enormously in the sun, the appearances being—

4922 (4921·3) = 30 times.
4713 (4712·5) = twice.

"These are not the only facts which can be adduced to suggest that the gas from clèveite is as complex as that from bröggerite, but while, on the one hand, the simple nature of the gases obtained by Profs. Ramsay and Clève, and by myself, must be given up, reasoning on spectroscopic lines, the observations I have already made on several minerals indicate that the gases composing the mixtures are by no means the only ones we may hope to obtain."

It will be seen that the laboratory separation of D_3 from the lines 5048, 5016, and 4922 was complete, and we now know that they belong to different series.

These lines have now been differentiated by Runge and Paschen by a different but equally satisfactory method.

Nor is this all. The difference between the results obtained by Thalén and myself seemed susceptible of explanation by admitting a fractional distillation, according to which D_3 and 447 came off first, and 4922, 5016, and 667 later on (Fig. 2).

Here also I got the same result as in the diffusion experiment referred to by Drs. Runge and Paschen. They found similarly—

Less bright.	More bright.
D_3	5016
	6678

All these various lines of evidence tend therefore to complexity, and there can be little doubt from the convergence of all these lines of work, the results of which

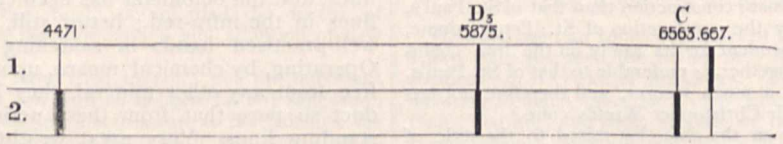

FIG. 1.—Diagram showing changes in intensities of lines brought about by varying the tension of the spark. (1) Without air-break. (2) With air-break.

Later on, in the same month, I returned to this subject, and showed that the lines at D_3 and 447 behaved in one way, and that at 667 behaved in another.

I wrote as follows[1]:—

"(1) In a simple gas like hydrogen, when the tension of the electric current given by an induction coil is increased, by inserting first a jar, and then an air-break into the circuit, the effect is to increase the brilliancy and the breadth of all the lines, the brilliancy and breadth being greatest when the longest air-break is used.

"(2) Contrariwise, when we are dealing with a known compound gas; at the lowest tension we may get the complete spectrum of the compound without any trace of its constituents, and we may then, by increasing the tension, gradually bring in the lines of the constituents, until, when complete dissociation is finally reached, the spectrum of the compound itself disappears.

agree among themselves, that we are in presence of at least two distinct gases, the complete spectra of which are those given by Drs. Runge and Paschen.

The second point is that there is no connection whatever between either of these gases and argon. Argon is of the earth, earthy, but helium and gas X are distinctly celestial, even more celestial than I thought when I claimed for them last May[1] the dignity of "a new order of gases of the highest importance to celestial chemistry." It was supposed at first that the spectra contained any number of common lines, next that there were two coincidences in the red between the new gases and argon; one I found broke down with moderate dispersion, the other has yielded to the still greater dispersion employed by Drs. Runge and Paschen; and, more than this, I have not found a single coincidence between argon and any line in the spectrum of any celestial body whatever. This happens, as everybody knows, also in the case of oxygen, nitrogen, chlorine, and the like.

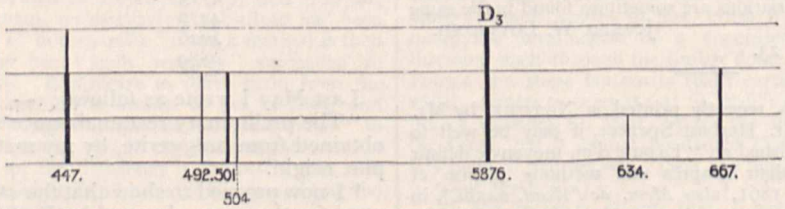

FIG. 2.—Diagram showing the order in which the lines appear in spectrum when bröggerite is heated.

"Working on these lines, the spectrum of the spark at atmospheric pressure, passing through the gas, or gases, distilled from bröggerite, has been studied with reference to the special lines C (hydrogen), D_3, 667, and 447.

"The first result is that all the lines do not vary equally, as they should do if we were dealing with a simple gas.

"The second result is that at the lowest tension 667 is relatively more brilliant than the other lines; on increasing the tension, C and D_3 considerably increase their brilliancy, 667 relatively and absolutely becoming more feeble, while 447, seen easily as a narrow line at low tension, is almost broadened out into invisibility as the tension is increased in some of the tubes, or is greatly brightened as well as broadened in others (Fig. 1).

[1] *Proc.* Roy. Soc., vol. lviii. p. 193.

The third point is as follows. So far I have worked upon some eighty minerals, and I have found the yellow line in sixteen; among the lines which I have already reported to the Royal Society are included all the stronger ones in the various series determined by the German physicists, but I can now add that in the region over which my work has extended, there is scarcely a single line in their series which I have not either seen or photographed in the spectrum of some celestial body or another. The following tables will show the results I have already obtained with all the six series of lines indicated by Drs. Runge and Paschen.

[1] *Proc.* Roy. Soc., vol. lviii. p. 117.

HELIUM.

11220	Sun.		Star or Nebula.
3889	C	E	N. III. γ
3188			
2945			
2829			
2764 *			
2723			
2696			
2677			
5876	C 100	E	
4472	C 100	E	
4026	C 25	E	
3820		E	α Cygni
3705			
3634			
3587			
3555			
3513			
3499 *			
3488			
3479			
3472			
3466			
3461			
7066	C 100		
4713	C 2	E	
4121		E	N. α Cygni
3868		?	
3777		E	Bellatrix
3652			
3599			
3567			
3537 *			
3517			
3503			
3491			
3482			

GAS X.

	Sun.		Star or Nebula.
5016	C 30	E	
3965		?	III. γ
3614		E	
3448			
3355			
3297 *			
3258			
3231			
3213			
6678	C 25		
4922	C 30	E	
4388		E	N. III. γ
4144		E	III. γ
4009			III. γ
3927			Bellatrix
3872			Bellatrix
3833		E	Hid by H line
3806			Bellatrix
3785 *			
7282			
5048	C 2		
4438			Bellatrix
4169			Bellatrix
4024		?	N. III. γ
3936	Hid in K.		
3878	C	E	α Cygni
3838	C	E	α Cygni
3803 *			

* Means that these lines are out of the range of my observations.

In the tables, under "Sun," C, followed by a number, indicates the frequency as given by Young; E indicates the lines photographed during the eclipse of 1893. Under "star or nebula" the references are to the tables given in my memoir on the nebula of Orion (*Phil. Trans.* vol. clxxxvi. (1895), p. 86 *et seq.* N = Nebula of Orion).

Hydrogen, helium, and gas X are thus proved to be those elements which are, we may say, completely represented in the hottest stars and in the hottest part of the sun that we can get at. Here then, in 1895, we have abundant confirmation of the views I put forward in 1868 as to the close connection between helium and hydrogen.

J. NORMAN LOCKYER.

RESEARCH IN ZOOLOGY AT OXFORD.[1]

THE second volume of the Linacre Reports, which has lately been printed, shows that the zoological laboratory at Oxford continues to be a source of production of many interesting and valuable contributions to knowledge.

In the course of a little more than one year the colleagues and pupils of Prof. Lankester have published a number of memoirs and essays, which, when collected together, form a bulky octavo volume, illustrated by numerous lithographs and woodcuts.

There is, as might be expected, considerable range in the interest and importance of the several items composing the volume, but not one of them could have been omitted without lessening its value to the zoologist. At least four of the memoirs are of such importance that they may be considered to be standard works to which reference must be frequently made in future by naturalists of all nationalities. Of these, perhaps, the most important is Prof. Poulton's memoir on the structure of the hair and bill of the duck-billed Platypus, which contains not only an excellent account of certain histological features of this rare animal, but some extremely suggestive remarks, derived from this research, on the relations of hairs and scales.

Dr. Benham's beautifully illustrated essay on the brain of the interesting Chimpanzee "Sally," which recently lived and died in the Zoological Gardens in London, forms an important chapter in "Man's place in Nature." The careful comparison which Dr. Benham gives of the large and valuable series of anthropoid and human brains which he has examined, makes this memoir one of special interest and importance.

Mr. Bourne's monograph on the post-embryonic development of Fungia gives us, at last, detailed information and good illustrations of a subject which has long interested zoologists.

The description of Prof. Lankester's collection of the species of Amphioxus and the genera allied to it, which has been carefully and ably written by Miss Kirkaldy, forms a memoir which will be welcomed heartily by zoologists in all civilised countries.

The other contributions to this volume are of less importance, perhaps, than those referred to above, but they are all useful additions to our knowledge of many widely separated branches of zoology, and being carefully written, and the result of work done under excellent advice and guidance, cannot be neglected by those who are specially interested in the branches of zoology of which they treat.

With such a volume of good useful work before us, it is truly lamentable to read in Prof. Lankester's editorial preface of the general indifference prevailing in the governing bodies of the Oxford colleges towards the progress of natural knowledge. The University of Oxford and the colleges together are the possessors of very large endowments for the cultivation of learning in all its branches. No university in the empire is so fortunately

1 "The Linacre Reports." Vol. ii.

situated, as regards funds, as Oxford is at the present day, and yet the just claims of the most progressive sciences upon her vast resources are persistently neglected, and she remains in the position of a follower rather than a leader in most of the scientific movements of the day.

The efforts that Prof. Lankester has so successfully made to stimulate his pupils to investigate natural things, have been made in spite of, and not as they should have been with the warm support and sympathy of the collegiate systems that prevail in Oxford.

During the past ten years only four fellowships have been awarded to young zoologists of promise by the Oxford colleges. The recipients of this support have each produced valuable work, which has reflected great credit upon themselves and the enlightened action of the colleges to which they belong. Not one of them has joined the ranks of the idle fellows which abound in the old universities of this country. The experiment cannot, therefore, be said to be a failure. It is as a fact the most conspicuous success of any of the college enterprises of the present day. Why then, it may be asked, have not other colleges followed the example that has been set? The answer to this question is to be found in the fact that, in consequence of the unfortunate competition that exists between colleges to swell the ranks of their undergraduates, the income of the endowments is frittered away in the salaries of the heads, the stewards, the bursars, and the tutors of the pass-men. Whether the time will soon come when a radical alteration will be made in the administration of the college endowments it is difficult to say, but there can be no doubt that the present state of affairs as regards the support of natural science in Oxford is little short of scandalous, and should call for the serious attention of men of influence who have her interests at heart.

Prof. Lankester is to be congratulated on the efforts he has personally made, as shown by the two volumes of "The Linacre Reports," to stimulate research in his own branch of science at Oxford; and it is to be most sincerely hoped that, in a little while, his enterprise will meet with the recognition from the colleges that it deserves.

SYDNEY J. HICKSON.

DEEP SOUNDING IN THE PACIFIC.

A DEEPER spot in the ocean than any yet known has been recently found by H.M. surveying ship *Penguin*. Unfortunately the observation was not complete, as a fault in the wire caused it to break when 4900 fathoms had run out without bottom having been reached.

Commander Balfour reports that this occurred in lat. 23° 40′ S., long. 175° 10′ W., about 60 miles north of a sounding of 4428 fathoms obtained by Captain Aldrich in 1888. A previous attempt to reach bottom had been foiled by a similar accident to the wire when 4300 fathoms had passed out, and the rising wind and sea prevented any further attempt at the time. As the deepest cast hitherto obtained is one of 4655 fathoms near Japan, it is at any rate certain that the depth at the position named is at least 245 fathoms greater.

It is hoped that before long a more successful attempt to find the actual depth will be made.

September 28. W. J. L. WHARTON.

LOUIS PASTEUR.

ON Saturday afternoon, M. Pasteur died at Garches, near St. Cloud, where he had gone for the summer in order to be near Paris, and at the same time to be near the large establishment for the preparation of antitoxic serum.

In 1868, Pasteur suffered from an attack of paralysis, the result apparently of a cerebral hæmorrhage; but although traces of this paralysis remained, he enjoyed fairly good health until 1887, when he developed symptoms of heart and kidney disease, probably a recrudescence of the diseases associated with his earlier paralysis. Four years ago he suffered from influenza, which appears to have left further weakness of the heart. Last winter he was unable to do any work, and in fact was confined to bed for several months; but when summer came, he was able to go to his country house at Villeneuve l'Étang, near St. Cloud, where he remained in comparatively good health, though easily fatigued, until about three weeks ago, when he seems to have felt that the end was approaching. It is stated that "about three weeks ago he kissed his grandchildren fondly, and pressed each for some time to his breast, sobbing as he did so. On being asked what was the matter, he said 'The matter is that I must so soon leave them.'" He appeared to be no worse at this time, but about a week later symptoms of uræmia began to develop, he became comatose, and on Wednesday last the uræmic poisoning became more marked, and by Friday it was evident that there could be only one termination to the illness.

In 1891 (NATURE, March 26) we gave a sketch of his life from the pen of Sir James Paget, some features of which may now be repeated. "Louis Pasteur was born on December 27, 1822, at Dôle, in the Jura, where his father, an old soldier who had been decorated on the field of battle, worked hard as a tanner." Father and mother alike seem to have been earnest, thoughtful people, whose one ambition seems to have been to "make a man" of their son.

"In 1825 they removed to Arbois, and as soon as he was old enough to be admitted as a day boy, Pasteur began his studies in the Communal College, and there, after the first year or two, he worked hard and gained distinction." He then, in turn, studied for a year at the college of Besançon and at the École Normale. He was only fourteen when he first applied for admission, but it was not until he had studied for a year that he went in for the examination; and in 1843 it is recorded that he was fourth on the list of successful competitors. At a very early period he devoted special attention to chemistry under Darlay at Besançon, and then under Dumas at the Sorbonne, and Balard at the École Normale. Here, too, in the École Normale, he commenced that study of molecular physics, especially in relation to the formation of crystals, which led up to his now classical investigation on the isomeric crystals of the tartrates and paratartrates of soda and ammonia. In 1847 he took his degree of Doctor of Science, after which he was appointed Assistant and then Professor of Chemical Physics in the University of Strassburg. In 1854 he was appointed Dean of the Faculty of Sciences at Lille, where he spent three years in organising the new school, and commenced those experiments on fermentation which seemed to follow naturally on his researches on the tartaric acids. He found that certain processes of fermentation were set up by distinct micro-organisms, under the action of which organic salts and even inorganic substances were broken down, and others were formed in their place. Three years later he was appointed Director of Studies in the École Normale in Paris, which office he retained until 1867. During this same period he was Professor, first of Geology, then of Physics, and latterly of Chemistry in the École des Beaux Arts. He also held the position of Professor of Chemistry at the Sorbonne.

As early as 1856, before his recall to Paris, the Royal Society of London awarded to him the Rumford Medal for his researches on the polarisation of light. In 1869 he was made a foreign member of the Royal Society, and in 1874 the Copley Medal was given to him. It is interesting to note in connection with his recent action as regards the Order offered to him by the Emperor William, that, during the bitterness caused by

the war, M. Pasteur sent back the Diploma of Doctor given to him by the University of Bonn in 1868, and subsequently received a message from the students calling him an impostor and a quack. In 1881 Pasteur was elected a member of the French Academy, succeeding to the seat of M. Littré. About the same time he was made an honorary Doctor of Science of the University of Oxford. In 1887 he was appointed perpetual secretary of the Academy of Sciences, but in 1889, owing to the failure of his health, he was compelled to hand over the duties of this position to M. Bertholet.

At the conclusion of his researches on crystals and wine fermentation, Pasteur commenced an inquiry into the diseases of the silkworm, and in no investigation that he undertook were his method and thoroughness more fully exemplified than in this. When he commenced his inquiry he had never even seen a silkworm, but for four years he spent several months of each year in tracing the germs of the "pebrine" disease through the various stages of development of the worm, egg, larva, chrysalis, and moth. He found what he described as "corpuscles," which he indicated were the contagious elements of the disease. These were taken up from the mulberry-leaves on which they had been previously deposited by diseased moths; some of the worms died, but others went on to the chrysalis and even to the moth stage, still affected by these "corpuscles," and the eggs laid by these moths were also found to contain them. He was convinced that the only way was to breed from moths not affected by the disease, and "to this end he invented the plan which has been universally adopted, and has restored a source of wealth to the silk districts: each female moth, when ready to lay eggs, is placed on a separate piece of linen, on which it may lay them all; after it has laid them and has died, it is dried, and then pounded in water, and, the water is then examined microscopically. If "corpuscles" are found in it, the whole of the eggs of this moth, and the linen on which they are laid, are burnt; if no corpuscles are found, the eggs are kept, to be, in due time, hatched, and yield healthy silkworms."

Pasteur's experiments on fermentation began to have a more direct bearing on disease when Sir Joseph Lister, applying the principles to the changes that occur in wounds, was able by his antiseptic practice to exclude putrefactive and septic germs from wounds, and so to prevent those terrible sequelæ which were the terror of surgeons of the past generation.

Then came Pasteur's great work in bacteriology, his attenuation of the anthrax bacillus and of other pathogenic organisms by which he procured a vaccinating virus, capable of producing a mild form of the disease: as a result of this attack vaccinated animals were protected against the attacks of the non-attenuated organism. This was first proved in connection with fowl-cholera, then in connection with swine erysipelas; but the most important application at that time was in connection with anthrax. His work on hydrophobia is still fresh in the minds of all. Pasteur's work does not end with his death. He had collected in the Institut Pasteur, which was raised as a memorial to his life's work, a band of able and well-trained investigators, who are imbued with the spirit that animated his mind and soul—men who, under his advice and encouragement, are working out the details of the great works that he initiated, who are endowed with some of his great mental power, and who have been fully trained under his eye in the methods of direct experiment and accurate observation, men who have been taught by him "n'avancez rien qui ne puisse être prouvé d'une façon simple et décisive," a rule always practised by himself.

France may well offer a public funeral. Louis Pasteur was one of her noblest sons—an honoured one during his life, and deeply lamented now that he is dead.

In Pasteur not only has France lost the greatest Frenchman, but the world has lost one of its greatest benefactors, not only of this age but of all time. Letters and telegrams of condolence have been sent by men of light and leading in many nations, and they indicate the sorrow felt unto the ends of the earth. No greater testimony than this could be given of the esteem in which the memory of the great investigator is held. The blessings which the human race owes to Pasteur have been recognised for some time, and now that the mind which gave them birth is at rest, one great outburst of grief arises. The expression of sorrow in France is full and sincere. At the funeral, which is arranged to take place next Saturday, the President of the Republic will be present, and other representatives of the French Government, together with a multitude of fellow-workers and friends who revere Pasteur's memory. The funeral procession will first proceed to Notre Dame, where a solemn requiem will be chanted in presence of the Archbishop of Paris. The body will afterwards be placed in one of the vaults of the cathedral until the celebration of the Centenary of the Institute of France, in three weeks' time, when it will be removed to its final resting-place. It has been arranged that the body of the great investigator shall be finally interred at the Institute which bears his name, and which will form a fitting monument to him. The representatives of science who will be assembled in Paris for the Centenary will accompany the transfer of the mortal remains of their foremost fellow-worker; so that while they unite to celebrate the foundation of the Institute of France, they will join together in sorrow for the deep loss which science has sustained.

NOTES.

THE eleventh International Geodetic Conference was opened at Berlin on Tuesday. Representatives were present from Austria, Belgium, France, Italy, Japan, Norway, Servia, Spain, Sweden, Switzerland, and the United States. The proceedings were opened by Dr. Bosse, the Prussian Minister of Public Education.

A NEW meteorological observatory is reported to have been opened on the Brocken, in the Harz Mountains, on Tuesday. The observations obtained there will be useful for discussion in connection with those made at the observatory on Ben Nevis.

SIR DAVID SALOMONS has arranged for an exhibition of horseless carriages on Tuesday, October 15, at the Tunbridge Wells Agricultural Show Ground, which has been lent to him for the occasion. The carriages will enter the ring at three o'clock p.m. The entrance money received will be used for prizes to be awarded at the show of the Tunbridge Wells and South Eastern Counties Agricultural Society next year, for the best horseless carriages intended to be used for agricultural, trade, and private purposes. Invitation tickets for the exhibition may be secured in order of application by Fellows and Members of the following Institutions sending an addressed envelope to one of the Secretaries—the Institution of Civil Engineers, the Institute of Electrical Engineers, the Institute of Mechanical Engineers, the Royal College of Physicians, and the Royal College of Surgeons.

THE Medical Schools attached to London and provincial hospitals commenced a new session on Tuesday with the customary introductory addresses. Prof. J. R. Bradford, at University College, discussed the positions occupied by biology, anatomy, and physiology in the medical curriculum. Dr. A. P. Laurie addressed the students at St. Mary's Hospital on the medical profession and unhealthy trades. At the London Hospital, Dr. J. Hughlings-Jackson was presented with his portrait and a piece of plate, in recognition of his great services to the London Hospital and Medical College, of his distinguished position in the profession, and of the advance he has effected in medical science by his laborious investigations and profound

insight into the diseases of the nervous system. The presentation was made by Sir James Paget, who also presented the prizes to the students. Mr. G. D. Pollock advised the students at St. George's Hospital as to their methods and aims of work. A valuable address on the more important developments of modern medicine, especially in the department of bacteriology, was given at Westminster Hospital by Dr. S. M. Copeman. Dr. W. J. Mickle discoursed on psychological medicine at Middlesex Hospital, and Dr. G. D'Ath read a paper at Guy's Hospital on "Our Profession, our Patients, our Public, and our Press." The introductory address to the students of the London School of Medicine for Women was given by Miss Ellaby.

THE annual exhibition of natural scientific specimens of the South London Natural History Society will be held at the St. Martin's Town Hall, Charing Cross, on the evening of October 17.

A PORTRAIT bust in bronze of the late Dr. Robert Brown, the botanist, has been presented to the Montrose Town Council by Miss Paton, a kinswoman of the botanist; it has been placed in a niche in the house where Dr. Brown was born in 1773.

THE *Lancet* announces that a subscription has been opened in Bristol to provide for the purchase and retention in that city of the celebrated collection of relics belonging to Jenner in connection with his introduction of vaccination. The collection is at present the property of Mr. Frederick Nockler, of Wotton-under-Edge, and was exhibited by him at the Bristol Exhibition in 1893, and since then in London, at each of which places it attracted a considerable amount of attention.

WAS any record obtained of an earthquake in England on September 13? A correspondent informs us that at 12.25 a.m. on that day, four slight but very distinct shocks were felt two miles north-west of Southampton. The shocks caused the room to shake, and a deep grinding noise was heard; they occurred a few seconds after each other, but the interval between the third and fourth was a little longer than that between the previous tremors. The last shock appears to have been the most intense.

ON Saturday, September 14, the ceremony of breaking the soil preparatory to the erection of the new building of the Brooklyn Institute, was performed in that city. The estimated cost of the new building is several millions of dollars, as its projectors intend it to be one of the finest and most complete of its kind erected. The Institute, which has a membership approaching 4000, has never yet had a suitable home, and it is confidently anticipated that rapid strides in membership and usefulness will be made when the present scheme has been carried to a conclusion.

WE much regret to have to record the death, from injuries received whilst riding his bicycle, of Prof. C. V. Riley, of Washington. Prof. Riley, who was fifty-two years old and a native of England, died on September 14. He was for many years State entomologist of Missouri, and from 1878 till 1894 was Government entomologist of the United States, and as such did very much in devising and applying means to destroy noxious insects. His successful experiment in checking the ravages of the white scale in California, a few years ago, by introducing the parasitic lady bug, *Vedalia cardinalis*, was among the most brilliant triumphs of economic entomology. Prof. Riley has written and published much. He was one of the original Fellows of the American Association for the Advancement of Science, and President of the Zoological Section in 1888, when he delivered an address on the causes of variation in organic forms.

AUTHORITIES have differed much as to the character of crystallised bromine. Gmelin-Kraut's Hand-book describes the solid substance as steel-grey and similar to iodine, whereas Schützenberger says "solid bromine is a crystalline, brown-red mass, and not grey-blue, as it is often described." The *Zeitschrift für Anorganische Chemie* (x. 1 and 2) gives a short account of its preparation by Henryk Arctowski by a new method. A very concentrated solution of bromine in carbon bisulphide, when cooled to $-90°$, deposits the halogen in the crystalline form and free from the solvent. When thus obtained, bromine forms a mass of fine needles of some millimetres length, which have a fine dark carmine-red colour like that of chromium trioxide. Solid bromine, obtained in mass, has a crystalline fracture, and has no well-defined metallic lustre like iodine; at the best, it has a dull black metallic appearance.

THE boiling point and the critical temperature of hydrogen, concerning which Prof. K. Olszewski made a preliminary statement in NATURE some little time ago, have since been determined by him with every precaution against error, with the result that his first estimate is proved to have been very near the truth. In the current number of *Wiedemann's Annalen* the process is described in detail. The "expansion method," which had already been successfully employed to determine the critical pressure, was again utilised, the critical temperature being the temperature at which liquid hydrogen, when slowly released from pressure, first boils up, and the boiling point being the temperature attained when the pressure is reduced to that of one atmosphere. The chief difficulty was, as usual, that of determining the temperature accurately. Prof. Olszewski succeeded here by using a coil of thin platinum wire immersed in the hydrogen, whose varying resistance indicated the amount by which it was cooled. This coil was placed in a cast-iron cylinder into which hydrogen was conducted from a reservoir under 180 atmospheres pressure. The cast-iron cylinder could be brought down to a temperature of $-210°$ C., not far from the absolute zero, by means of liquid oxygen. But the critical temperature of hydrogen was found to be still lower, viz. $-234{\cdot}5°$ C., and had to be found by extrapolation. The boiling point was $-243{\cdot}5°$ C., or $-406{\cdot}3°$ F.

IN a report on the Coosa coal-field, published by the Geological Survey of Alabama, Mr. A. M. Gibson describes some remarkable effects of the great "cloud-bursts" which devastated that region in 1872, and are still conspicuous after a lapse of over twenty years. Clean-cut channels, in one case sixty feet wide and three or four feet deep, are described as extending down the mountain sides. They were formed by the direct force of the downpour of water, and along them were carried great masses of rock—one weighing a hundred tons—earth, trees, &c., which formed moraine-like masses at the base, or were scattered far over the lower ground.

VOL. vi. of the new series of Reports of the Geological Survey of Canada has recently been published, and contains the annual reports for the years 1892 and 1893, two special preliminary reports on particular districts (namely, parts of Ontario and Nova Scotia), and chemical and mining reports illustrated by numerous statistical diagrams. Among the matters of general interest, we may note the results of Mr. Low's exploration of Labrador. He finds that the interior of Labrador is well-wooded, instead of being a treeless wilderness as generally supposed, and finds evidence that the continental ice-cap took its rise in the interior of that country. In the chemical report, Mr. G. C. Hoffmann records a remarkable mineralogical discovery. In the kaolinized perthite from a pegmatite vein are found spherules of metallic iron, mostly minute but at times measuring as much as a millimetre in diameter, and having a siliceous nucleus. Mr. Hoffmann refers to similar spherules described by him some years ago (*Trans. Roy. Soc. Canada*, vol. viii. sec. iii. p. 39), on the joint-surfaces of a quartzite, and considers that the explanation suggested in that case applies here again—that the iron has been reduced from limonite by the action of organic matter.

THE Canadian Geological Survey has published the second part of vol. iii. of its monographs on "Palæozoic Fossils," in which Mr. Whiteaves describes and figures fossils—chiefly Gastropods and Brachiopods—from the Guelph and Hudson River formations.

WE have received from Mr. J. H. Knowles, of Lavender Hill, S.W., a catalogue of various books of science which he has for sale. Many interesting and valuable works on Ornithology, Botany, Astronomy, and other sciences are included.

MESSRS. JARROLD AND SONS have just published an abridged edition of "The Official Guide to the Norwich Castle Museum," at the small price of sixpence. The chief author of the book is Mr. T. Southwell, who has produced a work that should be in the hands of all visitors to the museum, which it so well describes. The little work is admirably compiled, and is illustrated by numerous figures in the text.

THE valuable series of reprints now being published by Mr. Engelmann, of Leipsig, under the title of Ostwald's "Klassiker der Exakten Wissenschaften" has recently had four more volumes added to it. These, numbered 63 to 66, contain respectively the following papers:—"Zur Entdeckung des Elektromagnetismus," by H. C. Oersted and T. J. Seebeck; "Über die Vierfach Periodischen Functionen Zweier Variabeln," by C. G. J. Jacobi; "Abhandlung ueber die Functionen Zweier Variabler mit vier Perioden," by G. Rosenhain; and "Die Anfänge des Natürlichen Systemes der Chemischen Elemente," by J. W. Doebereiner and Max Pettenkofer.

WE have received part i. vol. vi. of the *Transactions* of the Norfolk and Norwich Naturalists' Society, by which it appears that the Society has just completed its twenty-sixth year, and to be financially in a prosperous condition; now numbering 275 members, amongst whom we recognise many well-known names. The presidential address, by Dr. Plowright, was mainly devoted to the consideration of some obscure points in the life-history and development of the various forms of *Puccinia*, which he showed had by no means been worked out, and indicated the direction in which further investigations should be pursued. Amongst the papers read before the Society, and published in their *Transactions*, is a very interesting one on "Neolithic Man in Thetford District," with illustrations of the various types of flint implements found in the river-gravels of that neighbourhood. The usual "Report on the Herring Fishery of Yarmouth and Lowestoft" is also published, which having been continued for fourteen consecutive years, in the absence of trustworthy statistics on the subject elsewhere, should be possessed of value; and the same may be said of the very full meteorological notes by Mr. A. W. Preston. A chatty paper on "Old-time Yarmouth Naturalists," by Mr. F. Danby-Palmer, should also be mentioned as giving some particulars of the more noticeable of the old-time naturalists, for which that ornithologically rich section of the east coast has always been remarkable. There are fifteen published papers in all, each of which speaks well for the vitality and usefulness of the Society.

THE additions to the Zoological Society's Gardens during the past week include two Bonnet Monkeys (*Macacus sinicus*, ♀ ♀) from India, presented respectively by Mr. Thomas Mackenzie and Messrs. Davies and Sons; a Chimpanzee (*Anthropopithecus troglodytes*, ♂) from West Africa, presented by Captain G. C. Denton; a Piping Guan (*Pipile cumanensis*) from Uruguay, presented by Mr. P. du Pré Grenfell; four Green Lizards (*Lacerta viridis*), three Wall Lizards (*Lacerta muralis*), European, presented by Mr. C. W. Tytheridge; two Laughing Kingfishers (*Dacelo gigantea*) from Australia, deposited; a Common Seal (*Phoca vitulina*) from Scotland, purchased.

OUR ASTRONOMICAL COLUMN.

RETURN OF FAYE'S COMET.—A telegram from Kiel, received on September 28, announces that Faye's comet was observed by Javelle at Nice on the 26th. At 12h. 34·8m., Nice time, it was in R.A. 21h. 8m. 11s., and Decl. 1° 54′ S. It is accordingly well situated in the north-western part of the constellation Aquarius, crossing the meridian a little before 9 p.m. At the time of observation it was noted as "feeble."

ELEMENTS AND EPHEMERIS OF COMET *a*, 1895 (SWIFT).—Dr. Berberich has computed the following new elements of Swift's comet, from observations made at Mount Hamilton, August 21; Nice, August 31; and Strassburg, September 16. These elements represent the comet's orbit with a greater degree of accuracy than those previously deduced, and the ephemeris determined from them closely represents observations made at Paris. In continuation of the ephemeris given in NATURE of September 5, we print the following, from *Edinburgh Circular* No. 46:—

T = 1895, *Aug.* 20, 88480 *M. T. Berlin*

$\pi - \Omega = 167^\circ\ 47'\ 7''\cdot8$
$\Omega = 170\ 16\ 17\cdot3$ 1895·0
$i = 2\ 59\ 24\cdot9$
$\phi = 40\ 22\ 17\cdot6$

$\mu = 502''\cdot654$
$\log a = 0\cdot565825$
$\log q = 0\cdot112686$
Period = 7·059 years.

Ephemeris for Berlin Midnight.

1895.	α app. h. m. s.	δ app. ° ′	Brightness.
Oct. 2 ...	1 24 7 ...	+4 32·9	
4 ...	1 24 41 ...	4 23·9 ...	0·62
6 ...	1 25 9 ...	4 15·3	
8 ...	1 25 31 ...	+4 7·1 ...	0·56
10 ...	1 25 50 ...	+3 59·5	
12 ...	1 26 6 ...	3 52·5 ...	0·50
14 ...	1 26 19 ...	3 46·2	
16 ...	1 26 31 ...	3 40·6 ...	0·44
18 ...	1 26 42 ...	3 35·8	
20 ...	1 26 53 ...	3 31·9 ...	0·38
22 ...	1 27 5 ...	3 29·0	
24 ...	1 27 19 ...	3 27·0 ...	0·33
26 ...	1 27 35 ...	3 25·9	
28 ...	1 27 53 ...	+3 25·7 ...	0·29

It will be noticed that the comet is diminishing in brightness, and on October 12 will only be half the brightness at the time of discovery, August 20.

γ VIRGINIS.—Of the many double-star orbits which have recently been computed by Dr. See, of Chicago, none presents more features of interest than that of γ Virginis. This famous double star has been very persistently observed since its discovery in 1718, but none of the orbits previously determined are consistent with the most recent observations. Including some of his own measures, Dr. See finds the following elements (*Astronomical Journal*, No. 352):—

P =	194·0 years ...	Ω =	50°·4
T =	1836·53 ,, ...	*i* =	31°·0
e =	0·8974 ,, ...	λ =	270°·0
a =	3″·989 ...	*n* =	1·8557

Apparent orbit:

Length of major axis = 6″·824
,, ,, minor axis = 3″·530
Angle of major axis = 140°·4
,, ,, periastron = 140°·4
Distance of star from centre = 3″·062

A comparison of computed and observed places shows, according to Dr. See, that these elements are probably the most exact yet found for any binary star. It will be seen from the figures given that the line of nodes coincides with the minor axis of the real ellipse, which is also the minor axis of its projection; and, owing to the small inclination, the apparent ellipse is only slightly less eccentric than the real ellipse, so that the foci of the two ellipses nearly coincide. Dr. See points out that one of the consequences of this disposition of the orbit is to make the movement of the radius vector in the apparent orbit very little different from that in the real orbit, so that γ Virginis furnishes the best test we have for the exactness of the law of gravitation in stellar systems. "If there is any deviation from the Keplerian law of areas, it must be extremely slight. There-

fore the force is certainly central, and if it differs at all from the law of Newton, the deviation must be relatively unimportant."

The orbit is also remarkable for its great eccentricity, which surpasses that of any known stellar orbit.

For many years to come the angular motion will be very slow, and Dr. See draws attention to the fact that observations of distance will be more valuable than angular measures in effecting a further improvement in the elements.

THE THIRD INTERNATIONAL ZOOLOGICAL CONGRESS AT LEYDEN.

FROM first to last this Congress, the Session of which lasted from September 15 to 21, was favoured by exceptionally fine autumn weather, and the quaint old town of Leyden, where the meeting was held, as well as the island of Marken, the Zoological Park at Graveland (where apteryx thrives and gnus are kept in free pastures), the Zoological Station at Helder, the sea-beach of Katwijk and Scheveningen, and the port of Rotterdam, to all of which places excursions were organised, were under these circumstances seen at their very best.

The character of the meeting was eminently international. The daily bulletin, although edited in French, contained announcements of lectures to be held and of papers to be read in English and in German, and in the Sections these three different tongues often succeeded one another rapidly and fraternally.

On the Sunday evening preceding the official opening there had been an informal mustering of the forces then already assembled, and Prof. Hubrecht, of Utrecht, who, as President of the Netherlands Zoological Society, gave a hearty welcome to those present, hinted at the inadvisability of allowing the use of more than these three languages.

Still, besides forty-two representatives from Great Britain and the United States, sixty-three from France and Belgium, and twenty from Germany and Austria, there were no less than eleven Russians, eight Scandinavians, and sixty-four Dutchmen inscribed as members, who had to restrict the use of their native language to conversation among themselves.

The total number of members inscribed was 232, and not only the number but also the quality of the zoologists assembled was such as to make this international gathering really a very representative one, which served to bring together some of the veterans of the old guard, and a great number of the younger generation of zoologists.

A glance along the list of those that were present will show this at once. There we find Jul. Vict. Carus, Th. Eimer, V. Hensen, A. Metzger, F. E. Schulze, R. Semon, J. W. Spengel, R. Virchow, Aug. Weismann, K. Grobben, Ch. Julin, E. de Sélys Longchamps, C. Lütken, H. Field, O. C. Marsh, W. B. Scott, C. W. Stiles, R. Blanchard, E. Bouvier, A. Certes, A. Milne-Edwards, E. Perrier, L. Vaillant, J. Anderson, Sir W. H. Flower, S. J. Hickson, John Murray, Adam Sedgwick, R. B. Sharpe, R. Trimen, d'Arcy Thompson, S. Apathy, S. Brusina, C. Emery, R. Collett, A. Kowalevsky, W. Schimkevitch, W. Salensky, W. Blasius, N. Zograff, W. Leche, F. A. Smitt, Th. Studer, van Wyhe, Max Weber, Vosmaer, Sluiter, van Rees, Lidth de Jeude, Kerbert Jentink, Hubrecht, Hoffmann, Hoek, Horst, Everts, Büttikofer, M. C. Dekhuyzen, E. Rosenberg, and van Bemmelen. Very many of these read papers in the Sections, three of them (John Murray, A. Milne-Edwards and Weismann) addressed general meetings; whereas on the Tuesday evening a lecture on the curiosities of bird life, illustrated by coloured lantern-slides, was given by Dr. Bowdler Sharpe, of the British Museum, and was attended by the young Queen and the Queen-Regent.

The Committee of Organisation, to whose excellent arrangements much of the success of the meeting was due, were Prof. Hubrecht of Utrecht, Dr. Jentink, Director of the Natural History Museum, Leyden (President of the Congress), Dr. Hoek (Secretary), and Dr. Horst (Treasurer).

There were six different Sections, a new feature of which was the inclusion of palæontology with recent zoology. There was no separate Palæontological Section.

In the first Section (general zoology, geographical distribution, with the inclusion of fossil faunas and evolution theory), Mr. A. Sedgwick, of Cambridge, gave an exposition of his views concerning direct cellular continuity in the living organism. In a later meeting of the same Section, Prof. Apathy, of Klausenburg (Hungary), demonstrated a series of the most beautiful and delicate microscopical preparations, which, already at an earlier date, have led him to conclusions very similar to those of Sedgwick just referred to.

Prof. Hensen, of Kiel, gave an interesting account of the Plankton expedition, its aims and its results.

Prof. Eimer, of Tübingen, spoke in this Section on the subject of orthogenesis, and on the impotence of natural selection for the production of new species.

In the second and third Sections, devoted to living and extinct vertebrates, their anatomy and embryology, papers were read by Profs. Zograff of Moscow, Vaillant, O. C. Marsh, Büttikofer, Lütken, Leche, Semon, Hubrecht, and van Bemmelen.

The fourth, fifth and sixth Sections embraced the invertebrates, one of them being specially devoted to entomology. Messrs. Wardell Stiles (from the United States), Hickson, Blanchard, Goto (from Tokyo), Perrier, Kowalevsky, Schimkevitch, Gilson, Salensky, and Julin were among the principal speakers in these Sections.

The sectional meeting which proved to be the most attractive was the one that was held on the last day of the meeting, when in the second Section, temporarily presided over by Rudolf Virchow, Dr. E. Dubois, the indefatigable naturalist, who has devoted the last six years to the collection of palæontological specimens in Sumatra and Java, gave a full account of the finding of the remnants of his *Pithecanthropus erectus*.

The four fragments (a femur, the upper part of a skull, and two teeth) upon which this new species, looked upon by its author as an intermediate stage between the anthropoids and man, was founded, were laid before the Section, together with a good many pieces intended for comparison. A most interesting discussion followed, in which Virchow, O. C. Marsh, Emil Rosenberg, Sir William Flower and Prof. Martin took a prominent part. Virchow's contention was that the four fragments did not belong to the same animal. He attempted to derive arguments from pathological anatomy, which would show that the osteophytic outgrowths of the femur described by Dubois were indications tending rather towards the human than towards the simian origin of the femur. Nevertheless, he spoke in a very appreciative tone, telling the Section that he had only wished to put in a point of interrogation where Dubois' affirmations did not appear to him to be as yet fully justified.

Prof. Marsh was inclined, on grounds derived from his vast experience in palæontological excavations, to support many of Dubois' conclusions. He had noticed exostoses of a similar nature as those of Pithecanthropus in fossil animals of quite different orders. He pointed out the necessity of carefully comparing these remains with those from the Sivalik Hills.

Prof. Rosenberg, considering more especially the femur and the cranium from the point of view of the anatomist, tried to show that the four characteristics, by which Dubois separates the femur of Pithecanthropus from that of man, are found also in human femora, in some few cases even all of them combined. The skull, on the contrary, is more that of a primate; but he did not agree with Dubois' argument that certain peculiarities of its *planum nuchale* tended to show that the animal had assumed a more erect gait. Very similar peculiarities are found in the New-World Cebus, which moves on all fours. Rosenberg acknowledged, however, that the high intrinsic value of the fragments was in no way diminished by the doubts expressed by him, because the femur, even if human, would prove Tertiary man to have existed in Java, the origin of man being thus pushed further back towards the earlier Tertiary period.

The results of this discussion, though not a decisive triumph for Pithecanthropus as a valid species, was a unanimous recognition of the great importance of Dr. Dubois' researches.

Another interesting afternoon lecture, which attracted numerous members of different Sections, was given by Prof. W. B. Scott, of Princeton, and was illustrated by lantern-slides. The wonderful continuity of the American tertiary formations, the vast geographical scale on which they are developed, and the excellent state of preservation of their fossils, was specially insisted upon. Skeletons of many members of the beautifully continuous phylogenetic series were projected on the screen.

Of the lectures held at the general meetings, those of Dr. John Murray and Prof. Milne-Edwards were most interesting to the audiences they addressed. Prof. Milne-Edwards spoke on the extinct avifauna of the Mascarene Islands in its relation to that of certain islands in the Pacific Ocean, and Dr. Murray gave an admirable survey of deep-sea exploration in general,

and of its principal results. In seconding a vote of thanks to Dr. Murray, Prof. Milne-Edwards availed himself of the opportunity of complimenting him, in terms of the highest eulogy, on the completion of the *Challenger* Reports, the cost of which has been so liberally met by the British Government, and the editorship of which has been in the hands of Dr. Murray since the death of the late Sir Wyville Thomson.

Prof. Weismann's lecture to the general meeting treated of a much more abstruse and complicated subject, viz. Germinal Selection. Under this name he introduced what he holds to be a supplementary hypothesis to that of Natural Selection, and by which he explains the fact that useful variations appear to be protected from their very first appearance, so that, when natural selection would require them, they are indeed always there. The simultaneous development of harmonious variations of different parts of the same organism was at the same time elucidated on similar principles.

It may be noticed in passing, that these theoretical views of Weismann's approach very closely to views expressed as the result of quite different series of palæontological observations by W. B. Scott and others. It is clear that an explanation of certain groups of facts is yet wanted. Weismann will have to show that his speculations do indeed bridge this gap.

In the three general meetings other questions of international significance were settled. In the first one, presided over by the Minister of the Interior, Mr. van Houten, the prize to which the name of the present Emperor of Russia is attached was awarded to Dr. R. T. Scharff, of Dublin. In the second one, of Wednesday, September 19, the conclusions of a report of M. Bouvier, on the question of bibliographical reform, were unanimously carried, and seven members of the Controlling Commission nominated, viz. Messrs. Spengel, Sidney Hickson, W. B. Scott, Blanchard, Hoek, Schimkevitch, and Lang.

Another commission for the definite codification of the rules of zoological nomenclature was appointed, and consists of Messrs. Blanchard, Victor Carus, Jentink, Sclater, and Wardell Stiles.

In the final meeting, Sir William Flower was nominated to the presidency of the next Zoological Congress, in 1898. Upon the proposition of the President of the Congress, in the name of the Committee of Organisation, it was decided to meet in England, the exact place of meeting being left to the consideration of the permanent Bureau.

During the Congress, as has already been announced in NATURE, three of its most eminent members—Messrs. Weismann, Milne-Edwards, and Sir Wm. Flower—received the honorary degree of Doctor in Science (Section of Zoology and Botany) from the Senate of the Utrecht University, upon the proposal of the Faculty of Natural Philosophy.

On Saturday the meeting closed, and the members united in a farewell banquet in the concert hall, where the Minister of the Interior was again present.

On Sunday, the 22nd, the Amsterdam Zoological Society *Natura Artis Magistra* invited the members to a luncheon party, and to a visit to its well-known gardens and aquarium.

After this the members of the Congress definitely separated. There is not one of them who has not extended the circle of his personal acquaintance amongst his fellow-workers in the field of zoology. And this extension of the feelings of international scientific fraternity is one of the great advantages of these cosmopolitan gatherings.

THE INTERNATIONAL CONGRESS OF PHYSIOLOGISTS AT BERN.

I.

MONDAY, September 9.—Presidents, Profs. Chauveau and Bowditch. Dr. Boruttau (Göttingen) demonstrated on a platinum wire contained in a glass tube filled with ·6 per cent. salt solution, electrical changes (negative variation), analogous to those occurring upon stimulation of a nerve trunk. The negative variation occurred not only upon electrical, but also upon chemical and mechanical stimulation of the wire. The apparatus used for the purpose were a Hermann's repeating rheotome and a Thomson's galvanometer.

Profs. Ewald and Goltz (Strassburg) showed a dog from which they had removed, at three successive stages, large portions of the spinal cord. In all 158 mm. had been removed; this involved all the spinal cord below the middle dorsal region, inclusive of the cauda equina. The dog had already survived the last operation two years. The condition was as follows:—(1) Entire muscular degeneration of hind limbs, and back muscles below mid-dorsal region; (2) evacuation of fæces, and sphincter ani ext., normal; (3) large quantities of urine collected in bladder, but were eventually evacuated; (4) vascular tone normal. Animal gave birth to young ones since last operation, and suckled them normally.

Prof. Fano (Florence) showed a special apparatus by which he could measure exactly motor reaction time. He worked on the dog, and found that it was 32·6 sec. for anterior paw, 27·32 for posterior. After removal of parts of cortical layer of frontal and occipital lobes this reaction time was diminished; upon stimulation of same regions it was increased. From this the author concluded that the cortical cells, especially of the frontal region, exert a constant inhibitory action on the spinal cord.

Prof. Langley (Cambridge) gave a demonstration on (1) the general anatomical relations of the sympathetic system; (2) connection of nerve cells and nerve fibres; (3) reflexes from the sympathetic system.

Dr. Mann (Edinburgh) read a paper, accompanied by lantern-slides, and gave a demonstration on the position of the psycho-motor areas in the rabbit, hedgehog, dog, and cat. The result of the author's researches was to show that (1) the same general scheme of arrangement of the psycho-motor areas holds good throughout the animal kingdom, and (2) that there exist in the above animals centres of varying psycho-motor value (higher and lower centres in the physiological sense).

Prof. Gaule (Zürich) discussed the growth of muscle, and came to the conclusion that it was periodic, and that there exist in muscular fibres changes corresponding to these periods. He further discussed and showed the effect of excision of the inferior cervical ganglion upon the biceps and psoas of the same side. Within twenty-four hours of this excision these muscles increase in weight, and have their resistance to mechanical strain greatly diminished (rupture easily).

Prof. Vitzou (Bucharest) produced blindness in a monkey by removal of the occipital region of the brain; two years after the operation the animal recovered, to a slight extent, its sight. Upon examining the brain at the seat of the lesion, he found a tissue of new formation; this tissue was very vascular, and its extirpation reproduced the blindness. Histological examination of this tissue showed the presence of nervous elements, which the author regarded as of true new formation.

Dr. Demoor (Brussels) stained the brains of animals to which he had given a strong dose of morphine or chloral hydrate by Golgi's method. Demoor found that the plotoplasm of the cell processes in these animals presented a characteristic mannilliform aspect, which was not to be observed in normal animals. The author showed his preparations.

Monday Afternoon.—Presidents, Prof. Hensen and Mosso.—Prof. Herzen (Lausanne) described the characters of a gastric juice obtained by the author and Dr. Fremont (Vichy) from the isolated stomach of a dog. The œsophagus was sutured to the duodenum, and a fistula was made, from which the gastric juice was collected. The juice was without smell or colour, was highly acid, and could digest its own weight of coagulated albumin. The author further gave the result of his researches on the influence of the spleen on pancreatic digestion. He found a given quantity of blood from the splenic vein, added to a pancreatic infusion, greatly increased its digestive power, whereas the same quantity of ordinary arterial blood did not.

Prof. Schiff (Geneva) discussed the effects of an isolated lesion of one pyramid, and showed that it produced degeneration in the pyramid only, and not in the pyramidal tract.

Dr. Gürber (Würzburg) described the results of his researches on the crystallisation of serum albumin. He treated horse serum after Hofmeister's method (ammonium sulphate), and obtained four kinds of crystals. The author showed diagrams of these, and gave the results of their analysis.

Prof. Tigerstedt (Stockholm) described a new apparatus, on the principle of Pettenkofer and Voit, for respiration experiments on man. The author's apparatus is of such volume as to be able to contain several men at the same time.

Tuesday Morning.—Presidents, Prof. Rutherford and Hegir.—Dr. His, junr. (Leipsig) supported Engelmann's view that the propagation of the rhythmic cardiac wave takes place from fibre to fibre. He could not confirm Kent's results. He found in mammals, including man, a single muscular bundle which showed cross striation, going from the inter-auricular down into

the inter-ventricular septum, in the neighbourhood of a cusp of the mitral valve. The author divided this bundle by a transverse incision of 2 mm., and found that after this the auricle and ventricle beat each with its own rhythm. This bundle contained no nervous elements.

Dr. Kaiser (Heidelberg) showed that upon pinching off the lower two-thirds of the partially emptied frog's ventricle, this portion remained motionless; but on subsequently clamping the bulbus arteriosus, tension being produced in the ventricle, it recommenced to beat. Dr. Kaiser explains this result by supposing the existence in the frog's heart of a series of neurons which are discharged by an impulse which starts in the sinus, so that the mechanism is that of a reflex action; he believes the pinching destroyed the continuity of the nervous apparatus, while it left the muscle intact.

Prof. Kronecker (Bern) demonstrated in a most striking manner the effect of a sudden arrest of the coronary circulation, by injecting paraffin melting at 39° C. into the descending coronary artery. The heart at once stops and enters into marked fibrillar contraction, from which, except occasionally in young animals, it never recovers. This effect is not produced by ligature of the same artery; this, in Prof. Kronecker's opinion, is due to collateral circulation being at once established. From this experiment Kronecker infers that the cardiac rhythm is due to the activity of some structures which are exceedingly sensitive to sudden cessation of their blood supply; this is not true of muscles or nerve trunks, but is of a nerve plexus or a ganglion cell.

Dr. Magnus (Heidelburg) showed a sphygmograph for use on a dissected out artery.

Prof. Hurthle (Breslau) showed a new method of registering the arterial blood-pressure in man. The arm is made bloodless by means of an Esmark's bandage, and introduced into a phlethysmograph connected with a tambour. Hurthle also showed a method for simultaneously recording the heart movements and rendering audible the heart sounds. The latter was effected by a resonating-box placed against the chest-wall; to the box a wooden tuning-fork was attached; the limbs of this vibrated in unison with the heart sounds, and varied the intensity of a current led through the primary coil of an induction apparatus, and through a microphone placed between the limbs of the fork; a telephone was connected with the secondary coil.

Dr. White (London) made experiments to show that perfect cardiac perfusion was not obtained with a Kronecker's canula as modified by Williams, the actual perfusion in a Williams' only extending to the top of the end-piece.

Dr. Zuntz (Berlin) described a new method for determining the velocity of the blood; it consisted in injecting into the carotid artery, during arrest of the heart produced by stimulation of the vagus, sufficient blood to bring the blood pressure back to the normal. Knowing the amount of blood which has to be injected, and the time this takes, the velocity of the blood, as well as the amount propelled by the heart, can be deduced.

Tuesday Afternoon.—Presidents, Profs. Wedensky and Tigerstedt.—Dr. A. Dastre (Paris) showed that if fresh fibrin is placed in strong neutral saline solutions, one finds after a certain time two globulins in the solution. (1) Globulin coagulating at 54°; (2) Globulin having the properties of serum globulin; and further, that proteose and true peptone are also present. This action of saline solutions on fresh fibrin can be divided into different stages. If fresh fibrin be submitted in the same manner to the action of the digestive juices, the same results are produced; it is then quite justifiable to speak of a "saline digestion" of fibrin. Fibrin submitted to the action of oxygenated water, and to that of micro-organisms, gave the same results. When gelatin is similarly treated, gelatoses are produced, and the gelatin loses its power of coagulation.

Dr. A. Beck (Lemberg) discussed the velocity of blood in the portal vein. The author found that the normal velocity was from 2000 to 2800 cms. per second, and that 0·62–0·79 grm. of blood flowed through 1 grm. of liver tissue in twenty-four hours. The author used Cybulsky's method.

Prof. Berry Haycraft (Cardiff) read a paper on the change of shape of the heart during contraction. The author found it difficult to kill animals with the heart in systole; this he finally did by injections of $HgCl_2$. Killing animals with the heart in diastole presented no difficulty. The animals were frozen immediately after death, and sections of their hearts cut at different levels. The author's results confirmed those of Ludwig and Hesser.

Prof. F. Gotch (Oxford). The discharge of *Malapterurus electricus*. The electrical discharge of the organ evoked in the living fish by mechanical and electrical stimulation was investigated by the capillary electrometer, the frog nerve muscle galvanoscope, and the galvanometer. Each apparently single shock of the organ was found to be multiple in character, showing an initial primary, followed by several secondary electrical outbursts. The primary outburst had a latency of 4/1000″ and a duration of 2/1000″. The E.M.F. = 120 to 200 volts. The secondary effects which follow the primary are plainly perceptible in the isolated organ after killing the fish; hence the multiple character of the single *secousse* is due to the organ itself. Each of the secondary effects occurs at an interval of from 4/1000″–6/1000″ after its predecessor. The primary as well as the secondary effects are monophasic in character; hence a very profound physiological effect is produced.

F. W. TUNNICLIFFE.

FORTHCOMING BOOKS OF SCIENCE.

MESSRS. C. GRIFFIN & CO., Ltd., will shortly issue:—An exhaustive treatise on "Petroleum: the Geographical Distribution, Geological Occurrence, Chemistry, Refining, and Testing, &c.," by Boverton Redwood and Geo. T. Holloway, in two volumes: "The Chemistry of Gas Manufacture: a Handbook on the Production, Purification, and Testing of Illuminating Gas, and the Assay of the Bye-Products of Gas Manufacture," by W. J. Atkinson Butterfield; "Chemistry for Engineers and Manufacturers," by Bloxam Blount and A. G. Bloxam, in two volumes: vol. i. "The Chemistry of Engineering, Building, and Metallurgy"; vol. ii. "The Chemistry of Manufacturing Processes"; "Electrical Measurements and Instruments: a Practical Handbook of Testing for the Electrical Engineer," by Charles H. Yeaman; "Textile Printing: a Practical Manual of the Processes used in the Printing of Cotton, Woollen, and Silk Fabrics," by C. S. Seymour Rothwell, with illustrative specimens (companion volume to the "Manual of Dyeing," by Messrs. Knecht and Rawson); "Bleaching and Calico-Printing: a Short Manual for Practical Men," by Geo. Duerr, with specimens designed specially to show various stages of the processes described; a third edition, revised and enlarged, of the "Outlines of Practical Physiology," by Dr. William Stirling; a fourth edition of "Foods: their Composition and Analysis," and a third edition of "Poisons: their Effects and Detection," both enlarged and revised, by A. Wynter Blyth; an eleventh edition, revised, of Munro and Jamieson's "Electrical Pocket-book"; a third edition, also revised, of Seaton and Rownthwaite's "Marine Engineering Pocket-book"; a new issue, revised, of "Griffin's Electrical Engineer's Price-book," brought up to date and edited by H. J. Dowsing; a second edition, revised, of "The Design of Structures," by S. Anglin; and the thirteenth annual issue of "The Year-book of Scientific and Learned Societies of Great Britain and Ireland," comprising Lists of the Papers read before Societies engaged in Fourteen Departments of Research during 1895.

In the Cambridge University Press's announcements we notice a series of volumes dealing with geographical and cognate subjects, which will be under the general editorship of Dr. F. H. H. Guillemard. The first volume will be by Prof. A. H. Keane, and will treat of Ethnology. This will be followed by "The Geographical Distribution of Mammals," by R. Lydekker. Mr. H. F. Tozer is to write on the "History of Ancient Geography"; and other volumes will deal with the "Renaissance Period of Geographical Discovery," by C. E. Ravenstein, and "Oceanography," by J. Y. Buchanan.; "The Scientific Papers of John Couch Adams," vol. i., edited by Prof. William Grylls Adams, with a memoir by Dr. J. W. L. Glaisher; "The Collected Mathematical Papers of the late Arthur Cayley," vol. ix.; "A Treatise on Spherical Astronomy," by Sir Robert S. Ball; "Catalogue of Scientific Papers compiled by the Royal Society of London," 1874–1883, vol. xi.; a second edition of Heath's "Treatise on Geometrical Optics; "A Treatise on Abel's Theorem," by H. F. Baker; "A Treatise on the Lunar Theory," by E. W. Brown; "An Elementary Treatise on Electricity and Magnetism," by Prof. J. J. Thomson; "A Treatise on Geometrical Optics," by R. A. Herman. In the Pitt Press Mathematical Series: "Euclid," books xi. and

xii., by H. M. Taylor; and in the "Cambridge Natural Science Manuals: "Mechanics and Hydrostatics: Part iii. Hydrostatics," by R. T. Glazebrook; "Electricity and Magnetism," by the same; "Solution and Electrolysis," by W. C. D. Whetham; "Sound," by J. W. Capstick; "Fossil Plants: a Manual for Students of Botany and Geology," by A. C. Seward; "The Vetebrate Skeleton," by S. H. Reynolds; "Text-Book of Physical Anthropology," by Prof. Macalister; and a second edition of "Practical Physiology of Plants," by F. Darwin and E. H. Acton.

Messrs. Swan Sonnenschein and Co.'s list includes:—"Text-Book of Embryology: Invertebrates," by Drs. Korschelt and Heider, part i., translated and edited by Dr. E. L. Mark and Dr. W. M. Woodworth, with additions by author and translators; parts ii. and iii. translated and edited by H. T. Campbell; "Text-book of Palæontology for Zoological Students," by Theodore T. Groom, illustrated; "The Indian Calendar," containing complete tables for the verification of Hindu and Muhammedan dates for a period of 1600 years (A.D. 300 to 1900) for the whole of India, by Robert Sewell, of the Madras Civil Service, in collaboration with Sankara Bâlkrishna Dikshit, with a table of eclipses by Dr. Schram; "Practical Plant Physiology," by Prof. Wilhelm Detmer, translated by S. A. Moor; "Introductory Science Text-books"—"Zoology," by B. Lindsay, with illustrations and diagrams; "Elementary Biology," by Dr. H. J. Campbell, second edition, with appendix; "Organic Chemistry," by J. Wade; Young Collector Series: "Fishes," by the Rev. H. A. Macpherson; "Mammalia," by the Rev. H. A. Macpherson; "Birds' Eggs and Nests," by W. C. J. Ruskin Butterfield.

Messrs. Longmans and Co.'s forthcoming books include:—"The Romance of the Woods: reprinted Articles and Sketches," by Fred. J. Whishaw; "The Life of Joseph Wolf, Artist and Naturalist," by A. H. Palmer; "The Life of Sir Henry Halford, Bart., F.R.S., President of the Royal College of Physicians, Physician to George III., George IV., William IV., and to Her Majesty Queen Victoria," by Dr. William Munk; "Darwin, and After Darwin: an Exposition of the Darwinian Theory, and a Discussion on Post-Darwinian Questions," by the late Dr. George John Romanes, F.R.S. Part ii. Post-Darwinian Questions: Heredity and Utility; "The Life and Letters of George John Romanes, F.R.S.," written and edited by his Wife; "Studies of Childhood," by Prof. James Sully; and in a new series of "Physical and Electrical Engineering Laboratory Manuals," "Elementary Physics," by John Henderson; "The Magnetic Circuit in Theory and Practice," by Dr. H. du Bois, translated from the German by Dr. E. Atkinson.

Messrs. George Philip and Son's announcements include:—*Maps*—Topographical Map of the Argentine Republic, in 10 sheets, scale 1:2,000,000, by H. D. Hoskold. Geological Map of the British Isles, forming part of the International Geological Map of Europe, scale 1:1,500,000. Philip's Topographical Map of England and Wales, in 40 sheets, scale 1:200,000. Philip's Library Map of India, scale 1:5,000,000. Philip's Large Map of Western Australia, scale 1:1,500,000. Philip's New Map of Liverpool, scale 6 inches to 1 mile. *Books*—"Telescopic Astronomy," by A. Fowler; "The Anatomy of the Human Head and Neck," illustrated by means of movable coloured plates, with description, by William S. Furneaux; "The Ox," its external and internal organisation, illustrated by means of movable coloured plates, with description, by Prof. G. T. Brown; "The Oarsman's Guide to the Navigable Rivers and Canals of the British Isles," by Members of the Cruising Club.

Messrs. Crosby Lockwood and Son hope to issue:—"Rural Water Supply: a Practical Hand-book on the Supply of Water and Construction of Water Works for Small Country Districts," by Allan Greenwell and W. T. Curry; "Dangerous Goods: their Sources and Properties, and Modes of Storage and Transport," by H. Joshua Phillips; "Practical Masonry: a Treatise on the Art of Stone-cutting," comprising the construction, setting out, and working of stairs, arches, niches, domes, &c., with fifty lithographic plates, by Wm. R. Purchase; "Refrigerating and Ice-Making Machinery," by A. J. Wallis-Tayler; and new editions of "The Metallurgy of Gold," by M. Eissler, with twenty-five additional plates and working drawings, and chapters on recent milling operations in the Transvaal, and the future outlook in the South African Gold-fields; and "Practical Tunnelling," by F. Simms, with large additions on recent tunnelling practice by D. K. Clark.

We find in the list of the S.P.C.K.:—"The Romance of Science" Series, "The Splash of a Drop," by Prof. Worthington, with numerous diagrams; "The Work of the Spectroscope," by Dr. Huggins; "Time," by Prof. Boys. Manuals of Science—"Physiology," by Prof. Macalister; "Ancient History from the Monuments: Babylonia," by Prof. Sayce, a new edition, edited and brought up to date; "Simple Methods for Detecting Food Adulteration," by J. A. Bower, with diagrams; "Gosse's Evenings at the Microscope," a new edition, revised by Prof. F. Jeffrey Bell; "Iceberg, Prairie and Peak: some Gleanings from an Emigrant Chaplain's Log," by the Rev. Alexander A. Boddy; "The Zoo," vol. iv., by the Rev. T. Wood, with coloured illustrations.

Among Messrs. A. and C. Black's new books will be:—The last part of Prof. Newton's "Dictionary of Birds"; "Artistic and Scientific Taxidermy and Modelling," by Montagu Browne; Vol. i. of "Zoology," by Prof. Ray Lankester; "Text-book of General Pathology and Pathological Anatomy," by Prof. R. Thoma, translated by Dr. Alexander Bruce, two volumes, illustrated; "Introduction to the Study of Fungi," by Dr. M. C. Cooke, illustrated; "Dynamics," by Prof. P. G. Tait; "Milk: its Nature and Composition," by Dr. C. M. Aikman, illustrated; and a new edition of "Black's General Atlas of the World," with twenty-six additional maps of the North American States.

Messrs. Cassell and Co., Limited, promise:—The Century Science Series, edited by Sir Henry Roscoe, F.R.S.; "Charles Lyell: his Life and Work," by Prof. T. G. Bonney, F.R.S.; "British Birds' Nests: How, Where, and When to Find and Identify them," by R. Kearton, with illustrations of nests, eggs, young, &c., in their natural situations and surroundings; "Popular History of Animals for Young People," by Henry Scherren, with thirteen coloured plates and numerous illustrations in the text; "The Year-book of Treatment for 1896," twelfth year of publication, illustrated.

The Religious Tract Society promises:—"Rambles in Japan: the Land of the Rising Sun," by Canon Tristram, with forty-five illustrations; "A Visit to Bashan and Argob," by Major Algernon Heber-Percy, illustrated; "Plants of the Bible," by Rev. George Henslow, illustrated; "A Primer of Hebrew Antiquities," by Rev. O. C. Whitehouse, illustrated; "Hidden Beauties of Nature," by Richard Kerr, illustrated; "Consider the Heavens: a Popular Introduction to Astronomy," by Mrs. William Steadman Aldis, illustrated; "A Popular Handbook to the Microscope," by Lewis Wright, illustrated, "Lighthouses: their History and Romance," by W. J. Hardy, illustrated.

Messrs. Sampson Low and Co. will publish by subscription "Twentieth Century Practice: an International Encyclopædia of Modern Medical Science," by leading authorities of Europe and America, edited by Dr. Thomas L. Stedman, in twenty volumes. Their other scientific publications include the second edition of "A History of Scandinavian Fishes"; "A Manual of Obstetric Nursing," by Marian Humfrey, vol. ii., and new editions of Hofmann's "Treatise on Paper-Making," and Davis's "Practical Treatise on the Manufacture of Brick, Tiles, and Terra-Cotta," both fully illustrated.

Messrs. Whittaker and Co. announce the following works:—"Transformers for Single and Polyphase Alternating Currents," by Gisbert Kapp, translated from the German; "The Inspection of Railway Material," by G. R. Bodmer; "The Chemist's Compendium, a Pocket-book for Pharmacists and Students," by C. J. S. Thompson; "Modern Printing, a complete hand-book of printing," by J. Southward; a new and enlarged edition of "Coal-pits and Pitmen," by R. Nelson Boyd; "A Practical Trigonometry for the use of Engineers, Architects, and Surveyors," by Henry Adams.

Messrs. Rivington, Percival, and Co. will issue:—"Clinical Illustrations of the Diseases of the Fallopian Tubes and of Tubal Gestation," by Dr. C. J. Cullingworth; "Mensuration," by Rev. A. D. Clarke; "Beginner's Text-Books of Science" Series, "Chemistry," by G. Stallard; "Geology," by C. L. Barnes; "Electricity and Magnetism," by L. Cumming; "Heat," by G. Stallard; "Mechanics" (treated experimentally), by L. Cumming; "Physical Geography," by C. L. Barnes.

In Messrs. Putman's Son's list we find:—"Wild Flowers of the North-Eastern States," drawn and carefully described from life, by Margaret C. Whiting and Ellen Miller, with 308

illustrations; "A Natural Method of Physical Training," by Edwin Checkley, illustrated from photographs, new edition; "The Law of Psychic Phenomena," a working hypothesis for the study of hypnotism, spiritism, mental therapeutics, &c., by T. J. Hudson.

The Clarendon Press has in active preparation:—"A New English Dictionary," portions of D, edited by Dr. J. A. H. Murray, and of F, edited by H. Bradley; "British Moralists of the Eighteenth Century," edited by L. A. Selby-Bigge, two vols.; "Index Kewensis," compiled at the expense of the late C. R. Darwin, under the direction of Sir Joseph D. Hooker, by B. Daydon Jackson, two vols.; and "An Introduction to the Algebra of Quantics," by E. B. Elliott.

Messrs. G. Bell and Sons have in the press:—"The Mechanism of Men-of-War," by Fleet-Engineer R. C. Oldknow, R.N.; "Torpedoes, Torpedo Boats, and Torpedo Warfare," by Lieut. J. Armstrong, R.N.; "Naval Gunnery," by Capt. H. G. Garbett, R.N.; "Naval Architecture, the Designing and Constructlon of a Warship," by J. J. Welch; "Logic: a Handbook for the Use of Students," by F. Ryland; "Gas Manufacture," by J. Hornby.

Messrs. James MacLehose and Sons, Glasgow, have in preparation a volume on "Deaf-mutism, including Chapters on the Education of Deaf Mutes," by Dr. J. K. Love and W. H. Addison; a new edition of a "Treatise on Diseases of the Ear," by Dr. Thos. Barr; "An Account of the Institution and Progress of the Faculty of Physicians and Surgeons of Glasgow," by Alexander Duncan.

Messrs. W. Blackwood and Sons' announcements include:—"Introductory Text-Books of Meteorology," by Dr. A. Buchan, new edition, with coloured charts and engravings; Page's "Advanced Text-Book of Geology," new edition, revised and enlarged by Prof. Lapworth; Dr. Mackay's "Elements of Physiography," rewritten and enlarged, "Elementary Algebra," "Mental Arithmetic."

The following additions will be made to Messrs. George Newnes' "Library of Useful Stories":—"The Story of the Earth in Past Ages," by Prof. H. G. Seeley, with original illustrations from the author's collection; and "The Story of the Solar System," by George F. Chambers.

Mr. Edward Arnold will issue:—"The Exploration of the Caucasus," by D. W. Freshfield, in two volumes, illustrated; "Cycling for Health and Pleasure," by L. H. Porter, revised; and "Strength; or, the Development and Use of Muscle," by C. A. Sampson.

Messrs. W. and R. Chambers's list contains:—Eminent Engineers: "Lives of Watt, Stephenson, Telford, and Brindley"; "Thomas Alva Edison: the Story of his Life and Inventions"; a re-issue of Chambers's Encylopædia, in ten monthly volumes.

Mr. Fisher Unwin gives notice of:—"The Evergreen: a Northern Seasonal," part ii.; "Electricity for Everybody," illustrated. The Criminology Series.—(2) "Criminal Sociology," by Prof. E. Ferri; (3) "Our Juvenile Offenders," by W. Douglas Morrison.

Messrs. A. D. Innes and Co. will publish:—"A Naturalist in Mid-Africa," by G. F. Scott Elliot, with numerous illustrations.

To Mr. Walter Scott's "Contemporary Science Series" will be added "Evolution in Art, as illustrated by the Life-Histories of Designs," by Prof. A. C. Haddon.

Messrs. W. H. Allen and Co. have in preparation:—"Ferns, British and Foreign," by John Smith, and a new edition of Herschel's "Popular Lectures on Scientific Subjects."

In Messrs. Macmillan and Co.'s announcements we find the following:—"Sir Joseph Banks's Journal," selections edited by Sir Joseph Hooker, K.C.S.I., F.R.S.; "Sketches in Sport and Natural History," by the late Dr. George Kingsley, with memoir by his son Charles Kingsley; "A History of Mankind," by Prof. Friedrich Ratzel, translated from the second German edition by A. J. Butler, with preface by Dr. E. B. Tylor, with thirty coloured plates, maps, and numerous illustrations in the text, in thirty monthly parts, and in three vols.; "Studies in the Art Anatomy of Animals," by Ernest E. Thompson, illustrated; "The Cambridge Natural History," edited by S. F. Harmer and A. E. Shipley, vol. v., Peripatus, by A. Sedgwick, F.R.S., Centipedes, &c., by F. G. Sinclair, Insects, by D. Sharp, F.R.S.; "The Structure and Development of the Mosses and Ferns (Archegoniatæ)," by Dr. Douglas Houghton Campbell; "The Scenery of Switzerland," by Sir John Lubbock; "A Handbook of British Lepidoptera," by Edward Meyrick; "The Structure of Man," by Prof. Wiedersheim, translated by H. M. Bernard, and edited by Prof. G. B. Howes, illustrated; "A Text-book of Comparative Anatomy," by Dr. Arnold Lang, translated into English by Henry M. Bernard and Matilda Bernard, vol. ii.; "Dictionary of Chemical Solubilities," by Dr. Comey; "A System of Medicine," edited by Dr. T. Clifford Allbutt, F.R.S., five vols; "A System of Gynæcology," edited by Dr. William Playfair and Dr. T. Clifford Allbutt, F.R.S.; "Elements of Palæontology," by Prof. Karl A. von Zittel, translated and edited by Dr. Charles R. Eastman; "Principles of Mechanics," by the late Prof. H. Hertz, translated by D. E. Jones; "Evolution and Man's Place in Nature," by Rev. Dr. Henry Calderwood, second edition, in great part rewritten; "Miscellaneous Papers," by the late Prof. H. Hertz, translated by D. E. Jones; "Electro-Physiology," by Prof. W. Biedermann, translated by Miss F. A. Wells; "The Scientific Basis of Analytical Chemistry," by Prof. Wilhelm Ostwald, translated by Dr. George MacGowan; "Text-book of Botany," by Prof. Strasburger and others, translated by Dr. H. C. Porter; "The Life of Agassiz," by Jules Marcou, two vols.; "Columbia College, Contributions to Philosophy, Psychology, and Education"; Columbia University Biological Series: "Fishes, Living and Fossil," by Dr. Bashford Dean; Columbia University Press Publications: "Statistics and Sociology," by Prof. Richmond Mayo-Smith; "An Atlas of Fertilization," by Prof. Edmund B. Wilson; "Elements of Geometry," by George C. Edwards; "The Theory of Sociology," by F. H. Giddings; "Alternating Currents," by D. C. Jackson; "A Laboratory Course in Experimental Physics," by W. J. Loudon and J. C. McLennan; "An Exercise Book of Elementary Practical Physics," by R. A. Gregory; "Elementary Text-book of Physical Geography for High Schools," by R. S. Tarr.

GEOLOGY AT THE BRITISH ASSOCIATION.

AFTER the presidential address, which was of great local interest, and listened to with much attention by a large audience, Mr. Harmer read two papers bearing on the Coralline and Red Crags. This veteran geologist, who, with the late Mr. Searles Wood, jun., did so much to unravel the age of the various Tertiary deposits in East Anglia, rendered much service to the Section, not only by the contribution of papers and in the discussions, but by attending the numerous excursions, and placing his knowledge and experience at the service of those less acquainted with Pliocene and Pleistocene rocks.

Taking the 240 more abundant molluscan species found in the Coralline Crag apart from those which are represented by rare or even unique species, he finds that their assemblage points, more distinctly than the mere aggregate of fossils, to the Southern character of the fauna; 57 per cent. being extinct, only one species is not found south of Britain, and not less than 36 per cent. are characteristically Southern. The following summary gives the principal facts on which this conclusion is based.

Summary of the abundant and characteristic Species of Mollusca occurring in the Coralline Crag.

Not known as living (37 per cent.)	89
Living in distant seas	8
,, ,, the Mediterranean	133
,, ,, the West European area	9
,, not south of Britain	1
Total	240

Species of European Mollusca occurring abundantly in the Coralline Crag.

Southern and not British (28 per cent.) ...	42
British (rare) and Southern	9
(35 per cent.)	51
British (characteristic) and Southern ...	91
,, and not Southern	1
Total	143
Total number of species	436

In his second paper, Mr. Harmer acknowledged that the Eocene shells, and probably some others found in the nodule bed at Waldringfield, were undoubtedly derivative; but he contended that it was possible that others belonged to the period which elapsed between the deposition of the Red Crag at Walton and that at Butley. This conclusion was mainly based on the fact that many of them are found *in situ* in the Belgian Crags of this age.

Mr. Burrows followed with a paper on the distribution of Foraminifera in the Crags. In the Upper Crag, or Newer Pliocene, there are 29 species of common North Atlantic Foraminifera; in the Red Crag 20 species; and in the St. Erth beds 163, of which 66 occur also in the Coralline Crag. Some of the Coralline Crag Foraminifera appear to have been derived from older deposits. Notes were given on the age of the different portions of the Coralline Crag now or formerly exposed at several important localities.

Next came two papers on Southwold; the first by Mr. H. B. Woodward, on a section recently exposed by denudation at the North Cliff, and a second on recent coast erosion there, by Mr. Spiller. The Norwich Crag is succeeded by chalky boulder clay, and that by a fresh-water loam, peaty earth, and a recent beach deposit, in which a human skeleton was found this year. Mr. Spiller's paper gave an account of the erosion of the North Cliff during a storm in May last, and by measurements taken since, and comparison with a map previously made by Mr. Whitaker, he concluded that different points on the coast had been eroded at the following rate:—

		Feet.
Easton Bavents	Loss in 6 years ...	20
Easton High Cliff ...	,, 13 ,, ...	22
Covehithe Cliff	,, 6 ,, ...	84

In two short papers which followed, the Rev. E. Hill attributed the formation of some boulder clays to rapid deposit by the agency of water under the influence of floating ice and ice-rafts, a conclusion strongly controverted by several advocates of the land-ice theory who were present. A third paper, by the same author, described traces of an ancient watercourse seven miles long in Suffolk.

A paper, by Messrs. Reid and Ridley, described their recent researches by boring, and an examination of the deposits above the water-level, at Hoxne. The following is the section disclosed, revealing the apparent existence of a temperate flora between the morainic deposits and the Arctic plant bed. A grant was made by the Association to enable Mr. Reid to continue this work, with a view of determining the relation of the Palæolithic remains to the Glacial epoch.

	Feet.
Gravelly surface soil ... ... about	2
Brick-earth; towards the base *Valvata piscinalis*, cyprids, bones of ox, horse, elephant (?), and Palæolithic implements ... ... about	12
Sandy gravel, sometimes carbonaceous, with flint flakes ... ... about	1
Peaty clay, with leaves of Arctic plants (?) ... about	4
Lignite, with wood of yew, oak (?), white birch, and seeds of cornel, &c. ... ... about	1
Green calcareous clay, with fish, *Valvata piscinalis*, *Bythinia tentaculata*, cyprids, *Ranunculus repens*, *Carex* ... ... about	4
Boulder clay.	

The day's work was closed by a paper from the President, on some Suffolk wells, six of which penetrate some distance into the chalk.

Tuesday was devoted almost exclusively to papers on glacial subjects, opening with an interesting communication by Prof. Sollas on artificial glaciers, or "poissiers," made of pitch. This paper was illustrated by pitch models split longitudinally, lantern photographs, and models in Canada balsam, images of which could be thrown on the screen. The main point to which attention was directed was the power of the viscous substance to carry grains of rice, sand, or pigment uphill when confronted by a barrier, or when driven into a narrow gorge. The conclusion drawn was that ice and pitch conformed to the laws of fluid motion, and this was further illustrated by the flow of water over a raised model of Ireland, when the currents conformed to the directions of former ice movement. The pitch sometimes travelled over heaps of loose material without disturbing them.

Mr. Clement Reid followed with some illustrations of the glacial sections at Cromer, showing the great chalk boulders, the contortion of the chalk, and the contortion, crushing, brecciation, and shearing of the boulder clay at that locality. Prof. W. B. Scott gave an illustrated description of the "Bad Lands," and showed that this area was in Tertiary times the site of a succession of great lakes whose history extended from the beginning of the Eocene period up to Pleistocene times. Evidence of change in climate is given by the gradual disappearance of palms, and the diminution in numbers and variety of the reptiles. A paper by Mr. R. B. White described various deposits in Colombia (New Granada) to which he attributed a glacial origin; he recognises moraines, erratic blocks, breccias and conglomerates, in places mostly made up of volcanic materials, but elsewhere made of the débris of sedimentary rocks. The paper concluded with some novel speculations as to the cause of the Ice Age.

Mr. B. Thompson described a number of pre-glacial valleys Northamptonshire, belonging to the following chief types. New valleys without drift and having old filled-up valleys near at hand; (2) valleys with rock on one side and drift on the other; (3) streams re-excavating old, drift-filled, valleys; (4) re-excavated valleys with the drift only left in the form of river-gravel derived from it. In his account of some Snowdonian tarns, Mr. W. W. Watts concluded that one of the shallow lakes in Cwm Glas was in a very shallow rock-basin, and the other dammed by scree- and stream-detritus. Glaslyn and Llyn Llydaw, though finding exit over moraine, had rock-barriers at depths of from thirty to fifty feet below the lake surface, so that they are either confined in true rock-basins, or else are very much shallower than is generally supposed.

The Committee for exploring the supposed glacial shell-bed at Clava, hoped to bring important results out within the year, and that engaged in exploring the Calf Hole cave also hoped to finish its lists of fossils in the same period. In reporting on the high-level flint drift near Ightham, Mr. Harrison described excavations made into a gravel 658 feet above the sea on the face of the chalk escarpment; worked flints, chiefly scrapers and flakes, were found in great quantity. In the discussion Sir John Evans expressed scepticism as to the human origin of the supposed worked flints.

The Committee on Coast Erosion published a final report which contains an abstract of previous reports, and a considerable amount of new information from Kent, Suffolk, Sussex, Hampshire, Norfolk, Yorkshire, the Northern counties, Lancashire, and North Wales. The Committee concludes that the work of devastation is much aided by the abstraction of shingle and sand, and also by the erection of unsatisfactory sea-walls and groynes. They further recommend that the subject should become the work of a departmental Committee of the House of Commons. The twenty-first and final report of another long-standing Committee gives a useful summary of principles guiding underground water supply, and then resigns its task to the local scientific societies, which are urged to communicate all information received to the Geological Survey Office at Jermyn-street, where careful records are now kept. Such a course naturally will give increased value to the information daily supplied to inquirers from that office. In the last paper Mr. Holmes gave further information on an ancient silted-up stream course which flowed between the high ground of Warley, Billericay, and Maldon on the one hand, and that of Laindon, Rayleigh, and Althorne on the other, into the Blackwater. The deposits of this river were covered by the highest (oldest) gravel terrace of the Thames system. A paper by Messrs. Lomas and Kendall dealt with the striæ produced by modern glaciers.

The first paper on Saturday was that of Prof. Marsh on some European Dinosaurs. He exhibited a diagram placing American and European forms side by side, and showing that the European types filled up gaps in the American series. In many of his restorations he differed decidedly from those which have been previously published, some of which he characterised as being like nothing "in heaven above, or in the earth beneath, or in the waters under the earth." The Connecticut Triassic footprints he attributed to Dinosaurs and not birds. The Committee appointed to endeavour to recover the missing portions of the Cetiosaurus skeleton in the Oxford Museum had been unable to carry out their work within the year, but they had now determined on their course of action, and obtained the requisite permission, so that they hoped to complete the work before the Liverpool meeting. Mr. Montagu Browne communicated a description of a section

on the new Manchester, Sheffield, and Lincolnshire Railway, exposing Rhætic rocks in Nottinghamshire, and gave a list of fossils derived from these beds.

The first part of Monday's sitting was devoted to papers by authors from France and Belgium. M. G. F. Dollfus considered that in Upper Tertiary times there were two great seas in Western Europe; one was to the east, not very far from Eastern England, in Miocene times, and extended over the Netherlands and North Germany; the other, or old Atlantic, was to the west of England, and extended in gulfs into France and Portugal, probably communicating with the Mediterranean Sea along the Guadalquiver Valley. In Pliocene times the seas occupied similar positions, but the land was rather higher, and a gulf on the Atlantic side appears to have reached Cornwall. The English Channel was closed, and the Eastern Sea appears to have been open only towards the north. M. Van den Broeck's paper described the present state of knowledge of the Upper Tertiary strata of Belgium. He had determined that the Upper Oligocene strata did not exist in Belgium, but that the Upper Pliocene was probably present there. He concluded that the line of march of the Miocene fauna was from east to west, for Miocene forms present in Belgium were absent from England. That the Miocene formation had been once present in England he inferred from the fact that half the Belgian Miocene fauna was to be found in the Coralline Crag. A communication from M. M. Boule described the finding of remains of *Elephas meridionalis* and *E. antiquus* in association with worked flints, some of them of elaborate workmanship, but others of St. Acheul type, and mammoth tusks, one of which was 2·85 metres in length; one flint was found under a tusk of *E. meridionalis*.

Prof. John Milne's report on Japanese earthquakes was given in full to Section A, but a short account of his work was communicated to Section C. The author has prepared a catalogue of 8331 shocks recorded in Japan between 1885 and 1892. The instruments used have recorded earthquakes which must have travelled right through the earth with a velocity greater than if its interior were composed of glass or steel. They also indicate movements corresponding with variations in barometric pressure and strong winds, and even a diurnal variation possibly due to the evaporation of moisture and the condensation of dew.

Dr. H. J. Johnston-Lavis reported on the activity of Vesuvius during 1895. (The substance of his report has already appeared in NATURE for August 8). The Committee on coral reef exploration presented an interim report on the negotiations between the Royal Society and the Admiralty as to beginning the work of sounding and boring. Mr. Osmund Jeffs reported that a number of the geological photographs collected by his Committee had found a home at the Museum of Practical Geology in Jermyn-street, and that the rest would shortly be deposited there. Prints to the number of 1200 had been received and catalogued, but numerous localities, and particularly the Eastern Counties, were as yet poorly represented. The report contained some valuable recommendations for the apparatus suitable for continuing the work, and the Committee proposed to carry on its collection, and to make special efforts to induce local societies and individuals to fill up the blanks in the collection, and to make it a thorough photographic survey of geological phenomena throughout the United Kingdom. A valuable appendix to the report contained a list of such of the photographs as had been employed in illustrating geological works. Dr. Hatch's paper on the auriferous conglomerates of the Witwatersrand showed that gold occurred only in the matrix of these rocks, and not in the pebbles; it had probably been introduced by subsequent infiltration. Mr. E. A. Walford, in a report and paper, described the succession of limestones, clays, and sandstones which have been revealed by sinking between the Stonesfield slate and the Inferior Oolite in Oxfordshire, and traced these divisions northwest and south-east, correlating the upper calcareous division with the Fullonian, and the middle sandy division with the Northamptonshire Estuarine series.

The early part of Tuesday was devoted to papers on deep borings, and the later part to work chiefly on invertebrate palæontology. The President described the succession of rocks revealed by the experimental boring at Stutton. The section which heads the top of the next column gives that succession. The lowest rocks are likely to be of Carboniferous or Silurian age, but the absence of fossils renders it impossible to be sure which of these divisions they really belong to. The boring has now been carried down to a depth of 1356 feet, mostly in highly inclined and even vertical strata of the same doubtful character.

	Feet.
Drift (river gravel)	16
London clay and Reading beds	54
Upper and middle chalk	720
Lower chalk, with very glauconitic marl at the base (almost a green sandstone)	154½
Gault	49½
Palæozoic rock, with a high dip.	

Mr. J. Francis gave the methods and results, hitherto unpublished or incorrectly stated, of the attempt to determine the dip of strata met with in deep wells at Ware and Turnford. After rejecting various magnetic and mechanical appliances, the following device was hit upon. The boring tools were lowered with extreme precautions to prevent any torsion during the lowering, and by means of steel points connected with them the direction of a known diameter was marked by vertical chases on the circumference of the core while still *in sitû*; during the raising of the tool no twisting occurred; a wax mould of the top of the core *in sitû* was then taken, and again the lowering and raising were done without twisting. The core was then broken and lifted, and by means of the diameter marked on it *in sitû*, confirmed by a known line on the wax mould, the direction and amount of dip was ascertained. To test the method the boring was continued, and after the top of the core had been ground to a flat surface, steel-punch marks along a known diameter, maintained by careful lowering and raising with the same precautions, were impressed on the surface, and again the core was broken and lifted. This observation was within a degree of the previous one; so that there is probably only a negligible error, or none, in the observations. The dip of the Silurian rock at Ware at 828 feet below the surface was 1° west of south, at an angle of 41°. Similar experiments at Turnford, carried out with rather less success, gave the dip of the Devonian rocks at 994 feet as 17° west of south at 25° from the horizon. These dips correspond with those of the Secondary rocks off the Wealden axis. The south-easterly dip which has been published for one of these instances is incorrect. Mr. Harmer, in a paper which followed, advocated that the survey of deep-seated rocks by borings should be systematically carried out by the Geological Survey, the expense being provided for indirectly by the appreciation of real property, and directly by royalty, wherever success attended the operations.

Prof. Claypole described some whole specimens of Cladodonts from the Devonian rocks of Ohio, which showed that many species hitherto defined from single and isolated teeth can no longer be maintained. The Upper Devonian shales of the same region have yielded many genera of large Placoderms; the head of *Dinichthys* measured from 2 to 3 feet in length; *Titanichthys* was still longer; and the jaws of *Gorgonichthys* alone measured 24 inches in length, ending in teeth or points from 6 to 9 inches in length. All these genera are closely allied to *Coccosteus*.

One of the most important papers of the meeting was that by Prof. Nicholson and Mr. Marr on the Phylogeny of the Graptolites. They are led to believe that a character of essential importance in dealing with the classification of the Graptolites, and one which, in all probability, indicates the true line of descent, is found in the shape and structure of the hydrothecæ, the point of next importance as indicating genetic relationship being the "angle of divergence"! These views are illustrated by reference to forms belonging to the "genera" *Bryograptus*, *Diplograptus*, *Tetragraptus*, and *Didymograptus*, which appear in turn in this sequence. Out of nine *Tetragrapti* (and the authors know of no other forms referred to this genus which are represented by well-preserved examples), eight are closely represented by forms of *Didymograptus*, which are closely comparable with them as regards characters of hydrothecæ and amount of "angle of divergence," whilst the ninth is comparable with a *Didymograptus* as regards "angle of divergence" only. Moreover, four of the *Tetragrapti* are comparable as regards the two above-named important characters with forms of *Dichograptus* and *Bryograptus* with eight or more branches, and the authors confidently predict the discovery of forms belonging to these or closely allied many-branched "genera," agreeing with the remaining *Tetragrapti* in what they regard as essential characters. They give details showing points of agreement of each group of the various series, including a two-branched, a four-branched, and a many-branched form, and point out how difficult it is to understand how the extraordinary resemblances between the various species of *Tetragraptus* and *Didymograptus* (to take one example) have

arisen, if, as usually supposed, all the species of a "genus" have descended from a common ancestral for each genus, in the one case four-branched, and in the other case two-branched. On the other hand, it is comparatively easy to explain the more or less simultaneous existence of forms possessing the same number of stipes, but otherwise only distantly related, if they are different ancestral types. Phenomena somewhat analogous have been detected amongst the species of Ammonites and Brachiopods. Following these inferences to their legitimate conclusion, the authors point out how "genera," like *Diplograptus* and *Monograptus*, may contain representatives of more than one "family" of graptolites according to the classification now in vogue, which would account for the great diversity in the characters in the monograptid hydrothecæ.

Messrs. Garwood and Muir followed with a paper on the zonal divisions of the Carboniferous system. The following zones are recognised by them :—

Zone of *Productus* c.f. *edelburgensis*.
,, ,, *latissimus*.
,, ,, *giganteus*.
,, *Chonetes papilionacea*.
,, *Spirifera octoplicata*.

Mr. Garwood has traced the zone of *P. latissimus* occupying the same position relative to that of *P. giganteus* from Settle, in Yorkshire, to the Northumbrian coast, near Howick Burn. In conclusion, the authors hope that their work may be continued by a Committee, and one was appointed by the Section and confirmed by the General Committee of the Association.

Prof. T. Rupert Jones, in the twelfth report on Palæozoic Phyllopoda, gave a *résumé* of these organisms referred to in previous reports, and appended some valuable notes and two tables by Prof. Lapworth, of which the first gives a general correlation table of the Lower Palæozoic rocks; the second, the horizons of the chief species of Phyllopods. A third table gives a list of the geological order of species. After hearing interim reports from the Committees on Eurypterids, and on type specimens, the Section listened to a paper by Dr. Woodward on Decapod Crustaceans from the Cretaceous rocks of Vancouver, in which the following new species were described. *Callianassa Whiteavesii*, *Palæocorystes Harveyi*, *Plagiophthalmus (?) vancouverensis*, and *Homolopsis Richardsoni*. Many of these forms approach contemporaneous European types. The closing report was that on erratic blocks. The Yorkshire Boulder Committee and that of the Hull Geological Society are promoting a systematic survey of the ground. New work has also been done in Lincolnshire, Shropshire, Cheshire, South Wales, and Ireland.

A very pleasant feature of this year's meeting has been a series of afternoon walks or drives, carefully planned by the Local Secretary, Mr. Ridley; in many of these the President took the leadership, and several members of the Section attended. The list of these included Bramford, Sproughton, Orford, Sudbourne, Butley and Chillesford, Woodbridge and Sutton, Tattingstone, Bawdsey, Foxhall, and Cromer. At several of these localities the sections had been freshly scarped or reopened by the Local Committee and by the landowners. It is much to be hoped that in future similar opportunities may be afforded of acquiring as full a knowledge of the geology of the neighbourhood in which the meeting is held.

ZOOLOGY AT THE BRITISH ASSOCIATION.

AS this Section was occupied with dredging excursions on the Saturday and Wednesday, only four days were available for sectional meetings, and as the number of papers and reports to be discussed was large (nearly fifty), the sittings were continued late into the afternoon. The majority of the papers dealt with marine zoological subjects, and fishery questions received special attention.

After the President's address on Thursday, the following reports of Committees were taken :—

On the marine zoology, botany, and geology of the Irish Sea. The report deals with nine dredging expeditions held during the past year, and discusses the additions made to the known fauna. Statistics of the dredging results are given to show (1) the relative richness, per haul, of the shallower over the deeper waters, and (2) the relatively large number of genera represented by the species in one haul; pointing to the conclusion that, as a rule, allied species are not found together. The submarine deposits round the Isle of Man, and the currents of the Irish Sea are also discussed.

On the migration of birds. The nine years' observations are now being tabulated for presentation at next meeting.

Investigation of the zoology of the Sandwich Islands. Valuable collections are being made and brought home, and unless these are made now they can never be done, as the extinction of much of the present fauna is not only inevitable, but will be immediate.

Research at the Zoological Station at Naples. The British Association table has been occupied by Mr. M. D. Hill, who has been investigating the maturation and fecundation of the ova of Echinodermata and Tunicata.

Research at the Marine Biological Laboratory at Plymouth. This Committee have enabled Miss Florence Buchanan to work out the blood-forming organ in the larva of Magelona; Mr. E. J. Allen to work on the nervous system of the embryonic lobster; and Mr. Sumner to work at the Echinoderm fauna of Plymouth.

Investigation of the fauna and flora of the West Indian Islands. The Committee reported upon the progress made in working up the collections.

On an Index Generum et Specierum Animalium. In Mr. Sherborn's hands the Index is making satisfactory progress.

On the physiological applications of the phonograph. The Committee are studying the marks on the cylinder of the phonograph by microphotographs and by recording curves, and they propose to make these available for philological purposes in the study of dialects.

The following papers were then taken :—

On the Stereornithes, by C. W. Andrews. They are a heterogeneous group of extinct birds, found in Patagonia, whose chief points of resemblance lie in their large size and reduced power of flight. Some of them, at least, have no special affinities with the living Ratitæ. They are not represented in European museums.

Facts and reflections on budding in compound Ascidians, by Prof. W. E. Ritter (California). The author argues for the polyphyletic origin of the compound Ascidians; he considers that there is no homologue of the "epicardium" of *Clavelina* in either *Goodsiria* or *Botryllus*; he suggests that budding has arisen in small Ascidians as a compensation for diminished power of sexual reproduction; he believes that physiological necessities have modified the course of development by budding, so that the endoderm now produces some organs originally formed from ectoderm.

A new classification of the Tunicata, by W. Garstang. The author gave his reasons for proposing to modify the classifications given by Herdman and by Lahille, by adopting some of the features of each scheme. In the main he proposes to follow Herdman in the primary divisions, and Lahille in the subdivisions. He considers *Pyrosoma* to be related to the pelagic forms, such as *Salpa*, and not to the fixed Ascidians. He makes use of the branchial sac largely in classification. This paper gave rise to an interesting discussion.

On the presence of skeletal elements between the mandibular and hyoid arches of *Hexanchus* and *Læmargus*; and on the presence of a sternum in *Hexanchus griseus*, by Dr. P. White.

On the Creodonta, by Prof. W. B. Scott. This and some of the other papers gave rise to considerable discussion, and the Section did not adjourn till about five o'clock.

In the course of the day's proceedings it was moved by Prof. W. A. Herdman (President of the Section), seconded by Dr. P. L. Sclater (past-President), and carried unanimously, that the zoologists of this Section desire to present to Dr. John Murray their congratulations on the completion of the *Challenger* publications, and their best thanks for his splendid services to science. This resolution was duly conveyed to Dr. Murray, and a letter of thanks from him was received by the Section later in the meeting.

Friday was devoted to papers and discussions on the marine fisheries. Prof. McIntosh led off with a paper on some of the results of scientific investigations as applied to the fisheries. He gave a useful summary of what had been effected by the Scottish Fishery Board; he showed that the three-mile limit was insufficient to protect the spawning fishes, and in conclusion urged that scientific investigations on the fisheries should be carried out by Government and not be left to Universities.

Prof. Haddon followed with a report on the Royal Dublin Society's Fishery Survey, and also gave an account of the Fishery School at Ringsend, near Dublin. He pointed out the special conditions of the Irish fishery grounds, the lack of access to markets and of fish-curing stations on the west.

Dr. Bashford Dean (U.S. Fish Commission) gave an account

of oyster-cultural methods, experiments, and new proposals. He pointed out the difficulties in "spat" collecting, and showed that if these could be overcome the problem of raising oysters successfully would be solved. He dwelt on the effects of bad aeration, and of changes of temperature, and on the difficulty in retaining the embryos in closed areas, such as the *mare piccolo* at Taranto and the Brénéguy lake in France. Finally he discussed the cultural methods recently patented in the United States.

Prof. W. A. Herdman and Prof. R. Boyce gave a paper on oysters and typhoid, in which they explained the investigations they had made on the normal and abnormal life-conditions of the oyster, including the effect of pathogenic organisms. The oysters were laid down in various kinds of water, and fed on a variety of substances, both in the laboratories at Liverpool and also at the Port Erin Biological Station. Some of the results obtained are: the beneficial effects of aeration, the superiority of natural food (protophyta, &c.) over artificial (oatmeal, &c.), the deleterious effects of stagnation, great toleration of sewage, inimical effect of typhoid fæcal matter, the identification of *Bacillus typhosus* in oysters fourteen days after infection. The observations are still in progress, and a Committee of the British Association has been formed for the purpose of carrying on the investigation.

Dr. H. C. Sorby read a paper on the oyster culture in the Colne district, which was to be visited by a party of zoologists from the Section the Wednesday following. He described the grounds where spat was obtained, and the celebrated Pyefleet creek where the "natives" are fattened for the market.

Mr. J. T. Cunningham gave the last of the fishery papers, on fish and fishing grounds in the North Sea. This author disputed the idea that the great quantities of young plaice in the eastern parts of the North Sea are derived from the spawn and embryos carried across by currents, and that these plaice when they grow large supply those parts of the North Sea that lie further west. He suggests that the plaice on the German side are a smaller race, and that they correspond in distribution to a tract of warmer Atlantic water. He urged the necessity for a scientific investigation of the North Sea fisheries, and for experiments in rearing young food fish in artificial ponds. A discussion followed, in which the authors of the papers, the President, Mr. Alward, Mr. A. O. Walker, and others took part.

In the afternoon a discussion took place on zoological bibliography, opened by Dr. Haviland Field with an account of his scheme for the establishment of an international bibliographical bureau, to be located at Zürich. The organisation is now nearly completed, and the bureau is expected to start work in January 1896. Dr. Field asks England to form a National Committee, to organise a service of correspondents, and to give a grant towards the Bureau. A Committee of the British Association has been appointed to consider the matter and report.

Dr. Field also read a paper on the date of publication of zoological papers, in which he urged that the date of *distribution* be adopted as "publication."

Rev. T. R. R. Stebbing gave a paper on economy of labour in zoology, proposing that an effort should be made to gather into a succinct form all the most indispensable knowledge in each branch of zoology.

Prof. G. Gilson (Louvain) described the septal organs of *Owenia fusiformis*; Prof. F. Y. Edgeworth read a paper on the statistics of wasps; and Mr. W. Garstang exhibited a simple and efficient collecting reservoir for the surface tow-net. This tow-net was experimented with on Saturday's dredging expedition, and was found to work very satisfactorily.

On Monday forenoon, Prof. L. C. Miall gave an account (illustrated by the lantern) of our present knowledge of the causes and conditions of insect transformation. He pointed out the fundamental distinction between the metamorphoses of insects and those of other animals. The metamorphoses of marine animals were larval, those of insects adult metamorphoses—the migatory stage being late in the life. In insects the migration was undertaken by the adult, the feeding by the young. This caused considerable difference between these two stages, the adult insect becoming more and more highly organised and specialised and the larva more and more degenerate. This marked contrast brought about the necessity for a quiescent pupa stage between. This paper led to some discussion on metamorphosis.

Dr. H. C. Sorby exhibited a series of marine animals caught in the Suffolk estuaries, and mounted as lantern-slides after various methods of preparation.

Dr. Sorby gave an account of his apparatus for catching minute marine animals, and for estimating the number of organisms in given quantities of sea water.

Dr. E. Frankland read a paper on conditions affecting bacterial life in river water, in which he showed that in a series of monthly observations on the water of the Thames bacteria were more numerous in winter than in summer. There were three conditions which might affect the bacteria, and which he had disentangled, viz. temperature, sunshine, and the volume of water. Sunshine was a powerful germicide, but its effect ceases at a small depth in muddy water. The amount of microbes was found to vary with the amount of flood water. Storage has a very beneficial effect in purifying river water from bacteria.

Prof. A. C. Haddon made an appeal to zoologists to urge upon Government and scientific societies the necessity for an immediate exploration of oceanic islands of the Pacific. He pointed out that the great depths of the sea would remain for long unaltered, that the Antarctic was probably not undergoing any rapid change, but that the fauna and flora of the islands, and the customs of their inhabitants, were all undergoing change from year to year, and therefore ought to receive our first attention.

A paper on the Coccidæ of Ceylon, by Mr. E. E. Green, illustrated by beautiful plates, was read by Prof. Howes.

Dr. H. O. Forbes gave a paper, "Criticisms on some points in the summary of the results of the *Challenger* Expedition," in which he dealt with the supposed greater size of the sun in Carboniferous times, and also with the views of Dr. Murray in reference to the occurrence of similar forms in Arctic and Antarctic regions. Finally he pointed out that the evidence for an Antarctic continent in Tertiary times is really supported by the *Challenger* collections, rather than the reverse, as held by Dr. Murray.

A paper on the marine fauna of Houtman's Abrolhos Islands, West Australia, by W. Saville-Kent, showed that the anomalous character of the fauna of Abrolhos can only be accounted for by the assumption that an ocean current setting in from the equatorial Indian Ocean penetrates as far south as this island group.

Dr. Gregg Wilson read a paper on hereditary polydactylism, and also one on the reproduction of the common crab. Dr. Wilson was of opinion that an increased size limit would be a very distinct protection to the crab. A close time at the end of the year would protect the female at a time when there is most destruction.

On Tuesday, Prof. Lloyd Morgan gave an account of his experiments on instinct in young birds. He reared young moorhens, chicks, &c., for the purpose of determining how far the activities of locomotion (swimming, diving, running, flying), feeding, bathing, &c., are instinctive or congenital, and how far their definiteness is a matter of individual acquisition. It was found that timidity had a congenital basis, but was perfected by individual acquisition. There was no instinctive avoidance of insects with warning colours, but such avoidance was rapidly acquired by the individual. There appears to be little support for the view that what is individually acquired is then passed on by heredity.

Dr. Bashford Dean gave an exhibition of ova and larvæ of *Amia*, *Lepidosteus* and *Acipenser*, with some notes on the early development of the Ganoids, in which he brought out that Embryology supports the views derived from Palæontology. Dr. Dean considers that *Lepidosteus* is the oldest or most primitive, and *Amia* the form which comes nearest to the Teleosts.

Dr. Otto Maas (Munich) discussed some questions relating to the morphology and distribution of Medusæ. He exhibited some plates of supposed deep-sea Medusæ from the *Albatross* expedition showing the prevalence of a purplish tint, which he supposed to be the complementary tint to the green phosphorescent light given out by many deep-sea animals.

Mr. J. E. Moore's paper on spermatogenesis in birds, showed that the spermatic elements of pigeons have a marked tendency to form multinucleate masses. The whole course seems to correspond more closely with elasmobranchs than with mammals.

Prof. G. B. Howes read a paper on the mammalian hyoid. He showed that there were two types: (1) Proterostylic, found only in man and marmosets, and (2) Opisthostylic, known only

in rabbits and some other rodents, The following papers: On the development of the teeth in certain Insectivora, by M. F. Woodward; on the poison apparatus of certain snakes, by G. S. West; on the value of myology in the classification of animals, by F. G. Parsons; and on ultimate vital units, by Miss Nina Layard, concluded the ordinary sittings of the Section.

A notable feature of the meeting was the very successful dredging expeditions organised for the Zoological Section by the Local Committee, with the help of the President of the Section and Dr. H. C. Sorby. On Saturday a large steamer was chartered from the Railway Company for dredging outside Harwich. Many hauls of the dredge, and of various forms of tow-net, both surface and bottom, were made off the Naze and in the neighbourhood of the Gunfleet bank. Large quantities of material were obtained, including representatives of most groups of the Invertebrata. The specimens picked out were arranged in a number of large glass jars, and on the return journey Prof. Herdman gave a demonstration on the most interesting forms obtained. On Wednesday, the 18th, the second zoological excursion took place, to Wyvenhoe to inspect the Colne Oyster Fishery, by invitation of the Mayor and Corporation of Colchester. The party were taken on board the new steam oyster dredger of the Fishery Board, and hauls of the dredges were obtained at various points in the estuary of the Colne in order to show the condition of the oyster ground. Large quantities of the Polyzoon *Alcyonidium gelatinosum* and of common Ascidians, especially *Ascidiella virginea*, were found associated with the oysters. The steamer then proceeded to the Pyefleet creek, where three millions of the famous Colchester "natives" are now fattening; here the party landed and inspected the packing sheds, where they were entertained to an oyster luncheon. On returning to the steamer, dredging was again carried on further down the estuary, so as to see as much as possible of the ground, and the different ages and conditions of the oyster. Every facility was given to the party for examining this important fishery, and a most favourable impression was received of the healthiness of the ground, the purity of the water, and the excellent condition of the stock.

GEOGRAPHY AT THE BRITISH ASSOCIATION.

THE brilliant International Geographical Congress, recently held in London, seems to have afforded sufficient intellectual dissipation for most British geographers this year, and many familiar faces were absent from Section E. Comparatively few papers were presented for reading, and several of these were read by the Secretaries, as the authors could not attend. It is doubtful whether papers presented in this way should be brought before the Association, for fair discussion is impossible unless the author is present to support his arguments and answer questions.

If Section E retained its usual popularity this year—and the large lecture hall was occasionally crowded—it was not because of the sensational character of the communications made; there was not even a lady-traveller to read a paper. A characteristic of the meeting was the exceptional scientific value of the papers, which dealt less with exploration than with research.

During recent years the President of Section E has almost always been a practical geographer with a commanding knowledge of one branch of his subject, and this year the succession was worthily upheld by Mr. H. J. Mackinder, the Reader in Geography at Oxford, whose experience of higher education in geography enabled him to formulate a scheme for restoring that science to its proper place in a rational university system. The older universities have not responded as was expected to the proposals of the Royal Geographical Society as to the institution of Chairs of Geography, and the time seems to have come for the Society to take a fresh departure, either independently or in conjunction with a new university not blind to the value of the experiment which has been tried and found satisfactory in Germany. A Committee of the British Association has been appointed, without a grant, to investigate the teaching of geography in this country, Mr. Mackinder being chairman and Mr. Herbertson secretary.

The President's contention that geography is not "the science of all things," but a correlating study dealing with the results of all sciences relating to the earth from a special standpoint, was driven home by many of the papers presented to the meeting.

Mr. W. B. Blaikie demonstrated by his greatly-improved cosmosphere the astronomical relations of geography, the combination of a terrestrial globe with a transparent celestial globe on which the constellations are printed, forming a great advance on the old armillary sphere; while the ingenious device of removing a celestial and terrestrial hemisphere allowed of the working of plane problems on the section as readily as of spherical problems on the surface of the outer sphere.

Climatology was discussed in the report of the Committee on the climate of tropical Africa, which was presented by Mr. Ravenstein, the chairman. It shows the results already obtained from the six stations in tropical Africa equipped by the Association. The Committee was reappointed with a small grant and with a change of secretary, Mr. H. N. Dickson taking the place of Dr. H. R. Mill.

Dr. John Murray gave a sketch of the central problem of oceanography—the circulation of the oceans; and the Section instructed the President to write a letter to Dr. Murray, congratulating him on the completion of the *Challenger* Reports, the most important contribution to physical geography of recent years.

Mr. H. N. Dickson summarised the result of the recent international observations on the North Atlantic, in which he took part, and by the aid of lantern diagrams showed that the distribution of the temperature of the surface-water was intimately associated with the distribution of mean atmospheric pressure over the ocean, and that consequently the temperature of the Atlantic water was an important factor in determining the weather as well as the climate of Western Europe.

Mr. A. Trevor Battye read an interesting paper on the struggle for existence in Arctic regions, dealing with biogeographical problems, but unfortunately there was no time to discuss it. A biological discussion which greatly pleased the audience, but was perhaps somewhat inappropriate to the Section, arose on Mr. Borchgrevink's paper describing his recent experiences in the far South, and a proposed plan for a private Antarctic expedition. Sir Joseph Hooker, the veteran of Ross's Antarctic voyages, who was received with great enthusiasm, referred to his adventures in the Antarctic seas, and while congratulating Mr. Borchgrevink on his work in the Norwegian whaling trip, expressed little hope of great results following a private expedition. Sir William Flower had the meeting with him in declaring that no more attempts should be made to send out ships on the pretext of looking for whales or seals, but with the hope of gaining scientific information.

The return to Vardö of the *Windward*, after landing Mr. Jackson in Franz-Josef Land, occurred during the meeting, and Mr. Montefiore, Secretary of the Jackson-Harmsworth expedition, gave a brief account of the start of the land party.

In the historical aspect of geography, Mr. J. L. Myres contributed a discussion of the maps of Herodotus, which enabled an interesting contrast to be drawn between the *à priori* methods of the ancient world and the scientific inductions of to-day.

The papers descriptive of exploration dealt with Africa and Asia. Captain Hinde's experiences in the Congo State, and Mr. G. F. Scott-Elliot's admirable expedition for the scientific study of the Ruwenzori region, have already been before the public in other forms. Mr. H. S. Cowper's journey through Tarhuna and Gharian in Tripoli was new, and the archæological features which he observed seem to be deserving of further study.

The Rev. W. Weston gave one of the most valuable travel-papers—an account of his explorations in the Japanese Alps. This range occupies the centre of the largest island, with summits rising to elevations of over 10,000 feet. The snowfall on the western side is enormous on account of the moisture in the prevailing wind, while the eastern side of the range remains comparatively free of snow. Although the snow-line in summer is as low as 7000 feet in places, there are no signs of glacial action. The volcanic mountains abound in hot mineral springs of high repute as baths, and ores of copper and silver are mined in several places. The flora and fauna are both rich, and the people retain their ancient politeness and hospitality, while many curious customs and beliefs survive amongst them.

Mr. John Dodd, who was not able to be present, sent an exhaustive memoir on Formosa, where he had resided from 1864 to 1890. As a trader he had been much in contact with the aboriginal tribes of the interior, and he gave a graphic account of

their mode of life and their relations with the Chinese colonists. The resources of the island were described, and the prospects of foreign trade discussed. Probably no European is so well able as Mr. Dodd to speak from experience of the latest accession to the empire of Japan.

Dr. A. Markoff drew attention to the geography of Russian Asia, especially with reference to the Siberian railway.

Major Darwin gave an epitome of the work of the sixth International Geographical Congress.

Mr. Miller Christy directed the attention of geographers to the remote islet of Rockall, off the west coast of Scotland, which has never been properly studied, and he suggested that it would be a good field of research for a hardy yachtsman. This paper provoked a lively discussion, in which the value of Rockall as a weather-forecasting station was referred to, and the practical difficulties in the way of utilising it considered.

The Section authorised the President to write a letter of condolence to the parents of the late Mr. Joseph Thomson, expressing the high opinion universally held as to the value of the work he did in Africa, and the warm affection with which his genial personality was regarded by every geographer.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Report just issued by the Somerset County Education Committee shows that the work of technical education is being developed, and mostly in the right direction. Much of the instruction given was of a very elementary character, but this is just what is needed by the type of student for whom it is intended. It is satisfactory to note that a course of experimental science was followed by a number of teachers. The instruction was confined almost entirely to experiments suitable for class demonstration, and, where possible, for repetition by evening school pupils. The words of Mr. C. H. Bothamley, the Director of Technical Instruction in Somerset, as to the use of such practical work, are worth repeating here. "Since the chief object of science teaching in evening schools is not so much to impart a knowledge of useful facts (though that is important), as to train pupils to use their eyes in their daily occupations, to observe accurately, and to reason correctly from what they have observed, it is clear that, if this end is to be attained, the pupils must see things for themselves, and not simply be told things, and the experimental proofs must be complete, and the reasoning based on them must be sound." We will go further and say that the only real scientific knowledge is obtained not from seeing experiments performed, but by doing them. Clear and accurate class demonstrations are undoubtedly good, but practical work carried out by the pupils themselves is far better, and the more facilities that are given for such work, the firmer will be the foundation upon which a superstructure of technical education can be built.

AMONG the recent appointments we notice the following:—Dr. A. Heydweiller, Privat-docent in Physics and Physical Chemistry at Strassburg, to be Extraordinary Professor at Breslau; Dr. Leo Gruenhut to succeed the late Prof. Borgmann at the Fresenius Chemical Laboratory, Wiesbaden; Dr. K. W. v. Dalla-Torre, Privat-docent in Zoology at Innsbruck, to be Extraordinary Professor. Dr. K. Zickler to the full Professorship of Electrotechnology at the Brünn Technical High School, and Dr. Dzieslewski to a similar post in the Technische Hochschule at Lemberg; Dr. E. Yung to succeed the late Carl Vogt as Professor of Comparative Anatomy and Zoology at Geneva; Dr. B. Weinstein to be Extraordinary Professor of Physics in Berlin University; Dr. Max Verworn to be Extraordinary Professor in Physiology at Jena; Dr. Herbert Hurst to be Demonstrator in Zoology, and Mr. Vaughan Jennings to be Demonstrator in Geology, at the Royal College of Science, Dublin; Dr. J. P. Kuenen to the new Harris Chair of Physics in University College, Dundee; Dr. Rawson to be Headmaster of Huddersfield Technical School.

AT the recent Matriculation Examination of the City and Guilds Central Technical College, seventy-six candidates presented themselves, and sixty-two have been admitted to the College. The highest place was taken by M. Solomon, to whom the Clothworkers' Scholarship of £60 a year and free education has been awarded.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 23.—M. Fizeau in the chair.—On a specimen of black diamond from Brazil, by M. Henri Moissan. The specimen is from Bahia Province, and weighs 630 grams (about 3073 carats). Its surface is in part rough, appearing when slightly magnified as if gas had escaped therefrom while in a pasty condition. It resembles the microscopic grains of crystallised carbon produced in the interior of suddenly cooled silver and iron masses. This specimen is porous, and has lost weight since removal from the soil to the extent of sixteen grams.—On the existence of phlorizic glycosuria in dogs after section of the spinal cord, by M. R. Lépine. On the administration of phlorizine, glycosuria follows almost as in the case of healthy dogs, and differs from the latter case merely in the production of a less total quantity of glucose.—A brochure entitled "The actual limits of our science; a presidential address to the British Association at Oxford, delivered August 8, 1894, by the Marquis of Salisbury" (translated by M. W. de Fonvielle), has been printed in the Correspondence of the Academy.—On the composition of pélagéine, by MM. A. B. Griffiths and C. Platt. The violet pigment of the Medusa (*Pelagia*) has the composition $C_{20}H_{17}NO_7$, and is termed by the authors pélagéine. It is soluble in alcohol, ether, and acetic acid, very soluble in carbon disulphide, and insoluble in water. It gives no characteristic absorption bands.

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