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THURSDAY, OCTOBER 29, 1874

METEOROLOGY IN FRANCE

WE hail with much satisfaction the movement which has just been made by the French Government in the direction of a more effective organisation than has hitherto existed for the investigation of the meteorology of France. The best results may be expected from the step just taken, which is detailed in the printed documents quoted below,* and when we consider the great contributions made to practical meteorology by Le Verrier, the distinguished head of the Paris Observatory, in the *Bulletin International*, the *Atlas des Mouvements Généraux de l'Atmosphère*, and the *Atlas des Orages* originated under his direction, we may rest assured that these hopes will be fully realised.

In the decree of February 13, 1873, in which the basis of the reorganisation relative to the meteorology of France was laid down, occurred the following resolutions :—

"1. The investigation of the great movements of the atmosphere and meteorological warnings for the seaports and for agriculture are remitted to the Observatory of Paris.

"2. The working out of the meteorology of the various river-basins of France, and cognate inquiries, is handed over to Commissions representing the different regions and departments of the country, the organising of which the Council of the Observatory is commissioned to prosecute."

In carrying out these resolutions, the meteorological warnings to the seaports were re-established by the Observatory on May 17 of the same year. The duty of issuing meteorological announcements to all departments for the benefit of agriculture, especially in time of harvest, was recognised, and it was at the same time suggested that an inquiry be set on foot with the view of organising a system by which this could be effectually done.

As regards the second resolution, a systematic inquiry into the climate of France had been organised in 1865 by the appointment of Departmental Commissions, and the establishment of a system of observations chiefly by the primary normal schools. At first, when the Departmental Commissions were yet imperfectly organised, it was found necessary to concentrate the observations made over the country in the Observatory of Paris, which undertook their discussion and publication ; but this system, which was forced on the Observatory at the time, could not be indefinitely continued with advantage. The grounds for this opinion are stated in these words :—

"From 1869 the Observatory continued to point out that the discussion of the climatic conditions of the different river-basins of France could not be concentrated in Paris with advantage. It seemed necessary that the large body of skilled meteorologists that had been formed during the four years which had elapsed should boldly take the observations into their own hands, in order to discuss them and deduce from them the scientific truths they may be shown to teach. It was not merely from the advantages which would accrue to meteorology itself by adopting this line of action that the effort towards decentralisation was put forth, but from the intimate bearing which the partition of the work of meteorological inquiry over the whole breadth of the country had on the scientific movement of France, in favouring the spirit of original inquiry and research without which no nation can take a high position in science."

The circumstances which followed hindered the carrying out of these proposals. Subsequently, however, the matter has been resumed and dealt with successfully in several parts of the country, particularly in the basin of the Meuse and over the western sea-board of the Mediterranean, by concerted action on the part of the five departments of Hérault, Gard, Aude, Pyrénées-Orientales, and Lozère. The Astronomical Commission nominated for the purpose of proposing the best measures to be taken in reorganising the astronomical department entered into the same view, and recommended further that inquiries referring to the climate of France be remitted to Regional Committees appointed by departments grouped together according to the river-basins.

"But it must be observed that the proposed institution of Regional Committees will in no way interfere with the Departmental Organisation, but is intended, on the contrary, to give greater weight and vigour to the operations of the Departmental Commissions, in that united action in certain lines of inquiry is thereby facilitated ; it being evident that the area embraced by a single department is too small for the proper study of many of the widespread meteorological phenomena which pass across it. The local Commissions have repeatedly drawn attention to this great disadvantage ; the organisation by regions will, however, henceforth give to the departments the means of publishing the results of their inquiries in a more complete form. In correcting the system of centralisation which had been carried to so great an excess, it is not intended to leave the Commissions to themselves, with no connecting link between them and the Central Administration. On the contrary, the Observatory of Paris is specially instructed to be in active and fruitful correspondence with the Departmental Commissions, and to give assistance, as far as the Commissions may desire, in organising them by regions."

The programme, thus briefly sketched, has been only imperfectly followed out, solely on account of the pecuniary difficulties. But these difficulties the National Assembly has now removed by authorising the necessary funds. What then is now required, and what is now asked by the Minister of Public Instruction, is that the Prefects enter in the departmental budgets such a sum as may in each case be required by the Commission, and we are glad to learn that there is no doubt that the request will be generally acceded to. M. de Cumont concludes his letter with the remark : "I shall act in concert with my colleague, the Minister of the Interior, in carrying out the propositions of the decree of Feb. 13, 1873, to secure the regular despatch of the meteorological warnings to those departments whose scientific Commissions are put in possession of the requisite funds to enable them to take advantage of the warnings in the interest of agriculture."

In the meantime, the Observatory has hastened the resumption of the publication of the "Atlas Météorologiques de la France," which has been stopped for some years. To make up for lost time, the first issue, which is ready for delivery, embraces the three years 1869, 1870, and 1871, and consists of four parts, viz. :—

* "Letter from M. A. de Cumont, Minister of Public Instruction to the Préfets of the Departments, Paris, October 9, 1874." "Letter from M. Le Verrier, Director of the Paris Observatory, to the Presidents of the Meteorological Commissions of the Departments, Paris, October 9, 1874."

(1) Discussion of the thunderstorms (*orages*) of these years, illustrated with forty-six maps. (2) Hailstorms, with three maps. This part of the work, which is of so much importance to agriculture, has been unfortunately neglected for some time, but is now to be vigorously prosecuted. (3) Report on the climatic observations made in France, and particularly on the distribution of rain, with four maps. (4) Meteorological memoirs and documents (thirteen in all), contributed by different meteorologists of France and other countries, a section of the work which is expected to receive a fuller development in future issues.*

A noteworthy feature of the publication consists in the fact that the materials which make it up have been collected under the auspices of the Departmental Commissions, and in great part discussed by them. This is, particularly for such a country as France, an admirable arrangement, since there is no European country the working out of the meteorology of which presents a more complex problem, owing to the great diversity of the climates of its different regions; and further, the agricultural interests of no other country would benefit more than those of France, were a correct knowledge of its climate generally disseminated among the people. Now, this feature of the publication gives the local colouring to the reports which is fitted to arrest general attention and secure the putting forth of those local efforts by which alone the meteorology of France can be satisfactorily worked out.

It may be here pointed out that the French meteorological organisation is based on the Commissions which have been appointed in each of the departments; it being to them that the Government, in the decree of Feb. 13, 1873, has remitted the working out of the meteorology of the different river-basins, and inquiries connected therewith. They are invited to unite together for certain objects into Regional Commissions, for the purpose of imparting to their investigations greater breadth and exactness. They are not put under the Central Administration at Paris in the sense of being controlled by it, but are connected with it in order that they may be aided by it in cases where aid is needed. The Departmental Commissions have free automatic action in working out the problem of the local climates of the respective districts which have been entrusted to them.

The programme assigned to the Central Observatory of Paris, consisting of the investigation of the great movements of the atmosphere, and meteorological warnings for the seaports and for agriculture, is too limited in its scope; and we cannot suppose that its illustrious head will be satisfied till he has succeeded in including in the regular work of the Observatory those physical researches we have already strongly advocated in NATURE (vol. x. p. 99) as an indispensable part of the work to be undertaken by the Central Meteorological Office of each country, and which have been more recently and ably stated by Prof. Balfour Stewart and Col. Strange (pp. 476 and 490).

In the same article we urged the necessity of the State and the country working together; indeed, in no other way is it possible successfully to work out the great national questions of storms and of local climates in their bearings on the health, productions, and commerce of the country. In France we see that this essential requisite, of the State and the country working together, has been effected, and it may not be irrelevant to add that the French Government has clearly recognised the position that unaided voluntary efforts are insufficient of themselves to cope with the subject, and that if the undertaking is to be conducted in a manner worthy of the nation and of the ends to be subserved by it, it must be supported with aid from the public funds.

* The price of the volume, post free to England, is, we understand, 10s. (12 fr.)

*MAREY'S "ANIMAL MECHANISM"**

Animal Mechanism. By E. J. Marey. "The International Scientific Series." (London: Henry S. King and Co., 1874.)

II.

IN his treatment of aërial locomotion, Prof. Marey has been even more successful than in his investigations with regard to progression on land. Nearly two centuries ago the general principles of this subject were very ably worked out by Borelli, who, after having shown that in the wing the anterior margin is rigid whilst the posterior portions are more and more flexible as they go backwards, inferred, as will be self-evident to all, that in the downward stroke of the flying bird the plane of the wing becomes directed downwards and backwards on account of the hinder margin yielding slightly to the resisting air. It not having struck him that the wing was elastic in its horizontal as well as its vertical direction, Borelli assumed that the stroke was strictly vertical.

By a series of experiments, the logical sequence and convincing power of which are perhaps unequalled in any other extant biological problem, Prof. Marey has been able to demonstrate the effects of the horizontal yieldingness of the wing, and to prove that in insects the stroke, instead of being, as Borelli assumed, a simple vertical line, is a vertical figure of 8. In proof of this original and, at first sight, unexpected observation, he shows that if the tip of the wing of a wasp be gilt, and the insect allowed to buzz n a beam of sunlight, a very elongated vertical figure of 8 image is seen, as in Fig. 1, to be produced by the reflecting tip of the rapidly moving wing; "sometimes, indeed, the wing seems to move entirely in one plane, and the instant afterwards the terminal loops which form the 8 are seen to open more and more. When the opening is very large, one of the loops usually predominates over the other; it is generally the lower one which increases, while the upper diminishes. Indeed, by a still greater opening, the figure is occasionally transformed into an irregular ellipse, at the extremity of which we can recognise a vestige of the second loop."

There is still more to be learnt from this simple experiment. By carefully gilding one surface of the wing alone, the buzzing wing, when intensely illuminated, exhibits the figure of 8 of unequal intensity in its two moieties, as seen in Fig. 1; so that it resembles the figure printed thus, 8, if its thick part be considered to represent that which is most illuminated, and its thin part the darker half. This result can only be produced by the plane of the

* Continued from p. 500.

wing being different in the up and down strokes ; and, as is found to be the case, the thick limb is reversed by turning the insect round so that it presents its other side to the observer. The same conclusion is arrived at by the employment of the method to be now described.

Without sensibly interfering with the movement of the wing, its tip may be made to come in contact with a revolving cylinder, in which the surface is covered with smoked paper. "Although the figures thus produced are for the most part incomplete, we are able, by means of their scattered elements, to reconstruct the figure which has been shown by the optical method." Fig. 2 is one

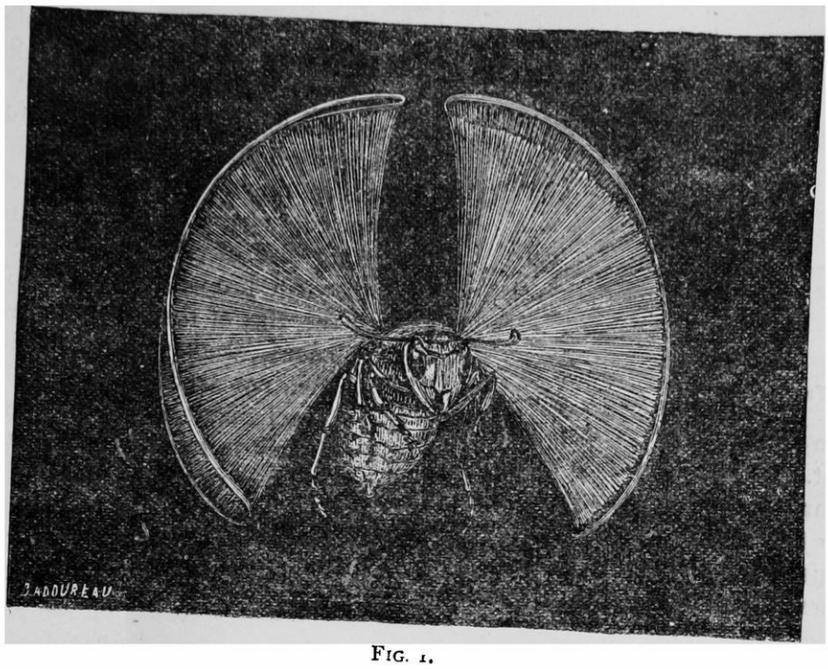


FIG. 1.

of the results obtained, in which several of the loops are distinctly seen, as is generally the case when, as here, the insect is so held as to rub the cylinder with the hinder edge of the tip of the wing. That a figure of 8 movement of a point, when made to record on a revolving drum, produces a similar curve, is seen from Fig. 3, which is a tracing of a Wheatstone's kaleidophone rod, tuned to the octave, or, in other words, vibrating twice transversely for each longitudinal vibration.

Still we are not able to say in which direction the wing is moving in the different branches of the 8 figure ; the following simple experiment determines this completely.

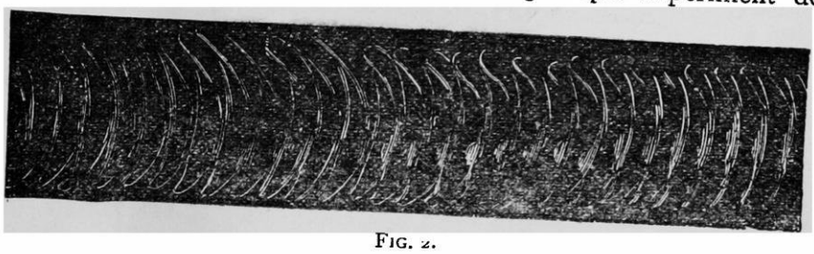


FIG. 2.

A slender glass rod is smoked at the tip in the flame of a candle, and held at right angles to the direction in which the wing moves, in the different parts of the wing-tip tract, as in Fig. 4. It is evident that if the wing hits the rod whilst it is descending, it will rub off the smoke film from its upper, and whilst ascending, from its lower surface. Supposing that, in the figure, the head of the insect is directed to the right: when the glass rod enters the loops at b' and a it is found to strike the upper surface; when at b and a', the lower; consequently the arrows indicate the true direction of the wing's motion.

The foregoing facts, when taken in connection with

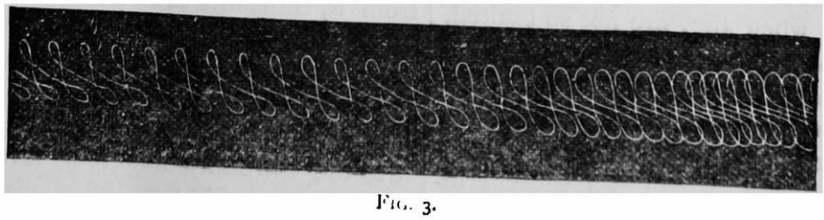


FIG. 3.

their known anatomical arrangements, place us in a position to discuss the mechanism of the flight of insects. These animals possess muscles, &c., which produce direct downward and upward movements of the wings, and these movements only ; therefore the expansion of this vertical line into a figure of 8 must be caused by forces acting external to the thoracic or wing-moving mechanism ; in other words, by peculiarities in the structure of the wings themselves. Simple inspection of the wing of a fly shows it to be formed of a rigid, or comparatively rigid, anterior nervure, which supports a thin more yielding membrane behind it. In its descent, the resistance of the air retards the movement of the more yielding posterior portion of the wing sufficiently to cause the lower surface of its

otherwise horizontal plane to become directed slightly backwards, and in its ascent the same cause directs it somewhat forward. But an inclined plane striking the air has a tendency to move in the direction of its own inclination; consequently, both in the down and up stroke of the wing, it tends to move forward at the same

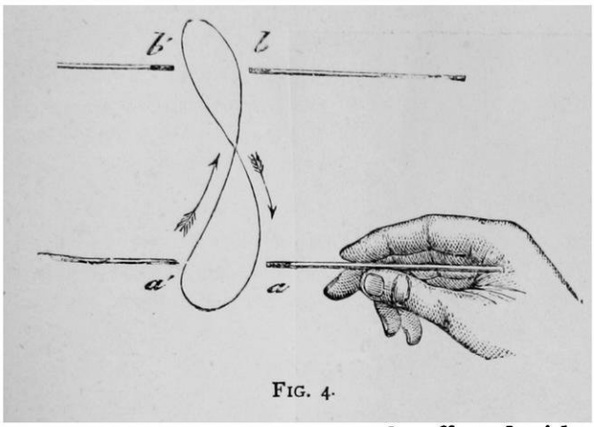


FIG. 4.

time. "But this deviation cannot be effected without the nervure being slightly bent. The force which causes the wing to deviate in a forward direction necessarily varies in intensity according to the rapidity with which the organ is depressed. Thus, when the wing towards the end of its descending course moves more slowly, we shall see the nervure, as it is bent with less force, bring the wing backwards in a curvilinear direction. Thus we explain naturally the formation of the descending branch of the 8 passed through by the wing;" and the same theory applies to the ascending branch of the figure.

Acting upon the suggestions of his theory, Prof. Marey has constructed artificial wings, which are planned and move upon the same principle as those of insects. He has not succeeded in making a flying machine, it is true; this, however, is not from any fault in the wings, but because it is impossible to obtain an engine sufficiently light to drive them. He has, however, contrived an apparatus which, when the motor power is supported, is capable of moving horizontally with rapidity, of rising and of falling, just like an insect; and, what is more, when propelled by a simple up and down movement, the tips of the wings describe a figure of 8 of their own accord, as they ought to do upon the theory which led to their construction.

The mechanism of the flight of birds is a problem far more difficult to master than that of insects. The size of the subjects of experiment, and the comparative slowness of the movements of their wings, remove them beyond the reach of the optical and direct graphic method previously employed. Each stroke of the wing has to be

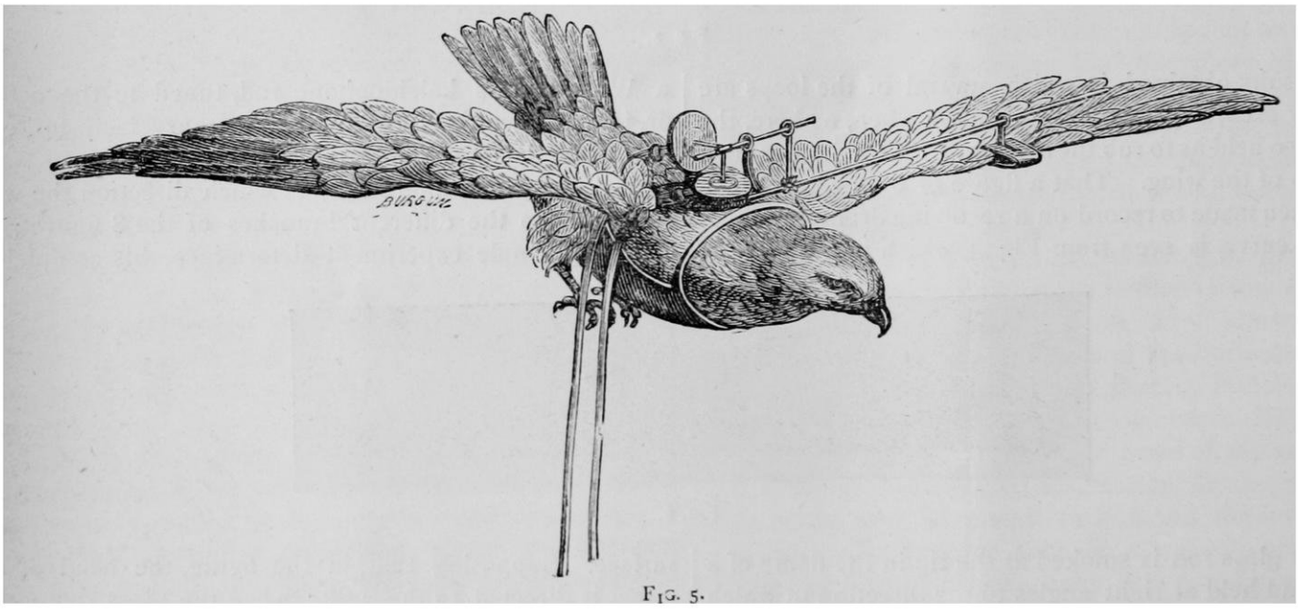


FIG. 5.

recorded through the intervention of a complicated system of tubes and levers, as fragile as they are delicate, and as expensive, as they are liable to be broken. Movements in a single plane are capable of being transferred to paper with comparative ease, but when they are not so limited, and may be in any direction, the necessary complication of the recording machinery becomes immense. The number of little details which have to be continually remembered, and the oft-repeated futile attempts which have to be allowed for, makes Prof. Marey's success in his investigations a matter of more than ordinary surprise. He has mastered the whole subject, having by separate and by combined check methods demonstrated what is the rapidity, direction, and inclination of the wing of the bird in every part of its course. Further than this, he has shown what effects the stroke has on the movements of the body of the bird, and this by a very ingenious new method. The way in which the author invents means for reproducing and originating any quality of movement he may want to develop, must be a source of admiration and almost astonishment to all readers of his work.

Fig. 5 shows a buzzard saddled with the machinery which, by means of the two tubes running downwards from it, transmits the vertical and horizontal movements of its wing to the recording apparatus, which is not represented. In the study of the more intricate points the necessary instruments are so heavy that the whole bird has to be partially supported. This is done by attaching it to the extremity of a long lever which revolves, with scarcely any friction, on a pivot. This is found not seriously to interfere with the normal flight of the bird.

Most of the facts made out by the employment of this apparatus are shown in Fig. 6, which is constructed to illustrate the inclination of the plane of the wing with reference to the axis (*Av*) of the body of the bird during flight. The direction of the movement of the wing is from *H* to *Av*. It shows "that the wing during its ascent assumes an inclined position, which allows it

to cut the air so as to meet with the minimum of resistance; while in its descent, on the contrary, the position of its plane is reversed, so that its lower surface turns downwards and slightly backwards." During the descent

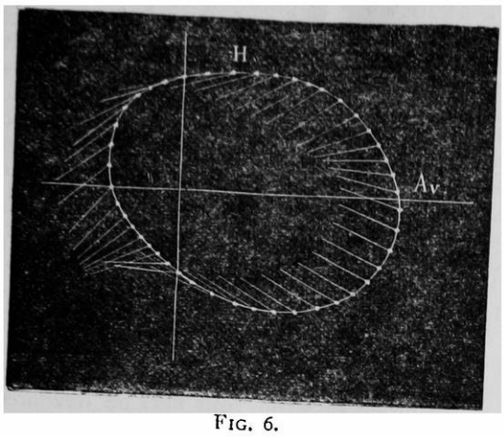


FIG. 6.

of the wing the body of the bird is carried forwards as well as upwards. The resistance of the air explains the elliptical form of the figure.

We hope that in the short glance which we have taken of some of the most important points discussed in the work before us, we have succeeded in interesting our readers sufficiently in its contents to make them curious to learn more of its subject matter. We cordially recommend it to their attention. To the student of art it gives rules and general principles which will be found invaluable in all attempts to portray the various attitudes of man and his faithful companion, the horse; and these, when understood, will direct attention to the most salient points in the locomotion of other animals.

To the student of physiology it is useful in at least two ways. It shows how invaluable is a knowledge of manipulatory details and the principles of mechanics. Prof. Marey, in the period of his studentship, must have learnt more than the simple routine facts of a medical education. The mechanical Cardan universal joint and Wheatstone's kaleidophone rod are as familiar to him as is the valvular mechanism of the heart; it is his control of method which is one of his most marked characteristics. It shows how elaborate are some of the phenomena which at first sight seem so simple, and how much the science of physiology is within the domain of physics.

The translation, as far as we have had the opportunity of judging, seems a good one, except in one or two cases, where improvement would not be impossible.

OUR BOOK SHELF

The Protoplasmic Theory of Life. By John Drysdale, M.D. (Baillière, Tyndall, and Cox, 1874.)

THE author of this small book is one of the editors of a work on Pathology, by Dr. John Fletcher, of Edinburgh, whose "Rudiments of Physiology" contains much speculative biology of no mean quality. As a disciple he enters into an analysis of the philosophy of his master, discussing its details in connection with the light thrown upon it by modern research, especially the bioplasm theory of Beale. Fletcher argued thus:—The peculiar property, vitality, does not reside in the tissues of the living body indiscriminately, but in one anatomical element alone; because, as the various tissues differ extremely in their physical properties, and these latter are almost exactly the same after as before death, it is hardly to be expected that the living matter can rearrange itself on death, in a short time, into a number of different forms, which shall possess exactly the same physical properties in the vital as in the ordinary state of combination. The concordance of this idea with the theory of Dr. Beale, which divides all tissues into a living forming material (bioplasm), and a dead formed material, the composition of the latter of which alone varies to any extent, must be evident to all; and the working out of its minutiæ occupies several chapters of the work before us. The author also enters fully into the muscle and nerve theory of Dr. Beale in a manner which we do not think will throw much light on either subject. He remarks that the insulating power of the medullary sheath of the nerve-fibre is not demonstrable, therefore "the nerves are not fitted for simple conduction of electric currents; and these have no reason to choose the nerves as their channels, so they spread through the moist tissues almost uniformly." With this opinion we think there are few or no physiologists who will agree, as there is not the least doubt that it is through nerve-fibres that electric stimulation will most readily and most powerfully affect muscular fibres at a distance; otherwise, what is the peculiar value of the "nerve-muscle preparation" of the physiological laboratory? In his remark that Dr. Sanderson is premature in arguing with regard to the Dionæa "that because the contraction of the plant-leaf depends on changes, apparently in the contents of the cells, the muscular contraction of the higher animals is of the same nature," the author is, we think, more fortunate; we have never been able to see that the two phenomena have anything in common. From the consideration of the less speculative protoplasmic theory of the origin of tissues, such points as the nature of life, the connection of force with life and mind, consciousness, and materialism, subjects beyond the pale of precise knowledge, are treated of in a manner which will quite repay perusal by those who are fond of speculating on those precarious topics.

Out of Doors. a Selection of Original Articles on Practical Natural History. By the Rev. J. G. Wood, M.A., F.L.S. (London: Longmans and Co., 1874.)

MR. WOOD is well known as one of the most successful popularisers of natural history. He has himself an extensive and thorough knowledge of his subject, as well as a genuine love of it, and his genial enthusiasm cannot fail to infect the minds of the fortunate boys and girls into whose hands his books may fall. The present volume consists of a number of thoroughly readable papers which have already appeared in various periodicals. They are written in an easy, graceful, chatty style; and while apparently trying only to amuse his readers, he manages to convey a great deal of valuable information about animals and plants, especially about such as anyone who likes to take the trouble may observe for himself. Some of the papers are concerned with exotic animals, as in that describing "A January Day at Regent's Park," in which are contained many facts concerning the inhabitants of the Zoological Gardens. Most of them are, however, about the "common objects of the country," as is indicated by such titles as "A Sand Quarry in Winter," "Under the Bark," "My Toads," "The Children of the New Forest," "The Repose of Nature," the last concerned with hybernating animals. In "Medusa and her Locks," and "Life on the Ocean Wave" (describing a visit to the Crystal Palace Aquarium), "The Green Crab," &c., we are introduced to the denizens of the ocean. The book is an excellent one to give to a boy or a girl, who, we are sure, would enjoy it, as indeed would many whose boyhood or girlhood is only a sad memory.

LETTERS TO THE EDITOR

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

Automatism of Animals and Men

I WAS surprised to see by Mr. Wallace's letter of last week that he and I had understood Prof. Huxley's address in senses entirely different. I understood Prof. Huxley to mean that not only the reflex action of animals, but also all the conscious, so-called voluntary actions of men—those, for example, that we perform for the first time and, as we say, with a conscious end in view—are purely automatic; that is, that consciousness, while it accompanies the workings of the animal machine, never stands in a causal relation to any movement whatever; that no movement ever was the result of a state of consciousness, that every movement is the result of physical antecedents which, being present, the movement must of necessity follow, and that in this physical chain there is no break whatever. Years ago I saw no escape from this conclusion, and I have repeatedly made explicit statements of it in the pages of this journal and elsewhere. I was therefore gratified to find Prof. Huxley agreeing with the doctrine; and that the British public should be so little startled by his announcement of an opinion which has seemed absurd to almost everyone to whom I have attempted to expound it, struck me as rather curious. But the explanation is easy, if a man of such fine and cultured intellect as Mr. Wallace could so completely miss the meaning of Prof. Huxley's discourse.

DOUGLAS A. SPALDING

The Edible Frog

YOUR correspondent Mr. Miller (vol. x. p. 483), will find, in Cooke's "British Reptiles," p. 103, accounts of other endeavours to naturalise *Rana esculenta*. About ten years ago I imported a basket full from the Parisian fish-market, where they can easily be obtained, and turned them out into a pond at Woburn Abbey, in Bedfordshire. They thrived and multiplied there; but our summers are seldom hot enough to enable the tadpole to attain his full development before the cold autumnal nights set in. Last week, for example, I forwarded to Prof. Huxley a living tadpole of *R. esculenta*, born in Bedfordshire, who will scarcely complete his evolution before the winter, though his hind legs are fully developed. I have several summers, however, observed a plentiful supply of young *esculentæ*, and I believe that in our climate the young will pass the winter as tadpoles, and complete their transformation in the following spring. But this would require more accurate observation before I can affirm it with certainty. During the past summer I imported from Berlin a fresh supply of 200 exceedingly fine specimens, as my French frogs had been reduced in numbers after the frequent visits of a heron. *R. esculenta* is easily imported in the spring, and will travel many days packed in damp moss. These frogs are easily preserved, being more aquatic in their habits than our *R. temporariæ*, who roam through the woods and meadows in search of food when the breeding season is over, while the edible frog remains on the banks of his native pond, into which he plunges, describing a graceful curve, at the slightest approach of danger. They have been introduced into Ireland quite lately, from France, by the Earl of Granard, at Castle Forbes; with what success I am unable yet to say. In the spring any number can be easily obtained from the Parisian market, or the aquarium shop of M. Carbonier, 20, Quai du Louvre, Paris; or from the keeper of the reptiles in the Jardin des Plantes, who always has a plentiful supply to feed his snakes.

The laboratories of our lecturers on physiology are supplied from Leipzig, annually, with living *R. esculenta*, and Mr. Miller can easily obtain the address of the dealers who export them.

Oct. 26 ARTHUR RUSSELL

Colour in Flowers not due to Insects

FROM Mr. F. T. Mott's letter, in your last issue (p. 503), I can hardly imagine him to be acquainted with the literature of the subject on which he writes. The difficulties he suggests, though great, are, I think, not unanswerable.

1. Cultivation seldom greatly affects the size or colour of the first cultivated individual. In the cases in which it does so, Mr. Darwin considers the origin of the variation to be due, as suggested by Knight, to change, or excess in food ("Origin of Species," chap. i.) Where the variation is at first slight and slowly intensified, this is the result of artificial selection.

2. When we consider the exhausting character of the reproductive process, we may perhaps think that the abortion of the sexual organs by the multiplication of phyllæ is the result of weakness; but a high state of cultivation, or any excess of food, predisposes to the degradation of organs, the excessive growth of parenchyma, rapid growth, and disease. Organs are also absorbed by heat or by frost. As to the perpetuation of such forms, Mr. Darwin instances ("Origin of Species," chap. viii.) some varieties of the annual stock which produce both double sterile and single fertile seedlings, justly comparable to the fertile and neuter forms of social insects.

3. The "abortive flowers" of such umbellate and capitulate inflorescences as the Guelder Rose, Hydrangea, and Centaurea, where not effected by artificial selection, act as a lure to the central fertile florets, as shown by Dr. Ogle (*Popular Science Review*, April 1870), originated according to the law of balance of growth.

4. The beauty of fruits "serves merely as a guide to birds and beasts, in order that the fruit may be devoured and the manured seeds disseminated" ("Origin of Species," chap. vi.)

5. "We meet very commonly with gaily-coloured chemical products, essentially connected with the normal processes of development, and originating from venomous infection by insects, or from decomposition. These colours appear to be merely an accidental quality of the chemical products . natural selection is without any influence as to colours, unless animals are attracted or repelled by them" (Hermann Müller: NATURE, vol. ix., p. 460). Mimicry has been recorded in fungi (NATURE, vol. vii. p. 55). Mr. Mott's letter indicates the fallacious opinions that mere beauty or variety are objects in nature, and that the Darwinian hypothesis deals with the origin of variations.

G. S. BOULGER

Harrow Road, W., Oct. 26

ABLER pens than mine will probably reply to Mr. Mott's letter in NATURE, vol. x. p. 503; but if not, may I be permitted to point out that the facts therein adduced, as not harmonising with the theory that colour in flowers has been assumed for the purpose of attracting insects, are capable of explanation.

1. *Cultivated flowers.*—The greater size and brilliancy of colour attained by these is not due to cultivation alone, but to selection practised by the cultivator. He chooses his seeds from the plants that bear the largest and best coloured flowers, and thus, directly and intentionally, performs the very work that in a state of nature is carried out, indirectly and unconsciously, by the insect fertiliser.

2. *Double flowers* are only accidental, and not permanent, in a state of nature. The cultivator has succeeded in producing and preserving them by giving a preference to, and propagating from, those plants which bear flowers with a tendency to become double. Here also intentional selection by the gardener has taken the place of natural selection by the insect.

3. The *abortive flowers* of the Guelder Rose and Hydrangea, as they grow naturally, are confined to the outer part of the corymbs, and serve the same purpose as the ray of Compositæ (which in some species consists of neuter florets) and the highly coloured floral bracts of some plants, viz., to attract insects to the fertile flowers they surround. The garden forms of Viburnum and Hydrangea, the corymbs of which are composed entirely or nearly so of sterile flowers, are, like double flowers, the result of intentional selection by the cultivator.

4. The brilliant colours of many succulent fruits have resulted from their superior attractiveness, not indeed to insects for the purpose of fertilisation, but to birds and other fruit-eating animals for the purpose of dissemination, as has been well described by Prof. Hildebrand. The occurrence of brilliant colours in the vegetable kingdom, independently of the agency of insects, as on fruits, galls, fungi, and lichens, is no more irreconcileable with the theory that the colour of *flowers* has been brought about by that agency, than is the occurrence of bright colours on insects themselves and other members of the animal kingdom, or the vivid colour of many mineral substances.

Newton-le-Willows, Oct. 20 THOMAS COMBER

Migration of Birds

I HAVE waited for some time to see if anyone would ask Prof. Newton or Mr. Tegetmeier, on what evidence the latter gentle-

man has been led to "declare that knowledge of landmarks obtained by sight, and sight only, is the sense which directs these birds," viz., carrier-pigeons. (See NATURE, vol. x. p. 416.) As no one has asked this question, I am obliged to do so myself; but at the same time I should like to say that it is only because the subject is one of great importance that I think we should not here be satisfied with an authoritative statement of opinion, without some indication of the kind and degree of evidence on which such opinion is based. Moreover, it seems to me particularly desirable, that if a man of Mr. Tegetmeier's immense experience in this matter has any conclusive reasons for his decision, the public should have the benefit of their recital; so that the vexed question as to the "homing" of pigeons may once for all be settled.

The importance of settling this question I deem almost impossible to overrate; for, with all deference to Prof. Newton, I do not see why "sight alone cannot be regarded as of much aid to birds which at one stretch transport themselves across the breadth of Europe," if it is once satisfactorily proved that "sight, and sight alone, is the sense which directs" carrier-pigeons, say, from Paris to London. For it must be remembered that carrier-pigeons are descended from a non-migratory species of bird, and may therefore well be supposed not to have the faculty of remembering landmarks so fully developed as is the case in migratory species, where this faculty has doubtless been deeply impressed by means of natural selection. Further, we must not forget that in the case of all migratory birds, the younger generations fly in company with the older ones; so that the former must make several journeys before it devolves upon them to lead the way.

When the instinct question was last discussed in NATURE, I published a summary of the evidence which had been adduced by the correspondence. As at that time I thought with Prof. Newton that the supposition of sight being the faculty to which the return of carriers is due was a very improbable one, I argued that to account for the facts of migration by a similar supposition would be unwarranted. But when so great an authority has found cause to alter his opinion regarding the supposition on which my previous argument was founded, I think the fact bids fair, not only to destroy that argument, but, as just shown, to reverse it. Now I call attention to this in order to show how much depends upon a final determination of the instinct question so far as carrier-pigeons are concerned. In no other case of "homing" (and migration is nothing more) are we able to subject the birds to experiment; so that if this has been done in the case of pigeons with unequivocally positive results, we are at any rate in possession of a valid analogy from which to establish a probability as to the nature of the migratory instinct in general. And the value of this probability would be more definite if Mr. Tegetmeier would tell us what he thinks, or knows, to be the utmost limit of a pigeon's memory for landmarks.

GEORGE J. ROMANES

The Aboriginal "Murri" Race of Australia

(Communicated by Sir J. Lubbock, F.R.S.)

HAVING lately had an opportunity of reading your work on "The Origin of Civilisation," it has occurred to me that some information which has come to my knowledge during missionary tours among the aborigines known as the race of Murri, and during a journey afterwards undertaken at the instance of the Government of this Colony to the Namoi and Barwun Rivers, may be acceptable to you. Through Prof. Max-Müller my journal and my grammar of "Kamilaroi, Dippil, and Turrubul" were transmitted to the Anthropological Society; and I suppose all I have written is accessible for the purposes of philosophical investigation among the records of that society. I now confine my statements to points touched upon in those parts of "The Origin of Civilisation" which treat of the Australian aborigines.

Page 11. In the north-western part of this colony, about the tributaries of the Darling, a man will not look at his mother-in-law. If they meet accidentally they turn back to back, and take no further notice one of another.

P. 34. My experience differs entirely from that of Mr. Oldfield. Having shown many drawings and paintings of animals and men—including their own likenesses—to the aborigines, I always found them quick at perceiving the design. They themselves trace on the trees, with their tomahawks, fair representations of snakes and other animals.

P. 109. It is true no man may marry a woman of the same names as his sisters. But it is by no means true, as Dr. Long stated, on imperfect information, that no one can marry a woman "of the same clan," taking the word "clan" in the common sense of the term as equivalent to "gens." The rule that restricts marriage is founded on an exact law of pedigree and class names. It is as follows among the aborigines of the Namoi; and other tribes have rules similar in the main, though the names differ widely.

The men are all divided into four classes—Murri, Kumbo, Ippai, and Kubbi. The Murri (whose name differs from that designating the race, "Murri," only in the quantity of the last syllable) are regarded as the most important; the Kubbi are the lowest in esteem. The sisters of these four are respectively Mātā (or Matha), Būtha, Ippatā, and Kubbotha (the vowels are pronounced as in French). So that in one family every son bears the name Murri, every daughter the name Mata; in another family every son is Kumbo, every daughter Butha. There is also another classification marked by "totems," in which a second name is given to everyone according to birth. Thus there are the *bundar* (kangaroo), *meité* (opossum), *dīlī* (iguana), *nūrai* (black snake), *dīnoŭn* (emu), and others. On these classifications are based laws of marriage and descent. A Murri may marry Butha of the same totem, and of any other totem he may take a Mata, though she bears the name of his own sisters, who are all Mata. So Ippai dīnoŭn may marry Ippata nurai, but not Ippata dīnoŭn. But Ippai dīnoŭn may marry Kubbotha dīnoŭn.

Children always bear the second name (or totem) of their mother; and the first name of the child depends on the mother's. Thus the sons and daughters of Mata are always Kubbi and Kubbotha; those of Butha are Ippai and Ippatha; those of Ippatha are Kumbo and Butha; those of Kubbotha are Murri and Mata. As Ippai generally marries Butha, Ippai's son is generally Murri, but not always. When Ippai's wife is other than Kubbotha, his son is other than Murri. At first it seemed to me that the father's name determined that of the son; but afterwards I found that it is by the mother's name that those of the children are fixed. It is remarkable that while the second name of a child is the same as the mother's, the first, though dependent on the mother's, is always different. Mata's daughter cannot be a Mata, but is always Kubbotha. The Rev. Lorimer Fison, who had been in communication with Prof. Goldwin Smith and others on the "Tamil" system, and had found that system in Fiji, on seeing the rules of marriage and descent which I had noted down as prevailing among the Kamilaroi of Australia, said the principles of the "Tamil" were observed here also.

They have no words meaning simply brother and sister, but use terms signifying elder brother and younger brother. Thus "daiadī" is elder brother, "gullami" younger brother; and in a family of six brothers the eldest has no daiadī, but five gullami; the youngest has no gullami, but five daiadī; the third has two daiadī and three gullami. "Bcādi" is elder sister, "burandi" younger sister. "Gunī" (γυνή) is the child's word for "mother dear."

P. 205. The Kamilaroi and Wiradhuri tribes, who formerly occupied a large territory on the Darling and its tributaries, have a traditional faith in "Baiame" or "Baiamai," literally "the Maker," from *baia*, to make or build. They say that Baiame made everything. Some say that he once lived as a man upon earth; and near the Narran River is a hole in a rock, somewhat in the shape of a man, where they say Baiame used to rest. He makes the grass to grow, and provides all creatures with food. Baiame gave them a sacred wand, which they exhibited at their "bora," the initiatory rite of admission to manhood, and the sight of this wand is essential to make a man. Baiame once showed the black fellows how to get rid of "Mullion," a demon in the form of an eagle, who lived in a tree and devoured many people. Baiame is also the Supreme Judge who awards to men their future lot. When people die, the good ascend to Baiame, and he appoints them a place on the great *warramool* (watercourse, with groves, fruits, and animals, for the enjoyment of the blessed), in the sky—the Milky Way; the bad perish at death.

The Rev. James Gunther, of Mudgee, who was many years engaged in the instruction of the Wiradhuri tribes, has recorded the fact that these people ascribe to Baiame "three of the attributes of the God of the Bible"—supreme power, immortality, and goodness. There are among them men who make light of these traditions; but even when first spoken with by Christian instructors, some were evidently devout in their thoughts of Baiame and their hopes of a future life; and as to a future

state, they generally have a lively expectation. A squatter, M. De Becker, who lived many years at a remote station, where the blacks were in frequent communication with him, told me he had seen many of them die with a cheerful anticipation of being soon in a "better country." WILLIAM RIDLEY

Paddington, Sydney, Australia, July 11

Reported Discovery of Gold in Samoa

FROM a note in NATURE (vol. ix. p. 273) I am surprised to learn that Mr. Williams, H.M.'s Consul in these islands, has stated, in an official despatch to the Foreign Secretary, that gold in quartz has been found on Upolu, in a valley about three miles from the Port of Apia. The samples assayed are said to have yielded at the rate of 3,000 ozs. to the ton.

No geologist who knows Samoa will believe that gold in paying quantities has been found in this island. Still, I think it right to give the following explanation of what gave rise to the above report.

A few months ago gold was said to have been found, as reported by Mr. Williams. Most people here, however, disbelieved it, thinking the report had been raised by unprincipled men for the purpose of attracting settlers and promoting the sale of land. Some believed the pretended specimens of Samoan gold had not been found in Samoa, and felt quite certain they had not been procured in the particular valley specified.

The facts of the case have been lately disclosed, since Mr. Williams left the islands in ill health; he was therefore in ignorance of them when he wrote his despatch from Sydney in October 1873.

The specimens of gold assayed were brought from the Thames gold diggings in New Zealand, and two or three foreign settlers here, who own land in the valley where the gold is said to have been found, raised the report in order to sell their land at a high price. They appear to have imposed upon the credulity of the Consul, who took the specimens to Sydney and had them assayed there. S. J. WHITMEE

Upolu, Samoa, June 2

Photographic Irradiation

I SHALL be obliged if you will allow me space to state more specifically why I am not able to concur in the irradiation theory of Mr. Aitken (vol. x. p. 439). I understand from his last letter that he fully agrees with Lord Lindsay and myself as to the cause of the outer irradiation, and our only difference of opinion now lies in the amount of the inner irradiation that can be traced as due to what he has termed *molecular reflection* within the thickness of the collodion film. Mr. Aitken and Capt. Abney both appear to consider this as the chief cause of the inner irradiation fringe, while I am disposed to rank the irradiation arising from the optical imperfections of the instrument with which the photograph is taken; together with any irradiation that may arise in the wet plate processes from circulation in the film of fluid covering the plate—before—or as very much greater in amount than the irradiation due to dispersion within the collodion film.

We should expect that light dispersed within the thickness of the collodion film would produce its photographic effect in all directions round the illuminated point—and that the area of action would not be affected, or certainly would not be decreased, by covering the front surface of the portions of the collodion film adjacent to the directly illuminated area with an opaque object. Indeed, if the opaque object were a good reflector, such as a bright piece of platinum foil, we might expect slightly to increase the area of photographic action due to dispersion within the film; for the light dispersed towards the front surface of the film would be in great measure reflected back into the thickness of the collodion. But, as I have shown in former letters, placing a piece of platinum foil in immediate contact with the collodion film causes the photographic image of a bright image to be sharply cut off, and no perceptible irradiation can be traced under the edge of the foil.

Again, we should expect the action of dispersed light to extend further within a thick film of collodion than within a thin film; for there would be a greater thickness of illuminated collodion, and the angle through which light could be radiated directly upon the adjacent area without suffering reflection at either surface would be increased, but I have not been able to detect any perceptible difference in the amount of irradiation of similarly exposed plate coated with four thicknesses of collodion and in those coated with but one film.

I have felt myself therefore driven to look for the cause of irradiation either in some circulation taking place within the film of liquid covering the collodion at the time of exposure, which film would be interrupted and its tension greatly altered by the contact of a solid body; or else to seek its explanation in the optical imperfections of the photographic instrument. Possibly, in the wet-plate processes, circulation within the fluid film may produce a very sensible effect. Indeed, there are phenomena which make this more than probable. When a wet-plate picture of a strong light projected upon a dark background is taken with a decided over-exposure of say ten minutes or a quarter of an hour, the inner irradiation fringe is seen to be most opaque on its outer edge; and the phenomenon is so marked that it cannot be held to be an effect of contrast. This, of course, should not be the case if the irradiation edge were due merely to the optical imperfections of the instrument. Again, in the small negatives of the eclipse of December 1871, taken at Dodabetta and Baikul, there is a decided structure in the irradiation under the prominences: under the brightest of them it can be distinctly seen that the opacity of the irradiation fringe is greatest along lines radiating from the prominences—while along the outside, that is, furthest from the prominences, there is an arc of slightly greater intensity. The same structure is traceable in all the negatives, but it is most marked in the Baikul series, and especially in those negatives in which the prominences are most exposed, viz., on the east and west limbs, at the beginning and at the end of totality. This, of course, cannot be accounted for merely by the optical imperfection theory. Again, the little brushes mentioned in a former letter as extending under the edge of the platinum foil, cannot be accounted for without supposing that there is circulation within the liquid film. I hope on my return to England to carry out some further experiments for determining the amount of the inner irradiation which in the wet-plate processes may be due to such circulation. A. COWPER RANYARD

Florence

Curious Rainbow

THE unusual phenomena described by Mr. Swettenham as having been observed by him in a rainbow in the Kyles of Bute (NATURE, vol. x. p. 398), are due, I think, to interference. If I remember rightly, he will find an explanation of the matter in "Deschanel's Natural Philosophy," by Prof. Everett.

Clifton, Bristol, Oct. 19 G. J. THOMSON

Aurora

A BRIGHT display of aurora was seen here on Friday, Oct. 16, between eight and eleven o'clock. At ten o'clock, when I first saw it, the arch of the aurora stretched from Pollux to Arcturus, then both near the horizon, the apex of the arch being under Ursa Major. Deep fringes of light hung from the inner side of the arch and moved with a curtain-like motion to the north. The light was white. On Saturday night numerous streamers were seen darting upwards from the horizon; and many falling stars, two of them leaving trains of light for about a second.

JAMES S. ANDERSON

Castletown, Caithness, N.B.

Sneezing in Animals

I HAVE a rough-coated terrier dog which will sneeze when told to do so. I taught him this trick by repeatedly imitating sneezing in his presence.

When about to perform, he shakes his head obliquely once or twice, just as many people do, and then ends with a good sharp sneeze. J. F. M. H. S.

THE RECENT ERUPTION OF ETNA

PROF. ORAZIO SILVESTRI has published* his observations on the eruption of Etna which occurred on the 29th of August, and reminds us that two months previously he predicted not only the formation of the fissure on the Mongibello side, but likewise the eruption by which it was accompanied.

After an uninterrupted period of eruptive phenomena by which the central crater was considerably modified, at

* "Notizie sulla eruzione dell' Etna del 29 Agosto 1874." Catania, 1874.

4 A.M. August 29, subterranean rumblings were followed by two shocks, when a formidable column of black smoke and flaming materials rushed up into the air, and, carried by the wind, fell at great distances, in the form of small scoriæ and sand. Numerous other columns succeeded, with roaring, rumbling noises, lasting for seven hours with great intensity, dying away towards night. The noises ceased on the 30th of August, and vapour and smoke alone rose from the crater and along the line of disturbance.

When the volcanic tremors were most intense, at 4 A.M. 29th August, a fissure appeared on the north side of the great central crater, extending for five kilometers, with an axis running E. by 8° N. The centre of the impellant force was at an elevation of 2,450 metres, between two mountains of lava known as *Fratella Pii* and *Monte Grigio*, where the rent widened to its maximum width of fifty to sixty metres, whence it narrows very steadily towards the base, terminating after a course of three kilometres. And at this altitude, where the greatest thrust was manifested, may be noticed the formation of a new mountain, or crater, with an elliptical contour, coinciding with the fissure in the direction of the axis. It has a diameter of about 100 metres, and covers a superficial area of about 117,734 square metres. This crater, now appearing as a new mountain, is formed of doleritic lava and a pre-historic grey Labradorite, torn from the surface by the black lava of this eruption, in which they are enveloped. There are thus mingled two lavas of the most distant epochs in the history of Etna, the older forming the framework of the mountain. The crater shows internally the usual funnel shape; and near its base, over a width of fifty to sixty metres, there are ten eruptive mouths, open wide, which succeed each other like button-holes;—those nearest the crater are abysses twenty-five to thirty metres in diameter along the line of the fissure. There are also two other groups of small cones, in which the diameter of the mouths is not more than from one to three metres—eight in the second group, and four in the third; so that within a distance of half a kilometre from the crater there are twenty-two minor cones in linear extension. The crack is now continued down a declivity formed by the lava current of 1614, which slopes to the north at an angle of 13° or 14°. Although the rent traverses this lava, there are no more small cones for a distance of 600 metres, when a fourth group of five mouths, each two to three metres wide, is found at an altitude of 2,170 metres; these latter have poured out a torrent of lava descending in a stream 150 metres long, 60 metres wide, and two metres thick. A little lower, at a height of 2,150 metres, is a fifth group of three mouths, more active than the others, but situated like the last group on the great lava stream of 1614. The torrent of lava hurled from these mouths is 400 metres long, 80 wide, and two metres thick, and forms two short bifurcations. Finally, near the end of the crack, at an altitude of 2,030 metres, a sixth and last group of five mouths is formed, which have ejected large quantities of cinder and scoriæ. They are situated about twelve kilometres from the old crater of Mojo, towards which this great crack runs down the side of Etna from its central crater. Besides this principal rent there are an infinite number of smaller clefts, breaking up the soil and radiating from the centres, of great dynamic activity. In a few hours the new mountain and its system of about thirty-five subordinate cones were thrown up, and thus there was brought to the surface a total quantity of about 1,351,000 cubic metres of volcanic materials.

The mingling of the old and new lavas will form the subject of a subsequent memoir. The recent lava, like all modern lavas, is augitic, black, magnetic, and has a metallic lustre. Its specific gravity is 2·3636 at a temperature of 25° Cent. The superficial temperature of the lava was 70°, while at a depth of half a metre it was 90°, and a still higher temperature was recorded where fumeroles were active.

From the remarkably short duration of the eruption, Prof. Silvestri anticipates a more powerful outburst to come, which will be manifested along the rent in making which the present internal explosion has spent its force.

Concurrently with this disturbance the whole of volcanic Italy has been affected. The island of Volcano, after a century of quiescence, discharged cinders and flaming materials from its vast crater for nine months previous to the eruptive phenomena of Etna in the autumn of 1873. The eruption of Volcano continued decreasing in intensity through July 1874, and traces of it are still continually seen. Stromboli last June made a rare eruption, sending out small stones with great energy in place of its characteristic feeble incessant explosions.

Vesuvius has not been unsympathetic, and discharged an unusual volume of dense vapour at the end of August contemporaneously with the eruption of Etna.

THE SECOND AUSTRO-HUNGARIAN EXPEDITION TO THE NORTH POLE, UNDER WEYPRECHT AND PAYER, 1872—74.

ON the return of the Austrian North Polar Expedition we gave in NATURE, vol. x. p. 439, an outline of the discoveries made. From the original memoirs on the achievements of the voyage, by Dr. A. Petermann, Dr. Joseph Chavanne, and Dr. v. Littrow, which have been kindly forwarded to us by the first-named, along with the map, we are able to give still further details.

No general with his victorious army returning from battle could have been welcomed with greater enthusiasm and cordiality than this little band of twenty-two men. For though they only come home from a North Polar expedition, people instinctively feel that the accomplishment of the *Tegetthof's* voyage is a heroic deed. To gain a battle, hetacombs of precious human lives must be sacrificed; here all came safely back. A battle does not demand greater endurance and courage, for the battle of the *Tegetthof* lasted two years. We think of the times of Columbus and Vasco da Gama, of their discoveries and return to Palos and Lisbon. It is true the Austrian expedition did not find an America or an India; but Columbus, and other great discoverers, did not really discover more than Weyprecht and Payer. Before Columbus traversed it, men believed that the western ocean was not navigable, and similar ideas prevailed with more reason concerning the sea just explored. One of the first describers of polar regions, Scoresby, had, in the year 1820, in his famous work, drawn a line over the whole sea from Bear Island, in 74½° N. lat., to Novaya Zemlya, and said, with confidence, "Here is the icy barrier where navigation must end;" and the unknown regions beyond this line were regarded by mariners with pious dread. The Austrian expedition has torn away the veil up to 83° N. lat., and has narrowed the undiscovered parts of the earth by a space of 8° to the north.

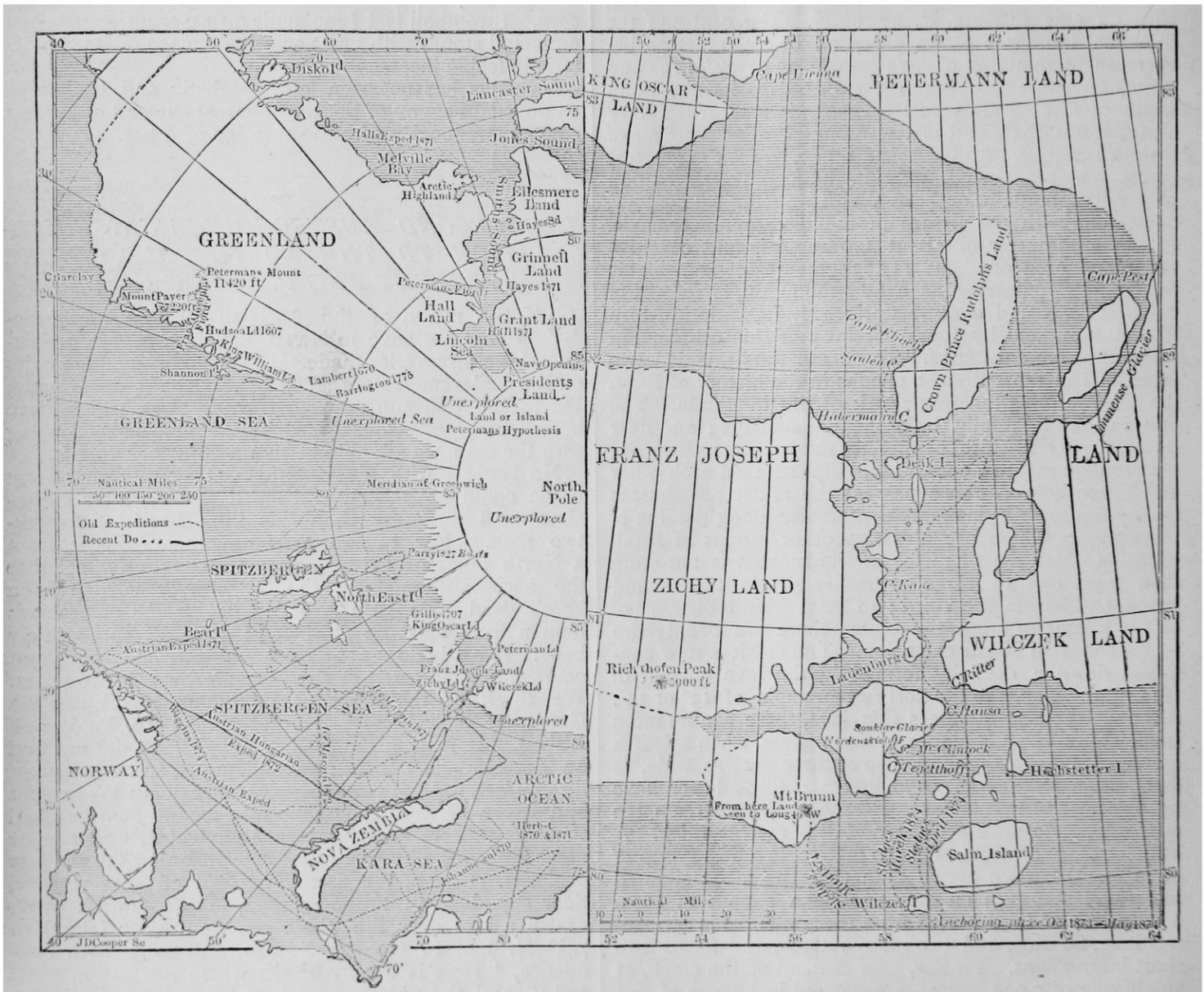
They had to stay at Novaya Zemlya for four weeks, and work their way out of thick ice for at least 240 geographical miles before reaching Cape Nassau, which was the starting-point of the expedition. They then encountered the most terrific dangers which can befall a polar expedition, for they were hemmed in by an ice floe, and shut up for fourteen months in pack ice, and driven about in the Siberian icy ocean. Eventually a tolerably safe place in the open ice was found for the second wintering, when the crew heroically divided themselves, the better to explore the land they had discovered.

The comrades of the *Tegetthof* have shown themselves worthy to take rank with their prototypes, Ross, Parry,

M'Clintock, Kane, Hayes, and Hall, for they have made a breach in a place where no one since Barents, during all the 300 years of arctic discovery, had attempted an attack. The explorations are here shown on a map constructed from the original preliminary sketch by Payer, with the geographical constants drawn by Dr. Petermann.

The nature of the North Pole is not so fully known but that the learned world is still fighting as to whether it is land or water, or an everlasting ice-cap, stretching like our home glaciers, or obeying other laws, or dissolving and opening under the influence of the warm sun, air, or water, like our own seas. And since any expedition can only discover a proportionally small part of the great unknown arctic world, there will always be some people ready with ape-like wisdom to pronounce against any endeavour to unfold the laws of nature within the inner polar regions. Dr. Petermann has for ten years urged that Germany should send out a polar expedition far into the great European polar sea, and is particularly anxious to get the whole breadth of the European North Sea explored from East Greenland to Novaya Zemlya, north of Bear Island.

The results of this expedition have marked an epoch in various ways. First by the drift for fourteen months in



The map on the left shows the state of polar exploration up to the end of September 1874; that on the right is the newly-discovered land.

the ice-floe. Such driftings have occurred before on a larger scale, as in the case of De Haven, M'Clintock, the *Hansa* people, and the *Polaris* people; but all these expeditions drifted south—the *Polaris* crew from 80° N. lat. to 53°. But entirely new and full of significance for physical geography, is the circumstance that the path of the Austrian expedition was uninterruptedly towards the north.

The following instances also show that the icy sea is navigable. Hall's expedition north from Smith's Sound proved that from Tessiusak in 73° 20′ N. lat., through the ill-famed Melville Bay, Smith's Sound, Kennedy Channel, Robeson Channel, to 82° 11′, was reached with ease in eleven days, the distance being more than 700 miles; and the best officers of this expedition declare their united conviction that they could easily have reached further north. The Karis Sea, formerly called the Ice-cellar of the North Pole, has proved to be completely navigable. Admiral Sir E. Parry, after Sir James Clark Ross perhaps the most experienced of all polar travellers, going north from Spitzbergen, came to the conclusion that a ship might sail to 82° N. lat. without encountering a piece of ice. Admiral Beechey, one of the most excellent and perhaps the most scientific sea captain who has ever lived, said in 1831 that he considered the navigation of the coast of the arctic region as practicable.

Dr. Petermann then asks: Is the experience of the Austrian expedition a measure of the resistance offered by the ice in the icy sea just explored? Are all the results which are opposed to it, from the former expedi-

tion of Weyprecht and Payer, not worthless? Is it worth nothing that numerous Norwegian fishermen in sailing boats have been able to sail round Novaya Zemlya since 1869 and penetrate far into the Siberian ice sea, always finding it navigable and quite free from ice? Is it not worth remembering that at the time Payer and Weyprecht found the unwonted accumulation of ice by Novaya Zemlya, the western half of the great sea, *quite against the rule*, was free from ice, so that the Norwegian fishermen were able for the first time to reach the mystic Gillisland, which is King Charles Land? Under certain unfavourable conditions of wintering, the north side of Novaya Zemlya is, without doubt, as difficult and impossible for navigation as the north side of Spitzbergen, or Cape Horn, or the Cape of Good Hope, or the English Channel, or the mouth of the Weser.

The *Tegetthof* is a small steamer of 220 tons, and though her supply of coal was necessarily small, it proved ample, for steam could only be got up three times in the first three weeks of the voyage. And thus, as in all recent voyages, rowing boats proved themselves better fitted than steam launches for exploring work. In the summer of 1872, the journey from Cape Nassau could not be made in a straight course, but Count Wilczek's journey in the sailing vessel *Isbjörn* demonstrated that it was practicable by following a tortuous course.

The best and first account of the results of the Austrian expedition, in relation to their bearing on the present state of knowledge of arctic geography, and of the current setting into the icy sea from the south, is given by Dr. Joseph Chavanne, and is as follows :—

"The rising polar sun of 1874 lighted up and discovered a new land, now named Franz Joseph Land, and the expedition set off to explore it in sledges. They found the country to be a narrow, far-extending foreland, divided from Greenland by a wide arm of the sea now named Austria Sound. It is mountainous, approaching to a plateau, with steep conical mountains 5,000 feet high, covered with enormous glaciers. This newly discovered land stretches for more than 15° of longitude, and bounds the horizon with mountains as far as the eye can carry to the north and west. In 83° N. lat. they sighted Cape Vienna, the most northern point visible, and Cape Pesth, one degree further south, and finding the great glaciers impassable in this latitude, they returned to their icebound ship. Imperative necessity compelled them to abandon their vessel upon its icy platform, and they set out to return to Europe with four sledges. They travelled on for sixty-nine days, and then fell in with the Russian schooner *Nikolai*, who landed them at Vardoe, in the north of Norway. Austria Sound, and other fjords, were filled with icebergs. They met with no trace of human inhabitants, and remark that animal and plant life is scarce and small in the south."

Twenty-two years ago Dr. Petermann indicated on a map of the arctic regions the polar extension of the Gulf Stream. Though generally regarded at the time merely as the hypothesis of a German philosopher, the unwilling drifting of the *Tegetthof* in the ice has proved that the principal northern branch of the Gulf Stream washes the west and northern coast of Novaya Zemlya. Between the west coast of Novaya Zemlya and the east coast of Spitzbergen, enormous masses of ice press westward with the polar current flowing from New Siberia Island and the Siberian rivers, and penetrate wedge-like into the Gulf Stream. The temperature of Franz Joseph Land in the winter of 1872-73 was 40° Réaumur.

The remarkable correspondence between the coasts on the two sides of Greenland supports the conjecture that the polar land, if not subdivided into a number of islands by ramifying arms of the sea, is at least deeply indented by fjords, as is demonstrated by Hall's discovery of Petermann's Fjord on the west coast of Greenland and Franz Joseph's Fjord on the east.

PHYSICS AT THE UNIVERSITY OF LONDON*

II.

TURNING then first of all to the Regulations for Matriculation in the University of London, we find that the knowledge of Physics that is required is specified under four heads: namely, *Mechanics; Hydrostatics, Hydraulics, and Pneumatics; Optics;* and *Heat*, which last, until quite recently, was included in the examination in Chemistry; and the whole is accompanied by a general qualifying note to the effect that "the questions in Natural Philosophy will be of a strictly elementary character." The particulars, which are given under each of the above general heads, read as if they might have been copied, as they stand, from the table of contents of an elementary treatise on Natural Philosophy published about a hundred years ago. I have examined them often and carefully, and have never found a tittle of internal evidence to show that they were drawn up within the present century; and yet we know that they are the work of a University, not yet forty years old, which owes its very existence to the demand for educational progress, and began its career—without indeed the wealth or the prestige of its older compeers—but also without the trammels of tradition and ecclesiasticism, which render it so difficult for them to advance with the times. It is not a sufficient defence of the antiquated character of these Regulations to say that the very nature of the examination to which they refer would make the introduction of new discoveries entirely out of place, and that, in point of fact, the fundamental doctrines relating to the subjects in question were as fully established a hundred years ago as they are now. This is so nearly true (except in the case of *Heat*), that it would not be worth while to dispute it; but my objection is not to the want of novelty in the subjects enumerated, but to the want of perception, which the manner of the enumeration indicates, of the possibility of progress or improvement in the ways of teaching long-known truths. Instead of giving prominence to general principles in such a way as to suggest to teachers the use of easy and comprehensive methods, these Regulations cut up the subjects to which they relate into a number of detached propositions, of greater or less generality, which teachers and students, who accept these Regulations as their guide, generally treat as independent units of knowledge each of which is to be put into a separate hole of the memory. It would be wearisome, but not difficult, to illustrate my meaning by particular examples; the substance of it is that this examination does not encourage good teaching of the elementary parts of Physics, but induces candidates to trust to memory almost to the total exclusion of any attempt at thinking. My opinions on this subject have not been formed *à priori*, but have been forced upon me by reading examination papers and by trying to teach in what I believed to be the best way. It is in general nearly hopeless to try to get students, who have the fear of the London Matriculation Examination before their eyes, to make any serious attempt to understand the principles of Mechanics; but they often show a lamentable willingness to learn statements of them by heart, and when they go up for examination they know a great deal and understand next to nothing. They know that in a lever of the first kind, whose weight is neglected, the power is to the weight as the weight's arm to the power's arm; that when a heavy body falls from rest, the spaces described in successive seconds are as the natural series of odd numbers; and they are ready at the shortest notice to write down the formula for calculating the specific gravity of a solid body heavier than water; but it is only in the rarest possible

* Introductory Lecture delivered at the opening of the Session of the Faculties of Arts and Laws and of Science, in University College, London, on Monday, Oct. 5, 1874, by G. Carey Foster, F.R.S., Professor of Physics.

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cases that they can be got to reproduce the reasoning by which these results are connected with general physical principles. The industry displayed in acquiring separate fragments of information about Physics is often extremely creditable; but it is impossible not to regret that the same method should be employed in learning what is called Science, as in learning the dates of accession of the Kings of England.

A still more curious instance of the antiquarian tendencies of the University of London is afforded by the Regulations for the Degrees in Science, which were instituted as recently as 1860. It might have been supposed that when the Senate had once determined to make so great an innovation in the traditional usages of English Universities as to grant Degrees in Science, they would have been impelled by the spirit of their own act to frame such regulations for the examinations as should be in full agreement with the present state of science. I recognise as fully as anyone the impropriety of introducing anything that can fairly be called a new discovery into examinations such as those for the London degree of Bachelor of Science, but between such a course and that adopted by the University there is a very broad *via media*. In order to obtain the degree of Bachelor of Science, a candidate requires, after Matriculation, to pass two further examinations, called respectively the First and Second B.Sc. Examination. At the former, a paper is set in what is called "Mechanical Philosophy," and another in "Natural Philosophy," the Mechanical Philosophy being a repetition of the subjects called Natural Philosophy at Matriculation, with a few additions, chiefly under the head of Optics, while the Natural Philosophy includes *Heat*, *Electricity*, and *Magnetism*. At the Second B.Sc. Examination there are two papers in "Mechanical and Natural Philosophy," which are explained by the Regulations to mean nearly the same parts of Statics, Dynamics, Hydrostatics, Pneumatics, and Geometrical Optics as those prescribed for the First B.Sc. Examination, but treated a little more fully, and with the addition of a very little Acoustics, a little Physical Optics, and a smattering of Astronomy. The details given in the Regulations under each of these general heads are open to the same general criticisms as those which I have already ventured to make upon the mode in which the requirements in Natural Philosophy are stated in the Regulations for Matriculation; in fact, those parts of the subject which are common to the three examinations are specified in very nearly the same words in each case, the difference being that a slightly more mathematical treatment of them is expected at the higher examinations. In each case there is the same failure to suggest general and comprehensive points of view, and the same enumeration of particular examples, as though they were of equal importance with the general principles which they illustrate. It is just as if, in an examination in Latin or Greek, instead of its being stated that candidates would be required to answer questions in grammar, lists of particular nouns and verbs were given with the announcement that candidates might be required to give the declensions or principal parts of any of these. But these Regulations are defective not only in form but in substance—not only in spirit but in matter. Without going into further details in order to justify this statement, I may mention, by way of illustration, that at the First B.Sc. Examination, under the head *Electricity*, there is no distinct reference to any of the quantitative laws of the science, and it is only by a laxity of interpretation quite unsuited to the subject that an obscure allusion to Ohm's Law can be discovered—the great law expressing the connection between the strength of an electric current and the nature of the circuit which it traverses; while, under *Heat*, no liberality of interpretation could detect the smallest trace of the Dynamical Theory of Heat. This last omission, however, ceases to be surprising when we find the steam-engine classed with the common pump and forcing-pump; the hydrostatic press, the barometer, and the air-pump, under *Hydrostatics*, *Hydraulics*, and *Pneumatics*. It might have been natural a hundred years ago to look for Newcomen's atmospheric engine among such company; but, even then, James Watt had nearly converted the old atmospheric engine into the modern steam-engine.

But there is no need to enter upon any minute investigation of the Regulations for these examinations, in order to be convinced that their effect upon the study of Physics must be unfavourable. The small amount of encouragement which they hold out to pursue this subject seriously is shown by the fact that a London Bachelor of Science is not required to have any more knowledge of heat, magnetism, or electricity than candidates for degrees in Medicine are required to show at the "Preliminary Scientific (M.B.) Examination," which, in the usual course of things, is taken one year after Matriculation; and also by the fact that the papers in Mechanical and Natural Philosophy set at the Second B.Sc. Examination are identical with those set in the same subjects at the Second B.A. Examination. I have no fault to find with one side of this last arrangement; I have already given reasons for considering that Physics ought to occupy an important place in general education, and, from this point of view, the physical subjects for the Second B.A. Examination are, on the whole, not injudiciously chosen; but it is certainly strange that a degree in Science should not imply any greater acquaintance with the fundamental principles of Mechanics than is demanded of candidates for the degree of Bachelor of Arts, the examination for which is in the main literary and classical. Another fact, which may be regarded as a sort of experimental proof that the examinations of the University of London do not promote such a study of the elements of Physics as can serve as the foundation for a more advanced study, is that for the last five years a special examination for Honours in Experimental Physics has been held in connection with the First B.Sc. and Preliminary Scientific (M.B.) Examinations, at which a Medal and a Scholarship of 40*l*. a year, tenable for two years, are offered to the most deserving candidate in case of his exhibiting sufficient absolute merit, but hitherto the scholarship and medal have never been awarded, and only once has a candidate obtained a First Class at this examination.

The other examinations of the University of London into which Physics enters to a greater or less extent, are, that for the degree of M.A. in Branch II., and those for the degree of D.Sc. in certain branches; but as these examinations come at a stage of a man's career at which it may be supposed that his methods of study are not greatly influenced by the regulations of examining bodies, and as, moreover, the Regulations of the University relative to these degrees do not go much into detail, there is no reason for dwelling upon them in connection with my present subject.

I do not propose to say much about that part of the examinations for which the Examiners, rather than the Senate, are directly responsible: but there are one or two considerations which, although sufficiently obvious, it may be worth while to point out. First of all, however, I shall venture, presumptuous as it may be thought, to make one remark on the choice of the persons best fitted to be examiners. It has more than once been claimed as a special merit of the University of London, that the examiners are not teachers, or at least that they have nothing to do with teaching the candidates whom they are called upon to examine. Fortunately, however, this is not the case. As a matter of fact, the great majority of the examiners are always teachers, and it may quite well happen, at least at some of the smaller examinations, that a majority of the candidates have been pupils of a single examiner. But I venture to think that, instead of this state of things being considered as a more or less

regrettable accident, it ought to be recognised as natural and desirable. If the real object of the examinations be to promote good teaching and sound learning, it is most important that, in setting the questions, the examiners should always keep in view their probable effect in giving direction to the studies of future candidates; and there can be no doubt that the men who are both most likely and most able to do this are those whose constant business it is to consider how the subjects in which they have to examine can be best brought before the minds of learners. Moreover, it is very difficult for examiners who are not also teachers, and teachers accustomed to pupils who are at about the same stage of advancement in their studies as the majority of the candidates, to know what amount of knowledge it is reasonable to expect. A man, however minute his own knowledge of his subject may be, generally soon forgets the exact steps by which he acquired it; and, unless he is in frequent contact with the minds of learners, he is no longer able to tell what, at any particular stage, it is creditable to know, and what it is disgraceful to be ignorant of. And again, though this perhaps is a less important consideration, the necessity which a teacher is under of periodically reviewing the whole round of his subject, is a great help towards a varied selection of questions.

With regard to the particular kind of questions which are most desirable in examinations like those of the University of London, I wish to say only a very few words. If the general considerations to which attention has been drawn in an earlier part of this lecture are of any value, it follows at once that examination questions in Physics ought to be selected with a view to testing the reasoning power and not the memory of candidates. If what are called *book-work* questions are admitted at all, they should be such as will bring out the power of reproducing trains of consecutive reasoning, and bringing facts to bear on the establishment of general conclusions, and not the power of simply recollecting individual facts. It may be said that such questions would be unfairly difficult. I can only say in reply that, if teaching were what it should be, I do not believe that this would be the case; but if it should be found to be so, I maintain that the inference is, not that any other style of examining in Physics should be adopted, but that the whole subject should be dropped. A late very distinguished member of the University once said that, in the case of candidates for Matriculation, all that could be fairly required at the examination in Physics was evidence of "correct acquisition." It would in my opinion be only a little more absurd to say that all that ought to be required at an examination in Geometry is evidence of the "correct acquisition" of Euclid. If Physics is not a subject upon which the intelligence should be exercised from the very beginning, it seems to me to be a waste of time to teach it at all.

The consideration of the kind of questions that are best suited to be of use in promoting improved methods of teaching and learning, suggests a remark which bears upon the distinction that has often been pointed out between the subjects which it is desirable to teach and those which are most suitable for examinations. In the particular case of Physics, I am inclined to think that the very elementary parts of such branches as Heat and Electricity are not well adapted to form the subjects of examinations like those we are considering, where the examiners have no means of knowing the exact points of view from which the matters dealt with have been presented to the candidates. My reason for this opinion is the difficulty in these subjects of setting questions which require anything more on the part of candidates than mere exercise of the memory, and which at the same time are not unreasonably hard. As a practical inference, it appears to me that, if the amount of acquaintance with Heat, Electricity, and Magnetism represented by the London regulations for the First B.Sc. Examination (supposing the regulations to be strictly interpreted) is all that can be fairly demanded at this stage of a student's progress, it is at least a question whether these subjects should not be deferred until a more advanced stage, when something more than descriptions of apparatus or the solution of arithmetical problems might be reasonably required.

If any of my audience have listened to this lecture with the consciousness that they will soon be going up to one or other of the examinations that I have been discussing, it may very possibly seem to them that I have been pleading throughout for making these examinations more difficult. To any to whom this seems to be the tendency of my remarks, I would venture to suggest one or two further considerations. In the first place, I fully admit that if examinations in Physics were to be such as I have advocated, that is, if they required candidates to *think*, while the teaching of Physics remained what too much of it now is—a mere loading of the *memory*—candidates would, no doubt, have a hard time of it; but the whole intention of what I have said is that examinations should be improved *in order* that teaching may be improved through their influence; and I believe that if teaching were what it should be, good examinations would be found to be no more difficult than bad ones. I may also observe that after all the precise degree of difficulty which an examination presents is not the most important consideration even for an intending candidate; what it really is important, not only for candidates but still more for those who regulate examinations, to consider is, what is the permanent educational value of the work which an examination requires, and not simply what is the amount of work needed. I have many a time in reading examination papers felt sincerely sorry for the writers when I saw how much labour they had evidently gone through in order to learn nothing—nothing that is of real use—and have thought how much the same amount of labour might have accomplished if it had only been better directed; and I beg leave to assure any who look upon examinations from the under side, that I have no wish whatever to add to the quantity of work that is already required of them; but what I do wish sincerely is, that whatever work they may be required to do in preparing for examinations may be such that they will be intellectually better and stronger for having done it. It cannot be too often repeated that degrees and university distinctions are of no more value in themselves than the Queen's head upon the coin: unless the metal is genuine, the stamp only makes it into a lying counterfeit. This has been urged upon students over and over again; what I shall be glad if this lecture tends in any degree to accomplish, is to press the same truth upon the attention of our University authorities. It is important for them to remember that a man is not really either better or worse for all the degrees that they can give him; and that their boast should be, not in the length of their lists of graduates, but in the extent to which they have promoted "a regular and liberal course of education."

NOTES

ONE of the first results of the Transit of Venus expedition with regard to the geological aspect and vegetation of a comparatively little known island, comes to us from Rodrigues, and is contained in a communication from Mr. J. B. Balfour to Dr. Hooker, under date, from the above island, of August 23, 1874. As a proof of the inhospitable, or rather the uncivilised nature of the island, it is stated that the party belonging to the expedition were warned in Mauritius before starting for Rodrigues that they must take everything from the former island that they would be likely to require as it would be impossible to get anything at Rodrigues, and even labour is most difficult to be obtained. After providing himself with various articles of also-

lute necessity, Mr. Balfour started from Mauritius, and after a voyage of exactly a week, landed at Rodrigues on August 18. The appearance of the island as seen from the vessel while steaming along near the coast, presented few features which could be looked upon as evidencing any large amount of granite entering into its constitution. On the contrary, the columnar structure of the cliff lines, both on the coast and in the interior, along with the terraced aspect of many of the ridges separating deep ravines, cutting far back into the island, clearly showed that, whether the main mass of the island were granite or not, certainly at some period of its history it had been the scene of very extensive volcanic action. On the 19th of August an excursion was made across the island to survey the channel on the south side. The vegetation on the island is very rank. The trees do not grow to any great size, and in most places do not form thick forest, but are scattered singly over the slope of the hills. It is only in the deep valleys and gorges that they grow into thick forest. The commonest tree seems to be the Vacoa (*Pandanus*), of which there are probably at least four species. The under-scrub is very dense and very spiny, which renders walking through it by no means a pleasant task. Neither ferns nor mosses appear to be very abundant, but lichens are pretty plentiful, especially in their pulverulent state; and in many places the basalt was nearly covered with white powdery patches. The basalt forming the rocks near Port Mathurin is, in its unweathered condition, a very beautiful compact stone, with large crystals of several minerals scattered through it. The difficulties in landing upon the island seem to be very great, owing to the extent of the coral reefs.

THE Yorkshire College of Science at Leeds was opened without ceremony on Monday, by the delivery of one of the introductory lectures by Mr. A. H. Green, the Professor of Geology and Mining. The other professors—A. W. Rücker, Dr. T. E. Thorpe, and W. Walker—give their introductory lectures during the course of the present week, and the teaching of the session will then be proceeded with. Very suitable buildings have been obtained, containing ample accommodation, which has been fully utilised for lecture-rooms, laboratories, &c., which are well furnished with the necessary appliances. Still, as Mr. H. Brown said, "they must look forward to having a noble building like that of Owens College, Manchester;" if the College is to maintain its position and to advance at all, it cannot but end in this. The number of students enrolled is as yet small, but, no doubt, will gradually increase. Prof. Green, in his address, spoke of the importance of a thorough training in abstract science as the necessary groundwork of a technical education. "Before they could understand," he said, "the practical application of a science, they must be master of the science itself. What was sometimes understood as technical education was a sheer impossibility, and a contradiction in terms. They could not explain the technical application of a science without first laying down the scientific groundwork on which it rested. A science like geology could not be taught piecemeal. Technical education in the popular sense was a misnomer, because the teaching which would limit the range of a man's vision to the subjects of which he could see the use did not deserve the name of education, the very essence of which was the strengthening of the intellect by mental exercise. It was his earnest wish that he might be able to give a teaching which in the end would have an important bearing on their practical occupations, and enable them to manage their mining, engineering, and other pursuits in the conduct of which a knowledge of geology came in useful—better than if they knew no geology at all. But if he was to succeed in doing so, he must begin by telling them many things which at first sight would seem to be of no practical value whatever." With such a spirit as these words indicate, animating the professors of this new college, the best results may be expected from their teaching.

A MEETING of some of the friends of the late Dr. Stoliczka was held in the rooms of the Zoological Society on Friday, the 16th inst., at which it was determined to obtain, by subscription, a bust, to be presented to the Asiatic Society of Bengal, of which society Dr. Stoliczka was for some years before his death one of the honorary secretaries. A committee was appointed to act in concert with one previously formed in Calcutta, and upwards of 50*l.* was subscribed in the room for the purpose mentioned. Subscriptions, we are informed, will be received by Messrs. Grindlay and Co., 55, Parliament Street.

THE *Athenæum* announces that the *Contemporary Review* for November will contain an account of a new scientific discovery by Prof. Tyndall.

AMONGST the works which are progressing favourably at the Observatory of Paris we may mention the determination of the velocity of light, by MM. Fizeau and Cornu. These able physicists are using for their second station the Tower of Montlhéry. The light is transmitted to Montlhéry through a refracting telescope of 12 in. and returned to the Observatory with a 7 in. The distance between the Observatory and Montlhéry being 26 kilometres, the total distance traversed by the ray of light is 52 kilometres. The space of time required amounts to something less than one-thousandth of a second.

THE polishing of the great reflecting telescope is almost completed. The immense lens to be covered with silver by the Foucault process, is nearly ready. It is said that everything will be finished by the beginning of May 1875.

AT Agram, the chief town of Croatia, a Croatian University was formally opened on Oct. 19 by the highest magistrate of the land, who is called the Ban, and exercises a kind of vicereg power on behalf of the Emperor of Austria. The University is to be called "Francis-Joseph," from the name of its founder. The Rector delivered a very able oration, summarising the progress of the higher studies in Croatia from the time when Maria Theresa established the Society of Sciences. Many delegates of foreign or other Austro-Hungarian Academies were present at the ceremony (Krakow, Berlin, Bologna, Pesth), and delegates from the Servian societies of learning. It is expected that the new University will play a most important part in the civilisation of the East, and be indeed the vanguard of Europe in science in that direction.

MUCH remains to be done in this respect if the information we collect from Levantine papers be correct. It appears that in one of the principal islands of the Greek Archipelago some poor women have been imprisoned and starved, under the charge of sorcery. They were arrested for having attracted a host of locusts to their native land. The locusts not retreating, the persecution was extended to the husbands of the wretched creatures.

THE International Commission of Geodesy will hold its next meeting in Paris, in accordance with the decision come to at Dresden, where it held its sitting this year. The Government will assign it a public building for its meetings.

MR. J. E. TAYLOR, F.G.S., has discovered a buried forest in the Orwell. The forest is represented by a layer of peat containing trunks, leaves, and fruits of the oak, elm, hazel, and associated with which are the remains of the mammoth. A of freshwater shells containing species not now living in Orwell underlies the peat. Mr. Taylor remarks that this marine forest is contemporaneous with others along the which existed previous to the depression separating Engl from the Continent.

MR. J. E. TAYLOR, who has done so much to create an interest in science in Ipswich, is to give a course of twenty lectures (free) in that town during the coming winter, on "Plants: their Structures and Uses."

AN important discovery has been made at Highwood, near the village of Ashill, in Norfolk, consisting of a vast collection of Roman remains in an oak-lined well, 40 ft. deep. The Norfolk and Norwich Archæological Society visited the spot on the 16th inst., when the well, under the superintendence of Mr. Barton, was emptied of its contents by a number of workmen. The well contains a great variety of articles, the most abundant being urns, of which about 100 have been obtained; more than fifty of these are perfect, and many of most beautiful form and ornamentation. There is considerable doubt as to the purpose which these wells were intended to serve; there are other two at Ashill, and others have been found elsewhere.

THE *New Quarterly Magazine* for October contains, with other articles of general interest, a paper by Mr. Richard Jefferies on "Small Farms." The writer notes the enormous development of science in modern farming, saying: "New plans, new inventions and discoveries follow each other in constant succession. The capabilities of agriculture seem inexhaustible. The number of clever and intellectual men who turn their attention to it multiply daily. It has its colleges, its professors, its students, and it would require a great volume to describe the machinery alone that has been contrived of late years, and is now in the market. The chemistry of agriculture would fill many more such volumes. Geology, botany, entomology, almost all the sciences, are pressing forward to its aid." Deprecating, in the present state of agricultural science, the advantages of small farms, Mr. Jefferies goes on to say: "The utility of bringing up a race of students instructed in chemistry, geology, entomology, mechanics, &c., in agricultural colleges, with the assistance of professors, if they are afterwards to be placed on small farms, is a matter of much doubt; they would have no room for the exercise of their attainments. Whether it be considered from the tenant's own side, or from the labourer's, or from the landlord's, the balance of argument appears to be indisputably in favour of large farms. To the nation, to the ever-increasing population, the large farm offers a greater present produce, and possibilities of still further development. The political economist, who judges the prosperity of an occupation by the amount of capital attracted towards it, must also decide in its favour, for capital will never flow into small farms."

WE commend to the notice of the Goldsmiths' Company the letter from "A Jeweller's Assistant" in yesterday's *Times*. Let us hope that this, as well as the other wealthy City Companies, are now waking up to a sense of their responsibilities, and that they will lose no time in utilising the immense wealth at their disposal, and which has hitherto been utterly wasted, in the promotion of technical—which ultimately means scientific—education. Let them not provoke a "City Companies' Commission."

ON the 12th inst. was opened the London School of Medicine for Women. The Council had determined that no inaugural address should be given, and thus a day which the future may possibly prove to have been one of no little importance passed by unmarked more than by the fact that the first lecture had been given in a Medical School devoted exclusively to the teaching of the female sex. The school is now in full working order, and women can receive an education fitting them to practise medicine. The services obtained by this school need not stop short at preparing women for the medical profession. There are many branches of science allied to the study of Medicine, Chemistry, Botany, Comparative Anatomy, &c., in all of which a course of lectures is given as part of the medical education. These subjects are separately adopted by men as a means of gaining a livelihood. A knowledge of any one of these subjects is attainable equally by women as by men, and there is no reason why women should not achieve a scientific reputation and earn a fair competency by engaging in these studies and by imparting their knowledge to others.

IT is announced by the last Indian mail that a smart shock of earthquake was experienced in Central Ceylon early on the morning of the 19th of September, at five o'clock. The vibration was considerable, and was accompanied by a dull rumbling sound. The motion was from east to west, apparently; the rumbling was decidedly in the east. The shock appears to have been felt in the centre of the island only. Earthquakes in Ceylon are such rare events that this one has had a good deal of attention bestowed upon it.

WE would draw the attention of our readers to the excellent introductory lecture delivered by Prof. Leoni Levi at King's College, on "The Educational and Economic Value of Museums and Exhibitions," which is published in the *Society of Arts Journal* for the 16th inst. He gives many valuable suggestions as to the uses for purposes of popular teaching which might be made of our museums. He thinks that London is still deficient in museums, and states that there are at least some two hundred cities and boroughs which have taken no step to secure museums and public libraries for themselves.

THE *Augsburg Allgemeine Zeitung* of the 22nd inst. gives the following facts and statistics from the various University Calendars just published:—The University of Berlin shows the largest attendance, having had, in the summer term of 1874, 2,980 students and 187 professors. While this University had for a time the second place and Leipzig the first, the order is now reversed, and Leipzig follows with 140 professors and 2,800 students. Then comes Halle, with 1,055 students and 95 professors; Breslau, with 1,036 students and 107 professors; Munich, with 1,031 students and 114 professors; Tübingen, 921 students and 84 professors; Würzburg, 901 students and 58 professors; Heidelberg, 884 students and 104 professors; Bonn, 858 students and 98 professors; Strassburg, 667 students, and 81 professors; Königsberg, 603 students and 76 professors; Greifswald, 540 students and 58 professors; Jena, 493 students and 69 professors; Münster, 451 students and 27 professors; Erlangen, 442 students and 51 professors; Marburg, 440 students and 62 professors; Giesgen, 342 students and 58 professors; Freiburg, 297 students and 52 professors; Kiel, 210 students and 62 professors; Rostock, 132 students and 38 professors. In these numbers the non-matriculated students are also included. The German-speaking Universities outside the German Empire show the following attendance:—Basle, 163 students and 62 professors; Berne, 332 students and 63 professors; Zürich, 331 students and 75 professors; Dorpat, 768 students and 67 professors; Graz, 932 students and 68 professors; Innsbruck, 615 students and 52 professors; Prague, students (?) and 122 professors; Vienna, 3,615 students and 227 professors. Vienna, therefore, is at the present time the largest German University.

M. HURQUERLOT, a gentleman who was largely interested in railway speculations, died a few months ago and left a legacy of 24,000*l.* to the city of Paris for the purpose of establishing a railway school. But the sum, although very large, having been considered insufficient for the purpose, the Municipal Council has been reluctantly obliged to reject the money, which will revert to the lawful heirs.

MORE than 18,000 young men have gone successfully through their examinations, and have been admitted as volunteers for one year in the French army. About half of that number have been

rejected as not having received a sufficient education. The report of the examiners shows an improvement in the mean capacity of candidates. Many young men are admitted, without having to pass previous examinations, Bachelors of Arts, Sciences, or Letters, Pupils of Public Schools of Arts and Public Works and Mines, and Beaux Arts, and a few other institutions. The number of the volunteers of that class is about 4,000. Each volunteer has to pay besides a sum of 60*l.* to the Government. Education must be combined with money, in order to shorten the service in the remodelled French army.

THE study of "seaweeds" is probably affected as much by the general public as that of fish; and whether or not the great mass of people who visit the Brighton Aquarium and other similar resorts really go there with any idea of becoming more intimately acquainted with the wonders of the deep, there is no doubt that the exhibition of varieties of ocean plants would be as popular as that of fish. A seaweed growing in water is very different from seaweed cast up on the shore, and a careful selection and arrangement of specimens would greatly enhance the interest of the tanks, while at the same time their presence would prove beneficial to the fish. We recommend the hint to the notice of the authorities of the Brighton, Crystal Palace, and Southport Aquariums.

AN Industrial Exhibition is to be held at Leighton Buzzard for a short time about Whitsuntide 1875. The district to be represented is limited to a radius of twenty miles around Leighton Buzzard, and the proceeds of the exhibition will be devoted to the formation of a lecture fund for the purpose of securing courses of high class (largely scientific, we hope) public lectures in connection with the Working Men's Society, and the increase of the Society's library.

TO increase the general instructiveness of their Museum, the Leeds Philosophical and Literary Society have published Descriptive Guides to the different collections of which it is composed. That on the British Birds, by Mr. L. C. Miall, is before us, containing a short and instructive account of each species exhibited. This method of combining instruction with amusement is one which it would be well if other public institutions were to adopt, instead of leaving their collections, often valuable ones, for the idle gaze of the many uninitiated, and the careful study of the but too few special students of special branches of science and art.

IN many parts of the coasts of this country where fish are abundant, enormous quantities are used as manure: in Cornwall and on the Eastern coasts this is particularly the case, but no means are adopted to convert the fish into a manufactured manure, and they are thrown, as caught, on the land. The same remarks apply to America. But recently a system has been adopted in certain localities by which the fish are prepared specially for manuring the land. At Lucages, Long Island, a factory has recently been established for preparing the surplus quantities of "Menhaden" caught near there. The oil is first extracted from the fish, and the residue is prepared in a certain manner and converted into "fish guano," which has a good reputation as a fertiliser.

ARRANGEMENTS have been made for placing on board one of the steamers running between Liverpool and New York, one of the "American Aquarium Cars," a newly invented contrivance for transporting live fish, which has succeeded very well in long overland journeys, and by means of which it is hoped to effect a useful interchange of living fish of various kinds between this country and America. There are many American fish which might with benefit be introduced into England, and we at the same time might transport to the other side of the Atlantic some varieties of fish which are not found there.

THE exhibition of insects in the Orangery of the Tuileries Gardens, Paris, has been brought to a close. The distribution of prizes took place on October 5. The higher medals were taken by a Viennese *savant* for a magnificent atlas exhibiting all the organs and forms of *Phylloxera vastatrix;* but the Phylloxera question is left open, and no reasonable solution appears to have been presented. Lectures were delivered daily on entomology, and every one of them was illustrated by projections with the solar microscope. Almost every kind of insect was thus presented to the public. The exhibition proved wonderfully successful; more than 20,000 persons paid the entrance fee, and the number of free tickets issued amounted to 30,000 in the brief space of twelve days.

WE have received a lecture on "The Life and Works of Dr. Priestley," delivered in Paris at the time of the celebration of the Priestley Centenary by M. W. de Fonvielle. It is published by Auguste Ghio, and is dated 1875.

THE additions to the Zoological Society's Gardens during the past week include a Bengalese Leopard Cat (*Felis bengalensis*) and a Common Paradoxure (*Paradoxurus typus*) from India, presented by Capt. W. Reynolds; a Great Eagle Owl (*Bubo maximus*), European, presented by Lord Londesborough; an Indian Fruit Bat (*Pteropus medius*) from India, presented by Dr. Stafford; a Monteiro's Galago (*Galago monteiri*) from Angola; a Tooth-billed Pigeon (*Didunculus strigirostris*) from the Samoan Islands, deposited; two Geoffroy's Doves (*Peristera geoffroyi*) from the Island of Fernando de Noronha, and a Gentoo Penguin (*Pygosceles taeniatus*) from the Falkland Islands, new to the collection, purchased.

KENT'S CAVERN*

BEFORE entering on this, their tenth Report, the committee desire to express their deep sense of the great loss they have sustained in the decease of Prof. Phillips. No member was more regular in his attendance at the meetings of the Committee or felt a livelier interest in the investigation with which they are charged. On March 18, 1874—little more than a month before his lamented death—though suffering from a severe cold, he visited the cavern, when he carefully inspected those branches of it which had been explored, and expressed his admiration of the clearness and importance of the evidence bearing on the question of human antiquity which had been obtained.

The investigation has been pursued without intermission during the entire period which has elapsed since the meeting at Bradford in 1873; the mode of operation has been that described in previous Reports and followed from the commencement; the work has been performed in the most satisfactory manner by the same workmen; and the superintendents have continued their daily visits and carefully recorded the results from day to day.

The interest felt in the exploration by the inhabitants and visitors of Torquay has suffered no abatement, and the superintendents have conducted a large number of persons through the cavern, including the members of the South-western Branch of the British Medical Association during a meeting of that body held at Torquay, and also the members of the Birmingham Natural History and Microscopical Society whilst on a scientific excursion to South Devon.

During May 1874, an arrangement was made with the superintendents by Prof. A. Newton of Cambridge, for Mr. Slater, one of the naturalists of the Rodrigues Transit Expedition, to spend some time in the cavern, studying the mode of exploration followed there; it being probable that he might have to explore some very interesting caves which exist in the island. Mr. Slater reached Torquay on the 1st of June, when everything was done to facilitate his purpose, and he spent some days watching the men at work.

Live rats continue to present themselves in the cavern from time to time, and prove occasionally to be very troublesome. Thus, in October 1873, one carried off six candles during the afternoon from a spot selected because it was believed to be in-

* Tenth Report of the Committee for Exploring Kent's Cavern, Devonshire. (Abstract.)

accessible even to rats, and which had been used as the candle store during a period of three years without any previous loss of the kind; and in the same month another ate through one of the workmen's basket between the hours of nine and one, and carried off his dinner. A large number have been captured during the last twelve months.

During summer, bees have frequently been seen and heard in the innermost branches of the cavern, very far beyond any glimmering of day-light.

The branches of the cavern in which the researches have been carried on since the ninth Report was presented in 1873, are those known as the Long Arcade, Underhay's Gallery, the Cave of Inscriptions, and Clinnick's Gallery. The exploration of the former two has been completed, but the work is still in progress in the latter. The deposits have been, in descending order, like those reported last year: first, or uppermost, the Granular Stalagmitic Floor, from 12 to 30 inches in thickness; second, the Cave Earth, which has nowhere been more than two feet deep, but has rarely exceeded one foot, and has occasionally thinned out altogether; third, the Crystalline Stalagmitic Floor, usually exceeding the Granular Floor in thickness, but which had, in certain places, been partially broken up and removed by some natural agency before the deposition of the cave earth; and, fourth, or lowest known, the Breccia, consisting of materials not derivable from the cavern hill, and which appear to have been introduced through openings or mouths of the cavern at present choked up and unknown. The depth of this deposit has not been ascertained, as its bottom has nowhere been reached.

In the Long Arcade the surface of the upper or granular stalagmite was occupied with large natural "basins," some of them 12 inches deep, such as have been described in previous Reports. The following points of interest were noted respecting them during the progress of the work:—

1. The stalagmite forming their walls was harder and tougher than that surrounding them; whilst that composing their bottom was comparatively soft and friable.

2. The walls were traceable through the entire thickness of the Stalagmitic Floor; in other words, during the entire deposition of the floor, basins had existed in it, the bottom rising with the walls, but at a slower rate.

3. The water which filled them in rainy seasons passed down through the bottom in three or four hours at most.

4. Immediately beneath most of the basins there was an almost continuous interspace of about half an inch in height between the bottom of the stalagmite and the top of the cave earth; caused, no doubt, by the finer particles of the deposit being carried by the percolating water through interstices to a lower level.

It happened that the exploration of that part of the Arcade in which the basins were thus numerous was carried on during a wet season, when the water, passing through the Stalagmitic Floor, as just mentioned, caused two or three slips of the deposits beneath. In the largest of these a well-rolled flint nodule was found with some remains of animals. No such specimen had been previously seen within the cavern.

At the junction of the Long Arcade, the Cave of Inscriptions, and Clinnick's Gallery, there is a huge boss of stalagmite, in the form of the frustrum of an oblique cone, 43 feet in basal circumference, 14 feet along the slant side—which forms an angle of 40 degrees with the horizon, and thus gives a vertical height of fully 13 feet for the mass—and contains probably no less than 630 cubic feet of stalagmite. Its base consists of the older or crystalline stalagmite, and the upper portion, without any intervening cave earth, of the granular variety, which not only surrounded and completely encased the former, but, by flowing in copious sheets, formed the thick Granular Floor, spreading without a break and for great distances in every direction. Though inscriptions exist in various parts of the cavern, this mass is, with perhaps the exception of the almost inaccessible Crypt of Dates, more thickly scored with names, initials, and dates than any other equal area within the cavern; and hence it has acquired the name of the Inscribed Boss of Stalagmite. The inscriptions occupy its outer or most exposed semi-surface, where in certain places they form a network. Letters of all sizes, from some fully three inches in height to others as small as ordinary writing, cross each other and thus add to the difficulty of decipherment. Some of them were cut with great care and finish, and must have occupied a large amount of time, whilst others were but hasty scratches. It seems to have been somewhat fashionable to surround the inscriptions with rectangular parallelograms, varying from 6·5 to 3·75 inches in length, by 5·5 to 3·5 in breadth. In at least one or two cases the cutting of the parallelogram preceded that of the inscription, as the latter extends beyond the boundary. Not unfrequently several names occur together, whether within a parallelogram or not, and in each such case the entire work seems to have been performed by the same hand. At least four of them belong to the seventeenth century, and the earliest of the series, so far as at present known, is that of "Peter Lemaire, Rich. Colby, of London, 1615." Amongst the names is that of "Deluc," probably the well-known geologist, "Champernowne," that of a well-known old Devonshire family, and several prevalent in the immediate district.

In 1846 the Torquay Natural History Society appointed a committee of three of its members, including the two superintendents of the present exploration, to make some very limited researches in the cavern. One of the spots which that committee selected was in Clinnick's Gallery, immediately adjacent to the incribed boss, where they made a very small excavation. The materials dug up on that occasion were, as usual at that time, thrown on one side, where they remained until removed in May last when they were taken out of the cavern by the present committee. Before this was done, the surface of the mass was carefully examined to ascertain what thickness had been reached by the stalagmite which, as the superintendents well knew, had been accreting on it during the last twenty-eight years. The result was a small film not thicker than ordinary writing-paper, and limited to two examples, each covering not more than two or three square inches.

Underhay's Gallery was found, when the work of exploration was completed, to be about 20 feet long, from 2·5 to 7 feet wide, and from 6 to 7·5 feet in height, the latter measurement being taken from the bottom of the excavation. Before the committee commenced their operations there, its mouth was almost entirely closed with large masses of limestone. Notwithstanding this, the late Mr. Underhay, for several years guide to the cavern, forced himself into the gallery about fourteen years ago, even though after passing the entrance, he must have found the Granular Stalagmitic Floor within a foot of the roof in certain places. Here he found *on* and *sticking into* the stalagmite a few small bones which he succeeded in bringing out, when they were found to be phalanges of human feet. Though these specimens did not appear to be of an antiquity at all approaching that of the cave-hyæna and his contemporaries, the superintendents, who were familiar with them, very carefully watched the progress of the work, in the hope of finding some further traces of the skeleton; and on reaching Mr. Underhay's very limited diggings they met with a series of bones, all *on* and *in* the stalagmite, some of which were certainly human, whilst others were as clearly not so. The whole were at once sent to Mr. George Busk, a member of the committee, who has been so good as to forward a report on them to the effect that twenty-eight of the specimens are human, and include an astragalus, a navicular bone, a trapezium, a patella, a metatarsal, an ecto-cuneiforme, phalanges of fingers and toes, and fragments of humeri, ribs, and vertebræ; that they appear to be the remains of an adult individual of small size and delicate make, and probably of a female, on which point, however, it is impossible to speak positively; that the bones are not necessarily of any very remote antiquity; that the remaining specimens are not human, but belong to small sheep or goat, probably the former, which must have been of the smallest Welsh type.

When the very contracted character of this gallery, prior to its excavation by the committee, is borne in mind, it is difficult to understand how the remains were introduced. There were neither potsherds nor charcoal, nor, in short, anything suggesting that the bones were the remnants of a body disposed of by cremation, such as were met with in another branch of the cavern in 1872; nor were there any marks of teeth on the bones such as might have been expected had they been taken thither by a carnivorous animal, or the relics of a skeleton buried or secreted there, of which all other portions had been carried off by some carnivore.

The only noteworthy objects met with in the Granular Stalagmitic Floor during the year were a tooth of bear, fragments of bone, one considerable "find" of coprolites, and charred wood on two occasions, all of which occurred in the Long Arcade.

The Cave Earth has yielded during the period under notice 187 teeth of various kinds of mammals, of which 94 occurred in Underhay's Gallery, 63 in the Long Arcade, 20 in the Cave of Inscriptions, and 10 in Clinnick's Gallery; 102 belonged to hyæna, 36 to bear, 27 to horse, 8 to elephant, 8 to fox, 4 to rhinoceros, 1 to lion, and 1 probably to wolf. There were also

numerous bones and fragments of bone, of which some were gnawed, and a few appear to have been burnt. Coprolites were very abundant, 69 distinct "finds" having been met with during the twelvemonth. They sometimes, though rarely, consisted of a solitary ball, whilst at others upwards of 20 were lying together and not unfrequently cemented into large lumps. Occasionally the amount of matter of this kind found in a single day was sufficient to fill a large basket.

Fifteen specimens of flint and chert were also met with in the cave earth, 6 of them occurring in the Cave of Inscriptions, 5 in Underhay's Gallery, 2 in the Long Arcade, and 2 in Clinnick's Gallery. The finest of the series is No. 6324, found December 30, 1873, in the second foot-level, beneath the floor of granular stalagmite from 2 to 2·5 feet thick. It is a very symmetrical tongue-shaped tool, fashioned with much labour out of a chert nodule, and worked to an edge all round the perimeter except at the butt end, where portions of the original surface remain on both faces. It is 3·8 inches long, 2·3 inches in greatest breadth, 1·5 in greatest thickness, and convex on both faces, from each of which several flakes have been struck. Though fashioned out of a nodule, which is very rarely the case amongst the cave-earth implements, its symmetrical form and comparatively high finish are highly characteristic of the era to which it belongs.

No object of interest of any kind has been found in the Crystalline Stalagmitic Floor during the year; but the Breccia lying beneath it has been by no means unproductive. In this oldest of the cavern deposits the remains have been, as heretofore, exclusively those of bear, so far at least as is at present known, and in addition to a large number of bones, including a considerable portion of a skull, 441 teeth have been met with in it, of which 149 were in the Long Arcade, 115 in Underhay's Gallery, 91 in the Cave of Inscriptions, and 86 in Clinnick's Gallery.

Twentys-six pecimens of flint and chert have also been found in this deposit, of which 10 occurred in the Long Arcade, 6 in Clinnick's Gallery, 5 in Underhay's Gallery, and 5 in the Cave of Inscriptions.

The finest of the series (No. $\frac{1}{611}$) and indeed one of the finest the cavern has yielded from the commencement, was found April 23, 1874, in the fourth or lowest foot-level, with 1 tooth of bear, fragments of bone, and a small chert flake (No. $\frac{2}{611}$) which had probably been rolled. It measures 4·5 inches in length, 3 inches in greatest breadth, 1·1 inch in greatest thickness, is very convex on one face, slightly so on the other, retains a portion of the original surface near the butt end, and is rudely quadrilateral in form, with the angles rounded off. Several flakes have been struck off each face, and the edge to which it has been reduced along its entire margin, except at the butt end, is by no means sharp; its surface is almost completely covered with an almost black, probably manganesic smut, whilst a slight chip near the pointed end shows it to consist of a very light-coloured granular chert. Several lines betokening planes, probably of structural weakness or perhaps of fracture, entirely surround it. If it has really been fractured, it must have occurred where the tool was found, and the parts have been naturally reunited without being faulted. Its character as well as its position shows that this fine implement belonged to the era of the Breccia.

This specimen is of considerable interest, both on account of the lines which cross its surface and of the position it occupied.

Amongst the flint implements found in Brixham Cavern that known as No. 6—8 has attracted considerable attention, and has been described and figured by Mr. John Evans, both in his "Ancient Stone Implements" and in the "Report on the Exploration of Brixham Cave." It was found in two pieces, the first on the 12th of August, 1858, the second, 40 feet from it, on the 9th of the following September; and it was not until some time after the latter date that the late Dr. Falconer discovered that the two fragments fitted each other, and when united formed a massive spear-shaped implement. The lines on the Kent's Cavern specimen just described show that it had either been fractured where it was found, or, what seems more probable, that it is traversed by planes of structural weakness, such that a slight blow would break it into two or more pieces, which a stream of water would easily remove and probably separate, and thus produce a repetition of the Brixham case.

The Kent's Cavern tool was found in a small recess in the wall, just within the outer or wider entrance of Clinnick's Gallery, within a very few feet of the Inscribed Boss of Stalagmite, and, as has already been stated, in the fourth foot-level of the Breccia; that is, at the greatest depth in the oldest of the cavern deposits to which the present exploration has been carried, and is thus wonderfully calculated to take the mind step by step back into antiquity.

First, very near the spot occupied by the specimen, there rises a vast cone of stalagmite, which an inscription on its surface shows has undergone no appreciable augmentation of volume during the last two-and-a-half centuries.

Second, prior to that was the period spent in raising the greater portion of this cone, which measures upwards of 40 feet in basal girth, reaches a height of fully 13 feet, and contains more than 600 cubic feet of stalagmitic matter.

Third, still earlier was the era during which the cave earth was introduced, in a series of successive small instalments with protracted periods of intermittence, when the cavern was alternately the home of man and of the cave hyæna, and the latter dragged thither piecemeal so many portions of extinct mammals as to convert the cave into a crowded palæontological museum.

Fourth, further back still, was the period during which the base or nucleus of the cone or boss was laid down in the form of crystalline stalagmite.

Fifth, and earliest of all, was the time when materials not derivable from the immediate district were carried into the cavern, through openings now probably choked up, entirely unknown, and the direction in which they lie but roughly guessed at, when apparently the cavern-haunting hyæna had not yet arrived in Britain. At an early stage in this earliest era man occupied Devonshire; for prior to the introduction of the uppermost four feet of breccia, one of his massive unpolished tools, rudely chipped out of a nodule of chert, found its way into a recess in the cavern, and having a character such as to show that it must have lain undisturbed in the same spot until it was detected by a committee of the British Association.

SCIENTIFIC SERIALS

THE *Journal of the Chemical Society* for September contains the following papers communicated to the Society:—On the products of the decomposition of castor oil, No. 3. On the decomposition by excess of alkaline hydrate, by E. Neison. The action of sodium hydrate mixed with water gives rise to the formation of a mixture of an alcohol and a ketone on distillation. The alcohol is an octylic alcohol, which the author regards as the secondary alcohol methyl-hexyl carbinol $H\begin{cases} C_6H_{13} \\ CH_3 \\ H \\ OH \end{cases}$ The ketone is methyl-hexyl ketone. The olefine derived from the alcohol has been examined. The supposed heptylic alcohols of Städeler and Petersen turn out to be a mixture of octylic alcohol with methyl-hexyl ketone.—On the action of nitrosyl-chloride on organic bodies, Part I. On phenol, by Dr. W. A. Tilden. The phenol is oxidised to quinone, which substance is then converted into chloramil, the nitrosyl-chloride being completely reduced—a certain amount to ammonium chloride.—Aniline and its homologues, &c., in coal-tar oils, by Watson Smith.—On the action of chlorine, bromine, &c., upon isodinaphthyl, by Watson Smith and James M. Poynting. The action of chlorine gives rise to the formation of a tetrachlorinated derivative, $C_{20}H_{10}Cl_4$. Bromine replaces seven atoms of hydrogen, giving rise to the compound $C_{20}H_7Br_7$. With concentrated sulphuric acid a conjugate acid is formed, of which the barium and sodium salts have been examined. Both the chlorinated and brominated derivatives are amorphous powders.—On hydrogen persulphide, by William Ramsay. The persulphide was prepared by first saturating alcohol with ammonia gas, and then passing sulphuretted hydrogen through the solution. The ammonium sulphide thus produced was shaken up with sulphur and a solution of strychnine in alcohol added. White crystals having the formula $C_{21}H_{22}N_2O_2H_2S_3$ separate out on standing. These crystals treated with sulphuric acid yield hydrogen persulphide in the form of oily globules, but the yield is small, and the separation from the sulphuric acid extremely difficult. The author finally adopts the old method of pouring calcium persulphide into hydrochloric acid. Analyses of the compound thus obtained gave results indicating a formula between H_2S_7 and H_2S_{10}. The properties of the persulphide have been examined in some detail.—The journal contains its usual valuable collection of abstracts.

Geological Magazine, Oct. 1874.—The original articles contained in this number are (1) a continuation of Mr. Lechmere Gupp's article on West Indian Tertiary Fossils; (2) Notes on

the impression of *Palæontina oolitica* in the Jermyn Street Museum, by A. G. Butler, including a discussion on its zoological place; (3) The structure of Lambay Porphyry, by Prof. Hull, a paper read before the Geological Society of Ireland; (4) Geology of West Galway and South-west Mayo, by S. H. Kinahan, an epitome of a communication made to the British Association; (5) Note on the Phonolite of the Wolf-rock, by S. Allport.

Zeitschrift der Österreichischen Gesellschaft für Meteorologie, Sept. 15.—This number contains a description of the self-acting printing barometer, invented some years ago by Mr. Hough, director of the Observatory at Albany, U.S., but not very well known in Europe. By the employment of electricity, the barometer will record movements as slight as ·0005 in., and will print not only curves, but a register as well, at any required intervals per hour. The apparatus does not require frequent attention.—Among the *Kleinere Mittheilungen*, we have a notice of M. Goulier's aneroid, provided with a scale of heights beside the scale of millimetres. It is contended against this arrangement that two scales make a correct reading less easy, that the precision of the scale of heights, where the intervals between the lines are not equal, must be doubtful, and that the correction proper to each aneroid would not be easily applied to the scale of heights.—M. Mühry has an article On differences of temperature as a cause of latitudinal oceanic circulation. He maintains that two causes are at work, each of which tends to produce latitudinal circulation, namely, the diminution of the force of gravity towards the equator, and the increase of temperature with consequent expansion and diminished specific gravity. The lower strata of cold water rise at the equator towards the surface, and a corresponding descent of warm upper strata must take place in polar regions. With regard to the debated question on the point of greatest density of sea-water, he holds it to be the same as that of fresh water, and late experiments bear out his argument on this subject.

Bulletins de la Société d'Anthropologie de Paris, fascicule vi. tome 8, 1874.—In the closing number of the Society's last year's Reports, the remains found at Solutré, near Macon (in August 1873), formed a large proportion of the subjects of the papers. The assumed find at Solutré of a metallic ring, enamelled green, on one of the phalanges of the skeleton which had been uncovered in the presence of MM. de Quatrefages, Broca, and nearly fifty other persons, has been rejected by the Society as unworthy the consideration of scientific men; while M. Broca, in a detailed report of the investigation in which he on that occasion took the principal share, has clearly shown the impossibility of such a ring escaping his notice had it been present. M. Broca in another paper considers at length the characteristics of the various crania which have been found at Solutré since the spot was first examined by MM. de Ferry, Arelin, de Freminville, Lortet, and others, and described by the two first-named in their work "Le Mâconnais Préhistorique" (1870): and he draws attention to the various prehistoric and historic epochs at which interments have been made at Solutré, and by which the question of the true age of these remains has been surrounded with greater difficulties than belong to the palæontological character of any other similar spot in France. The prehistoric crania at Solutré are in a very bad condition; but they present a large capacity of nearly 1,600 cubic centimetres, with an index of only 82·87. Platycnemic tibiæ, with the characteristic columnar femures, were found, but M. Broca seems on the whole to assume that the earliest discovered men of Solutré belonged to a mixed race similar to those of the Belgian caves of La Lesse. M. Hamy has demonstrated that brachicephalic crania supervene at Solutré on the dolichocephalic, as at Cro-Magnon.—M. Topinard read a paper on the systems of craniometry, in which he endeavoured to show by the contradictory cranial determinations arrived at in reference to the Solutré and other recent finds, how important it is to show a definite method of cranial measurement. In the discussion which followed, M. Rochet opposed the notion that craniometry in art is based upon individual fancy more than scientific accuracy; while M. Broca admitted the defects of the present methods.—A note by M. P. Bert, on the twin monster known as the double-headed nightingale, led to a general discussion on double or twin monsters, and to the inquiry whether they were produced from two distinct embryos or from one germ endowed *ab initio* with the property of doubling or reproducing certain parts. It was generally admitted that external circumstances have no power to induce embryonic duality.—Madame C. Royer, in a very original paper on the origin of different human races, protested against the hypothesis which derives all European races from Asia, and endeavoured to show by the geological history of the earth that man must have appeared first on the great Austral continent, and radiated thence to the other continents. Her novel views were received with marked attention, and it was felt that if she should be able to adduce sound geological proof of her statements, her hypothesis of primary human migrations will be as important as it is original. Till she fulfils her promise of clearly expounding her theory, her arguments cannot, however, be accepted as more than ingenious speculations.

Revue d'Anthropologie, tome iii. No. 3.—M. Paul Broca supplies us in this number of the review, of which he is sole editor, with a comprehensive history of the course of observations which have led to the enunciation of the theory propounded by him (in the *Bulletins de la Soc. d'Anthrop. de Paris* for January and February 1874) in regard to the hygrometric properties of fossil crania. After considering the important but inadequately appreciated experiments made in 1859 by M. Welcker in reference to this point, he enters at great length into the consideration of the numerous carefully conducted series of observations and measurements by which he was led to the conclusions which he has adopted, and his paper constitutes, therefore, a most valuable *résumé* of the physical as well as the palæontological bearings of the subject.—M. Bérenger-Feraud, surgeon in the French navy, gives, as the result of personal investigation, an account of the different tribes who occupy the shores of the Casamanca in Inter-tropical Africa. This stream, on which the Portuguese and French have a few scattered trading stations, is one of the numerous rivers of Western Africa which take their source on the western slope of the Fonta-Djalon mountain-ranges. The author considers the Casamanca peoples under the three heads of primary or autochthonic, invading, and immigrating races; the first including the Feloups and Bagnouns, the second the Belantes, Mandingues, and Peuls, and the last the Onolofs, Saracolais, Machouins, Taumas, &c.; and passing each in review, he describes their habits, the form of fetichism followed by each, and their general social condition. Among the Balantes he notes the singular custom of making the duration of marriage responsibilities dependent on the conservation of the "pagua" or festive garment given to the wife by the husband on the occasion of their wedding. The woman who wishes to secure a divorce has merely to wear out her pagua as fast as she can, and then present it in a tattered condition to her family, on which she obtains her release from the power of her husband. Among the same people a charge of sorcery, which is very common with them, can only be met by a public appeal to the ordeal of the "mançone" or "ago broumedion," which is said to be a decoction from the bark of a poisonous tree, and which it would appear is always fatal unless rich gifts have secured the copious watering of the draught by those to whom its preparation is confided.—MM. Daleau and Gassies give a report of the appearances presented by a cavern at Jolias, in the canton of Bourg (Gironde), which, on its recent exploration, yielded in a stratum of red diluvium below a solid calcareous bed, a rich deposit of bones, many of which had been cleft, but none of which belonged to extinct species, numerous flint implements similar to those found at Moustier and Solutré, but no remains of pottery, except in the upper part of the cavern, where they had probably been thrown aside long after the disuse of the cavern.

Zeitschrift für Ethnologie, heft vi. 1873.—The first article in this number gives some interesting details in regard to the almost unknown Red Indian tribe of the Tulus of Panama, believed to be the descendants of the Churchures, who successfully resisted the attempts made by the Spanish Conquistadores for their subjection. Representatives of these people appeared last year at Bogota with the object of making complaints against the collectors of caoutchouc, cacao, and elephant nuts, who had come to their woods and been guilty of violence against the tribe, and it was from his examination of these men that the author drew up his report.—In a suggestive article by Prof. Bastian on the nature of ethnology and its relations to geography, the author points out how essential the knowledge of physical laws is to the right comprehension of ethnology, which is in itself less a zoological history of man than a history of the geographical distribution of man considered in relation to physical habits, which, like the physical characteristics of different fauna and floras, depend primarily upon geographical position, and secondarily on climatic, geognostic, and other analogous conditions.—Herr Virchow laid before the society several skulls of the Goldi, a hitherto almost unknown tribe, who occupy the shores of the Amoor at the point where

the Sangari and the Ussuri join the main stream. He is of opinion that these people are more nearly allied to the Tunguses than to the Esquimaux, the crania in his possession being remarkable for their high brachicephalic form and large cranial capacity.—In a letter from Dr. Bleek, addressed to the society, the writer draws attention to the peculiarity evinced by the Bushmen of becoming fairer and lighter in skin after they have for a time enjoyed good and abundant food, with the comforts of civilised life. This special characteristic he regards as a proof of the difference between these peoples and the negro races of South Africa, and as an evidence of their nearer affinity with more northern tribes. Dr. Bleek at the same time expresses his opinion that the dances by moonlight, which are systematically practised by the South African tribes, are connected with some form of moon-worship; while Dr. Fritsch, on the other hand, believes that these dances are in no way religious, and are simply called forth by the charm of tropical moonlit nights.—Herr Virchow exhibited some stone implements or wedges precisely similar to the so-called flint knives, which we are accustomed to assign to the Stone Age; yet these were of modern fabrication, being made in the present day in Syria, where they are used, amongst other purposes, to keep the different parts of the Syrian threshing machine (*tribulum*) in their places.

Astronomische Nachrichten, No. 2,007, contains the observations of position and magnitude of 148 comparison stars and 13 minor planets, made with the meridian circle at Berlin.—No. 2,008 contains the positions of 108 more stars, reduced to the mean equinox of 1870, and the positions of 20 planets, made by the same instrument. With the Berlin refractor the positions of some 58 planets have been determined, and some of them have been observed on a number of nights.—In No. 2,009 L. Schulhof gives an ephemeris and the following elements of Comet III. 1874, discovered by Coggia on the 19th of August:—

$$T = \text{July } 5{\cdot}16629 \text{ Berlin time.}$$
$$\pi = 347^\circ\ 20'\ 2''$$
$$\Omega = 213^\circ\ 12'\ 15''$$
$$i = 28^\circ\ 25'\ 41''$$
$$\log. q = 0{\cdot}15831$$

M. Geelmuyden gives elements of Coggia's first comet of 1874, and assigns a period of 10,445 years.—D'Arrest contributes a number of spectroscopic observations of Secchi's types III. and IV.—Ormond Stone gives a note on certain expressions of the distance of a comet from the earth, and a paper on Brünnow's method of correcting the orbit of a comet.—Dr. Holetschek gives an ephemeris of Borrelly's comet, the two last positions of which are—

	R.A.	DEC.
Oct. 29 ...	6h. 21m. 9s.	+ 50° 37' 6
Nov. 2 ...	6h. 5m. 11s.	+ 47° 36' 7

and an ephemeris of Coggia's comet of the 19th of August—

Oct. 29 ...	5h. 0m. 41·8s.	− 0 12' 55"
Nov. 2 ...	4h. 48m. 46·4s.	− 1° 49' 50"

Memoria della Società degli Spettroscopisti Italiani, August.—Father Secchi contributes a paper discussing the theory of solar spots set forth by Galileo, and he compares the theories and observations of Wilson, Kirchhoff, Faye, and Gautier. Tacchini adds a note discussing M. Faye's theory of the formation of solar spots, and opposing it on the ground that spots and faculæ seem to accompany eruptions. Tacchini also gives notes on the positions of the chromosphere where magnesium vapour was observed in January last, and he also mentions the position of prominences accompanying spots at the limb, and containing metallic vapours. The magnesium line and 1474 occur most frequently.—Notes and measurements of the comet (Coggia) made by E. Dembwoski with a 7-inch Merz, together with drawings of the nucleus, appear in this number.—Schiaparelli contributes a note on the new star observed in Sagittarius in 1690. He thinks it the same as the variable star S Sagittarius, R.A. 287 40', Dec. 19° 18'. Tacchini gives a table with notes showing the number of meteors, with their brightness, observed in each fifteen minutes from 10h. 30m. to 15h. 15m. on the 9th, 10th, and 11th of August last. The radiant point

			R.A.	DEC.
On the 9th,	of 35,	was	2h. 5m. ...	54° 56
,, ,,	of 8,	,,	2h. 14m. ...	55 45
,, 10th,	of 71,	,,	2h. 5.5m. ...	54 40
,, ,,	of 11,	,,	2h. 14m. ...	56 14
,, 11th,	of 14,	,,	2h. 5.5m. ...	54 45
,, ,,	of 10,	,,	2h. 14m. ...	56 20

SOCIETIES AND ACADEMIES

MANCHESTER

Literary and Philosophical Society, Oct. 6.—Rev. William Gaskell, M.A., vice-president, in the chair.—On the ossiferous deposit at Windy Knoll, near Castleton, by Mr. Rooke Pennington, LL.B.—On some teeth from a fissure in Waterhouses Quarry, in Staffordshire. Mr. Pennington called attention to some teeth of a bison (*Bos priscus*) from a fissure in a quarry at Waterhouses. The animal had evidently fallen in while coming to drink at the river Hamps. It had been erroneously described as an Irish elk.—On the extent and action of the heating surface for steam boilers, by Prof. Osborne Reynolds, M.A.—Dr. Joule made a further communication respecting his mercurial air pump described in the Proceedings for Dec. 24, 1872, and Feb. 4, Feb. 18, and Dec. 30, 1873. He had successfully made use of the glass plug proposed in the Proceedings for Feb. 4, 1873. This he constructs by blowing out the entrance tube and grinding the bulb thus formed into the neck of the thistle-shaped glass vessel. To collect the pumped gases he now employs an inverted glass vessel attached to the entrance tube and dipping into the mercury in the upper part of the thistle glass.

WINCHESTER

The Winchester and Hampshire Scientific and Literary Society held the first meeting of its sixth session on Oct. 19; Dr. Heale, treasurer, in the chair.—The Rev. F. Howlett, F.R.A.S., delivered an introductory address, noticing many of the more important discoveries made during the past year in various departments of scientific research.

BOOKS AND PAMPHLETS RECEIVED

BRITISH.—Report of the Weather Telegraphy (E. Stanford).—Annual Report Aëronautical Society of Great Britain (Hamilton and Co.).—Journal of the Iron and Steel Institute, 1874 (Spon).—Note on the Perception of Musical Sounds: J. G. McKendrick, M.D. (Neill and Co.).—Flora Cravoniensis: John Windsor, F.R.C.S., F.L.S., &c. (Cave and Co.).—The Contrast between Crystallisation and Life: John E. Howard, F.R.S., F.L.S., &c. (Hardwicke).—Atomism: Dr. Tyndall's Theory Examined and Refuted: Rev. Prof. Watts, D.D. (Mullan, Belfast).—Brixham Cavern: N. Whitely, C.E. (Hardwicke).—Philosophy, Science, and Revelation: Rev. C. B. Gibson, M.R.I.A., &c. (Longmans).

AMERICAN.—Nomenclature of Diseases: J. M. Woodworth, M.D. (Washington).—Proceedings of the American Association for the Advancement of Science.—Notes on Ophidiidæ, &c.: F. W. Putnam.

FOREIGN.—L'Astronomie Pratique: C. André and G. Rayet (Gauthier-Villars, Paris).—Einige Bemerkungen über den Werth, welcher im Allgemeinen den Angaben in Betreff der Herkunft menschlicher Schädel aus dem ostindischen Archipel beizumessen ist: Dr. Meyer (Wien).—Uber neue und ungenügend Vögel von New Guinea und den Inseln der Gelvincks Bai: Dr. Meyer.—Manuel de la Cosmographie der Moyen Age: A. F. Mehren (Copenhagen).—Neues Handwörterbuch der Chemie: Dr. H. von Fehling (Viewig and Son).—Die Geologie: Franz Ritter von Hauer (A. Holder, Wien).—Normale Zeiten für den Zug der Vögel: K. Fritsch (Wien).—Fosselen Bryozoen: Prof. Dr. A. E. Roon Reuss (Wien).—I precursori di Copernico nell' antichita: G. V. Schiaparelli (W. Hoepli).—Osservazioni Astronomische e Fisiche: G. V. Schiaparelli (W. Hoepli).

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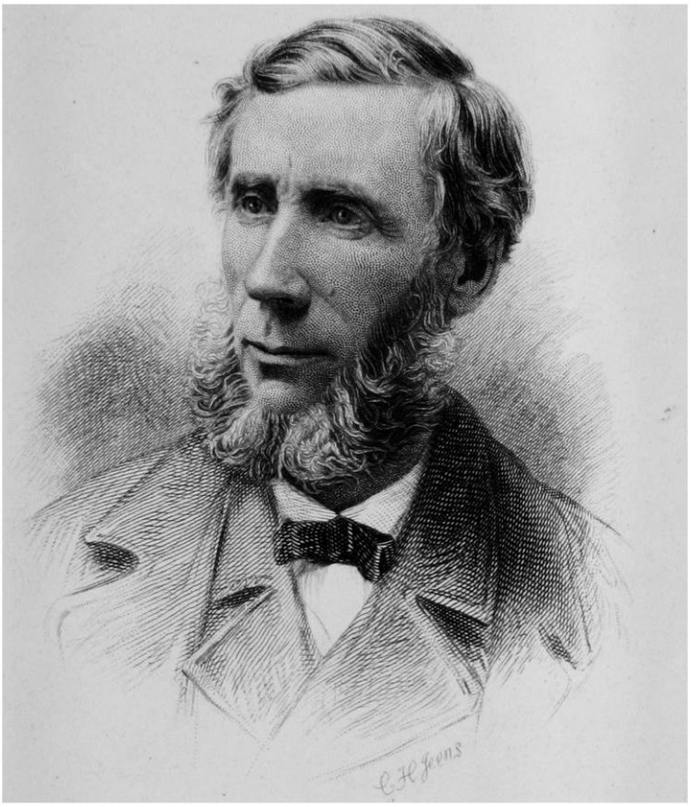

John Tyndall.

Engraved by C.H. Jeens from a Photograph.

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