THURSDAY, AUGUST 14, 1879

THE DISSOCIATION OF CHLORINE

DURING the past few years the well-known chemist, Prof. V. Meyer of Zurich, has rendered signal service to his brother workers by the introduction of numerous improvements in methods of determining vapour densities. At about the close of last year, in conjunction with Herr C. Meyer, he described a simpler method than any hitherto introduced, available for high temperatures, and yielding results of very considerable accuracy.

This method consisted in heating a vessel to a temperature at which the substance whose vapour density was to be determined was completely converted into gas, then introducing a small weighed quantity of the substance in question, and subsequently measuring, at the ordinary atmospheric temperature and pressure, the air displaced from the vessel by the vapour of the substance. In this manner, the volume of vapour, measured at the atmospheric temperature and pressure, generated by a known weight of substance is ascertained, and the density deduced from these data by a simple calculation. The great advantage of the method is that it does not require a knowledge of the temperature of the vapour, and the entire series of operations may be performed in a very short space of time.

The apparatus employed is also extremely simple, and consists of a cylindrical bulb of about 100 c.c. capacity, sealed to which is a glass tube about 6 mm. in diameter and 600 mm. long; this tube is widened out at the open end, so as to admit of the introduction of a caoutchouc stopper, and has a side tube, 1 mm. in diameter and 140 mm. long, sealed on to it about 100 mm. below the open end. The side tube is once bent nearly at right angles and the end slightly turned up, so that, when dipped into water, it will deliver gas into a graduated glass vessel inverted over it. For determinations at high temperatures the bulb is constructed of porcelain and is heated in a gas furnace; when operating at lower temperatures the bulb is heated either by means of a vapour bath or in a bath of molten lead. The operation consists in heating the bulb until it acquires a constant temperature, which is indicated by the non-appearance of air-bubbles at the orifice of the side tube which is plunged under water; the stopper is then removed, the weighed quantity of substance introduced and allowed to fall into the bulb, the stopper quickly reinserted, and the end of the side tube then brought under the measuring vessel; directly air ceases to issue from the extremity of the tube, the stopper is removed, and the air thus collected is afterwards measured in the usual manner. In the case of substances which undergo oxidation when heated in air, the air is first displaced from the apparatus by a current of pure nitrogen.

Operating in this manner, the Messrs. Meyer have determined the vapour density of a variety of inorganic compounds, such as indium chloride, stannous chloride, cuprous chloride, zinc chloride, ferric chloride, phosphorus pentasulphide, and arsenious anhydride, and have obtained results showing the molecular formulæ of these substances to be as follows:—

$InCl_3$, Sn_2Cl_4, Cu_2Cl_2, $ZnCl_2$, Fe_2Cl_6, P_2S_5, As_4O_6.

They then directed their attention to elementary bodies, and in a recent communication to the Berlin Chemical Society, they describe the results of experiments, showing that at a temperature as high as about 1,567° C. the molecular composition of mercury, oxygen, nitrogen, and sulphur is correctly represented by the formulæ—

$$Hg,\ O_2,\ N_2,\ S_2,$$

which are those generally adopted.

But with chlorine they obtained very different results. They employed platinous chloride as the source of this body, as it can be obtained perfectly dry and readily splits up into chlorine and platinum when moderately heated; a known weight of the chloride was introduced into the bulb in each experiment, the air having been previously expelled by a current of nitrogen. The numbers obtained in a first experiment at about 620° C. agreed with those required on the assumption that the chlorine molecule has the formula Cl_2, which is that generally accepted; but on determining the density at about 800° C. a lower number was obtained, and a still lower density resulted from experiments at about 1,028° C. and 1,242° C., but no further change of density was observed on making determinations at temperatures of about 1,392° C. and 1,567° C. The density (referred to air) observed at the various temperatures was as follows:—

Approximate temp.	Density.	
620°	2·42	2·46
808°	2·21	2·19
1028°	1·85	1·89
1242°	1·65	1·66
1392°	1·66	1·67
1567°	1·60	1·62

The density at about 1,200° and above, it will be observed, is two-thirds of the density at 600°; the change in volume undergone by chlorine when heated is therefore precisely similar to that undergone by oxygen in its passage from the condition of ozone to its ordinary condition, and it might therefore be supposed that a similar change had taken place. The researches of Sir B. Brodie have placed it beyond doubt that if we regard ordinary oxygen as having a diatomic molecule represented by the formula O_2, ozone has a triatomic molecule of the formula O_3, the conversion from ozone into oxygen being represented by the equation—

$$2O_3 = 3O_2.$$

Inasmuch, however, as chlorine has the atomic weight 35·4, such an explanation of the change in density of this gas is inadmissible; it would only be possible if what we at present regard as the atom of chlorine is a compound of 3 sub-atoms each of the weight $\frac{35{\cdot}4}{3}$. The only other explanation, however, which can be given is that chlorine after all is not an element but a compound of at least two elements which are dissociated by heat. Mr. Watson Smith in a letter from Zurich, printed in the *Chemical News* of last week, states that the Messrs. Meyer incline to this latter explanation, and that in all probability *oxygen is one of the components of chlorine*; we hear also from another source that they have actually separated oxygen from it, but hitherto no description of this part of the investigation has reached us.

It needs not to be pointed out that such a discovery as is here foreshadowed is of the highest importance. There can hardly be a doubt that if chlorine be found to give way

so easily, other so-called elements, and especially those which, like bromine and iodine, are closely related to chlorine, will not long resist the attacks to which they will now be subjected; indeed, the Messrs. Mayer already state in their paper that the behaviour of iodine is similar to that of chlorine.

In concluding this notice I cannot refrain from stating that to my knowledge Mr. Lockyer has for several months past been engaged in the spectroscopic investigation of the non-metals, and that he has repeatedly assured me that the views he has already published with regard to the metals are equally applicable to the non-metals. He has shown me, moreover, that with the spark at a particular tension the *red line of oxygen* is one of the most prominent lines in the spectrum of chlorine, the freedom from which of admixed air and moisture is attested by the absence of the characteristic nitrogen and hydrogen lines. Mr. Lockyer regards this as confirmatory of the Meyers' discovery. HENRY E. ARMSTRONG

SCIENCE IN THE ARGENTINE REPUBLIC

Description physique de la République Argentine; d'après des Observations personelles et étrangères. Par le Dr. H. Burmeister, Directeur du Museo Público de Buénos-Ayres. Tome Cinquième: Lépidoptères, 1re Partie, contenant les Diurnes, Crépusculaires et Bombycoides. (Buénos-Ayres, Paris, et Halle, 1878, 8vo.; Atlas de xxiv.[1] Planches, 1879, 4to.)

IN commencing a notice of this work it is impossible to avoid an expression of admiration for the persistent energy displayed by its septuagenarian author. Half a century has elapsed since his "inaugural dissertation" (on an entomological subject) was read at Halle, and during this time a continuous flow of valuable works and articles has appeared from his pen, not only in the long period of his professorship at Halle but also since he became permanently located in Buenos Ayres. Now, at an age when most men who have attained it have lapsed into "the sere and yellow leaf," so far as laborious work is concerned, we find him undertaking a gigantic enterprise, of which entomology is only a portion. All those who have had occasion to consult his former works will heartily acquiesce in the hope that he may live to complete this.

Without doubt the most valuable features of the volume under consideration consist in the numerous direct observations by the author and his son, on the structure and life-histories of the insects treated upon, from living subjects, in contradistinction to what may be termed mere museum work. In one respect disappointment will be felt. It might have been expected that an author of such vast experience, and with such admirable opportunities, would have been explicit in expression of opinion on those important subjects of philosophical inquiry that now occupy the attention of all entomologists, and for which South America furnishes such notable materials.

On the question of mimicry he appears to be absolutely silent, contenting himself by occasional remarks on the fact of resemblances, but without comment. On the theory of evolution he is scarcely more explicit, and the only remarks that bear, even indirectly, on this subject are those that appear in the "Avertissement" to the description of the plates, where he says:—

"I am unable to share the views of those specialists who augment the number of species indefinitely by slight variations; on the contrary, I am a partisan of the opinion, well founded on experience, that each species, although from a scientific point of view fixed and up to a certain point invariable, is forced to modify itself under different external influences of climate and food, and that these influences may, to a certain extent, alter some of the subordinate specific qualities. This faculty will be greater in proportion as the territory over which the species is spread may be more vast, and one will only find altogether invariable, those local species that have never quitted their place of origin. From this restricted point of view I am a partisan of the theory of the variability of species."

From this it will naturally be understood that our author is no advocate for the reckless creation of "species" now so alarmingly put in practice, to apparently little other purpose than the gratification of the vanity of those species-makers who wish to see their names attached to an endless list of synonyms. That the author is right in his reductions in the case of those species inhabiting the region immediately under his observation, possibly few only will dispute, and, above all, not those who know the exactitude of his critical powers in this respect; but other reductions concerning forms from the more northern parts of the South American Continent may be open to question, unless on the standpoint taken as to the value of the term "species."

The existence in the southern portion of the vast continent of South America of certain genera belonging to the nearctic fauna, has not escaped the author's notice. He alludes to the subject more than once, even in connection with the purely Argentine fauna, but without further comment.

The introductory anatomical portion is, as might have been expected, of the utmost value, and may be studied with advantage by students of Lepidoptera generally. Exception might probably be taken to too great importance being attached to the covering of scales as an attribute of the order. Instances (p. 1) might have been cited of the existence of "scales" in other orders, such as the well-known *Podura* and *Thysanura*, many *Curculionidæ*, some *Trichoptera*, certain forms of *Psocidæ*, &c., if not on the trunk itself, at any rate on the wings and other appendages.[1] An entire chapter is devoted to the structure of the scales, and the conclusion arrived at is that the well-known longitudinal striations exist only on the *upper* surface; if the writer mistake not, microscopists have arrived at the same conclusion from an examination of that favourite "test-object," the "*Podura*-scale."

As in all his works, the author shows himself a rigid advocate for "purity of nomenclature," and does not hesitate to adopt the spelling he considers the more correct. On the question of priority we read (p. 110): "The strict observance of priority of nomenclature appears to me an exaggeration of scientific law; I prefer names given by masters, such as Linné, Fabricius, Latreille, &c., to those of simply collectors, as Cramer, Drury Donovan, &c., following the axiom *au mérite la couronne*." Regarding these words from a sentimental point of view,

[1] Of these only sixteen have as yet appeared.

[1] The neuropterous genus, *Coniopteryx*, cited by the author (p. 1, footnote), has no scales; the covering is apparently a waxy secretion, soluble in ether.

few will object; but the possibility of applying them in the present state of science is, and probably will be, fiercely contested; and it may be justly urged that the descriptions in the works of the masters he alludes to, would not, in many cases, have been recognisable had the types not been in existence, or had it not been for the beautiful iconographic works of those authors whom he somewhat derogatively terms "simply collectors."

Turning to the purely systematic arrangement of the author, we find the *Lepidoptera* divided into *Rhopalocera* and *Heterocera*, or into *Diurna*, *Crepuscularia*, *Nocturna*, and *Microlepidoptera*. This is broad grouping, and we shall be curious to see, in a future volume, how it is proposed to get over the difficulties of the last-named. On some points of minor arrangement the author's views will be regarded as rank heresy by most entomologists of the present day; and the most notable of these are the positions assigned to those anomalous groups known as the *Castniadæ* and *Uraniadæ*, which are boldly united with the *Rhopalocera*, as groups 10 and 11 of that division, in opposition to the ideas of almost every one, and notably to those of Boisduval and Westwood (the latter author's recent memoir on the genus *Castnia*, and others, in the *Trans.* Linn. Soc., ser. 2, Zoology, vol. i., 1877, is alluded to in the text attached to the plates). It is scarcely to be expected that the reasons given for this course will be found convincing to the majority; could it be so, the arrangement would be hailed with satisfaction by those numerous collectors who, confining themselves to "butterflies" only, are now debarred from adding to their stores some of the most beautiful insects that exist. The *Crepuscularia* are divided into *Sphingidæ* and *Sesiadæ*; the *Zygænidæ* are not represented in the author's faunistic region, but the *Glaucopidæ*, often associated with them, are transferred to the *Bombycoides*, and head that section. Many other points might be alluded to in which the author departs from common practice in systematic views, but it is only fair to him to state that, in all cases, he gives the fullest reasons for adopting the course, however insufficient they may appear to others; but this notice has already become too lengthy, and they must be left to the discretion of specialists, all of whom must of necessity possess the work. An inconsiderable number of new species are described.

The plates (only an uncoloured copy of the atlas is before us) are admirably executed, the drawings having been made by the author himself, and lithographed at Berlin, a course which has added greatly to their value, owing to the present impossibility of finding sufficiently skilled engravers in Buenos Ayres; at the same time it has naturally caused delay. The value attached to the beautiful representations of the transformations of many species, cannot be too highly estimated, and the explanatory text is very ample, containing also new matter, not appearing in the body of the work. R. McLACHLAN

MODERN METEOROLOGY

Modern Meteorology. A Series of Six Lectures Delivered under the Auspices of the Meteorological Society in 1878. (London: Edward Stanford, 1879.)

THE publication of "The Origin of Species" and the introduction of the spectroscope as an implement of research, have not wrought perhaps a greater revolution in the biological and physical sciences than has the invention of weather charts in the younger science of meteorology. One has only to look back a quarter of a century at the writings of meteorologists to see the radical change which has been brought about, not merely as regards the nomenclature of the science but even as regards the standpoint from which the whole phenomena of atmospheric movements are looked at. It was to diffuse more generally a knowledge of this change that the Council of the Meteorological Society arranged the delivery of these six lectures, which on the whole faithfully portray to the reader the present state of meteorology in its outstanding features.

From its important bearing on the future of meteorology in the British Islands, we note with great satisfaction the remark in the lecture on "Air Temperature" that the same pattern of thermometer box, viz., that known as the Stevenson, has been adopted at the stations of both the English and Scottish Meteorological Societies, to which may be added the stations of the Meteorological Office; and we heartily endorse the opinion expressed by the lecturer, Mr. J. Knox Laughton, that on such a vital subject as the observation of the temperature, absolute uniformity of pattern which is secured by the adoption of Stevenson's box, is better even than Utopian excellence.

The lecture by Mr. Strachan on the "Barometer and its Uses" is characterised by a full and exact knowledge of the instrument and its history, and a correct estimation of the present state of the problems relating to atmospheric pressure with which he has occasion to deal. His examination, for instance, of various theories which have been broached in explanation of the diurnal range of the barometer is acute and satisfactory, and from that examination he shows that a hypothesis yet remains to be framed which shall account for the diurnal oscillations of the barometer. The truth is, none who have yet attempted to account for the diurnal barometric oscillations—one of the widest spread and constant of terrestrial phenomena—have had before them sufficiently the facts of observation such as might indicate, with the requisite fulness of detail, the influence of geographical position on the problem which it is sought to solve.

Mr. Strachan throws out incidentally a valuable hint regarding the forecasts of our European weather which are wired from America. He says (p. 95):—

"It is worth while inquiring how our American friends manage this business. They are not very willing to show their hands, as the saying is. However, we may surmise how it is done. They have active agents who make extracts of the logs of all the steamers directly they arrive in New York, and by means of these extracts they can follow up all the storms which occur in our parallels. Thus it may often happen that information of storms is obtained by the *Herald* before they have had time to reach western Europe. The *Herald* at once flashes the news by telegraph. We get the telegram surely and speedily and the storm, if it does not vanish in the meantime, shortly afterward."

Whether this be the practice of the expert of the *New York Herald* or not, there cannot be a doubt that we have here an indication of the way in which substantial advance may be made in our system of weather forecasting, viz., by some central authority in America at once receiving by telegraph extracts from the logs of all vessels

directly they arrive at Atlantic ports; by the aid of which, warnings may be framed, and wired to Europe, of such storms as may appear to threaten its coasts. In this connection it is not possible to overestimate the importance of a telegraph wire to Farö and Iceland, by which warnings of many storms thus seen approaching our coasts, could be issued one or two days earlier at least than at present.

Mr. Clement Ley contributes an extremely interesting, and in some respects a very valuable lecture, on clouds considered as weather-signs, accompanied with nine well-executed illustrations in colours. Mr. Ley has been a close observer of the forms and movements of clouds almost from infancy, being even then strongly under the fascinating spell of their mystery and beauty. Habits of close and accurate observation were thus formed and the tendency has become so inveterate that to this day a twelfth part of his waking existence is spent in observing the clouds. For several years he has given the closest observation and study to a strict examination of the relations of different clouds to cyclones, anticyclones, and to thunderstorms, in other words, to changes of weather. It is the results of this examination which form the most valuable part of the lecture, these results being of the utmost importance to the isolated observer, who may take the trouble to follow up the subject, in enabling him with better success to forecast the weather though aided only by his own observations. A treatment of the subject with greater fulness than is possible in a single lecture would be warmly welcomed by meteorologists and all others interested in weather.

In one of the lectures it is stated with much emphasis that "the great need of every branch of meteorology is neither more observations nor more money (though neither of these is to be despised), but more brains, more hard workers, more deep thinkers." In a certain sense this is true, but in a wider sense it does not represent the most pressing needs of meteorology. In the last lecture of the series, Mr. Scott justly remarks that as regards synoptic work on a large scale, we may look our critics in the face and boldly ask for more observations, no matter how our shelves may be bending beneath the weight of undiscussed records. The truth is, those who are engaged with original researches in meteorology find themselves ever and anon seriously hampered, if not completely arrested in their work for want of the data of observation. We are unaware that any systems of observation at present exist which could furnish, for example, the data for the determination of the horizontal or vertical meteorological gradients, or for ascertaining how far and with what modifications the influence of the sea extends inland. Nay even, though thanks mainly to the indomitable energy of Mr. Symons, there are upwards of 2,000 gauges recording the rainfall of the British Isles, the number, not to mention positions, of these gauges, are too inadequate to admit of even a rude guess being formed as to the quantity of vapour abstracted from the air in the form of rain or snow during any of the storms that sweep across the country. Much less can we, without largely increased observation, give an indication of the varying hygrometric and thermometric states of the atmospheric currents to windward and leeward of the regions of large rainfall in Great Britain. Meteorologists, no less than astronomers, had cause to deplore a great loss in the death of Leverrier, the keenest sighted of physicists and prince of organisers of systems of observation, one of his last works being the establishment of a system of observation, by which the propagation of rain, hail, and other weather phenomena, could be followed from commune to commune over France. With such results as may be expected from this system, and from General Myer's magnificent scheme of monthly meteorological charts for the whole of the northern hemisphere, which will also bring into the field thousands of fresh observers, physical data leading towards the solution of some of the great meteorological problems will be supplied, without which observational data, mere brain-work—such is the complexity of the problems to be dealt with—would prove either useless or positively mischievous.

OUR BOOK SHELF

Farming for Pleasure and Profit. By Arthur Roland. Edited by W. H. Ablett. (London: Chapman and Hall, 1879.)

THIS small book has the defects as well as the merits which might have been expected in the work of an amateur farmer. His own practice seems usually sound and sometimes ingenious, but his explanations and advice cannot always be safely trusted. When he tells us what he has himself done, we listen with attention; when he offers us page after page full of antiquated veterinary nostrums, we cannot feel edified. We did not know till now that foot-and-mouth disease was *epidemic;* the cause and cure of apthæ (*sic*) is not quite adequately given on p. 205; and we should certainly hesitate before adopting the following treatment (p. 191) for a cow suffering from moor-ill:—"Some insert a seton in the dewlap and take away ten pounds of blood in very severe cases. A recipe has been given to administer, in very obstinate ones, six drachms of aloes, twelve ounces of sulphur, and sixteen drops of croton oil, the first day, in addition to a blood-letting of ten ounces," and so on with further directions of the heroic order. When Mr. Roland tells us of all the breeds of cows, of the cheese-factory system, and of a dozen other matters, of which, so far as we can learn, he has had no actual experience, we feel that his space and our time might have been more profitably occupied. That a good deal of information, and not a little amusement into the bargain, may be got out of Mr. Roland's book, is not to be denied, however. Whether "a great number of persons who would gladly supplement their incomes, if they could see their way clear to do it, by entering into rural occupations which are congenial to their tastes," would be able to follow the lead of Mr. Roland in his farming practice may be gravely doubted. It is not every amateur pig-feeder who will be so lucky as to find "a good pork-butcher, doing a superior trade, and ready to give nearly thirty per cent. more than could be obtained by selling young porkers haphazard." Nor will the amateur pea-grower always be able to adopt the following excellent and economical plan of disposing of his produce. Mr. Roland stows his green peas ready shelled in two flat wicker baskets under the first-class railway carriage in which he daily travels to town. He finds that the landlord of the hotel where he dines in the city will give him one shilling a quart for these peas, fetching them from the cloak-room of the station where they have been deposited. This ingenious method of marketing hardly admits, however, of general adoption; and, moreover, the railway authorities might have something to say about this plan of evading payment of carriage. Mr. Roland's previous attempts to dispose of cabbages and turnips (pp. 16 and 17) were less satisfactory in their

pecuniary results, though more accordant with ordinary experience. Let the reader of these eight chapters on "Farming for Pleasure and Profit" omit everything except what is given on the personal authority of the author, and he will gain a number of useful hints showing how to economise the vegetable food raised on a small farm, and to make amateur agriculture in some ways less financially disastrous than is usually the case. But we shall not find a complete system of practice here; nor do we discover any hints, however remote, of the chemical composition and physiological functions of food; and we look, too, in vain for any recognition of recent advances in our scientific knowledge as to methods of manuring and cropping.

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.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

Theory and Laws of the Microphone

Two hypotheses have been projected to explain the action of the microphone. One is molecular exclusively, and supposes that the molecules of certain conducting bodies contract and dilate under sonorous vibrations. Changes of *density* correspond with an increase or diminution of the resistance of the circuit. This hypothesis renders the phenomena analogous to those which selenium presents under the influence of light and radiant heat. The other explanation, partly mechanical and partly molecular, is the result of a discovery made some time since by M. du Moncel, according to whom the increase or diminution in resistance is due to changes of *pressure* at the points of electric contact. These changes of pressure are effected by the vibration of the air; hence the cause and the effect are similar.

As the result of numerous experiments, I shall endeavour to prove that, while one of these theories is altogether erroneous, the other is only superficially true.

1. If the piece of charcoal is fixed with wax without any pressure, the microphone remains silent under the strongest sonorous impulses, which would be impossible were the movement molecular.

2. The microphone may be inclosed in a vacuous chamber without altering the result; in this case waves of air can have no effect upon the density of the charcoal.

3. It is impossible to construct a microphone from one solid piece of charcoal, presenting stable contact, such as would not interfere with molecular action, but which prevents the sonorous waves from affecting the currents which traverse the carbon.

These afford sufficient reasons for rejecting any simply molecular theory.

Now against the second theory.

1. Lateral pressure on a compact electric conductor excites no microphonic action.

2. Longitudinal pressure within certain limits on the charcoal does not injure the apparatus.

3. An apparatus can be made to yield microphonic effects where there is no alteration of pressure. Pressure, therefore, is no essential cause of microphonic sounds, though it may be an accidental one.

In all microphones where contact is made at one point only, the current is interrupted whenever this point of contact is broken; a musical sound is heard when the two points are in vibration. This microphone, like Reis's telephone, can only transmit musical sounds. I have obtained the best results from a steel point and a membrane of a stretched bladder. A strip of tin-foil is gummed to the membrane to insure electric contact. With a single small cell of bichromate of potash a song can be heard through a whole room.

To transmit articulate sound it is necessary that the number of points of contact, the difference in this number during action, and the resultant changes of resistance, should be greater. The interruption of the current is then only partial; it becomes "undulatory." To this description belong the principal microphone of Mr. Hughes, Edison's carbon telephone, the transmitting telephone of two graphite pencils of MM. Pollard and Garnier, Helleren, &c.

A convenient form of microphone, which transmits words, music, the noise of a watch, &c., has the membrane of india-rubber stretched tight by a thin strip of tin-foil which unites the carbon underneath with the screw. The vibrations of the membrane throw a greater or less number of points into contact; all the shades of expression in the voice may be transmitted, owing to the rapidity of these small changes. It is the changes in the points of contact which here play the chief part, and there is little doubt that here we have the quality as well as the intensity of a sound reproduced.

This explains many of the microphonic actions, but not all. Here is one case:—

If the microphone is formed of two cylindrical pieces of charcoal, the points of contact cannot be made to vary by pressure, supposing the cylindrical shape to be perfect. The action here is due to the distance the current has to traverse the bad conductor; for the membrane to which these charcoal points are attached approaches or recedes from them when vibrating. The liquid telephone transmitters of Bell, Gray, and Salet rest upon the same principle where a change of resistance in the circuit is due to the varying depth of liquid traversed by the current. This, equally with the theory of the points of contact, explains the microphone of M. Righi, where a metallic disk is plunged into a powder of lead and silver mixed.

The next class of instruments consists of those where the current is created, and varies under the influence of microphonic electrodes (by this I mean the opposite parts of a microphone, whether in direct or indirect contact). Such are microphonic batteries. Each battery can act as a microphone if one of its poles is movable. Two ends of iron wire, dipped in ordinary water, and brought together, give signs of microphonic action. One pole is attached to the vibrating membrane, and dips at its extremity into the liquid, while the other pole remains there constantly. The current only passes when the movable pole is in the liquid. On singing into the tube the vibrations of the membrane cause the pole, which is also a microphonic electrode, to dip into the liquid, setting up chemical action as many times a second as there are vibrations in the note sung. If the pole touches the liquid constantly, the current is constant, but varies in intensity for four reasons: the different number of points exposed to electrolytic action; the different number of points of electric contact; the different number of the points of resistance of the liquid; and the different number of the points of approach of one pole to the other; all these are due to the movement of one of the microphonic electrodes.

There is yet another class of microphones. In all the instruments hitherto constructed, the direction of the current remains the same, but it is possible to make it change, thus introducing another difference in the manner of its action.

In all the possible forms of microphone, the chief causes of the action are:—a mechanical movement of its parts, a change in the points of conductivity, a change of resistance; these three essentials result from one another. The expression "points of conductivity" includes not only the points of contact, but also the route taken by the current.

The next point of consideration is the so-called increase of sound by a microphone, but this is not the case. All sounds are weakened by the microphone, and are transmitted only when the source of sound is in direct contact with the microphone or its stand. The microphone is less an instrument for transmitting sound than for transforming mechanical movement into sound. The intensity of a sound is, therefore, directly proportional to the energy of the mechanical movement accompanying the sonorous waves, or as a necessary consequence to the changes of resistance in the microphone. The distinctness of articulate sounds, transmitted by the microphone, is in inverse proportion to their intensity; for a loud sound tends to interrupt completely the current, and thus to prevent the transmission of articulate sounds. This is the chief hindrance to increasing, at pleasure, the loudness of the sound. The loudness of the sound is also dependent on the strength of the current.

Other experiments prove that the rapidity of movement of the parts of a microphone also affects very considerably the resultant sound, as well with a strong, as with a feeble current. Changes in resistance and in current strength are not sufficient, unless made rapidly, to excite microphonic action.

Great as is the invention of Mr. Hughes, the microphone reveals no new property of matter, neither does it show the direct effect of sonorous waves upon partially conducting bodies.

Lemberg University JULIAN OCHOROWICZ

"The Rights of an Animal"

I AM sorry that my review appears to have caused Mr. Nicholson some annoyance, but am not surprised that in his rejoinder he has not attempted to meet any one of my criticisms. As he now expressly avoids the well-known ambiguity which attaches to the word "same," he clearly avows his meaning to be what in my review I supposed it could not be, viz., that animals have "in all respects *identical* rights of life and liberty with man." If this proposition is seriously stated, it does not require a "writer capable of reviewing an ethical essay" to see that it cannot possibly have a place in any such essay, properly so called. And in supposing that this could not be the fundamental proposition which Mr. Nicholson intended to maintain, I did not "forget" that the animals which he allows "to be killed or worked were only allowed to come into life for these purposes." For if the rights of animals are *identical* with those of men, and if the breeding of animals for the purpose of killing them morally justifies the butcher in taking their lives, it certainly follows, for instance, that a physiologist would be morally justified in vivisecting his own children on the plea that it was for this purpose that he had begotten them. Where such is the necessary ethical conclusion, it is clear that the ethical premises by which it is evolved must be erroneous.

As regard the crustaceans, seeing that they are not "harmful animals," I chose them as a type of the class of animals which Mr. Nicholson plainly says it is in his opinion morally wrong to kill.

I may add that I omitted to mention the "plea" to which his letter in NATURE refers, because it had no relation to the opinion I was criticising—the opinion, namely, that harmless animals ought not to be killed for food. Here, however, is the "plea." "It may be answered that if none of these (*i.e.*, crustaceans) were killed more land animals would be killed for food; that their death allows more land animals to be kept alive for other purposes; and that this sharing of risks is only fair to the latter, the more so as they stand higher in point of intelligence and usefulness. Is this plea sound?" I can scarcely suppose that Mr. Nicholson will thank me even now for reproducing so feeble an argument, and in any case am quite sure that the latter, whatever it is worth, has no reference to the abstract principle which I was examining.

The relevancy of Mr. Nicholson's "protest" I fail to perceive. That "principle" and "self-interest" are not synonymous is sufficiently obvious, but I do not see how this consideration affects my charge of "inconsistency of principle." I simply pointed out that if we have a moral right to slay a harmful animal in order to better our own condition, it involves an inconsistency of principle to deny that we have a similar right to slay a harmless animal, if by so doing we can secure a similar end. And this obvious criticism is not affected by the irrelevant remark that "principle" and "self-interest" are not synonymous.

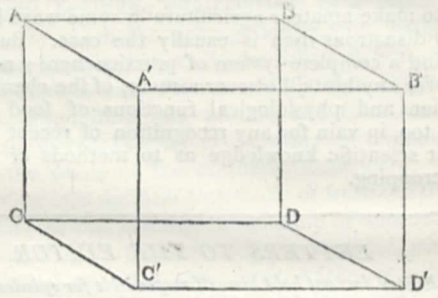
Again, as I was reviewing Mr. Nicholson's essay, and not Mr. Lawrence's book, I deemed it unnecessary to allude to the "reprints" from the latter, more especially as I saw nothing in these reprints of a nature either "interesting" or instructive. If my omission in this respect is calculated to damage the sale of the essay which I reviewed, I can only express my sorrow that such should be the case; but as I further omitted to state that the pages of the essay are small and very widely leaded, the idea which I conveyed of the size of the book as a whole was certainly not an inaccurate one.

I have taken the trouble to reply to the above remonstrance thus fully because I am conscious of having done what every honest reviewer ought to do, viz., to state what he thinks and to give his reasons for what he states. But as the result in this case has been to dissatisfy the author reviewed, I think it is now desirable to prove, by subscribing my name, that I have no personal *animus* against him. GEORGE J. ROMANES

A Suggestion on the Action of the Oblique Muscles of the Eye-ball

THE action of the so-called oblique muscles of the eye-ball has been a *quæstio vexata* amongst anatomists for a long time, but I, in all submission, venture to suggest the following experiment which *may* be entertained mathematically. I speak of my own eyes, and the method in which I endeavour to use my oblique muscles, according to authorities.

Suppose I draw a skeleton cube at haphazard thus—



and I *concentrate* my vision on the anterior plane of this cube (A′ B′ C′ D′) in the sketch; if I put in action (according to what we believe to be the action) the superior and inferior oblique muscles, the projection is immediately altered, and the plane A B C D is instantly the anterior? Pardon my apparent ignorance of physics, but may not some of your many correspondents, without ignoring my anatomical knowledge, make the statement a basis for research. A good explanation for the condition I must confess has escaped me?

It may throw some light on the question as to whether the oblique muscles definitely alter the optical functions of the eye, which is certainly a matter of the greatest practical interest.

EDWARD BELLAMY

Natural History Notes from Burmah

1. *The Dorian.*—The Dorian is a large capsular fruit with four or five loculamenta, each containing one seed which is covered with a layer of pulp, the part eaten. The rind, as well as the seeds, emits a strong odour of sulphide of methyl.

Dorian eaters say that the excellency of the fruit consists in the succession of exquisite flavours experienced in eating it. From my own experiments I believe this to be due to a reaction of the nerves of taste, analogous to that of the retina, which causes the images of objects to appear in their complementary colours when the eye is suddenly shut.

2. It is asserted that the weaver bird has the habit of fixing fire-flies to the side of its nest by means of a lump of mud, for the purpose of illuminating its nest at night. I have not observed it myself. Perhaps some of your readers may have seen or heard of the practice.

3. *Ants.*—There is here a species of small black ant, of which there occur gigantic specimens differing from the others only in size. They seem to act as the elephants of the community, carrying loads that the small ones cannot lift. Sometimes one of these "elephants" may be seen returning to the nest with several of the ordinary size clinging on its back.

Once while taking lunch in the image cave at Maulmain, we observed several large black ants wandering about. A chicken bone thrown in their path was soon discovered, and a messenger was despatched to the nest, from which a compact body of ants soon issued. But by some mistake they took the wrong direction from the nest, and proceeded towards a fragment of plaster that had fallen from one of the statues and lay on the floor of the cave. This they examined all over, and then returned to the nest in a less orderly manner than they had marched out, but at the entrance some other ants met them, who must somehow have given them the proper direction, for they at once changed their course towards the bone, which was soon covered with ants. I think this observation has some bearing on the way in which ants communicate. It is clear that the messenger's signs were misunderstood, and they went so straight to the bit of plaster that it appeared to me that they must have seen it, for sight is the only sense that could have been deceived. The distance was about four feet, and this occurred near the entrance to the cave, so there was light enough if their range of vision was great enough.

R. ROMANIS

Government High School, Rangoon

Pigeons and Weather Warnings

IN the *Standard* of the 5th instant is an account of a pigeon-race from Penzance to London, a distance of 270 miles, which was done by one bird in 5 hours 34 minutes, and by another in 5 hours and 59 minutes. Might not the carrier-pigeon be employed to bring accounts of the weather 300, 400, or even 500 miles out in the Atlantic, being despatched on outward voyages by ships leaving ports such as Queenstown, Southampton, Dartmouth, Plymouth, or Falmouth? The great difficulty in our system of weather-warnings is that storms reach us unannounced over the Atlantic, because stations are of course out of the question on the ocean. If the daily sailings of steamers from various ports could be utilised by means of pigeons, this void might to some degree be filled. If it be true that many storms come to us along the course of the Gulf Stream, a branch of it (Rennell's Current) would be met a little beyond the Scilly Islands, say 100 miles farther out, or about 150 miles from Falmouth. If a bird brought a weather-warning in three hours from what would appear to be an important point, it would surely advance matters a good deal. A great part of England can be warned from the Irish coast, but Scotland has no advance-guard of this sort. Steamers leaving Greenock for America could carry pigeons and send warnings back, thus giving Scotland some protection. R.

Putney, August 5

Napoleon III. and the Nicaraguan Canal

AT p. 249 of NATURE, vol. xx. it is made to appear as if the circumstance of the connection of the late Emperor of the French with the scheme of Central American canalisation through Nicaragua, was *quite unknown* to the public. But it is well known that Prince Louis N. Bonaparte, whilst at Ham, was in communication with Don Francisco Castillon, envoy to Louis Phillippe from the Nicaraguan Government upon this subject. After the escape of Louis Napoleon from France, he publicly advocated the project of the Nicaraguan Canal at the Institution of Civil Engineers, London. (*Vide Proceedings* I. C. E., 1847, vol. vi. p. 427; *vide* "The Gate of the Pacific," by Commander Bedford Pim, pp. 118, *et seq.*) S. P. O.

Vitality of the Common Snail

AT the beginning of July last year, I placed a couple of the *Helix aspersa* into a closed pot of earth immediately after copulation. They soon sealed themselves up, and so remained till the middle of May of this year, when it was discovered that of one of them that had died not a vestige was left except the empty shell. The other had shrunk to about a third its former bulk, but on being moistened and supplied with food, soon began to eat and to thrive. It had to trust largely to chance for its provender, but notwithstanding this, by the end of two months it was as big as its present quarters would allow it to be. The natural thing would have been to secrete more shell, for the animal was not full grown. Instead of this, however, it burrowed in the ground, and fell to laying eggs, the greater part of which have hatched out—a little colony of vigorous young snails. Had their parent been kept supplied with food and water after impregnation, they would, of course, have begun life a year ago. I wonder how high up in the animal scale such temporary suspension of the earliest stages of development is possible?

Trinity College, Cambridge, August 7 JAMES WARD

OUR ASTRONOMICAL COLUMN

VARIABLE STARS.—It may be hoped that some amateur in the other hemisphere—the class of observation is hardly suited to the professional astronomer, considering the work that remains to be accomplished in the southern heavens—may be keeping in view Lacaille's star, μ Doradûs, which is certainly variable to a great extent, and in a very long period. In the Catalogue published by the British Association founded upon the observations in Lacaille's *Cœlum Australe Stelliferum*, the star is rated 5 m., though in the Catalogue at the end of this work we find it 6 m., the estimate applying to the year 1751, and this is also the magnitude noted by Brisbane about 1825. The variability of the star was first shown by the late Capt. Jacob's observations at Madras early in 1850; he found no such conspicuous star as Lacaille and Brisbane had observed, but fixed the position of one which nearly agrees with the Paramatta place, and which was estimated 9·5; this star was reobserved at Madras in 1855 and rated 9·2. The next we hear of it is from Moesta, who, observing at Santiago, states (*Astron. Nach.*, No. 1,545) that from February, 1860, to January, 1865, he had found it 8½ or 9 on Argelander's scale. Finally Mr. Stone observed the star at the Cape of Good Hope in 1875 and estimated it a *seventh* magnitude, which should induce a close watch upon it at the present time. The star was formerly credited with a very sensible proper motion, but it would appear from the modern observations that this arose from an error in Lacaille; thus, bringing up all places to 1875·0 we have—

			Right Ascension.		North Polar distance.		
			h.	m. s.	°	′	″
Lacaille	1751 December	...	5	6 2·2	151	57	3
Brisbane	1825	...	5	5 51·42	151	57	55·2
Jacob	1850	...		53·16			59·3
—	1855	...		53·34			57·0
Stone	1875	...		52·74			59·3

There appears a suspicion of a similar case with regard to the star Brisbane 5935, observed once at Paramatta and estimated 6 m. This star does not occur in Lacaille, but it was looked for in 1850 by Jacob, who found only one 9·10 m. near the place given by Brisbane, differing however 4s. in R.A. and 1′ 18″ in N.P.D. Mr. Stone's nearest star is Lacaille 7093. If the objects observed by Brisbane and Jacob are identical, proper motion as well as variability will enter into the case.

The observations of Julius Schmidt at Athens in 1878 again show great irregularity in the variation of R. Scuti, the mean period he obtained for that year being 62·3 days, instead of 71·1 days, as determined by Prof. Schönfeld, and which was satisfactory in 1869. The last epochs determined at Athens in 1878 were, for a maximum, November 8, and for a minimum, October 11. The mean period of α Herculis in the past year was found to be 97·3 days, but the period varied from 86 to 113 days. In such instances it is obvious that observations, made as continuously as possible can alone determine whether the fluctuations follow any definite law.

THE MINOR PLANETS.—The discovery of a small planet by Prof. Peters at Clinton, N.Y., on July 28, raises the number of known members of the group to *two hundred*, the object detected by the same astronomer on July 16 proving to be an old acquaintance,—No. 77 (*Frigga*), which had not been recognised for upwards of ten years. Of the planets discovered during the present year, No. 193 (Coggia, February 28) has been named *Ambrosia*, No. 196 (Peters, May 17), *Philomela*, and No. 198 (Borrelly, June 13), *Ampella*.

THE SATELLITES MIMAS AND HYPERION.—According to elements which have been previously used in this column, *Mimas* would be found at its greatest eastern elongation on August 20, at 13h. 47m. G.M.T., distant 30″ from Saturn's centre or 8″ from the extremity of the ring; the period of revolution may be assumed 0·94243d. It appears difficult to make reliable prediction of the position of *Hyperion* from present uncertainty as to the motion of the line of apsides. Prof. Asaph Hall adopts a retrograde motion of less than 3° annually, but there are indications that the true motion may be in the opposite direction, and to a much greater amount. Mr. Marth, who has devoted so much time and labour to the motions of the satellites of Saturn, was of opinion some ten years since that the revolution of the line of apsides of *Hyperion* would be found to be very rapid, through the powerful action of the great satellite *Titan*. Three periods of *Hyperion* are almost exactly equal to four periods of *Titan*, if we adopt Prof. Hall's period for the former.

GEOGRAPHICAL NOTES

ON August 1 the International Conference of the Alpine Clubs was opened at Geneva, in the building of the Conservatorium. The Alpinists were very numerous, and the meeting was really an international one, as all nations have sent their representatives. M. Albert Freundler occupied the chair, and Mr. C. E. Matthews, president of the English Alpine Club, Prof. Talbert, vice-president of the Central Directory of the French Alpine Clubs, M. Budden, from Florence, Prof. Ed. Richter, delegate of the German and Austrian Alpenverein, and Prof. Charles R. Cross, from Boston, were elected vice-presidents. The subjects submitted for discussion were: 1. The improvements to be made in Alpine inns; 2. The regulations concerning shelters; 3. The instruction and examination of guides; 4. The possibility of a common action of the Alpine Clubs for obtaining from the railway companies a reduction of fares for Alpinists who travel in groups; and 5. Sanction by all clubs of the resolutions passed by some of them as to inns and guides. The discussion was alternated with communications of a more general interest. M. Henri de Saussure read a communication on the state of the Boston (U.S.) Appalachian Club, whose activity is remarkable as shown by numerous publications of a high scientific and artistic value. In the discussion on shelters M. Binet-Hentsch proposed to make the roofs of the Alpine shelters of bituminated paper; the experiment which was made by the government of the canton of Graubunden, proves these roofs to be excellent. M. Durier gave a brilliant account of his exploration of Etna, which he made eight months before the eruption of this year. The Rev. M. Denza, director of the Observatory of Moncalieri, read a paper on mountain meteorology. The memoir, which aimed to interest Alpine climbers in meteorology and to point out the services they could render to science during their travels, gave an account of what is done by Italian Alpine Clubs for meteorology, no less than one hundred meteorological stations having been erected by these clubs, fourteen of them at very high altitudes. The memoir gave rise to a very interesting discussion, during which Prof. Alphonse Favre spoke of the necessity of measurements of the motion of glaciers; and the Italian and Austrian representatives explained what is done in that direction in their countries. M. Henri de Saussure read three unpublished letters, written to his illustrious ancestor, Horace Bénédict de Saussure, as to his ascent of Mont-Blanc. The papers of that time having spoken of his project, his friends wrote to him numerous letters to dissuade him from the perilous undertaking. The Abbé Landriani entreats him in the name of science to take care of himself, and not to risk his precious life, and the Prince de Ligne, a very gallant officer, advises him to undertake a regular siege of the giant mountain; several relays of workmen, with pick-axes and shovels, should "level the asperities of the road, and so," he writes, "going up some ten fathoms per day, you could reach the summit after a six weeks' work." As to the instruction and the examination of the guides, M. Talbert recommends such institutions as that of Interlaken, in Switzerland; besides, he proposes to found libraries for the guides and to publish a manual like that just issued by the president of the Italian Alpine Club. As to the reduction on tickets, the French railways have made a reduction of fifty per cent. for all Alpinists travelling either in groups or separately, so that no less than 130 members went to the Conference of Geneva. No special resolution was taken on the fifth question, but it was resolved to maintain an active correspondence between the directors of all Alpine Clubs.

THE *Times* Berlin correspondent telegraphs that news has been received that Prof. Nordenskjöld has succeeded in getting out of Behring Straits. We are inclined to doubt the accuracy of this statement; we have reason to believe, at least, that no such news has been received by Mr. Oscar Dickson, of Gothenburg, who would most likely be the first to whom Nordenskjöld would communicate his success.

THE efforts which Commander Cheyne has been making for some time past to organise a new Arctic Expedition promise to be successful. Committees have been established all over the country, with a central Arctic committee in London, located in the rooms of the Literary Society. Lord Derby has subscribed 100*l.* towards the expedition, and his example has been followed by Mr. Samuel Budget. We believe that balloons will form an important part of the equipment of the expedition. The Bank of England, it is stated, has consented to open an account under the title of "The New British Arctic Expedition."

TWO well-known African travellers will again start for the Dark Continent during the autumn: Dr. W. Junker will visit the Egyptian Soudan, while Dr. Oscar Lenz, the eminent Ogowe traveller, will go to Morocco by order of the German African Society. This society is making arrangements to establish in Morocco a school for African travellers, as it were; the country, although comparatively near, being yet very scantily investigated. Moreover, the young travellers will there get thoroughly accustomed to Mohammedan life, and the Society will thus acquire well-trained representatives to be sent afterwards to various parts of Central Africa.

THE Admiralty have issued a hydrographic notice respecting the Siam coast in the Bay of Bengal, the information in which is derived from the notes of Commander A. D. Taylor, Superintendent of the Marine Survey of India, and from remarks by Commander A. de Richelieu, of the Siamese Navy. Among other items of geographical information contained in it, we learn that the town of Takuapah is situated on the Takuapah or Kopah River, in the Siamese province of Muang Takuapah, in 8° 48′ N. lat., about fifteen miles from the sea. It is surrounded by tin mines and large plantations, and its inhabitants are mostly Chinese. The only export is tin, of which a considerable quantity is sent away, and indeed, next to Puket, it is the largest tin-exporting place on the coast of Siam. The houses are mostly of bamboo and atap, though some few are built of brick. There are several mining villages along the banks of the river, and the country about Takuapah and to the northward is undulating and mountainous. Pia Sima, the highest mountain, about ten miles east of Koh Rah, culminates in three peaks of nearly equal elevation, and is upwards of 3,500 feet above the sea.

WE understand that a work by Mr. V. Ball, of the Geological Survey of India entitled "Jungle Life in India, or the Journeys and Journals of an Indian Geologist" will appear shortly. The volume will contain a popular account of the author's observations, extending over a period of fourteen years, on the geology, zoology, botany, and ethnology of Western Bengal, the Central Provinces, the Himalayas, Beluchistan, and Afghanistan, the Andaman and Nicobar Islands, and Burmah, interspersed with which are numerous anecdotes and sporting adventures. A number of beautifully executed woodcuts and a map, the former illustrative of the scenery and inhabitants of these comparatively little-known regions, will aid, it is believed, in commending the volume to a large and varied circle of readers. In a series of appendices some of the more strictly scientific topics are dealt with. The publishers are Messrs. Thomas De la Rue and Co.

RECENT news from South Australia states that a plentiful supply of fresh water has been obtained on the tube-well principle on the Mount Lofty Range, 1,700 feet above the Adelaide plains.

A PARAGRAPH recently went the round of English and foreign papers and geographical journals, purporting to give the population of Japan according to a census taken in 1878. We have the best authority for stating that no census has been taken in Japan since 1875, and that the numbers given as for 1878 were really those of 1875.

NORDENSKJÖLD'S ARCTIC EXPEDITION

LETTERS have just come to hand from the Swedish North-east Passage Expedition in the neighbourhood of Behring Straits. The latest date is February 20, when all was as well as possible. We take the following details from Prof. Nordenskjöld's report, addressed to Mr. Oscar Dickson, of Gothenburg. The *Vega* and the *Lena* parted company on August 27 at the mouth of the River Lena, the former shaping her course for the New Siberian Islands. The air was calm, but for the most part overcast; the temperature as high as 4° C., and the sea free from ice. On the 28th Semenoffskj or Stolbovoj, the most western of the New Siberian Islands, was sighted, and on the 30th Liakhoff's Island, but a landing was not effected on account of the shallowness of the water in its vicinity. On the 31st Svjatoi Nos was passed without difficulty, the weather being fine, and the land in the neighbourhood free of snow. The water was slightly salt, and had a temperature rising to 4° C. The weather continued fine until September 1, the wind being southerly, and the temperature of the air in the shade 5·6° C. On the night before the second the wind became northerly, and the temperature fell to – 1° C. The following night there was a large fall of snow. Next day the Bear Islands were reached. Tschaun Bay was passed on the night before September 6, and Cape Schelagskoj reached by 4 A.M. The nights now began to be so dark, and the sea so filled with ice, that the *Vega* had to lie-to at night, generally anchored to a large ground ice. Two boats resembling the *umiaks* of the Eskimo were now seen filled with natives, the first that had been encountered since the expedition left Chabarova at Jugor Schar. They were received in a friendly way, but none of them could speak Russian or any other language intelligible to the Swedes. A boy could, however, count ten in English, showing that the intercourse with American whalers was greater than with Russian merchants. On September 6 and 7 the *Vega* steamed slowly along in a narrow open and ice-free channel along the coast. On the 8th a landing was effected near a Tchuktch encampment, where the Swedes were received in a very hospitable manner. They found in one tent reindeer flesh boiling in a large pot of cast iron. Another start was made on September 6, but a fog compelled the Swedes to lie-to till the 10th. Many excursions were made on land. The strand was formed of sand which, immediately above high water-mark, was covered with luxuriant turf. Farther inland, a range of very high hills was visible, and beyond that, at a considerable distance from the coast, snow-covered mountain-tops. The low land consists of sand and clay beds, evidently raised above the level of the sea very recently. No erratic blocks were to be seen, from the absence of which Nordenskjöld concludes that there is not at present to the north of this any such glacial land as Greenland. The rocks here were non-fossiliferous. Few land plants could be collected on account of the advanced season of the year, and in the sea Dr. Kjellman dredged for algæ in vain. On land many graves with burned bones were found. On the night before September 10 the sea was covered with a very thick crust of newly-frozen ice, but the *Vega* continued her course. On the 12th, after passing Irkaipi, or the North Cape, the vessel had to be anchored to a block of ice, where she lay till the 18th, when another advance was made. After lying-to from September 24 to 26, the *Vega* reached Cape Onman, and on the 27th Koljutschin Bay. The following day the cape to the east of this bay was passed, and the *Vega* lay-to, anchored to a ground ice, waiting for a favourable change, but no such change took place. Northerly winds heaped greater and greater masses of drift ice along the coast, and soon extinguished all hope of getting free before the summer of this year.

SIR THOMAS MACLEAR, F.R.S.

THE last Cape mail brought intelligence of the death of Sir Thomas Maclear, which took place at his residence, Mowbray, near Capetown, on July 14.

Sir Thomas Maclear was a son of the late Mr. James Maclear, of the County of Tyrone, and was educated at Winchester. He was originally destined for the medical profession, but, after settling at Biggleswade, we find him occupying himself in astronomical pursuits. He joined the Astronomical Society in 1828, and erected a small observatory at Biggleswade, which contained the Wollaston telescope, lent by the Society, with which he observed many occultations and other phenomena. He also engaged upon astronomical calculations, chiefly for the prediction of occultations. In conjunction with Henderson he computed the circumstances of the occultations of Aldebaran for ten European observatories in 1829–31, and himself calculated such of the occultations in 1833, about 100 in number, as were visible at Greenwich, for the supplement to the *Nautical Almanac* of that year. On Henderson's retirement from the direction of the Royal Observatory at the Cape of Good Hope, Maclear was appointed his successor, and entered upon the office in January 1834. Of the great number of observations made during his superintendence a portion only have as yet been published. He entered upon an undertaking of the importance of which there cannot be two opinions—the verification of Lacaille's arc of the meridian, but it was allowed to disorganise the regular work of the observatory to a serious extent. The observations by Maclear and his assistant in 1834 were speedily reduced and published, and various series of observations of comets when beyond reach at the northern observatories, have appeared in the *Memoirs* of the Royal Astronomical Society, where also have been published his determinations of the parallax of α and β Centauri, the latter of which had not been previously investigated, and there are memoirs on other subjects. The field work for the re-measurement of Lacaille's arc was completed in 1847, but from various delays the results were not published until 1866, when they appeared in two quarto volumes, under the editorship of Sir George Airy. The time occupied upon this work prevented the reduction and publication of the meridian observations; so that on Mr. Stone's arrival at the Cape in 1870 (as successor to Maclear on his retirement) he states he found himself "confronted with the results of thirty-six years of miscellaneous observing, in all stages of reduction."

Acting upon his official instructions Mr. Stone completed the reductions and published in several volumes the results of the observations with the new transit-circle from 1856 to 1860 inclusive; there remain still unpublished the observations from 1834 to 1855 with the old instruments, and those from 1861 to 1869 with the new one. Of the large number accumulated in the former period, the places of southern stars will still be of value for proper motions, but Mr. Stone has expressed a doubt whether "the immense number of observations of well-known stars" made with the old instruments would now repay the labour of reduction.

Maclear was knighted in 1860. He had been a Fellow of the Royal Society since 1831, and was elected a Correspondent of the Institute of France in 1863 in place of the American astronomer Bond; in 1867 the Lalande medal was awarded him by the Academy of Sciences, and in 1869 he received one of the Royal medals annually adjudged by the Royal Society.

We are informed that at Sir Thomas Maclear's funeral, on July 16, all the principal residents in the colony were present. The Cape Parliament has passed a resolution or memorandum acknowledging the work he did for the colony.

A POINT AFFECTING THE DIFFUSION OF THE GASES OF THE ATMOSPHERE IN RELATION TO HEALTH

THE great importance in relation to health of the part played by the internal motion of gases, as indicated by the now established and admirably simple kinetic theory, would seem scarcely to receive adequate appreciation. The old and vaguely developed statical idea of a stagnant atmosphere with molecules at rest, has given place to the opposite view of a high activity of motion, even when the atmosphere appears to the senses to be still. By this motion noxious vapours or gases, instead of remaining stagnant, are rapidly scattered by diffusion, and thereby rendered harmless. The part apparently played here by inequality of molecular *velocity* (dependent on inequality of molecular mass) in contributing to this end, would seem scarcely to have received the attention it appears to deserve. In Prof. Tait's work, "Lectures on some Recent Advances in Physical Science" (p. 237, second edition), reference is made to the diffusion of the gases of the atmosphere under the kinetic theory, and here it would seem as if the influence of the *inequality* of the normal velocity of the molecules of the different gases of the atmosphere (dependent on inequality of molecular mass) had not been taken into account, and hence it would appear as if the gases in their mutual diffusion were regarded as subject to the pure contingencies of chance, as they would be if the velocities of the molecules were equal (or their masses equal); this necessarily leading to some rather startling conclusions, which make the continuance of life and health (as dependent on the equable mixture of the constituents of the atmosphere) a matter more or less dependent on contingency or accident. The passage in question runs as follows:—

"There is another extremely important point of this statistical question as to the particles of gases which I must carefully explain; and it is this, how it happens that in the enormous bulk of the whole atmosphere of the earth these particles of oxygen and nitrogen, moving about amongst one another, should not by chance, at some place or other, operate on one another in such a way that in some particular cubic inch the particles of nitrogen might for a moment expel from it all the particles of oxygen, so that in virtue of the great extent of the earth's atmosphere, compared with the size of a particle of gas, there might be at some definite instant a region filled mainly with nitrogen, and other regions filled mainly with oxygen. Now the beauty of this statistical method is that it explains to us how such an event, though perfectly possible, can never occur. It is a thing which is itself absolutely possible, but it never can occur in practice, because the probability of its occurrence is so exceedingly small. There is a probability (numerically measurable) for everything which is possible, but if that probability (reckoned in numbers) is as small as the probability of the accident we are considering, we never expect to find it occur. And not only do we never expect to find it at any time, but we can say boldly from experience that it is never met with at all, however long our observations are conducted, or through however great an extent of space we conduct them. If you had originally in a box divided into two equal parts, nitrogen in the one part and oxygen in the other, and then allowed them to mix with one another, the probability that in any assigned time you could find all the nitrogen back again in the space where it was originally, and all the oxygen back again in the space where it was originally, is certainly one which can be measured, but it is one which is so infinitesimally small that we know perfectly by experience that it can never be realised."

The above appears a somewhat unsatisfactory conclusion to contemplate, and there would seem to be something scarcely consistent in the inference that an event which is itself absolutely possible never can occur in practice, "because the probability of its occurrence is so exceedingly small." For we know from the doctrine of probabilities that an event of chance (if possible at all) *must* occur, if the range of time be not restricted, or at least its probability approaches with *indefinite* closeness to absolute certainty in that case. That the probability, for example, of suffocation in a room [taking the above illustration of a box on a large scale] within a given range of time, by the oxygen separating itself sufficiently from the nitrogen, could be rigidly calculated, seems scarcely pleasant to contemplate, however remote the contingency might be, and it is hardly satisfactory to think that the contingency of such an event approaches with indefinite nearness to absolute certainty if an adequate *time* be conceded. The very fact that considering the vast extent of the atmosphere and the range of historic time, no record whatever exists of any irregularity having been detected in the constitution of the atmosphere, would surely be strong argument for the existence of some physical cause tending to prevent such irregularity from occurring, and removing it from the pure contingencies of chance. The above quotation that—"we can boldly say from experience that it [*i.e.* the irregularity] is never met with at all, however long our observations are conducted"—would surely tend to prove that some preventive means existed.

If the molecules of nitrogen and oxygen of a mass of air confined in a room were supposed subject to the pure contingencies of chance in their mutual actions in diffusion, they would be comparable to a number of equal perfectly elastic black and white balls imagined to be moving and colliding freely among themselves, or left to their own dynamics in an analogous manner. In this case there would evidently be practically an infinite number of chances against the molecules of the two gases (represented by the two differently coloured sets of balls) from becoming uniformly diffused through the room; indeed the probability of this event would be exactly the same as the probability of the oxygen being all separated in one part of the room and the nitrogen in the other (or in analogy all the black balls separated from the white); for we know that, according to the doctrine of probabilities, every *assigned* arrangement for all the balls is equally probable.

I venture to suggest that the inequality in the *mean velocity* of the molecules of the two gases (dependent on the inequality of the masses of the molecules) plays an important part here. If this particular point has been considered elsewhere (without my knowledge), I may still perhaps give an elementary analysis of the problem, as it has occurred to me. It may be remarked that on account of the simplicity of the kinetic theory, its problems frequently admit of elementary treatment, and it will at least be admitted that wherever this is practicable, perspicuity does not lose thereby. We will imagine for illustration a portion (say spherical shaped) of pure oxygen gas to be at a given instant of time surrounded by an atmosphere of hydrogen. [We may neglect the existence of gravity, for simplicity, as it does not affect the point with which we have to deal.] Then diffusion at once commences. The molecules of hydrogen which have one-sixteenth less mass, are known to possess a normal velocity four times that of the molecules of oxygen. The molecules of hydrogen by their own normal motion will therefore rush into this spherical space occupied by the oxygen, four times as fast as the molecules of oxygen can move out by their natural motion. Owing to this inequality in the rate of exchange of places of the two gases, the mass of gas occupying the spherical space will begin to increase in density, and (for

a converse cause) the gas surrounding the spherical space will diminish in density to a corresponding amount. This initial irregularity of density will cause an initial irregularity of pressure, which will tend at once forcibly to readjust itself, and will do so by the gaseous mixture within the spherical space expanding,[1] and an exchange of energy (or "heat") taking place between the two gases—which abnormal state of things can only cease when the two gases become uniformly mixed, and consequently the dynamical conditions become symmetrical in all parts of the mixture. Owing to the absence of dynamical equilibrium in the case of two gases having different molecular velocities, *unless* the gases are uniformly mixed, there is therefore a forcible dynamical tendency to produce uniform mixture, and to maintain it against disturbing causes, when once the mixture has become uniform. When the molecules of the two gases possess unequal normal velocities (attendant on inequality of mass), it is evident that the distribution of velocities can be symmetrical throughout the mixture, *only* in that case where the mixture is uniform. If, on the other hand, the molecules of the two gases possessed the *same* normal velocities (due to equality of molecular mass), there would be no dynamical cause for any particular mixture more than another, or every assigned mixture (regular or irregular) would be equally probable: for the distribution of the velocities would be symmetrical or uniform, whatever the mixture might be. Taking our illustration of the spherical portion of gas, and supposing the gas surrounding it (though chemically different) to have *equal* molecular velocity, then the exchange of molecules between the gases would take place at the same rate, and consequently there would be no disturbance of the equilibrium of pressure at all, but one mixture would be as possible as another, and the distribution of the velocities would be symmetrical whatever the mixture might be.[2] In fact, it would resemble the case of the diffusion of two portions of one and the same gas into each other.

Thus it would appear that the fact of the molecules of the constituent gases of the atmosphere possessing unequal normal velocities (due to inequality of molecular mass) tends, through the dynamic action of the molecules, to produce and maintain forcibly a uniform mixture of these gases, and to prevent those detrimental irregularities of mixture that would inevitably occur (by a sufficient range of time and space), if the constituent gases of the atmosphere were of *equal* molecular masses, and consequently diffusion were brought under the pure contingencies of chance.

I have ventured to call attention to this point from its apparent importance, and as the passage above quoted would have the appearance at least of treating the problem as one of pure chances, or as if the influence of the *inequality* in molecular velocity had not been taken into account, but I shall be glad to accept correction if I am wrong.

The fact of the two gases of the atmosphere possessing unequal molecular masses would evidently seem to be of importance as a means for scattering and thereby rendering harmless, noxious vapours and gases which are emitted into the atmosphere. For even if the particular vapour (in a rare case) happened to be of the same molecular mass as one of the constituents of the atmosphere, it must differ from that of the other constituent, and thus a dynamical cause for dispersion exists. The considerable inequality in molecular mass of the most prevalent deleterious ingredient emitted in combustion and in the course of animal life (carbonic acid) thus ensures its dispersion.

In a paper published in the *Phil. Mag.* for April, 1875, by Lord Rayleigh—"On the Work that may be gained during the Mixing of Gases"—it was pointed out that work may be derived from gases in an unmixed state, and a special method for effecting this end was described. In two papers communicated by me to NATURE (vol. xvii. pp. 31 and 202), I, being at that time unaware of Lord Rayleigh's memoir, indicated a simple mechanical means of deriving work from unmixed gases by the use of porous diaphragms. If we imagine a cylinder, into the piston of which a disk or diaphragm of some porous substance (say plumbago) is fixed, and that two gases of unequal molecular masses (oxygen and hydrogen, for instance) are introduced into the opposite compartments of the cylinder, then diffusion commences in the known manner through the porous diaphragm. Owing to the inequality in the normal velocities of the molecules of the two gases, they pass through the pores of the diaphragm at unequal rates, thereby entailing an inequality of pressure on the two sides of the diaphragm. If then the piston (containing the diaphragm) be suddenly released, it will be driven towards the opposite end of the cylinder, and work may thus be derived. [A simple automatic device for continuing the work by a constant supply of gas was described in NATURE, vol. xvii. p. 204.] Although the work is here derived in a self-acting manner, solely at the expense of the normal temperature heat possessed by the gas, yet this would not apparently be out of harmony with the second law of thermodynamics [as the writer at first supposed]; for it appears that for such to be the case, the process would require to be a *reversible* one, or the gases would require to be restored again to their original unmixed state. But if it were possible that the gases could effect this themselves, or become unmixed by their mere action upon each other, and the probability, that in any assigned time we should find all the oxygen back again in the one half of the cylinder, where it was originally, and all the hydrogen back again in the other half, is one which can be measured (however remote this probability might be); then we should have a possible means of deriving work at the expense of normal temperature heat by a process that was self-reversible. Hence this result to which we are led would serve to confirm the above view, viz., that when gases are of *unequal* molecular masses, there is a forcible dynamical tendency to keep them mixed, or to prevent the gases from becoming separated again when once they have become mixed.

There would seem to be another consideration bearing directly on the above case. It was a law enunciated by Dalton that when gases of different kinds are placed in the same vessel, "each gas behaves to the other as if it were a vacuum." This, when viewed by the light of the modern dynamical theory, is no doubt true as regards the fact that the total pressure on the sides of the vessel is the sum of the pressures which each gas would exert independently if placed by itself in the vessel. But if the expression "that one gas behaves to another as a vacuum" were taken to refer to the *arrangement* of the gas in the vessel, then some modification would appear to be required in the statement of the law in the case where the different gases are of *equal* molecular masses (as also where portions of gas of the same kind are successively introduced into the vessel). For it appears from the above considerations that gases do not *necessarily* become uniformly mixed by the action of diffusion, excepting when the gases are of *unequal* molecular masses. For portions of gas of equal molecular masses behave to each other as portions of gas of the same kind. If we imagine (merely for illustration) the molecules of a portion of gas to be *marked*, and this portion of gas to be introduced into a vessel where already gas of the same kind exists, then it is evident that there

[1] The expansion may be seen by inclosing the oxygen in any elastic porous envelope, capable of expansion, and through which diffusion can freely take place. It may be observed that unmixed gases (of *unequal* molecular masses, of course) are known to possess a capacity for work, which ceases when the gases become uniformly mixed.

[2] It is conceivable that although the mean velocities or masses might be the same, the mean length of path of the molecules of the two gases might be slightly different. We must therefore either suppose a case where it is the same, or if minute exactness be desired, take it into account.

are an indefinite number of positions these marked molecules (representing the portion of introduced gas) could take up in the vessel, consistent with equilibrium, and there would be (practically) an infinite number of chances against the portion of introduced gas arranging itself as in a vacuum: for to do this, the marked molecules (composing the portion of gas) would require to arrange themselves in such a way that their mean distance is everywhere the same throughout the vessel, a contingency almost infinitely unlikely. What applies to marked molecules applies to chemically different molecules of *equal* mass, or which are *dynamically* similar. Hence it would follow that portions of gas of the same kind, or portions of chemically different gases of equal molecular mass could not be said "to behave to each other as vacua," in regard to *arrangement*. On the other hand, where the gases have unequal molecular masses there is (as we have seen) a forcible dynamical tendency for the gases to diffuse themselves symmetrically through each other, so that each gas behaves to the other as a vacuum, each gas becoming uniformly diffused through the vessel, as if it existed alone in a vacuum. The successive introduction into a vessel of portions of gas of the same kind (or of portions of chemically different gases of equal molecular mass) may be compared to the introduction into any closed space of successive sets of equal differently coloured perfectly elastic balls (the balls being supposed left in free motion among each other in analogy with the molecules of a gas), when evidently no one arrangement of the different coloured balls in the closed space (at any given instant) could be said to be more probable than another, and it would be extremely unlikely that the sets of coloured balls should "behave to each other as vacua," in the sense of each set diffusing itself symmetrically through the closed space, as it would do in a vacuum. But if the sets of balls were of *unequal* masses [in analogy to gases of unequal molecular masses], then no doubt the different sets would behave to each other as vacua, or each set would forcibly tend to arrange itself according to strict dynamical principles, so as to pervade uniformly the entire closed space, precisely as it would do a vacuum.

S. TOLVER PRESTON

OBSERVATIONS ON THE PHYSICAL GEOGRAPHY AND GEOLOGY OF MADAGASCAR

ALTHOUGH Madagascar is known to be the third largest island in the world, its actual size and extent is not very generally understood. It is easy to see how misconception on this point arises, for in maps the island is usually seen only in connection with Africa, and that great continent is so large that it dwarfs by comparison with itself everything in its near neighbourhood, so that the really large island sheltering under its south-eastern side appears but an inconsiderable appendage to its vast neighbour. If, however, we take a good-sized map of Madagascar, and put by its side the outline, to the same scale, of another country with whose dimensions we are familiar, such, for instance, as England, we begin to realise how important an island it is as regards size, being nearly 1,000 miles long[1] by about 250 in average breadth, so that it is nearly four times as large as England and Wales.

During the last ten years much light has been thrown upon the physical geography of Madagascar, principally through the researches of M. Alfred Grandidier, and the numerous exploratory journeys made in various parts of the country by missionaries and others. Until a very recent period there was no reliable map of the island; a number of mountain ranges were shown in positions where no such geographical features are to be found, and the physical geography was completely misunderstood. But it is now quite clear that instead of a "central mountain chain," as described in most histories and gazetteers, there is *an elevated mountainous region*, which, however, does not occupy the centre of the island, but is more to the east and north, leaving a considerable extent of country to the west, and all beyond the 23rd parallel of south latitude, at a much lower level above the sea. Broadly speaking, therefore, Madagascar consists of two great divisions, viz., (1) an elevated interior region raised from 3,000 to 5,000 feet above the sea-level; and (2) a comparatively level country surrounding it, not much exceeding 400 or 500 feet in elevation, and most extensive in the west and south.

The elevated region is largely composed of primary and crystalline rocks. Lines of hills traverse it in all directions, but they do not rise to a very great height, the highest points in the country, the peaks of the Ankàratra group of mountains, being a little under 9,000 feet above the sea-level. A very large extent of this portion of Madagascar is covered with bright red clay, through which the granite and basaltic rocks protrude. But there are also extensive rice-plains, especially near the capital cities of the two chief provinces, where there is a rich black alluvial soil; and it can hardly be doubted that some at least of these plains, from their perfect level, out of which the red clay hills rise like islands, have formerly been the beds of extensive lakes, subsequently drained, possibly by slight changes in the level through subterranean action.

A good deal of this portion of Madagascar is bare and somewhat dreary-looking country. The long rolling moor-like hills are only covered with a coarse grass, which becomes very brown and dry towards the close of the seven months' rainless season; but the hollows and river-valleys are often filled with a luxuriant tropical vegetation, and, wherever there is population, with the bright green of the rice-fields. There is, nevertheless, an element of grandeur in the landscape, from the great extent of country visible from many points in the clear, pure atmosphere, which renders very distant objects wonderfully sharp and distinct. And many portions of the central region possess still greater claims to admiration from its picturesque mountain scenery.

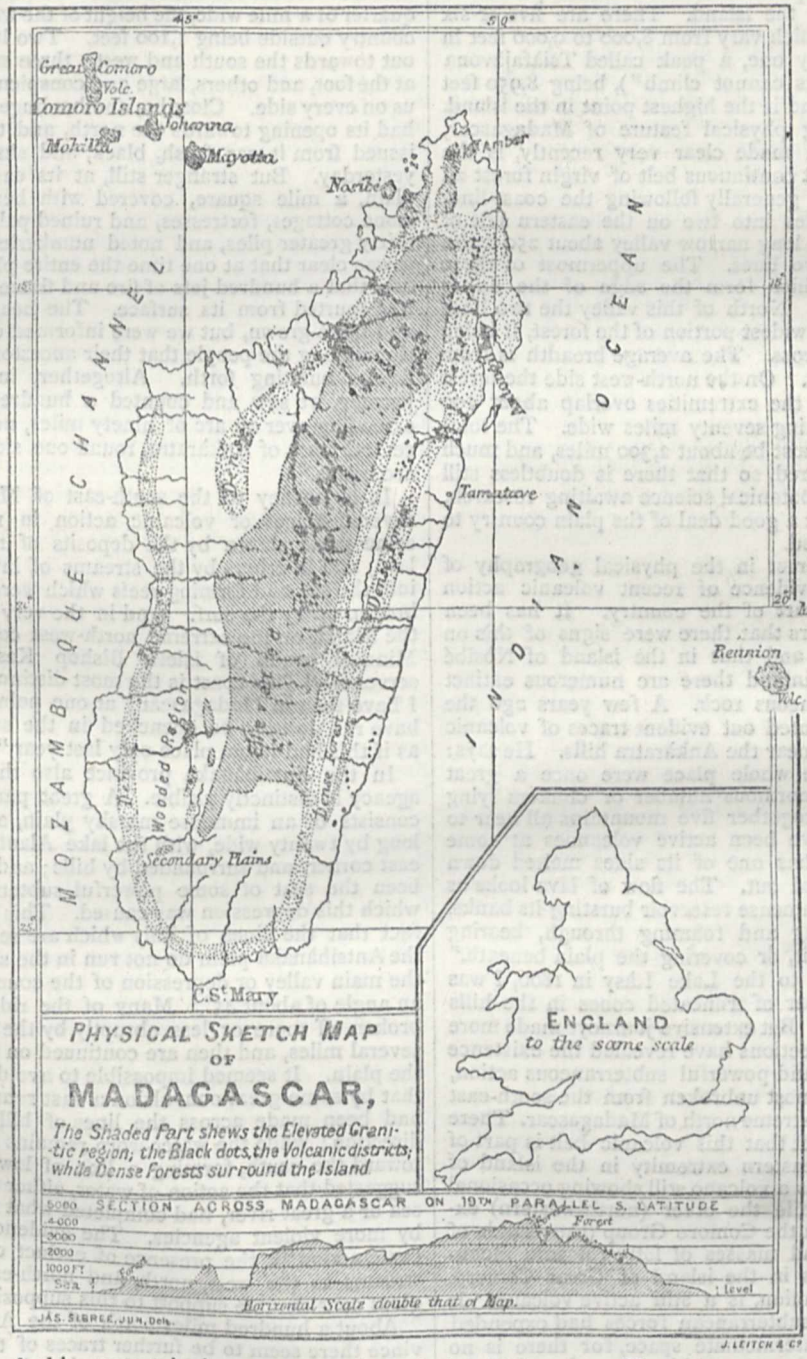
In the southern Bétsiléo country, the grand and varied forms of the mountains filled me with an exultant kind of delight. To the south was a crowd of mountain-tops, peak beyond peak, with the greatest variety of outline: one had the appearance of a colossal truncated spire, another had a jagged saw-like ridge, another was like a pyramid with successive steps, and another an enormous dome. Their summits were never long free from clouds, and many of the peaks must be at least 3,000 feet above the plain.

Sections taken by the aneroid across this elevated region from east to west at the latitude of the capital show that it has a depression in the centre, the edges on either side being considerably higher than the country between them. At some points this height of 4,000 to 5,000 feet is gained by a series of steps from the maritime plains, each range of hills rising higher and higher, while at other points it descends almost at one steep slope for nearly 3,000 feet. The water-shed is not in the centre of the island, but is much nearer the eastern side. Through the eastern wall many of the rivers cut their way by magnificent gorges, amidst dense forest, finding their way to the sea by a succession of rapids and cataracts, and occasionally by stupendous falls, as in the case of the Màtitànana river, which descends at one plunge 500 or 600 feet. Some of the western rivers, also, are said to form grand waterfalls, particularly that of the Mania, whose sound is reported to be heard at a distance of two days' journey, *i.e.*, about forty to fifty miles.

The lower region of Madagascar consists of extensive plains only a few hundred feet above the sea-level, but there are at least three prominent chains of hills traversing it from north to south, one of which appears nearly

[1] More exactly, 975 miles.

continuous in a very straight line for above 600 miles. The eastern side of the island is for the greater part of its extent without any bay or inlet, but the north-western side is deeply indented with large bays, into which the chief rivers fall. This part of the coast is bold and mountainous, and some of the finest scenery in Madagascar is to be found here, as the northern extremity of the volcanic region forms several very grand mountains, particularly the one called Amber or Ambòhitra. This is said to be about 6,000 feet high, and from its isolated position in the low country surrounding it, is a remarkably majestic hill as seen from every direction, as well as from far out to sea.[1] It has three summits, and its sides are clothed with impenetrable woods.



South-west of this mountain is a remarkable rock-fortress of the tribe inhabiting this portion of the country, who are called Antankàrana, that is, "the people of the rocks." It is an enormous, lofty, and precipitous rock, having an elevation of nearly 1,000 feet, and covering an area of about eight square miles. Its sides are so steep that they cannot be climbed unless artificial means are used, and it is thickly wooded wherever trees can possibly grow. The only entrance into the interior of the rock, which is full of caves, is by means of a subterranean passage, a portion of which is extremely narrow, allowing only a single person to pass along it at a time, and has on each side of it deep water.

The other principal group of mountains in Madagascar

[1] According to a French engineer's estimate, it considerably exceeds the above given altitude, being, so he says, 2,700 metres high.

is the great mass of elevated peaks called Ankàratra, in the central province. This has hardly the grand appearance of Mount Amber (although it considerably exceeds the latter in absolute height), since it rises from the elevated region of Imérina, which is at the capital about 4,000 feet above the sea-level. Ankàratra is nevertheless a noble group of hills, and is the most conspicuous feature of the landscape over a considerable portion of the central regions of the island. There are five or six principal summits, which vary from 8,000 to 9,000 feet in height, the most lofty one, a peak called Tsiàfajàvona ("that which the mists cannot climb"), being 8,950 feet above the sea-level, and is the highest point in the island.

Another interesting physical feature of Madagascar, which has only been made clear very recently, is the existence of an almost continuous belt of virgin forest all round the island, and generally following the coast-line. This forest-belt divides into two on the eastern side of the country, leaving a long narrow valley about 250 miles long between the two lines. The uppermost of these clothes the slopes which form the edge of the upper plateau of the island. North of this valley the two lines unite, and here is the widest portion of the forest, it being about forty miles across. The average breadth is from fifteen to twenty miles. On the north-west side the forest is not continuous, but the extremities overlap about 100 miles, leaving an opening seventy miles wide. The total length of this forest must be about 2,300 miles, and much of this is yet unexplored, so that there is doubtless still much of interest in botanical science awaiting research. Besides the forest-belt a good deal of the plain country to the west is well wooded.

A third fact of interest in the physical geography of Madagascar is the evidence of recent volcanic action throughout a great part of the country. It has been known for several years that there were signs of this on the north-west coast, and that in the island of Nòsibé and the adjacent mainland there are numerous extinct craters and much igneous rock. A few years ago the Rev. T. Campbell pointed out evident traces of volcanic agency in the district near the Ankàratra hills. He says: "It seemed as if the whole place were once a great smeltery, from the enormous number of clinkers lying about. There are altogether five mountains all near to each other, which have been active volcanoes at some remote period; each has one of its sides melted down and the inside hollowed out. The flow of lava looks as if it had been some immense reservoir bursting its banks, and the water dashing and foaming through, bearing everything away with it, or covering the plain beneath."

In a journey I took to the Lake Itàsy in 1866, I was struck with the number of truncated cones in the hills surrounding the lake. But extensive journeys made more recently in various directions have revealed the existence of a very widespread and powerful subterraneous action, probably extending almost unbroken from the south-east to the north-west and extreme north of Madagascar. There seems reason to suspect that this volcanic belt is part of a line which has its eastern extremity in the island of Réunion, where there is a volcano still showing occasional signs of activity; while the other (north-western) extremity passes through the Comoro Group (the islands of which consist of grand masses of lofty volcanic mountains), and terminates in the island of Great Comoro, where also, as in Réunion, is a still active volcano. It would seem as if the subterranean forces had expended their energy in the intermediate space, for there is no active volcano in Madagascar, while at each end of the line their presence is still occasionally felt. There are, however, signs of not altogether extinct forces in Madagascar in the slight earthquake-shocks which are felt almost every year, and in the hot springs of various kinds which occur in many parts of the country.

A large number of extinct volcanoes are found west of Lake Itàsy. These are thus described by Dr. Mullens :— "When we ascended the lofty hill overhanging the western end of the lake, crater after crater met our astonished gaze. There were forty in all, of which we were sure; we think there were others beyond to the north." "Fifty miles further south we came on the volcanoes again. We climbed a lofty rounded hill called Ivòko, and then found that we were on the crater wall. The inner hollow was a quarter of a mile wide, the height of the wall above the level country outside being 1,100 feet. Two lava streams went out towards the south and west; three small craters were at the foot, and others, large and conspicuous, were around us on every side. Close by, another huge crater, Iatsìfitra, had its opening towards the north, and the lava that had issued from it was fresh, black, and sharp, as if broken yesterday. But stranger still, at its eastern side was a plain, a mile square, covered with heaps of lava, like stone cottages, fortresses, and ruined palaces. I counted thirty greater piles, and noted numberless smaller ones; it was clear that at one time the entire plain had been on fire, that a hundred jets of fire and flame and molten lava had spurted from its surface. The heaps were now old and moss-grown, but we were informed of a vague tradition among the people that their ancestors had seen these flames bursting forth. Altogether, in that important journey, we saw and counted a hundred extinct craters, extending over an arc of ninety miles, not reckoning the central mass of Ankàratra, round one side of which that arc bends."[1]

In a journey to the south-east of Madagascar I discovered traces of volcanic action in many places; in some parts shown by the deposits of rolled pebbles of lava, and in others by the streams of lava rock running into the sea and forming reefs which were gradually being broken up by the surf. And in the very opposite part of the island, on the extreme north-west coast opposite the Minnow group of islets, Bishop Kestell-Cornish observes :—"This coast is the most distinctly volcanic that I have seen in Madagascar; at one point the lava must have run down to be quenched in the sea, and it looked as if this had taken place only last year."

In the Antsihànaka province also the same plutonic agency is distinctly visible. A great part of this region consists of an immense marshy plain, about forty miles long by twenty wide, with the lake Alaotra at its north-east corner, and surrounded by hills; and it has evidently been the seat of some powerful subterranean force by which this depression was caused. This is clear from the fact that the lines of hills which are seen on both sides the Antsihànaka plain do not run in the same direction as the main valley or depression of the country, but cut it at an angle of about 45°. Many of the ridges seem to be broken off more or less abruptly by the level ground for several miles, and then are continued on the other side of the plain. It seemed impossible to avoid the conclusion that by some great convulsion a vast rent and depression had been made across the lines of hills in a diagonal direction; while the water-worn remains of some of these toward the south, forming a line of low detached hills, suggested that the action of water, either as an arm of the sea or a great river, had completed what was commenced by more violent agencies. The evidence of former volcanic action in the presence of extinct craters and lava streams to the west, north, and north-east of the plain, gives considerable support to this supposition.

About a hundred miles north of the Antsihànaka province there seem to be further traces of the same agency. The Rev. J. A. Houlder thus describes a remarkable valley called Màndritsàra, which, until he saw it in 1876, was unknown to Europeans even by name, and not marked upon any map :—"It is a great basin, or rather a mighty elongated pit, sunk deep down among the surrounding heights. It is about thirty miles long and

[1] *Proc.* Roy. Geogr. Soc., January 25, 1875, pp. 187, 188.

nearly 2,000 feet below the level of the country east and west of it. Dante would have imagined it, not a 'circle' certainly, but a remnant of some region of the horrible pit itself, which for a wise and gracious purpose had been gently touched by the cooling breath of heaven. There had evidently been a great commotion going on there in the ages gone by; for all the long valley was dotted with rounded hills, giving it the look of boiling water or bubbling pitch, which by some strange process had suddenly become congealed."

It will therefore be seen that igneous agency has been a powerful factor in shaping the physical geography of many portions of Madagascar; in few places could that agency have been present in a grander scale than in the volcanic region of which Madagascar is the centre, and the Comoro and Mascarene groups the extreme points in either direction. An attempt has been made in the accompanying sketch-map to show the prominent features of the physical geography of the island already noted. Probably closer examination would show that the detached groups of extinct craters are all connected by intermediate links, so as to form a continuous line of igneous disturbance from the extreme northern point of Madagascar to at least as far south as the 23rd parallel; and from the appearance of a line of hills seen at a distance south of this latitude, I am strongly inclined to believe that there has been subterranean agency at work even beyond the upper granitic plateaux, but no examination has yet been made of this southernmost region.

With regard to the geology of Madagascar, but little is at present known with any exactness, for no competent geologist has yet made a systematic exploration of the country. There are, however, a few facts of a general character which have been noted by various observers, and these may be here collected together as a slight contribution to a knowledge of this subject pending a more complete and scientific treatment of it.

As already mentioned, the elevated region which forms so large a part of the central, northern, and eastern portions of the island is largely composed of primary and igneous rocks. Granite, gneiss, mica schist, and basalt are present almost all through this high region, and generally form the loftiest points in the country. In a single hill there is often a considerable variety of rock both in colour and texture: granite of various shades of grey, red, and rose-colour, with the constituent parts both fine and coarse. Veins of quartz, running both through these and the clays by which they are overlaid, are often met with, and very fine specimens of rock crystal are frequently found. A hard whitish stone, which has some resemblance to the Yorkshire stone called Bramley Fall, is used in Antanànarivo for public buildings, as well as for the native tombs.

The lower hills, as well as the high moors, are usually composed of a bright red clay, but below the surface this often seems to pass into a light pink or white earth resembling kaolin or china clay. This frequent change of colour would lead one to infer that atmospheric influences have something to do with the difference between the surface clay and that exposed in the numerous precipitous clefts which the rains excavate on the hill-sides. In many places the material found amongst the rock seems exactly like granite in its constituent parts, but without the cementing elements, so that it can be cut quite easily by a spade. The red clay is sometimes varied by a light brown clay on the hills, while the plains and valleys are filled with rich alluvial clays, blue and black in colour. In all these clays there is an apparently total absence of all organic remains, either animal or vegetable, so that it is not an easy task to determine their geological age, and there is little sign of stratification, although I have detected some appearance of this in the rocks, with tilting of the strata.

In this elevated region there seem to be few, if any, sedimentary rocks of a more recent age than the primary ones which are so prominent a feature of it. A soft dark red stone is found in some places, but this appears to be only a hardened clay. Columnar basalt has been noticed in two or three places, as well as extensive beds of volcanic ash, decomposed lava, scoria, and lava rock of all varieties of hardness, in some of which crystals of olivine are found in abundance.

At one point, however, in the upper region of the island a limestone deposit occurs. This is at Sìrabé, to the south-west of the Ankàratra mountains, and from the pits dug here most of the lime used for building in the central province is procured. It has not yet been examined by any one with competent scientific knowledge, but it appears to be a sulphate of lime, and is probably only a local deposit and not a stratified rock, and most likely is connected with the subterranean action so visible all around the district.

Clay slate is met with in the southern part of this elevated region; and in the Bétsiléo country a valuable slate, suitable both for building and for writing upon, is found, although it has not yet been worked to any extent. According to some accounts, greywacke or whinstone, silex, and chert with chalcedony, are also met with in the southern highlands.

From certain of the facts above given, as well as from other considerations, it appears highly probable that the extensive elevated region of Madagascar is very ancient land, and has most likely remained for many ages above the waters of the Indian Ocean; otherwise, some trace of marine deposits would surely be found in some portion of this great extent of country. I may, however, here note the fact that there are in some places such rounded boulder-like masses of blue basalt rock, sometimes on the surface and sometimes partially embedded in the soil, that did these occur in the temperate zone, one would certainly ascribe them to glacial action; but the point requires fuller investigation, and possibly some other solution may be given to the rather puzzling inquiry suggested. But in travelling to the north-west coast, as we got near the sea-level, we met with boulders composed of rock which certainly is not found *in situ* anywhere near the spot where these boulders occur, but has come from far away in the interior.

With regard to the lower region of Madagascar—the extensive plains to the west and south of the island, as well as the narrower extent of country on the east coast—we have a little more definite information as to the geology of some portions of it. This division of the country is only as many *hundreds* of feet above the sea as the granitic region is *thousands* of feet; and there we find not only deposits of the later Tertiary epochs, containing fossils of animals but recently extinct, but also fossils of the Secondary age. This fact was first pointed out by M. Grandidier, who, in speaking of the south and west portions of the country, says: "*Nerinea* and other characteristic fossils of the Jurassic formation which I have there collected prove the existence of Secondary strata, which cover a vast extent of this island" (*Bull. de la Soc. de Géog.*, août, 1871, p. 88). In a later number of the same publication (avril, 1872) he also speaks of an extensive "terrain nummulitique parfaitement charactérisé par des *Neritina schmideliana*, et pétri de foraminifères appartenant aux genres *Alveolina, Orbitoïdes, Triloculina*, &c." This is confirmed by the fossils discovered in the south-west of Madagascar, in the upper part of the valley of the St. Augustine river, by the Rev. J. Richardson in 1877. These occur in vast numbers, and from a drawing he gives appear to belong to the Neocomian formation, and are species of the genera *Ammonites, Terebratula, Nerinea* or *Turritella, Einoceramus*, and *Rhynconella*, together with an *Echinoderm*.

It is evident also that there are deposits of a much later date than the above, for in the south-west of Mada-

gascar M. Grandidier discovered the fossil remains of a hippopotamus (a pachyderm not now living in the island), of gigantic tortoises (which are now only found in the little island of Aldebra to the north of Madagascar), and of the probably very recently extinct struthious bird, the *Æpyornis maximus*, whose egg (12¼ in. × 9¼ in.) so far exceeds that of any other known bird. It seems highly probable, therefore, that a systematic examination of these less elevated portions of Madagascar would reveal the existence of much that is interesting both in palæontology and geology, and so light would be thrown upon many problems connected with the anomalous animal life of the country and of the neighbouring islands in the Indian Ocean. It is evident that these maritime plains were under water during portions at least of the Secondary period, at which epoch the high granitic region alone formed the Island of Madagascar, then a country probably only a third of its present extent.

Dr. Auguste Vinson speaks of seeing yellow sandstone on the eastern coast, and he also describes the plain between the two eastern lines of forest as being composed of beds of sedimentary formations, "rich in fossil remains." Unfortunately he gives no particulars as to these alleged extinct organisms, so we are still in the dark as to the geological age of these formations. In sailing down the river Bétsibòka to the north-west coast, I noticed at one point that for a considerable distance the river bank was formed by layers of yellowish sandstone closely resembling a low wall of masonry. Some of the courses appeared much weathered, while others had a smooth face as if of much harder materials.

From the account given by an intelligent native of some rocks in the western part of Madagascar, and a little to the south of the centre, a conglomerate seems to be found there, for he describes hard rocks of great size as being filled as thickly as possible with rolled pebbles of all dimensions and shapes. He also mentions that near the sea he found a hard black stone which rang like iron, and was full of shells in good preservation and appearance. Unfortunately he too brought no specimens for examination.

A little more information as to the geology of Madagascar is found in papers contributed to scientific periodicals in England and France several years ago. The earliest of these is by the late Dr. Buckland, who, in a "Notice on the Geological Structure of a Part of the Island of Madagascar" [1] (Port Louquez, near the northern extremity), describes a sandstone without fossils, which he compares to the New Red Sandstone, and in which are intercalated trap-rocks similar to those of Antrim in Ireland.

As to the north-west side of Madagascar, in the *Annales des Mines* (1854, 5me série, t. vi. pp. 570-576) there is a paper on the discovery of beds of lignite both in the island of Nòsibé and at two points on the north-west coast. In the opinion of the officers who made the exploration the beds of this combustible are more ancient than the Tertiary formation. It is contained in layers of sandstone and clay schists, is fibrous, and shining, and burns readily with a long and white flame, leaving little ash. If beds of this lignite should be discovered in greater thickness it will therefore be valuable both as steam coal and for use in the industrial arts.

In the same French publication of a little later date (5me série, t. viii., 1856) there is an "Essai sur la Géologie de Nòsibé," in which the soil of that island is described as consisting of three different groups of strata:—(1) granitic rock, gneiss, mica-schist, slaty-schist, and plastic clay; (2) red and yellow sandstones, traversed by veins of gneiss and quartz; while (3) is essentially volcanic, consisting of basaltic and trap lavas, overlaid in some places by beds of sandy material, tuffs, and volcanic *rappilis*. The essay is accompanied by a complete geological map.

[1] *Trans.* Geol. Soc. London, vol. v. p. 478.

Since the date of this last paper some further attention has been paid to this part of the country in connection with the French Company proposed by M. Lambert,[1] but hardly anything more has been done towards a scientific examination of other portions of Madagascar except a slight notice of the peninsula inclosing Antongil Bay,[2] although probably M. Grandidier will have some fresh information in his great work now in progress.

It may be here observed that a reef barrier of coral extends for at least 350 miles along the east coast, varying in its distance from the land from a quarter of a mile to three or four miles; while fringing reefs surround the northern end of the island, extending for 400 miles down its eastern side, and are also found on the south-west coast.

With regard to minerals, Madagascar is tolerably rich in some of the most useful metals. Iron is found in great abundance in Imérina, sometimes almost in a pure state. In some of the hills it is so plentiful that it is difficult to get a bearing with the compass, from the deflection caused by the iron in the ground. Copper, lead, and silver have also been discovered, and from the geological structure of the country it is highly probable that gold would be found in some of the ravines of the granitic highlands; but as it is at present a serious offence against the native laws to search for the precious metals, hardly anything has been done in this direction. Rock-salt is found near the coast, and nitre is also met with. Iron pyrites, from which sulphur is extracted, is also found in abundance; in the northern part of the island antimony seems to be plentiful, and oxide of manganese has been found about fifty miles south of the capital. A substance resembling plumbago exists in great abundance, and is used by the Malagasy to colour and glaze some of their articles of pottery. A considerable variety of ochres and coloured earths are met with, and are used not only for colouring the native houses, but also in dyeing some of the woven cloths made by the people.

In conclusion, it may be remarked that there is a vast extent of country on the coast-plains where the soil is most fertile, but which is only thinly peopled, or has no population at all. Many parts of the island which separate the territory of one tribe from another are well watered and wooded, and seem to invite occupation. Madagascar could well sustain a population from ten to twenty times its present amount, for hardly any portion of it is rainless or desert, except a small section of the extreme south-western coast. Surrounded by the ocean it enjoys an abundant rainfall, so that the droughts which constantly afflict large portions of Southern Africa never occur in Madagascar, while its insular position gives it a more equable climate, freer from extremes of temperature, than is enjoyed in most tropical countries.

JAMES SIBREE, Jun.

NOTES

THE first zoological station established in Scotland was opened the other day at Cowie, near Stonehaven. The work, which is more directly in connection with the natural history class of the Aberdeen University, will be carried on in a small wooden house which was erected in the beginning of last week on flat ground, a few yards to the north of Cowie, and close to the sea-shore. The building was constructed in sections, special provision being made for ventilation. It consists of two apartments, the lesser of which is to be fitted up as a library and office, while the main room will be devoted to reception of the proceeds of the dredging, trawling, and other expeditions. The latter department contains the dredging and trawling apparatus, a number of microscopes, with chemical and other appliances

[1] See *Annales des Mines*, 6me série, t. x. pp. 277-319.
[2] *Bull. de la Soc. de Géog.*, Sept. et Oct., 1867.

necessary. Two boats are at the disposal of students—a large yawl and a small boat, kindly lent by Major Innes of Raenoir, who has also given the use of his drill-hall as a store. A select party assembled at luncheon, after which Mr. G. J. Romanes, in a brief and happy address, formally declared the station open. The total sum now raised is 350*l.*, but this is not enough, and we regret that the appeal made through our columns and elsewhere, has not been so successful as it should have been. This, we believe, is more due to want of thought than illiberality, and we trust that the work at this the first genuine zoological station in the kingdom, will not be crippled from want of sufficient funds. Mr. Romanes will be happy to receive further subscriptions.

On Friday, in the House of Commons, Mr. Shaw-Lefevre asked what arrangements had been made as to the management of the Natural History Collection about to be removed to South Kensington? He hoped that advantage would be taken of this opportunity to make some change, so that the management of that collection might be entirely different from the management of the other collections of the museum. In reply, Mr. Walpole said that the recommendations made by the Royal Commission were communicated to the Treasury in February last, and were then transmitted to the trustees of the museum. The trustees had carefully considered those recommendations and had sent in a scheme to the Treasury, and the matter was now in the Treasury's hands. The views of those who took a particular interest in scientific matters and in the advancement of science had been taken into consideration, and he thought he might say the future management of the museum would give complete satisfaction, not only to them, but to the public generally.

Dr. J. Fr. Brandt, the veteran Russian naturalist of St. Petersburg, whose works were referred to in last week's Notes, died on the 7th ult., at the age of seventy-seven. Dr. Brandt has been for many years director of the Imperial Museum of Zoology in the Russian capital, and is author of many important memoirs in the *Transactions* of the Imperial Academy of Sciences of St. Petersburg.

The *Times* announces the death of Prof. Lamont, a Scotchman by birth, and director of the Munich Observatory. Prof. Lamont, who was seventy-four years of age, and had been employed at the Munich Observatory since 1835, may almost be called the father of modern terrestrial magnetism.

The death is announced of Herr Joseph Haardt von Hartenthurm, one of the most eminent of German cartographers. He died at Vienna on July 28, at the early age of thirty-nine.

The proceedings of the first Austrian Anthropological meeting began on July 28, the assembly being exceedingly numerous. Prof. von Hochstetter was the president, and spoke on ambulant meetings for the purpose of common work. Herr Deschmann, of Laibach, read a paper on the latest discoveries in the heathen hill tombs of St. Margarethen. Prof. Gurlitt, of Graz, spoke on clay vases, and Prof. Alfons Müllner on the method of beginning practical work in anthropology. A paper was then read on local geographical and personal names in Carniola, by Dr. Arnold von Luschin. On the 29th Count Wurmbrand and Herr Szombathy delivered lectures on skull measuring and investigations relating to the colours of hair, skin, and eyes. Herr Scheyer spoke on ancient sepulchres, and Herr Obermüller on prehistoric times. In the afternoon the meeting visited the lake-dwellings in the Moorgrund.

At the celebration of the 100th anniversary of the foundation of the "Naturforschende Gesellschaft" at Halle on July 30 last, Prof. Knoblauch welcomed the guests in an able address. Afterwards the secretary of the Society, Dr. Marchand, gave a historical retrospect of the Society's activity, and then followed a "festival" address by Prof. Kraus and the reading of a letter from Dr. Naegeli, of Munich.

A model of Mr. George Fawcus's gun-carriage slide (referred to in Nature, vol. xx. p. 337) may be seen at the Royal United Service Institution.

The *Tokio Times* of May 10 reports a meeting of the Biological Society of the Tokio dai Gaku, on Sunday, May 4. Prof. Yatabe made a communication on the flora of the Bonin Islands. He showed how seeds could be transported thither by means of currents, and called attention to the various currents affecting the fauna and flora of the dependency. He then described the general character of the flora, and pointed out the differences between the plants of the islands and Japan proper. He also called attention to the similarities existing between those of the Bonins and Southern China and India. Mr. I. Iijima communicated some facts regarding the habits of a species of pteropus, a large winged bat from the Bonin Islands, a living male specimen of which was exhibited to the Society. After briefly stating its relations to the mammals, and that the individuals of this group were frugivorous, he stated that there were about forty species known, distributed among the islands of the Pacific. The Bonin Island pteropus subsists chiefly on the banana, frequenting the trees during the daytime, and at night flitting in the air in considerable numbers. The features closely resemble those of the fox, and hence the name of flying-fox generally given them. The fur is long and black, with white hairs intermixed. A few hairs taken from the specimen and others from a Sumatra species were shown under the microscope, and their peculiarities explained. The pteropus constantly hangs from the roost head downward; and when about to sleep hangs by one leg, spreads its wings, and then wraps them closely about the breast, hiding its head beneath the membranous folds. The specimen had been fed almost exclusively on sweet potato, though it would eat boiled peas and rice, and orange if it was juicy. If a big piece of sweet potato is given it, the fragment is grasped by one of the hind legs, and not having an opposable thumb, it is held firmly against the breast. Reaching up the head, the bat tears away a large mouthful and then chews it a long time, making a smacking sound in the act, and at each movement of the jaws thrusts out its lanceolate tongue. The fibre of the potato and pulp of the fruit is invariably ejected from the mouth, and just before doing this, one or two vigorous sucks are heard, as if the animal was drawing out the remaining juice. This performance is accompanied by a singular jerk of the head. In the act of chewing, the morsel is changed from one side of the mouth to the other. When its appetite is fully satisfied it begins to scratch its body with its hind leg. The long tongue also comes into service to cleanse the fur. It is a curious sight to see the long nail on the thumb used as a toothpick. The toes are also employed for a similar purpose. Prof. Yatabe remarked that the banana was not indigenous to the Bonins, but had been introduced, and the pteropus had acquired a taste for it.

Arago having been born at Estagel, a small country place in the department of the Pyrenées Orientales, the citizens of Perpignan, the head town of this district, have decided to erect a statue to him by public subscription. The inauguration will take place on September 21 next, and will be celebrated by a three days' *fête*. We are informed that an address will be delivered by M. Paul Bert, the physiologist, and influential member of the Chamber of Deputies. It is strange that no astronomer or physicist has been selected for this great occasion.

The French Parliament voted before the vacation a law obliging landed proprietors to protect their vines against the invasion of the Phylloxera. The *Journal Officiel* publishes a report signed by M. Teissoniere, member of the Council of the Society

of French Agriculturists, and vice-president of the Chamber of Commerce of Paris, showing the efficacy of sulpho-carbonate for destroying that pest. The experiment was made on 464,557 plants, covering a surface of 110 hectares, or 272 acres. A quantity of about 35 tons of sulpho-carbonate was employed with 10,000 cubic metres of water. The total expense was about 4*l.* per acre. This sum will be reduced very shortly in a large proportion by a diminution of the sulpho-carbonate, which actually costs 2*l.* per cwt., and will be sold at 1*l.* when the method has been adopted on a large scale. The plants were unhurt, and the vegetation was found to be luxuriant. Insects injurious to grapes were destroyed at the same time.

ON the occasion of the inauguration of M. Thiers' statue an aëronautical ascent was made at Nancy on August 4. The wind was blowing from the west with a velocity of 16½ kilometres an hour, and no variation in the direction was perceptible from the ground to 800 metres. The altitude of the balloon was taken by officers from Mazléville, with a theodolite, and signals were exchanged with the ground during the ascent. The signals were given by the aëronauts with a flag, and by officers with a reflecting mirror placed in the end of a tube, and mounted as a telescope. The officers directed the rays of the sun on the balloon, and intercepted rays with a key in order to use the Morse alphabet. The distance of Mazléville from the balloon was more than six kilometres, and the signals could be seen at a much greater distance. This shows that in a besieged town a passing balloon could be used for giving orders to, or receiving news from friendly forces. The system of communication has been invented by one of the officers of the garrison. M. W. de Fonvielle was in the car.

IN 1789 the Royal Library of Paris contained 800,000 volumes and objects of every description. In 1859 the number averaged 1,200,000. During the last twenty years the increase has been more sensible, and the actual number is estimated at 2,000,000. The mean annual increase from legal deposits alone is 20,000. Out of these 2,000,000 about 450,000 are devoted to French history, 200,000 to theology, 90,000 to science and philosophy, 60,000 to natural history, and 120,000 to English history. The greater part of French and English historical and medical works are arranged in printed systematic catalogues placed in the hands of the public. In less than ten years the whole of the catalogues will be printed.

THE Trustees of the South African Museum at Cape Town issue a very satisfactory report for 1878. Several important improvements have been made in the building, valuable additions, especially of insects, have been made, and the collection has been inspected by a large number of South African and foreign naturalists.

A BRIGHT meteor was observed in many places in Saxony and the adjacent Voigtland, during the night of July 26–27. An observer at Droeda (a village in the south-west corner of the kingdom) reports: "At 12.45 the nocturnal darkness was suddenly interrupted by an illumination of the whole firmament, which nearly reached daylight in intensity, and which lasted for three seconds. A beautifully bright blue fire-ball was slowly moving in the heavens from south to north. At Plauen the fall of the meteor was observed, and at Greiz even two fire-balls were seen." Corresponding news reaches us from Leipzig, Dresden, Zwickau, Wiedersberg, &c.

MR. MORRIS'S report on the Ceylon coffee-leaf disease, to which we have before referred, urges the necessity of uprooting trees which are very seriously affected, and of treating the remainder with a compound of sulphur and lime. Grass, it is urged, should not be left near the trees, and all diseased leaves should be burnt. Before leaving Ceylon for Jamaica, Mr. Morris was to deliver an address to the Chamber of Commerce on the all-important subject.

THE *Times* Berlin correspondent states that Dr. Schliemann, after having spent a month's holiday at Kissingen, has gone to pass a few days at his home in Mecklenburg, after which he will proceed to London to superintend the publication of his new work on Troy, embodying all his most recent researches, to which Prof. Virchow will contribute the preface.

AN extremely satisfactory report for 1878 is issued by the Manchester Scientific Students' Association. It contains several interesting papers, including a short presidential address by Prof. Williamson, and instructive accounts of the numerous excursions of the Society. A satisfactory report for 1878-9 has also been issued by the Leicester Literary and Philosophical Society, and we are glad to see, from the seventh report of the Leicester Town Museum, that that institute is steadily improving. Mr. Octavius Stone's New Guinea Birds are being arranged in their new cases by Mr. Montague Brown, and will shortly be ready for exhibition.

THE Peking correspondent of the *North China Herald* states that a college will shortly be opened there for the training of young diplomats, and it is understood that it will be under the direction of a former professor in the Tungwên College, aided by competent assistants.

SOME time ago the *Japan Gazette* stated that the Government were engaged in surveying a line of railway from the coal mines at Horouchi, in the island of Yezo, to Koishigari, a town on the chief branch of the River Ishigari. The survey has now been completed, but the original plan has been altered materially. It appears that the country for some distance along the proposed route is low and subject to occasional inundations from the overflowing of the river. One of these recently occurred, and showed the difficulties of the proposed route. It has, therefore, been determined to make a shorter line to the village of Horouchi, on another branch of the Ishigari, which is navigable for flat-bottomed vessels. The specimens taken from these coal-mines to Yedo are said to be very fine, and as the mines are to be worked on the most approved system, they are expected to prove a great national benefit.

SOME valuable kerosene springs are stated to have been discovered in Uzen and Ugo, two Japanese provinces lying to the north of Yedo.

A JAPAN paper states that the new arsenal and dockyard to be founded at Mihara for the Japanese navy will be very complete and magnificent. Dry and wet docks are to be constructed fit for the largest war-ships; and there will be iron sheds, in which ironclads and wooden war-vessels may be built without hindrance from the weather, as well as foundries, engine-shops, rolling mills, stores, &c. The expense of these works, it is expected, will be enormous, especially as there are also to be barracks and fortifications for their protection.

THE additions to the Zoological Society's Gardens during the past week include a Rude Fox (*Canis rudis*) from Demerara, presented by Mr. G. H. Hawtayne, C.M.Z.S.; a Grey Flying Squirrel (*Sciuropterus fimbriatus*) from North India, presented by Mrs. Louisa Edwards; a White-whiskered Swine (*Sus leucomystax*) from China, presented by Mr. Theodore Hance, C.M.Z.S.; a Black-faced Ibis (*Geronticus melanopis*) from Chili, presented by Mr. C. H. Whaley; three North American Turkeys (*Meleagris gallopavo*) from North America, presented by Mr. R. Wynne Roberts; three Common Kestrels (*Tinnunculus alaudarius*), European, presented by the Rev. J. E. Campbell Colquhoun; two Vociferous Sea Eagles (*Haliaëtus vocifer*) from East Africa, presented by Dr. J. Kirk, C.M.Z.S.;

a Lanner Falcon (*Falco lanarius*), East European, presented by Lord Lilford, F.Z.S.; a Wood Owl (*Syrnium aluco*), European, presented by Capt. F. Lloyd; two Vulturine Guinea Fowls (*Numida vulturina*), four Elliot's Guinea Fowls (*Numida ellioti*), three Mitred Guinea Fowls (*Numida mitrata*) from East Africa, deposited; a Pileated Jay (*Cyanocorax pileata*) from South America, two Black Storks (*Ciconia nigra*), European, purchased; a Red-fronted Lemur (*Lemur rufifrons*) from Madagascar, a Tamandua Ant-eater (*Tamandua tetradactyla*) from South America, a Black Hornbill (*Buceros atratus*) from West Africa, four Specious Pigeons (*Columba speciosa*), a Banded Tinamou (*Crypturus noctivagus*) from South America, received in exchange; an Amherst Pheasant (*Thaumalea amherstiæ*), three Fork-tailed Jungle Fowls (*Gallus furcatus*), three Chilian Pintails (*Dafila spinicauda*), seven Brazilian Teal (*Querquedula brasiliensis*), an Australian Wild Duck (*Anas superciliosa*), bred in the Gardens.

ON SPHENOPHYLLUM, ASTEROPHYLLITES, AND CALAMITES[1]

I HAVE just received from Herr D. Stur an abstract of a memoir in which he announces that he has obtained a specimen from the Carboniferous rocks in which he finds twigs of Asterophyllites and Sphenophyllum, forming the branches of the stem of a Calamite, and that the strobili of Bruckmanniæ occur at the ends of such of the branches as support Sphenophylloid leaves. Herr D. Stur appears to regard Sphenophyllum as representing the foliage of the fruiting twigs of the plant, whilst Asterophyllites represents the ordinary vegetative foliage of the same plant.

That this should be true, so far as regards the unity of Asterophyllites and Sphenophyllum is concerned, appears to me to be most probable. As you are aware, I carefully investigated this subject in Part V. of my series of memoirs "On the Organisation of the Fossil Plants of the Coal-Measures." Accepting the conclusions of M. Renault, published in some of his valuable memoirs on the St. Etienne plants, as conclusive so far as Sphenophyllum is concerned, I showed that plants which are undoubtedly examples of Asterophyllites have stems the internal structure of which is identical with that of M. Renault's Sphenophyllums. These facts led me to the inevitable conclusion that the two genera were very closely allied to one another. In my Memoir, Part IX., I described an additional specimen (Fig. 32), which gave further support to my previously expressed opinion, and the further investigations which I then conducted led me unhesitatingly to affirm "that Asterophyllites and Sphenophyllum are genera so closely allied, *that their separate existence finds but little justification in nature*" (*loc. cit.*, p. 334). In fact, it has long appeared to me that, morphologically, the leaflet of Spenophyllum was merely the resultant of the coalescence of two or three leaflets of Asterophyllites.

Herr D. Stur's discovery appears to afford an unanswerable confirmation of these views. His further discovery of Volkmanniæ[2] connected with his plant, which combines Sphenophyllum with Asterophyllites, further sustains a conclusion which I have arrived at in my memoir, Part V., pp. 55–56, viz., "that *Calamostachys* (Volkmannia) *binneyana* has much closer affinities with Asterophyllites than with Calamites" (*loc. cit.*, p. 65).

But Herr Stur further states that the stem from which these Asterophyllitean and Sphenophylloid twigs spring is a Calamites which he names *Calamites sachsii*. Not being acquainted with the plant to which he gives this name, I can form no opinion as to its nature; but I must confess I find it impossible to believe that it can be a Calamite of the common and only type which we find in England. Both my memoirs, Part I. and Part IX., contain a series of illustrations of the structure of our English Calamites, from that of stems that must have been nearly half a metre in diameter down to twigs having only a diameter of ·000837 of a metre, which latter specimens are, I presume, the most minute examples that have been recorded by any observer. Yet all these graduated Calamites have exactly the same typical structure; they possess an ample medulla, which becomes fistular at an early age; this is surrounded by a circle of longitudinal canals, which run from node to node. External to each canal we find a corresponding wedge-shaped mass of radiating vascular laminæ. These wedges are widely separated, in young plants and branches, by large, radial prolongations of the pith—the primary medullary rays of my memoirs—but in older branches these rays diminish in size, so that the wedges become blended together at their broad subcortical portions. These Zylem structures are enclosed within a true Phloem, which is uniformly parenchymatous in its young state, but which becomes differentiated into two or more layers, as the plant grows older; the chief of these layers, so far as size is concerned, being a thick mass of prosenchyma. Now the internal structure of Asterophyllites and Sphenophyllum differs from that of Calamites *in every one of these features*. The youngest twigs, as well as the larger branches of these two genera, are equally devoid of a medulla. The place occupied by that cellular tissue in the *young* Calamite is filled, in equally young twigs of Asterophyllites and Sphenophyllum by an *exclusively vascular* bundle, transverse sections of which exhibit the form of a remarkable triangle with three very concave sides. There are no inter-nodal canals, and the vascular zone, which is largely developed externally to the primary triangular vascular bundle by an exogenous process of growth, is *not* divided into separate wedges by large primary medullary rays. In Calamites each vascular wedge is subdivided into laminæ by numerous, perfectly developed, secondary medullary rays. In Asterophyllites and Sphenophyllum, these rays are of the most rudimentary character, though they exist, as my friend M. Renault has shown, in the shape of groups of cells distributed through the vascular zone.[1]

The bark of the two genera in question is as distinct from that of Calamites as are the medullary and Zylem portions of the respective stems. It consists of two layers which have no counterparts in the Phloem of Calamites. In addition to these details, there is a general triquetrous arrangement in the organisation of Asterophyllites and Sphenophyllum, which has no existence in Calamites. The foliar vascular bundles of the former are only given off from the apex of each of the three prolonged angles of the central triangular bundle of the young twig, whilst no one of the wedges forming the regular Zylem-cylinder of the Calamite has any predominance over the rest.

Such extreme and fundamental differences as these, affecting, as they do, the structure of every layer of tissue from the centre to the periphery of the axis, and at every stage of its growth, make it absolutely impossible that Asterophyllites and Sphenophyllum can be associated with any of the Calamites that are so abundant in our English coal-measures, and with the organisation of which we are now so perfectly acquainted.

That the stem so long, but so improperly, associated with the genus Calamites, viz., the *Calamites verticillatus* of Lindley and Hutton may have been the arborescent stem of these Sphenophylloid plants is as I have shown in my Memoir, Part V., extremely probable. But, I repeat, this stem has no claim whatever to be included amongst the true Calamites.

Such being the conclusions at which I have arrived from the careful study of the inner structure of an enormous number of stems of Calamites and Asterophyllites, and from a comparison of these latter with the facts published in the valuable Memoirs of M. Renault on Sphenophyllum, I shall look forward with great interest to the results of a critical examination of the stem which our fellow-labourer at Vienna has discovered.

W. C. WILLIAMSON

Further Remarks to the Preceding Treatise, by E. Weiss, Berlin

Stur's remarkable paper, to which the above communication of Prof. Williamson, the esteemed investigator of Manchester, refers, is the description of a slab on which several branches of Asterophyllites give off, at certain points, lateral twigs with the foliage of *Sphenophyllum dichotomum*, some of which bear terminal spikes of Volkmannia, Stur; at other points he finds

[1] This brief contribution was originally a letter to Prof. Weiss, of Berlin, but it was kindly translated by him, and published in the *Neuen Jahrbuch für Mineralogie, Geologie und Paläontologie*, Jahrgang, 1872, as a communication, with the title of "Sphenophyllum, Asterophyllites, und Calamites, deren Stellung zu einander nach den letzten Beobachtungen." It is only republished now as being necessary to the understanding of Prof. Weiss's interesting communication, which he published along with mine, and which it appears to me desirable to republish for the benefit of English palæo-botanists. I am indebted to my friend Mr. Hartog for its translation into English.

[2] Herr Stur's Bruckmanniæ appear to be that form of spike long designated Volkmanniæ, but now separated as Calamostachys, and of which the *Calamostachys binneyana* is the only British example with the internal organisation of which we are acquainted.

[1] So imperfect is the organisation of these medullary rays, that M. Renault is not prepared to recognise their claim to the title, a point on which I am obliged to differ from him.

the same Asterophyllites bearing spikes of the type Bruckmannia, Stur, and in such relations that it can only be the offset from a Calamites found lying with it, of which no definition is given, but which has previously been designated *C. sachsii*, Stur. From this Stur draws the following conclusions:—1. Sphenophyllum is a branch of Asterophyllites. (2) Both Sphenophyllum and Asterophyllites are branches of a Calamites. (3) Sphenophyllum is not a distinct botanical genus, but the Macrosporophorous branch of an Asterophyllites—that is of a Calamites. This, if correct, would be one of the most remarkable results in Palæophytology. A Calamites bearing not only twigs, ascribed hitherto to different genera, but to such different fructifications! and besides, we have the incompatibility in the anatomical structure of the stems of Calamites and Sphenophyllum, to which Williamson's remarks are directed. It is not every one that can step so lightly over these difficulties in order to unite the three genera into one. Some grounds, one would think, are still left, not only to indicate, but to compel the separation of these genera, and even to warrant their location in different families, and to call for caution in the interpretation of such facts as the above. To estimate the importance of these facts, we will call attention to the present state of the question.

The widespread genus Calamites, whose structure has been elucidated by Williamson and others, is now almost universally associated with Equisetum in the group Calamariæ, while, as is known, Sphenophyllum has been repeatedly classed with Lycopodiaceæ within the last few years. Williamson insists on the anatomical incompatibility between Calamites and Sphenophyllum (with which he includes Asterophyllites) as brought out by his own microscopical researches; and indeed all previous investigations in botany would protest against the insertion of twigs with the structure of Sphenophyllum on stems or branches, with the structure of Calamites. They possess, in common, only the external characters of the transverse segmentation of the stem, and the conformity of the separate internodes; but this conformity of segmentation is the chief ground for Stur's view, that all such genera as Annularia, Asterophyllites, and now also Sphenophyllum, pass into Calamites. Many stems, such as that bearing *Stachannularia tuberculata* (see my Carboniferous Calamites in *Abhandl. zür geolog. Specialkarte von Preussen*, Band ii. Heft i., Taf. ii. Fig. 1), are Calamites in his eyes, which others do not recognise as such, and he will not allow of any [systematic] severance of a section of the Calamarioid stems from Calamites proper. Hence it is that from Calamites, Stur, most divers things ramify.

In the second point of importance, however, the close conformity of Asterophyllites and Sphenophyllum, Williamson agrees with Stur. According to him, either the two genera have altogether the same anatomical structure, or, at least, there are plants resembling the former having the stem-structure of the latter. Renault, on the contrary, is convinced that some of Williamson's preparations really belong to Sphenophyllum, agreeing with the fragments from Autun and St. Etienne investigated by himself.[1] The twigs which show Calamite structure are referred by Williamson to Calamites, and appear to be those which, without a knowledge of their internal structure, would be placed in Asterophyllites. These would come under Calamocladus of Schimper, whilst Williamson's Asterophyllites appear to be next related to Sphenophyllum.

These two forms agree so closely in the external characters of their sterile parts as to be undistinguishable without microscopic investigation; so that one is inclined to leave them together under the old provisional generic name of Asterophyllites, despite their probable essential difference. That section of Asterophyllites which shows the same stem-structure as Sphenophyllum may be allowed to be closely allied thereto, and, in some cases, even to belong to the same individual as Stur's discovery would indicate. It is possible that in well preserved fossils we may still find some single [external] character, which will distinguish this section of Asterophyllites from those which approach Calamites. It would lie in the decided trimery of the leaves in the verticils of the former (when regularly developed), corresponding with the triangular bundle of the axis, from the angles of which the vessels of the leaf spring. The difference of leaf-form as an absolute character separating Asterophyllites and Sphenophyllum must now be given up.

From the botanist's point of view there is another very important ordinal or generic distinction, to be found in the fructification. Every one must be astonished at Stur's pointing out both Bruckmannia and Volkmannia spikes on his plant. By the former he means Calamarioid spikes with sporangiophores and sporangia between pairs of approximated verticils of Bracts (Calamostachys, Auct.). By the latter, spikes with sporangiophores and the sporangia axillary (Palæostachya, Weiss.) Whether these two arrangements are really present here is not yet clearly shown; at least, in answer to my inquiries, Stur gives no definite information on that point, but refers to the forthcoming fuller memoir which he promises. Hence it is still an open question whether the arrangement is not that hitherto alone recognised as that of Sphenophyllum—that is, sporangia without sporangiophores, sessile in or near the axils of the leaves. This mode of attachment may certainly also be concluded from Renault's last excellent communication ("Nouvelles Recherches sur la Structure des Sphenophyllum," *Ann. d. Sc. Nat. Bot.*, 1877). My own observations on a beautiful spike from Wettin, give the same result.

But it must also be borne in mind that those spikes to which I have thought right to restrict the name Volkmannia, which in all probability belong to twigs with the foliage of Asterophyllites, have the same sessile, axillary sporangia, so far as can be determined. If this be correct, however, there can be no difficulty from this point of view in uniting these Volkmanniæ (not Sturs, which belong to Palæostachya) with the spikes of Sphenophyllum into a single group. This is a further corroboration of my formerly expressed conclusion, that the two form a group which must be removed from the Calamariæ.

On summing up the results of these critical comparisons, we find (what has not yet been thoroughly contradicted) that Sphenophyllum may be grouped under Lycopodiaceæ, anatomical structure and fructification alike removing it from Calamariæ. Only it becomes more and more impossible to dispute that the convenient generic names Calamites, Asterophyllites, &c., are purely provisional—unfitted, it is true, to show the real relations of the plants that bear them, but indispensable, in the great majority of cases, where the material is insufficient for complete investigation, important though it be. Plants with stems and leaves of undistinguishable appearance, especially in the ordinary state of preservation, but with such different fructifications as Calamostachys and Palæostachya, for instance, must retain their autonomy, and Sphenophyllum still more so. It is not every arborescent Calamarioid stem, not every so-called Calamites that belongs to this botanical genus. It has now become very evident that what has been hitherto termed Asterophyllites, comprises plants of several groups; yet Cingularia and Bowmannites had already been distinguished, though they both possessed the stem of Asterophyllites, as regards external structure and foliation. We see that the practical difficulties in the distinction and nomenclature of fossils are augmented; but this lies in the very nature of the case. It is thus unnecessary to doubt the co-existence of Asterophyllites and Sphenophyllum twigs on one plant, as Stur has observed, without going on to admit his conclusions that Asterophyllites, as a whole, is identical with Sphenophyllum, and that both are Calamites. If the spikes cited are really Calamostachys (Bruckmannia, Stur) and Palæostachya (Volkmannia, Stur), this would show the distinctness of the fossils regarded by him as identical. Renault has found both macrosporangia and microsporangia on the same spike of Sphenophyllum; this tells against the view that Volkmannia, Stur (that is, in this case, the Sphenophyllum spike) is the female, and Bruckmannia, Stur, the male fruiting spike of one and the same plant. It will be seen how desirable it is to have further cautious investigation and careful publication upon the interesting find on which we are to base such far-reaching conclusions as those which Stur has lately drawn.

[1] On this point M. Renault is mistaken; they differ in the chief features which distinguish Sphenophyllum from Asterophyllites, viz., in the number and shape of the leaves and in the number of the separate vascular bundles given off to these leaves.—W. C. W.

ANTHROPOLOGICAL INQUIRY IN FRANCE

THE published reports of the proceedings of the Société d'Anthropologie of Paris, for the year ending in the autumn of 1878, testify as usual to the diligence and zeal of a large number of its members. Limiting ourselves to the notice of papers which deal with questions of French local palæontology and sociology, we will begin our *résumé* by drawing attention to the interesting labours of M. Prunières, who has laid before the Society the result of several years' exploration of the Beaumes-Chaudes caverns in Lozère, the largest prehistoric ossuary yet brought to light. Here he recovered the remains of

300 individuals, besides a mass of more than 200,000 fragmentary pieces. These human bones were white, showing no trace of the action of fire, although charred animal bones and broken pottery were found near them, the whole being embedded in stalagmite and stalactite as hard as marble. The dolichocephalic crania, protruding jaws, and flat tibiæ, showed a close affinity to the Cro-Magnon and l'Homme-mort remains; and M. Prunières is of opinion, that at Beaumes-Chaudes we have evidence of the existence of a race differing essentially from those which have occupied France in modern times, and even from the pre-historic men of the neighbouring dolmens of Lozère. In the latter, and in the dolmen founders of western France generally, he recognises the more civilised agricultural race which waged war against the ruder cave-men, and finally exterminated them. And he believes we have indisputable evidence of this conflict of races in the fact, that while several of the Beaumes-Chaudes bones were found to have slender flints impacted in them of the kind discovered in the dolmens, and differing wholly from the flint arrow heads characteristic of the cave-men, only a few of the same form of silex were found lying loose in the *débris*, and these he thinks we may fairly assume to have become detached in the process of decomposition from the softer tissues of the body, in which they had been arrested. Some of the crania exhibited a hitherto unnoticed form of double-trepanning of the right and left parietals, whose different cicatrices appeared to show that a considerable interval had elapsed between the first and second operation, which probably was the pre-historic surgical remedy for convulsions, and all affections included in later ages under the term "possession."

At Cravanche, near Belfort, a somewhat similar mortuary cavern has been examined by M. Bernard. Here the seven nearly perfect crania, extricated from an enormous mass of human bones, were all remarkable for their large cubic capacity (1680 centims.), the vertical index being 70, and the cephalic index 72. No iron or bronze implements were found, but numerous flints and serpentine rings were obtained. M. Leguay has done much to settle the question of the implements with which pre-historic men cut and carved schist and bone objects, by his successful imitation of a schist amulet, found by M. Rivière 24 feet below the floor of the Mentone caverns. In the fabrication of this spurious antique, M. Leguay used some of the flint knives so common in pre-historic caverns, which are blunt at the extremity, and curved towards the middle; with these he was able after a little practice to effect all the graving and cutting required to produce exact facsimiles of the pre-historic originals, and he believes, that wherever we find an excessive accumulation of flint-splints and fragments we have evidence of being on the site of a work-place or factory, rather than that of an ordinary primæval dwelling. It should be observed that M. Broca has used a cave-silex in trepanning a dog, which recovered with less than ordinary inconvenience from the operation. The neighbourhood of Luchon in the French Pyrenees has long been recognised by geologists as an admirable locality for the study of glacial action, evidences of which abound in the moraines and huge erratic boulders which cover the southern flank of Mont Espiaup, and block up the valley of the Oô; but it is only within the last few years that French archæologists have directed their attention to the innumerable megalithic remains which occur in the district, and which, as in other parts of the Pyrenean range, still maintain some of their ancient sanctity in the eyes of the peasantry. These remains have now been carefully studied by MM. Piette and Sacaze, the results of whose most important investigations were given in detail in a paper printed in *Bulletin d'Anthropologie*, tome 12, série 2, 1877. From these and subsequent researches, it would appear that the megalithic circles and rows have generally been made to follow the direction of the granite boulders, smaller stones having been used to complete the desired outlines. Under the cromlechs and within the stone circles numerous urns were found, containing for the most part only ashes; but in one instance, two bronze armlets, nearly identical with those of the Swiss lake dwellings, were discovered. Local tradition and still existing practices warrant the assumption that the so-called fire-stones—menhirs—were long associated with fire-worship; while the form of certain stones, which in defiance of the clergy continue to be made the centres of various local games and dances, together with the character of the mysterious and hidden ceremonials which are practised in relation to them, as clearly point to a not wholly eradicated observance of phallic rites. Near Maintenon, M. Lamy has succeeded in proving the existence of menhirs and dolmens, and has opened a burial chamber in which, besides two adults, he found a child's skeleton standing upright in the grave.

The attention of several members of the Society has been directed to the improvement of instruments for the attainment of reliable craniometrical determinations; and among these the double graduated square, invented and used by Dr. Harmand during his extensive travels in India and China, and the portable cephalometer, specially designed by Dr. Le Bon for the correct measurement of the vertical height of the head, appear to have met with the greatest approval. The former is described at length in the tome 12, sér. 2 (1877), and the latter in tome 1, sér. 3 (1878) of the *Bulletin d'Anthropologie*. M. Broca has drawn attention to the injurious action of alcohol on the preservation of crania, and recommends the use of nitric acid, followed by immersion in glycerine before the varnish is applied. M. Personne on the other hand prefers the use of chloral, under the action of which he has found that the cranial bones contract, and become as hard as wood. Much interest has been excited in the Society by the report of M. Thulié, on the appearance of the brain of M. Asseline, one of its members who had belonged, like many of his anthropological confrères, to the Société d'Autopsie mutuelle. M. Asseline died in 1878, at the age of 49. He was a republican and a materialist; was possessed of enormous capacity for work, great faculty of mental assimilation, and an extraordinarily retentive memory; and had a gentle benevolent disposition, keen susceptibilities, refined taste and subtle wit. As a writer he had always displayed great learning, unusual force of style and elegance of diction, and in his intercourse with others he had been unassuming, sensitive, and even timid. Yet the autopsy showed such coarseness and thickness of the convolutions that M. Broca pronounced them to be characteristic of an inferior brain. The fossa or depressions, regarded by Gratiolet as a simian character, and as a sign of cerebral inferiority, which are often found in women, and in some men of undoubted intellectual inferiority, were very much marked, especially on the left parieto-occipital. But the cranial bones were at some points so thin as to be translucent; the cerebral depressions were deeply marked, the frontal suture was not wholly ossified, a decided degree of asymetry was manifested in the greater prominence of the right frontal, while, moreover, the brain weighed 1,468 grammes, *i.e.* about 60 grains above the average given by M. Broca for M. Asseline's age. The apparent contradictions between the weight of the brain and the great development of the anterior parts on the one hand, and the marked character of the parieto-occipital depressions on the other, attracted much attention, and the members of the Société d'Anthropologie have been earnestly invited by M. Hovelacque, in furtherance of science, to join the Société d'Autopsie, to which anthropology is already indebted for many highly important observations. This Society is forming a collection of photographs of its members which are taken in accordance with certain fixed rules.

M. Chervin has drawn attention to the frequency of stammering in the south of France, where from 12 to 13 cases are noted for every 1,000, while in the eastern departments the proportion is only 1 for every 1,000. It has been assumed that the defect was in many cases simulated to avoid the conscription; but according to the Abbé Petitot, there are two districts in the Bouches-du-Rhone, where all the inhabitants (15,000), stammer. This he ascribes to long continued inter-marriages among the communities, and to a consequent degeneracy of the race; and M. Chervin is of opinion that meningitis, induced by the great solar heat, which occasions so high an infantile mortality in this region, may possibly, when not fatal, leave an exceptionally great tendency to stammering.

M. Broca, with his usual diligence, has continued to work out his system of *cerebral topography* in man and in the lower animals; and he has lately presented the society with a large number of cranial moulds, on which every convolution, lobe, or other part, is distinctly marked by different colours, in accordance with sex, age, and race. M. Broca has also made the difference of position of the occipital foramen in man and animals the subject of two interesting papers, the former of which was laid before the society in May, 1877. Following up the investigations of Daubenton, who, as early as 1764 made this a subject of inquiry, M. Broca, after a long course of determinations which he gives in detail, has summed up the results of his labours in the proposition that while in all animals but man the orbito-occipital angle is *constantly positive*, in man it is almost always

negative. It is invariably so in European races, where the differences oscillate between −5° and −39°. In the inferior races it may amount to + 5°; in adult anthropoids on the other hand, the minimum is found as high as + 32, while in some gorillas it amounted to + 45. In women the orbito-basilar angle is habitually from 2 to 3 degrees less than in men.

The decrease in the population of France still continues to excite much speculation. In tome 12, sér. 2, of the *Bulletins* will be found a suggestive paper by M. Després, on the relation between the birth-rate of a country and its enforcement of restrictive enactments intended to diminish the result of public immorality. In comparing Belgium with France a difficult question suggests itself in the fact, that while both countries are under sanitary official supervision, and Belgium next to France has the lowest birth-rate, it has 279 legitimate births against every thousand married women between the ages of 15 and 50, although France has only 174 in the 1,000. The latter has, however, the large number of 140 married women of those ages in every 1,000, while the former has only 105 in the 1,000. In England, on the other hand, before the enactment of any sanitary restrictions, 248 legitimate births were registered for every 1,000 married women of the given ages, (the proportion of married women from 15 to 50 being 133 in the 1,000). But while in this country 120 for every 1,000 men marry between the age of 20 and 25, in Belgium only 33, and in France not quite that number, out of every 1,000 men marry at the same age. This later marriage of the men M. Després regards as an important factor in the lowness of the French birth-rate.

VOLCANIC PHENOMENA AND EARTHQUAKES DURING 1878

THE statistical review of volcanic phenomena during 1878, which Prof. Fuchs has recently published, and which forms the continuation of many previous statistical accounts of the same nature (see NATURE, vol. xv. p. 557, and vol. xviii. p. 241) shows the unusually large number of *twelve* eruptions in the course of the year. Most of them occurred in remote localities and gave evidence of the activity of volcanoes which were generally but little known, and which are all difficult of access. It is true, however, that Mount Vesuvius also, the last eruption of which had taken place in 1872, but which already during 1877 had shown symptoms of the re-awakening of the volcanic process, again entered into a period of activity on April 20, 1878. The mountain ejected ashes, frequent slight shocks occurred, a thick column of smoke ascended, and at the end of September a scanty flow of lava took place. This increased during the night of September 22-23 and the lava descended as far as the Atrio del Cavallo; but afterwards the volcanic activity sank down into the ordinary solfatara-state, which was only interrupted by little periodical explosions on October 11, and by the flow of little streams of lava from November 1 to November 9.

At the southern point of South America active and hitherto unknown volcanoes were repeatedly seen by passing ships, viz. on January 10 and 18; one of them is situated upon the middle island in the English Narrows, the other on the South American continent in about 48° 56′ lat. S.; this one was conspicuous by a majestic column of smoke, ejected from a high snow-clad mountain, and rising to a height of some 300 metres.

At the same time a great eruption occurred in the island of Tanna, the well-known and very active volcanic island in the archipelago of the New Hebrides. On January 10, at 10 a.m., between the so-called Sulphur Bay and the old crater, a new eruption cone formed; the outbreak was accompanied by a mighty tidal wave which inundated a great part of the island. In spite of its violence the eruption lasted only a short time, but on February 4, a second outbreak followed which also did great damage.

Simultaneously yet another eruption happened. Its seat was the large island of Birara, in the group of New Britain. The northern part of the island was completely devastated, and its coasts rendered inaccessible through enormous masses of pumice stone, which covered the sea for many miles. Formerly, no volcano had been known there. We have repeatedly referred to the masses of floating pumice stone in the vicinity of the Solomon Islands, through which, as Captain Harrington reported, ships had to force their way for two or three days. It is very probable that this pumice stone originated from the eruption on Birara, and not from some submarine eruption, as was generally supposed at the time of the occurrence. It is true that there are two volcanoes in the Solomon Islands, the Semoya and the Lammat upon the island of Guadalcanar, but from neither were any eruptions reported during 1878.

The third eruption of February, took place from the volcano Isluga in South America (lat. 19° 10′, S), which mountain had been inactive since 1869. The outbreak was accompanied by a fearful earthquake, and so great were the masses of lava ejected that the villages of Cariquima, Carima, Sotoca, and Chiapa, all situated at more than five leagues' distance from the volcano, were completely destroyed by the incandescent streams.

Smaller volcanic eruptions occurred from Mount Hecla (from February 27, to the end of March), from the Asamayama in Japan, from the Cotopaxi near Quito (in October), from the Tepaco, the Sitna, and the Isalco in San Salvador. The eruptions in the Aleutian and Society Islands were of greater importance. In the volcanic series of the Aleutian islands, the volcanoes on Amukta, Tscheguluk, and the Vsevidok volcano (almost 2,800 metres high) on Umnak were in eruption. In the Society Islands, according to the report of Captain Evers, the islands of Raiatea, and Borabora were completely devastated by the action of volcanoes.

At the end of the list of lava-eruptions Dr. Fuchs records the great mud-eruption of one of the well-known mud-volcanoes near Paternò in Sicily. After repeated shocks of earthquake in the province of Catania spreading over two months, this eruption began on December 10, numerous craters ejecting streams of mud with great noise. Several of these craters were continuously active, as the mud was of little consistency, and freely permitted the ascending gases to escape. The others had explosions from time to time, as the crater basin was filled with much thicker mud, which prevented the gases from passing upwards until their tension was sufficiently high, and they ejected the mud in high rays. At the end of the year this mud-eruption was still progressing with unabated force.

The number of earthquakes reported during 1878 amounts to 103. But amongst these there are many complete earthquake-periods during which shocks and oscillations lasted with short intervals for hours, days, and even for several weeks in the same locality. If we would or could count all the separate shocks which occurred, a very high total would be reached. Thus in the comparatively unimportant earthquake of Zengg twenty shocks were counted, and in the great earthquake of Terapaca in the night of January 23 no less than forty shocks, while the oscillations lasted here almost without interruption until April 12. An earthquake on the island of Tanna (New Hebrides) lasted for four weeks, and in the province of Catania the oscillations succeeded each other almost without interruption from October 4 to November 19.

The earthquakes were most frequent in winter and autumn, thirty-nine occurring in winter, twenty-six in autumn, and nineteen each in summer and spring.

The most violent and most destructive of all these phenomena happened on January 23 in that district of Peru and Bolivia in which the terrible earthquake of 1868 took place. The province of Terapaca suffered more than any other. Here, with the earthquake of May 9, 1877, which in violence was hardly surpassed by that of 1868, a great and considerably extended period of frequently-recurring oscillations had begun, amongst which the earthquake of January 23, 1878, was prominent by its particular force. At Iquique it began at 7.55 P.M., and the shocks continued during the whole night. As usual, the subsequent tidal-wave did still greater damage than the earthquake itself, and this was particularly the case at Arequipa, Pica, Mantilla, Pisaqua, Arica, and Terapaca.

The earthquake on October 2, in the southern part of the republic of San Salvador, was also very violent. In the town of Incuapa almost all the houses were destroyed, and many of the inhabitants perished. In the vicinity a number of villages disappeared entirely. The motion of the soil was first undulatory and ended with a terrible shock.

Of European earthquakes the following must be mentioned specially:—

On January 28, about noon, an earthquake shook the north-western part of France and the south of England. It was particularly distinct in Normandy, at Rouen, Havre, and Dieppe. Even in Paris the shock was so considerable that several houses were endangered. In England it occurred between 11.45 and 11.50 A.M., and was observed at Greenwich, London, Brighton, Southampton, Cowes, and several other places.

Repeatedly shocks were felt in north-western Switzerland and at the south-west corner of the Black Forest. The first and more marked phenomenon happened on January 16, and con-

sisted of several shocks separated by short intervals. These shocks were noticed at Basel, Brugg, Solothurn, on the Swiss side of the Rhine, and at Lörrach, Schopfheim, Waldshut, &c., on the Badish bank. They recurred at Basel on January 17, and on March 29 they were again felt in the whole area described, and then even at Freiburg and Strasburg.

Other instances of repeated earthquakes are :—

Innsbruck (January 3, 10, 11, February 2, August 9).

Gross Gerau (January 2, March 25).

Lisbon (January 26, 27, June 8).

Piemont (repeated shocks on November 25).

Constantinople, Ismid, and Brussa (continual shocks from 19 to end of May).

The damage done by the last-mentioned phenomenon at Ismid and Brussa on April 19 was very considerable; the little town of Esmé was quite destroyed, and many inhabitants lost their lives. The English fleet, which happened to be anchored in the Bosphorus at the time, noticed the oscillations, and on board of one of the ships it was believed that the others were making torpedo experiments, and consequently looked out for shelter.

Less remarkable by its violence than by its enormous extent considering its intensity, was the Low-Rhenish earthquake of August 26. The observations in this case were unusually exact and numerous, which gives additional interest to the occurrence. It began about 9 A.M., and was best observed in the city of Cologne. Here it consisted of an undulatory rising and sinking of the ground, which increased in intensity to such an extent that some buildings began to oscillate ominously. On the cathedral tower the smaller bell struck several times and the wavering pillars in St. Gereon's Church caused such a panic among the congregation, that all rushed out. In many parts of the city the walls of houses showed cracks. At the end of the oscillations a dull subterranean noise was heard and a second shock was observed by many persons. In almost all localities in the Rhenish Province, from Cleve and Emmerich to Kyllburg, Ottweiler, and Montjoie the observations of the phenomenon were similar to those made at Cologne; the same was the case on the opposite bank of the Rhine, at Düsseldorf, Wiesbaden, Münster, and other places. At Aachen (Aix-la-Chapelle) five distinct shocks were noticed; at Elsdorf (on the Neuss-Düren Railway) no less than eighteen until the morning of August 27; and at Düren and Buir their number was but little below this figure.

The area struck by the first shock, on August 26 at 9 A.M., may have measured over 2,000 geographical square miles, as its outlines may be indicated as follows :—Arnsberg and Hanover in the north, Offenbach on the Main and Michelstadt in the Odenwald in the south-east, Strasburg, Paris, and Charelville in the south, Liége and Brussels in the west, and Utrecht in the north-west.

Prof. Klinkerfues has collected the most reliable observations of time and reduced them to the meridian of Paris. According to these calculations the earthquake happened at Cologne at 8h. 38·7m., at Strasburg at 8h. 39·9m., at Göttingen at 8h. 40·9m., at Hanover at 8h. 42·4m., and at Paris at 8h. 45·0m. If the starting point of the oscillations according to number and intensity of the shocks be supposed to have been situated about 2·5 geographical miles to the west of Cologne, the above indications of time give a velocity of the earthquake in the ground of 6·78 geographical miles, with a probable error of ± 0·48 miles. The depth of the original starting-point is unknown. Prof. Klinkerfues is of opinion that it laid between 6·3 and 8·7 geographical miles from the surface. It is remarkable that the phenomenon was only noticed at the surface, and was all the more intense the higher the observer was above the ground. Many observations were made both at Cologne and at Hanover, which show that the oscillations were far more considerable in the upper storeys of houses than in the lower ones. At Remagen the shock was so great on the upper floor of the school-building that teachers and school-children rushed terrified into the street, while on the ground floor the phenomenon was hardly noticed; the workmen on the towers of Cologne Cathedral saw the scaffolding oscillate to such an extent that they feared for their lives, and a water-tank on the vault of the choir was almost entirely emptied. Yet not one of 1,100 miners working at a depth of 300 metres at Altessen noticed the least shock.

For a long time afterwards shocks occurred at Elsdorf and Buir. At the latter place they were observed on August 26, 27, 28, 29, September 2, October 24, December 3 and 10. Also in other places of the same area the shocks were repeated, so at Remagen (September 3), Wiesbaden (September 14), Osterrath and Crefeld (September 18), Cologne (December 10), Luxemburg and Namur (December 15).

With almost all earthquakes of slight intensity it is very difficult to determine to what class of earthquakes they belong. Thus in the Low-Rhenish earthquake no symptom points to any particular cause. We may surmise volcanic influence, because the most intense and most numerous shocks occurred near the north-western slope of the Eifel-plateau; but with perhaps greater reason we may look for the cause of the phenomenon in the Rheno-Belgian coal district. Altogether the earthquake of August 26 seems to be but a link in a great earthquake-period, which for some years past has been causing lasting changes in the coal-deposits of that neighbourhood. The names of Herzogenrath, Kohlscheid, Eschweiler, &c., recur in every one of Dr. Fuchs's yearly accounts, and apart from numerous weaker oscillations of small extent, considerable earthquakes occurred in this district from September 28 to November 12, 1873, and on June 24, 1877.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

IT is stated that the draft charter of the proposed Victoria University has, in accordance with the request of the Lords of the Privy Council, been submitted to that body. According to this draft, the University would have the power of conferring upon all persons, whether male or female, who have pursued a regular course of study in any of its colleges and passed its examinations, all degrees which can be conferred by any other University of the kingdom, with the exception of medical degrees, the Privy Council having declined to confer power as to these at a time when legislation on the whole subject of medical degrees and the licensing power for the practice of medicine has been proposed to Parliament and still remains unsettled. The charter, it is stated, contains provisions for establishing a convocation of graduates of the University, with appropriate rights and functions.

IN the late Higher Local Examinations of Cambridge University, Physiology and Experimental Physics were introduced as separate subjects in Group E for the first time. One student, Miss A. Johnson, of Cambridge, passed in Physics, and out of sixteen who entered their names in Physiology, in which subject Mr. J. N. Langley, Fellow of Trinity College, was examiner, eleven passed, but no candidate obtained the mark of distinction. Only three passed in Zoology out of eighteen candidates; but two were distinguished; the failures were about three-fifths of the thirty-four candidates in Botany, and three obtained distinction. Twenty-two passed in Geology and Physical Geography, five obtaining the mark of distinction. In the first class of Group E four students are placed: Miss C. E. Cross, educated at 56, Regent Street, Cambridge, is distinguished in Botany and Geology, and passes in Chemistry; Miss L. M. Passavant, of De la Haye House, Leeds, is distinguished in Botany and Zoology; the candidate numbered 294, Leeds, name not published, is distinguished in Geology and Zoology, and has passed in Physiology; Miss M. A. Broadhurst, Liverpool College for Girls, is distinguished in Geology and Chemistry. Six passed Second Class in Group E, and twenty-eight were placed in the Third Class, to attain which passing in one subject is required, no more than three to be taken in any one year; others may be taken in subsequent years. In Group C (Mathematics) only two obtained distinction, namely, A. G. Lee, Dedham, Essex, and C. E. Oldaker, Chesterton Road, Cambridge, and eight obtained a First Class. The award of Scholarships dependent on the results of this examination has not yet been known.

ABOUT three years ago publicity was given to a proposal by Mr. Holloway, of Oxford Street, to expend a considerable amount of money in the erection of a college for the higher education of women. Since that time Mr. Holloway has purchased about ninety-five acres of land at Egham, near Virginia Water, known as the Mount Lee Estate, and has vested the same in trustees. Before deciding upon the form of the building, Mr. Holloway and his architect, Mr. W. H. Crossland, visited the principal collegiate institutions in Europe, and during the past year the plans and specifications have been completed. We now learn that a contract has been actually signed by Mr. Holloway for the building of the college within four years, the contract price being upwards of 250,000*l.*, exclusive of fittings

and furniture. The building will be in the form of a double quadrangle, 510 feet from east to west, and 350 feet from north to south. The main buildings will be five storeys in height, and there will be cloisters 10 feet in width on two sides of each quadrangle. The style is to be that known as French Renaissance, and will be carried out in Portland stone and red brick. The object and scope of the college have been the subject of great consideration, and Mr. Holloway has had the advice and assistance of a large number of persons interested in the education of women. The proposed constitution of the college, to be embodied in a trust-deed, will, among other things, set forth that its object is to afford the best education suitable for women of the middle and upper middle classes, and it is intended to be mainly self-supporting. The trustees are to be a corporate body with perpetual succession, and to have all the usual powers and privileges. The governing body will consist of twenty-one persons, to be appointed partly by the University of London and partly by the Corporation of London, and it is stipulated that a certain portion shall always be women. Religious opinions are not in any way to affect the qualification for a governor. It is the founder's desire that power by Act of Parliament, Royal Charter, or otherwise, should be eventually sought to enable the college to confer degrees, after due examination, and that until such power is obtained the students shall qualify themselves to pass the women's examination of the London University, or any examination of a similar or higher character which may be open to women at any of the existing universities of the United Kingdom. The curriculum shall not be restricted to subjects enjoined by any existing university. Instead of being regulated by the traditions and methods of former ages, the system of education should be mainly founded on studies and sciences which the experience of modern times has shown to be most valuable and as best adapted for the intellectual and social requirements of students. The governors will, therefore, be empowered to provide instruction in any subject or branch of knowledge which shall appear to them from time to time most suitable for the education of women; and the curriculum of the college will not discourage students who may desire a liberal education apart from the Latin and Greek languages. Proficiency in classics is not to entitle students to rewards of merit over others equally proficient in other branches of knowledge. It is intended to provide twenty founder's scholarships of the value of 40*l.* each, tenable for not more than two years in the college. No professor will be required to submit to any test concerning his or her religious opinion, and denominational theology is not to be taught. The principal of the college must be a lady, and duly qualified lady physicians and surgeons are to be resident in the college. Mr. Holloway has determined to personally superintend the erection of the building, and has agreed to provide an endowment fund of 100,000*l.*, in addition to any fund that may be derived from the sale of such portion of the Mount Lee estate as may not be required for the purposes of the college.

THE following is the list of candidates successful in the competition for the Whitworth Scholarships, 1879, in connection with the Science and Art Department:—John Hardisty, engineer; George Harrison, millwright; Edward Shaw, engineer apprentice; John A. Simpson, engineer; John W. Geddes, mechanic; Sydney J. Harris, engine fitter; Thomas E. Sackfield, mechanic; John A. Brodie, engineer apprentice. As the result of the final competition of scholars appointed in 1876, Mr. Henry S. H. Shaw has received the first prize of 200*l.*, and Mr. Jerdan Nichols the second of 100*l.*

THE first Siberian university at Tomsk will be definitely opened for the term of 1879-80. The Czarewitch has signified his intention of being present at the inauguration.

FROM a report which has been sent us of the awards made at the conclusion of the session of the Johns Hopkins University, we notice that out of twenty Fellows appointed for 1879-80, twelve were in physical and biological science, all of them from other colleges than the Johns Hopkins, one of them being from the University of Tokio, Japan. The public spirit of the president and professors is shown in the fact that they have subscribed 500 dollars to be divided as scholarships to two meritorious students next year. In consideration of marked ability in the study of mathematics exemplified during a year's residence in Baltimore and previously, the trustees have invited Miss Christine Ladd to continue her mathematical studies in this university, and have voted that she may receive an honorary stipend, equal to that bestowed upon those who are appointed to fellowships. The trustees promised their aid to a specified amount for the encouragement of a journal of philology, to be published under the editorial control of Prof. Gildersleeve. This will be the fourth serial encouraged by the trustees—the others being the *Journal of Mathematics*, under Prof. Sylvester; the *Journal of Chemistry*, under Prof. Remsen; the *Biological Papers*, under Prof. Martin. The *Chesapeake Zoological Papers*, edited by Dr. Brooks, were published at the cost of a few liberal citizens of Baltimore. Arrangements have been matured for the continuance of the Chesapeake Zoological Laboratory during the ensuing year. The United States Fish Commission, under Prof. S. F. Baird, and the Maryland Fish Commission, under Major T. B. Ferguson, co-operate in this laboratory with the Johns Hopkins University.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, August 4.—M. Daubrée in the chair.—The following papers were read:—On the recent tornado in the United States, and on records of Buffon's and Spallanzani's observations of whirlwinds, by M. Faye.—Remarks by M. Berthelot on M. Wurtz's paper on hydrate of chloral.—Secreting and circulating effects produced by the faradisation of the nerves which traverse the tympanum, by M. A. Vulpian.—Supplementary note on the theory of the pulsations of the heart and arteries and their registration, by M. Bouillaud.—On the origin of hail, and on some whirlwinds in which the air was drawn upwards, by M. Colladon.—On the theory of fertilisation, by M. Dechant.—Note on the rotation theory of heavenly bodies, by M. Mougeolle.—A number of communications relating to *Phylloxera vastatrix*, by MM. Gayon and Millardet, G. Foex, A. Quercy, Borel, and H. Barthélemy, were read.—Observations of the occultation of Antares on July 28 last, by C. Flammarion.—On the normal calorific spectrum of the sun, and of the incandescent platinum lamp (Bourbouze), by M. Mouton.—Some observations on M. Mouton's paper, by M. P. Thenard.—On the vibrations on the surface of liquids, by M. F. Lechat.—On Ampère's currents by M. Trève.—On magnets, by the same.—On the distillation of liquids under the influence of static electricity, by M. D. Gernez.—On the employment of the diffusion method in the study of the phenomena of dissociation, by M. L. Troost.—On the action of pyrogallate of potassium upon nitric oxide, by M. G. Lechartier.—On solid hydrocyanic acid, by MM. Lescœur and A. Rigaut.—On synthetic methylpropylcarbinol, by J. A. Le Bel.—On the non-existence of a soluble alcoholic ferment, by M. D. Cochin.—On the colouring matter of *Palmella cruenta*, by Mr. T. L. Phipson.—On the vital properties of cells and on the appearance of their nuclei after their death, by M. L. Ranvier.—On the lymphatics of the perichondrium, by Messrs. G. and Fr. E. Hoggan.—Note by M. L. Hugo, on a number representing the sphere among the ancients.

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