THURSDAY, MARCH 12, 1874

THE LINNEAN SOCIETY

ON Thursday last the Fellows of the Linnean Society met together in a general meeting, which had been specially convened to consider the disputes which have almost paralysed its work for the past two months. One painful episode which arose out of these disputes has already been alluded to in these columns. This alone gave importance to matters which otherwise it would have been difficult to discuss with patience. But so serious a crisis as the resignation of a president so distinguished as Mr. Bentham brought together a larger meeting of the Fellows than had probably ever assembled together before in the history of the Society, and produced the very decided feeling that at least the prospect of a settlement must be reached before the meeting dispersed.

The result was, on the whole, a satisfactory one. After a debate which lasted for about two hours, and in which a considerable number of Fellows took part, a motion proposed by Major-General Strachey was finally carried with only three dissentients, to the effect that the Council possessed the confidence of the Fellows, and that the question of the disputed bye-laws should be referred to some authoritative legal adjudicator, whose decision should be regarded as final.

Those who have had no opportunity of taking any part in the proceedings will naturally wonder what can have been the nature of the portentous questions which have so violently disturbed so grave and staid a body as the Linnean Society. So far as we can arrive at a clear comprehension of the facts, they may be stated as follows:—

At the commencement of the present year the charter and bye-laws were out of print, and the Council having determined to reprint them, before doing so made and submitted to the Fellows a number of amendments in them which appeared to be advisable. It is necessary to explain that, by the constitution of the Society the Council alone has the power to legislate, and the general body of Fellows is only able to reject or ratify what the Council has done. At the meeting on January 15, when the amendments in due course came before the Fellows, the President was requested to put them to the vote *seriatim*, and not *en masse*. This was *primâ facie* a reasonable request, and might, perhaps, have been acceded to without any great inconvenience. The President, however, ruled against it, and his ruling may be defended on two grounds. In the first place the custom of the Society on other occasions appears to have been in accordance with it, and as a general principle it seems obvious that it would be inconvenient for the Fellows to modify in detail a scheme which the Council had presented to them as a whole. In the second place, although the charter is a most difficult instrument for a layman to interpret, it is held by those who ought to be able to construe it, to require that the Council's propositions should be accepted or rejected in their entirety and without modification. The amendments were accordingly put to the meeting *en masse*, and were carried by the necessary majority of two-thirds. The minority declared themselves much aggrieved by the course that had been taken. It is not easy, however, to appreciate their objection; for it is clear that to put all the amendments *en masse* cannot facilitate their acceptance, but that, on the contrary, it brings to bear collectively upon the whole scheme all the objections which might be raised separately to different parts of it.

At the meeting in which the amendments were carried, only one of them was actually objected to. The effect of this amendment was to enable the Council to pay a Fellow to assist in editing the publications. The sum proposed was not large, and it seems very desirable that the work should be paid for, and not voluntary. It is quite obvious that in the former case the secretaries would have no scruple in criticising, if necessary, what was done, which might easily seem an ungracious proceeding in the case of unpaid labour.

Subsequently, however, to the meeting, the minority discovered that another amendment, removing the appointment of the Librarian from the general suffrages of the Fellows to the Council, was repugnant to the provisions of the charter. A competent legal authority has declared that this is not the case; nevertheless, certain of the Fellows hold a contrary opinion, and regard the change as a derogation from their privileges.

We have already referred to what took place on February 5. Mr. Carruthers, who took the lead in the opposition, proposed to discuss the legality of the amendments, and attempted to raise this question upon the confirmation of the minutes of the meeting at which they had been carried. He and his supporters being in a majority in a very thinly-attended meeting refused to acquiesce in the ruling of the President against the regularity of this proceeding; the meeting broke up in confusion, and Mr. Bentham resigned the chair which he has occupied so long to the great advantage of the Society. The difficulties of the Society began like a slight and neglected illness which terminates fatally: before the general body of Fellows had time to even realise the nature of the dispute it had culminated in an event which it will never be possible to look back upon except with the strongest regret. It was, however, a matter for satisfaction that the Fellows assembled last Thursday were anxious to efface this from Mr. Bentham's recollection; and Mr. Carruthers, whose action was the immediate cause which led to the President's resignation, spoke with befitting dignity of the regard he felt for Mr. Bentham's services to the Society and to Science generally, and of his own extreme regret that the course he had considered himself compelled to take had led to such an untoward result.

As to the points apparently in dispute it is difficult to estimate seriously the position of the dissidents from the Council's action. It is objected that the person employed as sub-editor ought not to be a Fellow, or ought on accepting the position *ipso facto* to cease to be one. But where, it may be asked, can the Society expect to find, except in its own ranks, anyone competent for the work? and why should there be any more scruple about employing a Fellow for such a purpose than there is in employing Fellows as printers and engravers?

As to the election of a Librarian, what arrangement could be more objectionable than for the Society at large to elect to an office of this kind? How could testimonials be properly weighed by the members generally, or the fitness of candidates in any way tested? And when it is argued that the clerk and housekeeper, as well as the Librarian, ought to be appointed by the Society also, and not by the Council, the acme of absurdity in the matter seems to have been reached.

It is quite evident, from what has been said, that the less a learned Society indulges in legislation the better. What must be called the "opposition" were anxious, at the meeting on Thursday last, for a further revision of the whole laws of the Society; fortunately, however, the common sense of the Fellows was against them. Sir John Lubbock pointed out, at the conclusion of the debate, that none of the speakers had made out even a *primâ facie* case for further change. It may be hoped, therefore, that when the technical question of the legality of the amendments has been disposed of, the Society will enjoy undisturbed peace and quietness.

One practical suggestion seems to educe itself from what has been said. The only way to settle matters of dispute of this kind is to have an authoritative arbitrator. If we ever get a minister to take charge of our scientific institutions, a legal assessor might be conveniently attached to his staff to act in lieu of a Visitor to the learned Societies which now possess a quasi-official status from being housed at the public expense. If the points which the dissentients raised in the present case could have been authoritatively and impartially settled off-hand, there would have been no need for an important scientific Society to have wasted a considerable portion of its session over matters in themselves of the slenderest possible consequence, and absolutely without importance in a scientific sense.

THE MOON

The Moon Considered as a Planet, a World, and a Satellite. By James Nasmyth, C.E., and James Carpenter, F.R.A.S. With 24 illustrative plates of lunar objects, phenomena, and scenery, and numerous woodcuts. (London: Murray, 1874.)

THE illustrations to this book are so admirable, so far beyond those one generally gets of any celestial phenomenon, that one is tempted to refer to them first of all. No more truthful or striking representations of natural objects than those here presented have ever been laid before his readers by any student of Science; and I may add that, rarely if ever, have equal pains been taken to insure such truthfulness. Mr. Nasmyth, not content with the drawings he has been accumulating for many years, has first translated them into *models*, which, when placed with a strong light shining obliquely upon them, should reproduce the ever-changing lunar effects of light and shadow. Having obtained models which bore this test, he has photographed them with the light falling, now on one side, and now on the other, to represent the sunrise and sunset appearances on our satellite, as observed in the telescope. The result is perfect; far more perfect than any enlargement of photographs could possibly have been, because, by every such enlargement, a softness is brought about, whereas, the more powerful the telescope employed and the more perfect the atmospheric conditions, the more does the unevenness and sharpness of every lunar detail come out.

But, though I have given the first place to a general reference to the illustrations, I by no means intend thereby to imply that the text is of secondary importance. In fact, the more carefully the text is read, the more obvious does it become that Mr. Nasmyth has used his drawings as a means to an end, and that he and Mr. Carpenter between them have produced a work which is not only a very beautiful and a very readable one, but one of some importance. From this point of view it is to be regretted that the book had not been published a month or two later, as then the authors might further have illustrated their subject by a reference to Mr. Mallet's most important paper on volcanic energy, which has just appeared in the "Philosophical Transactions"—a paper which supports the authors' views in many important particulars, and though it clashes with others, if we are not mistaken, a discussion of the question from the two points of view presented will ultimately enable us to carry our conclusions further than they have gone hitherto.

Again, it is not a little curious that another communication presented to the Royal Society not long ago, and

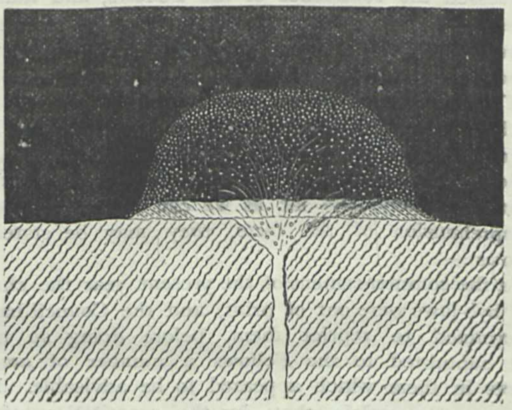

FIG. 1.—First stage of a lunar Volcano

not yet published in this country, may also throw new light upon one at least of the interesting points presented to the student of lunar physics. I refer to the working hypothesis on which I have attempted to explain the absence of metalloids from the sun's reversing layer in its bearing upon the moon's atmosphere.

Before, however, more detailed reference to these points, it is as well to state briefly, for those less conversant with lunar matters, the principal points in which Selenology differs from Geology, or rather the principal effects which have been produced on the moon in past time which differ from the effects which have been produced on our planet in past time.

First among these is undoubtedly the evidence of volcanic action on a scale far surpassing anything that we have an idea of here. Witness craters 74 miles in diameter, and if the walled plains are accepted as craters, then diameters of craters reaching 300 miles, the volcanic energy not being scattered here and there, but making up the entire surface over large areas.

Next, after the tremendous evidence of vulcanicity afforded by the craters and walled plains, come the bright streaks which have ever been a puzzle to observers. These are seen under various illuminations to radiate from several craters for hundreds of miles. Here I will quote from the book, p. 133:—

"There are several prominent examples of these bright streak systems upon the visible hemisphere of the moon; the focal craters of the most conspicuous are Tycho, Copernicus, Kepler, Aristarchus, Menelaus, and Proclus. Generally, these focal craters have ramparts and interiors distinguished by the same peculiar bright or highly reflective material which shows itself with such remarkable brilliance, especially at full moon; under other conditions of illumination they are not so strikingly visible. At or nearly full moon, the streaks are seen to traverse over plains, mountains, craters, and all asperities; holding their way totally disregardful of every object that happens to lie in their course. The most remarkable bright streak system is that diverging from the great crater Tycho. The streaks that can be easily individualised in this group number more than one hundred, while the courses of some of them may be traced through upwards of six hundred miles from their centre of divergence. Those around Copernicus, although less remarkable in regard to their extent than those diverging from Tycho, are nevertheless in many respects well deserving of careful examination; they are so numerous as utterly to defy attempts to count them, while their intricate reticulation renders any endeavour to delineate their arrangement equally hopeless."

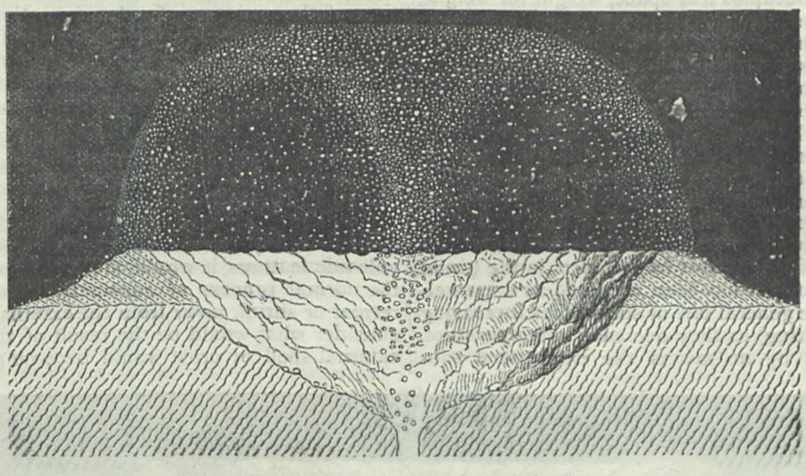

FIG. 2.—Second stage. The crater increases its diameter

Quite different from these radiating streaks are very definite "cracks," some of which are easily seen with moderate telescopic powers. There are, however, a very large number recorded, some of which are excessively delicate objects.

Last among exceptional phenomena to be recorded is the circumstance that our satellite has no atmosphere to speak of: no clouds, no fogs have ever been seen on the moon as on Mars, while no effects have been produced at occultations of stars and planets by the moon such as should be produced did an atmosphere in any way comparable to our own exist on our satellite.

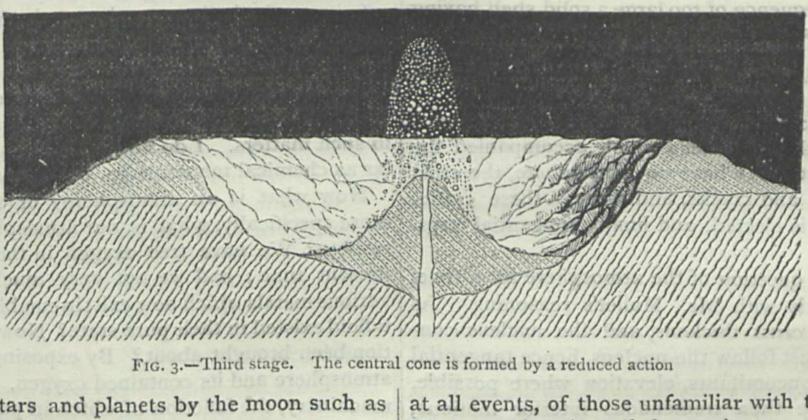

FIG. 3.—Third stage. The central cone is formed by a reduced action

Although the most important part of the text consists of an attempted explanation of all but the atmospheric phenomena, much of it deals, and in a very admirable way, with lunar topography, a perusal of which will be desirable before the discussion is taken up, in the case, at all events, of those unfamiliar with the moon's surface. The consideration of the various questions involved is preceded by chapters on the cosmical origin of our system and the generation of heat, the result of which was that at one time the moon was an incandescent sphere with a cooling crust, and even then if I understand the authors, there was no lunar atmosphere (p. 17), for they give an answer, or think they do, in this sense to the question

"How can a volcanic theory of the lunar phenomena be upheld consistently with the condition that it possesses no atmosphere to support Fire?"

In the chapter on the cooling of the crust (Chap. III.), special attention is directed to observations tending to show that cast-iron and even slag and Vesuvian lava expand on cooling. This will be new to physicists:—

"The broad general principle of the phenomenon here referred to is this: That fusible substances are (with few exceptions) specifically heavier while in their molten condition than in the solidified state, or in other words, that molten matter occupies less space, weight for weight, than the same matter after it has passed from the melted to the solid condition. It follows as an obvious corollary that such substances contract in bulk in fusing or melting, and expand in becoming solid. It is this expansion upon solidification that now concerns us.

"Water, as is well known, increases in density as it cools, till it reaches the temperature of 39° F., after which, upon a further decrease of temperature, its density begins to decrease, or in other words, its bulk expands, and hence the well-known fact of ice floating in water, and the inconvenient fact of water-pipes bursting in a frost. This action in water is of the utmost importance in the grand economy of nature, and it has been accepted as a marvellous exception to the general law of substances increasing in density (or shrinking) as they decrease in temperature. Water is, however, by no means the exceptional substance that it has been so generally considered. It is a fact perfectly familiar to iron-founders, that when a mass of solid cast-iron is dropped into a pot of molten iron of identical quality, the solid is found to float persistently upon the molten metals—so persistently that when it is intentionally thrust to the bottom of the pot, it rises again the moment the submerging agency is withdrawn" (p. 20).

There will be many for whom this part of the work will possess great interest, but I take it few will accept the startling conclusions drawn from the asserted expansion.

"This expansion of volume which accompanies the solidification of molten matter furnishes a key to the solution of the enigma of volcanic action; and that such theories as depend upon the agency of gases, vapours, or water are at all events untenable with regard to the moon, where no gases, vapour, or water appear to exist" (p. 27).

I will return to this point presently, but meantime let us follow the contracting globe. Messrs. Nasmyth and Carpenter quite accept tangential pressure as being the only true cause of elevation, and its effect is very well put:

"When the molten sub-stratum had burst its confines, ejected its superfluous matter, and produced the resulting volcanic features, it would, after final solidification, resume the normal process of contraction upon cooling, and so retreat or shrink away from the external shell. Let us now consider what would be the result of this. Evidently the external shell or crust would become relatively too large to remain at all points in close contact with the subjacent matter. The consequence of too large a solid shell having to accommodate itself to a shrunken body underneath, is that the skin, so to term the outer stratum of solid matter, becomes shrivelled up into alternate ridges and depressions or wrinkles" (p. 28).

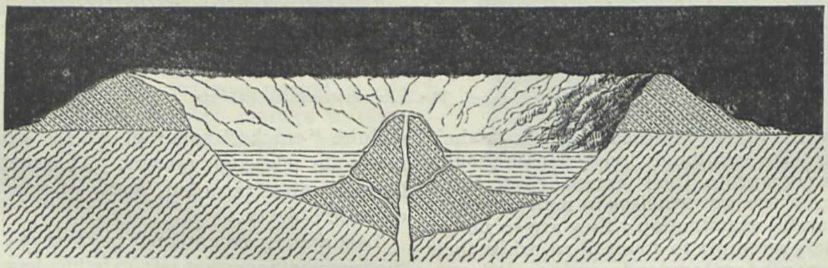

FIG. 4.—Fourth stage. The old crater is nearly filled with lava, leaving the cone visible in the centre

The preceding extracts will give an idea of the authors' view of the general phenomena which accompanied the cooling of the crust. We have no atmosphere, the crust as it cools expands and cracks, and through these cracks the interior liquid is ejected, and finally tangential pressure does the rest.

Now leaving the question of the atmosphere for a time, let us compare this with Mr. Mallet's reasoning. As a planet cools, the crust thickens, and the nucleus contracts; the crust must follow the nucleus, hence tangential pressure and its concomitants, elevation where possible, where not possible then tremendous interior motions, which motions are converted into heat, which heat + water produces volcanic activity. Further, the smaller a globe is, the more rapidly will it cool, and the more marked will the phenomena which accompany cooling be. Hence Mr. Mallet's hypothesis is competent to explain all the extreme development of volcanic activity on the moon by exactly similar causes which we know to have gone on here.

Now as I have said, Mr. Mallet wants water for his volcanoes, both here and on the moon, but Messrs. Nasmyth and Carpenter will not even allow that an atmosphere, still less water, has ever existed there. Now here I unhesitatingly range myself on the side of Mr. Mallet. I believe in an absolute uniformity throughout all Nature in such matters. I do not mean uniformity of matter, so far as chemical materials go, but of manner.

Now what is an atmosphere? or to put the question more specifically, what is our atmosphere? Is it not a residue? We have free oxygen in the atmosphere at the present time; had we not very much more before the various metals which now exist in combination with that metalloid existed in their pure state? Now how has combination been brought about? By exposing the metals to the atmosphere and its contained oxygen. Now suppose the machinery, the function of which in past time has been to bring these metals to the surface, had been a thousand times more powerful, would there be as much oxygen in the air now as there is? A child can answer this question, and it is one of several which might be asked all tending to show that it is as unnecessary as it is unphilosophical to suppose that there never was a lunar atmosphere, because there is only a tenuous one at the best now. I shall not follow this subject out further now because it is part of a larger one, which deals with the atmospheres and densities of all the bodies of our system, and to discuss it at length would lead me too far from the present subject; suffice it to say that the enormous atmospheres of Saturn and Jupiter and the absence of a lunar atmosphere result from one single cause, that cause being if I mistake not the chemical constitution of the exterior parts of the solar nebula as each planet was thrown off, and the subsequent action on each globe.

To come to details. Whether the walled plains are really due to volcanic action or not, our authors offer no opinion beyond referring to the hypothesis of Prof. Dana, as being the most rational. Dana suggested that, as at Kilauea, the lava was simply boiling, and gradually extending its boundaries from a centre, so that at last, if the heat continued, a quasi-crater might be formed of any extent. That the smaller craters are true craters Messrs. Nasmyth and Carpenter take great pains to show, and their evidence is of the closest and most satisfactory kind. The woodcuts which we produce will show how the central cones, which *are scarcely ever absent in the craters we are now discussing*, have originated on the theory advanced; at the same time it is shown how, on this idea, even when the central cone is absent or the crater is filled to the brim, as in the case of Wargentin, one of the most curious of lunar objects, the effects observed may be explained.

Mr. Nasmyth long ago illustrated the bright streaks on the moon by the experiment which he here details, and a very striking one it is. He took a glass globe, filled it with water, and having hermetically sealed it, plunged it into warm water, "the enclosed water expanding at a greater rate than the glass, exerts a disruptive force on the interior surface of the latter, the consequence being that at the point of least resistance the globe is rent by a large number of cracks diverging in every direction from the focus of disruption."

From the photograph, it is clear that the result is strikingly similar to the rays which have Tycho for a focus, and on the strength of this similarity the authors claim this as another effect of expansion due to cooling. I so, however, the experiment with the glass globe is not in point. But however the cracks were produced, they imagine that thus having them travelling along for hundreds of miles irrespective of surface inequality, there was an up-flow of molten matter which spread out on both sides and turned the narrow crack into a broad streak.

I trust I have said enough about this book to induce all interested in physical problems to peruse it for themselves; it is altogether an admirable production, and if space permitted each picture even would merit a special paragraph.

J. NORMAN LOCKYER

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Natural Selection and Dysteleology

IN his reply to a criticism which appeared in NATURE, Prof. Struthers alluded to a question of considerable interest to evolutionists, viz., whether or not the presence of useless organs "proves too much for the argument." * The difficulty is one often met with, and has been well stated by Prof. Huxley, thus:—"Prof. Haeckel has invented a new and convenient name, 'Dysteleology,' for the study of the 'purposelessnesses' which are observable in living organisms—such as the multitudinous cases of rudimentary and apparently useless structures. I confess, however, that it has often appeared to me that the facts of dysteleology cut two ways. If we assume, as evolutionists in general do, that useless organs atrophy, such cases as the existence of lateral rudiments of toes, in the foot of a horse, place us in a dilemma. For, either these rudiments are of no use to the animal—in which case, considering that the horse has existed in its present form since the pliocene epoch, they surely ought to have disappeared—or they are of some use to the animal, in which case they are of no use as arguments against teleology," &c.†

Now it appears to me (as I think it must to all upon adequate consideration), that the dilemma thus presented is only apparent; its first-mentioned horn having no existence. In other words, we can never in any single case be sure that any length of time would have been sufficient to enable natural selection totally to obliterate a useless organ.

Mr. Darwin, in the "Origin" and in the "Variation," has mentioned three causes which operate towards the removal of useless structures. These causes are Selection, Disuse, and Economy of Growth. Recently he has suggested a fourth cause, which may be epitomised as the dwarfing influence of impoverished conditions, progressively reducing the average size of the useless structure, by means of free intercrossing.‡ I shall endeavour to show that these causes are not sufficient to obtain the complete extinction of rudimentary parts in all cases.

Selection may be considered as applying only to those rare instances in which changed conditions of life may be supposed to have rendered a previously useful organ injurious; for so far as selection operates in obliterating a merely useless organ, it will be more convenient, for the sake of brevity, to identify it with the Economy of Growth.§ Since, however, it is obvious that an injurious organ must pass through the merely useless stage before it becomes wholly suppressed, we may dismiss this cause without further comment.

Disuse and Economy of Growth are so much entangled in their operation, that it is hopeless to find examples illustrating their separate action. In so far, therefore, as we choose to disentangle them, we must discuss the question in the abstract.

Disuse may be left out of the question, so far as its influence is due to the principle of inheritance at corresponding periods of life; for, as Mr. Darwin tersely observes, "as most organs could be of no use at an early embryonic period, they would not be affected by disuse; consequently they would be preserved at this stage of growth, and would remain as rudiments." ‖ It may,

* NATURE, vol. ix p. 83.

† "Critiques and Addresses," pp. 307–8.

‡ NATURE, vol. viii. pp. 432 and 505.

§ I think, also, that if the Economy of Growth is really a principle independent of the "more general principle," viz., the *direct* influence of "natural selection in continually trying to economise every part of the organisation" (Compare "Origin," 1873, pp. 117–18), it may yet, without any great stretch of inference, be considered as due to the *indirect* influence of natural selection. For, the survival of the fittest demands that each individual shall utilise its stock of nutriment to the best advantage; and, this demand being continued through many generations, it does not seem in itself improbable, that it should thus at last secure to all the members of the surviving species an inherited tendency so to economise their nutritive power when fresh occasion requires—an advantageous innate *temperament* distinct from the external *eliminative* agency of Natural Selection. Only in some such way can we account for the facts of acclimatisation, in those cases where the adaptive changes take place immediately after the transportation of the organism: also for an analogous class of facts, such as that of the shells in the same species of Mollusca, differing in their thickness upon the weather and the lee sides of the Plymouth breakwater.

‖ "Variation," vol ii. p. 317. I may mention, also in passing, that it seems to me not unopen to question whether disuse is the *principal* cause even of reduction There is no doubt that disuse causes more or less of atrophy in the individual, and from this fact it is argued, that the principle of inheritance at corresponding periods of life must entail the continued reduction of a disused part in the species. Now the only effect of the principle relied on is that of prolonging, as it were, the life of the disused part over many generations—thus affording it an indefinite time to succumb to the conditions which reduced it in the life of the individual. But it is necessary for the validity of the inference that it would so succumb, to show that these conditions are the efficient causes of this reducing process in the one case, as they prove themselves to be in the other. Suppose, for instance, that failure of nutrition is the principal cause of atrophy under disuse, does it follow when such failure has done, to all appearance, its utmost during the life of the individual (as we see in disease), that it could do any more were that life indefinitely prolonged? Of course in the case of short-lived animals, where the dwarfing influences may not have time to exhaust themselves in a single generation, the principle of inheritance at corresponding ages may be drawn however, be objected that the doctrine which Mr. Darwin elsewhere inculcates,* and deems sufficient to account for the total suppression of rudimentary organs, viz., inheritance at earlier periods of life, is fatal to dysteleology as a prop to evolution—at least in the case of long-lived species. And so it would be, were not this principle of so shadowy an application that, while it is perfectly legitimate to point to it as a possible cause of total suppression in some cases, it would be simply absurd to argue that such must be its effect in all.

We next come to the Economy of Growth. Suppose an organ to become suddenly useless, this principle would at first cause its rapid reduction. In proportion, however, as its presence ceases to be injurious, the arresting process becomes slower and slower, until a point is reached at which it is presumably *nil*. That such a point of rest must somewhere be attained seems evident, if we consider that the smaller the diminishing organ becomes the less is it subject to the influence of the Economy of Growth. In other words, when the organ undergoing reduction becomes so minute relatively to the size of the animal (or, more correctly, to the available store of nutrition), that the supply of nourishment it requires is no longer perceived by the organism at large, it then remains permanently of that size. "The economy of growth will not account for the complete or almost complete obliteration of, for instance, a minute papilla of cellular tissue representing a pistil, or of a microscopically minute nodule of bone representing a tooth ;"† and, the whole principle being one of relation, it is a question, for instance, whether the rudimentary digits of a horse consume a greater relative amount of nutrition than does the "minute papilla." Besides, without entering into details, I think there is very good reason to believe that the Economy of Growth is unable to reduce an organ which was originally large, to the same absolute size as it can an organ which was originally small. From all this it follows, that if the struggle for existence were in any case so keen as to afford Selection (*i.e.*, Economy) the opportunity of totally obliterating every rudimentary organ, it seems probable that the species itself would require to become extinct.

Turning now to the last of the causes propounded by Mr. Darwin, there can be no doubt that it is (theoretically) sufficient to procure total obliteration. Forasmuch, however, as we can never know in any given case whether or not the requisite conditions have been supplied,—*i.e.* impoverished nutriment for an enormous length of time,—this newly added cause affords no further justification for the old statement, that the theory of Natural Selection fails to account for all the facts of Dysteleology.

The perusal of the last-mentioned thoughtful conception has suggested to me the probable existence of another cause, having a more general application ; but as it can never induce complete suppression, I shall reserve it for the subject of another communication.

Mr. Mivart supposes that organs may become suddenly aborted ‡ ; but, apart from the weighty objections to this view,§ there is no case on record, so far as I am aware, of an organ thus becoming *totally* suppressed in any domestic species. A sport of this kind always leaves a rudiment, and it is upon the analogy of such sports alone that Mr. Mivart's argument is founded.

Having now enumerated all the causes ever proposed by evolutionists to account for the reduction of useless parts, it is evident that we should antecedently expect to find innumerable examples of such parts in the condition of rudiments.‖ Indeed the only difficulty is to account for that final disappearance of organs which must, by any theory of evolution, be postulated to have taken place. The solution is afforded by the exhaustive contemplations of Mr. Darwin, for, whether or not we believe in pangenesis, we cannot but deem it in the highest degree probable that the influence of inheritance is not of unlimited duration. If so, we have at once an adequate cause for the eventual destruction, even in the embryo, of rudimentary parts ; but, as it is a cause which would only act after an immense lapse of time, it would have no influence until the original specific type had undergone a considerable modification. Thus, the facts of dysteleology, far from "cutting two ways," afford the strongest confirmation of the natural selection theory ; for, as time is thus shown the chief agent in the final destruction of rudiments, and as species are always undergoing change, on the one hand we have an explanation of the fact, that the greater the divergence of the specific type from its original the fewer rudiments do we find of organs characteristic of the latter, while on the other hand, the less such divergence the greater the number of such rudiments—a fact of which the necessary consequence is, that "with species in a state of nature, rudimentary organs are so extremely common that scarcely one can be named which is wholly free from a blemish of this nature."

GEORGE J. ROMANES

upon until the point of such exhaustion is attained ; but is it not open to question whether this point can never be reached at all? It must de remembered, too, that in the case of wild species the effects of disease are always associated with other reducing causes, so that here we may easily over-rate the share it has in the work ; but in the case of domesticated species the effects of disease are much more isolated (in consequence of Economy of Growth, etc., being, to a great extent, in abeyance) ; and here we find that atrophy of disused parts, although at first very rapid, eventually does not proceed to nearly so great an extent as it does in the case of wild species. The question thus raised, however, is of no practical importance, since whether or not disuse is the chief *cause* of atrophy in species, there is no doubt that atrophy *accompanies* disuse.

* "Variation," vol. ii. p. 80.

† "Variation," vol. ii. p. 397.

‡ "Genesis of Species," 1st ed. p. 103.

§ See "Origin," pp. 201—204.

‖ It is unnecessary to consider the *collective* action of these causes, for a moment's reflection will now make it evident that none such exists below the point at which the Economy of Growth ceases to be felt.

The Action of the Heart

HAVING replied to Mr. Garrod's criticism of my "Locomotion of Animals" (NATURE, vol. ix. p. 281), I now wish to show that the explanation given by him of the diastole of the heart is not in accordance with fact.

In a recent number of NATURE (vol. ix. p. 282) I asked Mr. Garrod to explain "how the left ventricle of the heart opens after a vigorous contraction in which all the blood contained in the ventricular cavity is ejected and the ventricle converted into a solid muscular mass, if not by a spontaneous *elongation* of all its fibres." He replies :—"At first sight it might seem that the active dilatation of the heart during the diastole did depend on an inherent power in the muscular fibres of the ventricles to elongate, but the peculiarities of the coronary circulation are quite sufficient to explain the phenomenon without the introduction of so unnecessary a theory as that of Dr. Pettigrew. For in the heart when removed from the body, as in the living body during diastole, the injection of fluid into the coronary vessels causes the whole heart to open up from the congestion of the ventricular walls, and so produce the active dilatation which is well known to occur" (NATURE, vol. ix. p. 301).

The explanation given by Mr. Garrod of the manner in which the ventricles of the heart open up during the diastole is eminently unsatisfactory. In fact it is no explanation at all. He informs us that the active dilatation of the ventricles is due "*to peculiarities in the coronary circulation*" . . . "for in the heart when removed from the body the injection of fluid into the coronary vessels causes the whole heart to open up from the congestion of the ventricular walls, and so produce the active dilatation which is well known to occur."

The coronary vessels, as everyone is aware, simply supply the blood which nourishes the substance of the heart. There is no peculiarity whatever in the circulation of the blood through them. The blood flows through the coronary vessels in a more or less steady stream as through all the other vessels of the body. In other words the substance of the heart is full of blood during the closure or systole of the ventricles, as well as during the opening or diastole of the ventricles. The presence of the blood, therefore, within the coronary vessels can exert no influence in opening up or actively dilating the ventricles. This is proved by direct experiment. If the heart be cut out of the living body and the coronary vessels divided, the ventricles go on opening and closing with the utmost regularity for protracted periods. Here, however, the power which, according to Mr. Garrod, opens the ventricles is inoperative. The same thing happens when the heart is cut out of the body and the vessels laid open. If, however, the ventricles open and close when the coronary vessels are freely divided, and the blood which is said to distend or open up the ventricles is allowed to escape from the cut surfaces, it is quite clear that the blood pressure within the ventricular walls can exert no influence whatever in producing the diastole. If blood is not admitted into the coronary vessels, or if admitted it is allowed freely to escape, it cannot of course act as a distending medium. Allowing, however, for the sake of argument, that the flow of blood through the vessels of the ventricles occasioned the opening or dilatation of the ventricles, it is evident, for the same reason, that the presence of the blood within the ventricular walls, from the fact that the blood is nearly constant in quantity and virtually incompressible, would prevent the closing or contraction of the ventricles. Mr. Garrod, I opine, is here on the horns of a dilemma. He evidently puts the cart before the horse. It is the movements of the heart which determine the movements of the blood, and not the converse.

The cardiac movements are due to a change of shape in the sarcous elements or ultimate particles of the muscular fibres of the heart, and in the adult organ can only be effected by a vital and alternate elongation and shortening of all the fibres composing the heart; the elongation occurring during the diastole and the shortening during the systole. Similar remarks are to be made of the voluntary muscles which, as stated in my work on "Animal Locomotion," are endowed with centrifugal and centripetal movements.

That the opening and closing of the ventricles of the heart are in no way connected with the passage of blood through the substance of the organ, is proved indirectly by the movements of the heart of the embryo. Here the heart opens and closes with time-regulated beat, while yet a mass of cells, and before it contains blood either in its cavities *or in its substance.* But that the presence of blood is not necessary to such movements is placed beyond doubt, for rhythmic movements occur in the vacuoles of certain plants, as *e.g.* the *Volvox globator*, *Gonium pectorale*, and *Chlamydomonas*, where no blood is present.

Lastly, if a frog be slightly curarised and its spinal cord destroyed, it is found, on exposing the heart, that the sinus venosus, vena cava inferior, the auricles and ventricles *are quite destitute of blood*, and yet the organ beats normally and with the utmost regularity. Mr. Garrod has consequently not yet succeeded in answering my query as to how the diastole of the left ventricle is produced He has failed to show that it is not effected by the *active elongation or centrifugal movements of all its fibres.*

J. BELL PETTIGREW

Lakes with two Outfalls

HAVING observed the discussion lately carried on in your pages as to the existence of lakes with two outfalls, I think the following description of such a lake by Prof. Bell, of the Geological Survey of Canada, may be interesting to some of your readers. It occurs on the summit of the high Laurentian country between Lake Superior and Hudson's Bay :—

"In crossing the country from Lake Nipigon to the Albany River, we first followed the Ombabika River to its source, which is in Shoal Lake, three and a half miles long and one mile wide, lying at a distance of twenty-five miles north-east of the mouth of the river. This lake lies due north and south, and discharges both ways, the stream flowing northward towards the Albany, called the Powitik River, being nearly as large as the southern outlet. No portage occurs on the Ombabika for about nine miles before reaching Shoal Lake, nor for nearly five miles beyond its northern outlet; so that we passed the height of land with the greatest possible ease, having had about seventeen miles of uninterrupted canoe navigation, from the time we made the last portage, in going up the southern side, till we came to the first on going down on the northern. Shoal Lake has an elevation of scarcely 300 ft. over Lake Nipigon, or about 1,200 ft. above the sea."—"Report of Progress Geological Survey of Canada for 1871-72," p. 107.

GEORGE M. DAWSON

Montreal, Feb. 19

The Ink of the Cuttle-fish

WITH reference to the interesting account in NATURE, vol. ix. p. 332, of a gigantic Cephalopod captured in American waters, and of a still larger one, which attacked the boat belonging to some fishermen near Newfoundland, by twining its arms round the vessel, and which, having had two of those arms cut off by the fishermen, moved off, "ejecting a large quantity of inky fluid to cover its retreat," I desire to draw attention to an observation respecting this fluid, which I made on the occasion of a visit to the Crystal Palace Aquarium. My friend Mr. Lloyd was good enough to dislodge a cuttle from its place of concealment, and the usual inky discharge followed, as the creature shot across the tank. Mr. Lloyd states in his interesting "Handbook to the Marine Aquarium," "that the ink (which is viscid) does not generally become diffused through the water as writing ink would be, but is suspended in the water in a kind of compact cloud till it gradually settles down, and is dispersed in flakes." Now I quite think, with Mr. Lloyd, that this being the case, it is difficult to perceive how, according to the generally received opinion, its retreat is covered by the ejected cloud. It seems to me more likely that this discharge is to divert the attention of a pursuer—a dog-fish for instance—which would for the moment be startled by the sudden appearance of masses of dark colour in the water, and in the confusion the cuttle makes his escape.

Now that public aquaria are becoming so general in our great towns, it is much to be hoped that this and many other interesting problems in marine zoology may be solved.

Birmingham, Feb. 28 W. R. HUGHES

Transmission of Light in a Squall

ON the Admiralty Pier, Dover, during a "squally" gale, I remarked an occasional jerking or unsteadiness in one of the adjacent lights, say two miles off, to one of the coast-guard's men with whom I was talking at the time.

To him this was a well-known observation in squally weather. At times, he said, two lights could distinctly be seen for a second or so; frequently the shape of the light was changed, by elongation, vertically and horizontally.

The above phenomenon, if not generally known, might be worth noticing and verifyin in your excellent paper.

I suppose an explanation is to be found in the different densities of the atmosphere through which a ray of light must pass in rough unsteady weather; the second image being simply the persistence of the one seen immediately before the change in position of the ray by refraction.

JAMES C. INGLIS

DR. LIVINGSTONE AND THE CAMERON EXPEDITION

IN NATURE for Feb. 26, we expressed the desire which we felt, in common with our readers, for information respecting the orders that have been sent to Zanzibar as to the disposal of Dr. Livingstone's body. We now have great pleasure in being able to announce that Lord Derby acted with the promptitude and energy which might be expected from a statesman who has always shown a warm sympathy for the cause of geography. With the concurrence of the family, his Lordship has sent a telegram ordering the body of the illustrious traveller to be sent to England, and we believe that it is to be accompanied by one or two of Livingstone's faithful negro followers.

The melancholy death of Dr. Dillon and the return of Lieut. Murphy, leaves Lieut. Cameron alone, to proceed to Ujiji, to recover the box of papers left there by Livingstone, and to prosecute further geographical exploration. Heavy unforeseen expenses obliged Lieut. Cameron, who has proved himself to be a resolute and observant explorer, to purchase stores at exorbitant rates at Unyanyembe. The necessity for providing for the march of Murphy and Dillon to the coast, with Livingstone's body and most of his followers, is his complete justification for incurring this unauthorised expenditure, and there can be no doubt that the Geographical Society will treat its gallant emissary in a generous and liberal spirit. Cameron has suffered cruelly from fever and ophthalmia, and he is now resolutely pressing onwards in the performance of his work—the Society's work—in the face of greater difficulties than were encountered by any previous expedition. He carries with him our warmest wishes for his success, and the sympathy of every true geographer in England.

ON THE NEW RHINOCEROS AT THE ZOOLOGICAL GARDENS

A GLANCE at our list of additions to the Zoological Gardens during the last week will inform the reader that the Zoological Society has been successful in adding to its already unrivalled collection of specimens of the genus Rhinoceros still another species, which is exhibited for the first time in the Society's collection, and most probably in this country.

It is well known amongst naturalists that in Asia there are to be found two species of Rhinoceros, with a single horn developed on the top of the nose. The larger of these is the gigantic Indian Rhinoceros (*R. unicornis*), many specimens of which have been brought to this country, and a very fine male example of which is living in the Regent's Park Gardens. In it the skin, which is immensely thick, is thrown into massive folds or shields, making the animal appear as if clad in armour-plating. Each shield is thickly studded with nearly circular slightly-raised tubercles, which look very much like the heads of innumerable bolts intended to strengthen and retain the shield in position. The folds that surround the neck, where it joins the head, are very ample, producing the appearance of the now so fashionable ruff, somewhat modified. According to the observations of the late Mr. Edward Blyth, the Indian Rhinoceros is found only at the foot of the Himalayan hills, and in the province of Assam, along the valley of the Brahmapootra.

The second species of one-horned Rhinoceros is generally called the Javan Rhinoceros (*R. sondaicus*). It is found in Java, and in the country stretching from Malacca up through Burmah to Assam. It is considerably smaller than the Indian species; the shields are not so strongly marked, and are not arranged in an exactly similar manner, the gluteal shield not being completely divided into two by a transverse fold situated half-way down it; and the middle neck fold, instead of running backwards on each side before it reaches the spine, crosses the middle line, and so divides off a saddle-shaped shield, which is median, and as deep from before backwards as from side to side. The fold which surrounds the neck is also much less significant, and the head is narrower and less formidable in aspect. The tuberculation of the shields is more slightly marked, and each tubercle is proportionately smaller in diameter.

It is a specimen of this Javan Rhinoceros (*R. sondaicus*), a nearly full-grown male from Java itself, which the Zoological Society has succeeded in purchasing, and which is now exhibited in the same house as the Indian species, so that every opportunity is at last afforded for a more minute study of the differences which will most probably be found to distinguish the two species.

The other species of Asiatic Rhinoceroses, namely, the Sumatran Rhinoceros (*R. sumatranus*), and the Hairy-eared Rhinoceros (*R. lasiotis*), are both two-horned, and have been divided off as a separate genus, that of *Ceratorhinus*, by Dr. J. E. Gray. The skin is not divided into shields, and is thinner than in the one-horned species. The type specimen of the Hairy-eared Rhinoceros, the only example known, is now living in the Zoological Gardens. About a year ago the Sumatran animal was also represented, and rumour says that the gap caused by its loss will not be long unfilled.

NEIL ARNOTT, M.D., F.R.S.

WE have this week to record the death of this well-known man of science, which took place at his residence in Cumberland Terrace, Regent's Park, on the 2nd inst. He was born at Arbroath in May 1788, and had consequently reached his eighty-sixth year.

While Neil was yet young his father died, and the family removed to Aberdeen. Neil went to the Aberdeen Grammar School, being there with Lord Byron, and succeeded so well in the one thing then taught, Latin, that he gained a bursary by a competition in Marischal College, which he entered in 1801. In his third year he came under Patrick Copeland, Professor of Natural Philosophy, renowned for his admirable course of lectures, and especially for his power of experimental illustration. Arnott was one of Copeland's best pupils, and afterwards turned to full account the careful notes that he had made of the lectures.

He began the study of medicine in Aberdeen, and in 1806 he went to London to prosecute the study. Young Arnott, while his medical education was still incomplete, went aboard an Indiaman, as assistant-surgeon, making the usual voyage of a trading East Indiaman in those days. He was the intellect and soul of the ship, associating with everyone that could learn or teach anything; he was the resource in all serious emergencies, of whatever kind.

On his return to England, in 1811, he settled as a medical practitioner in London. He was the chief medical adviser to a colony of French refugees who settled in Camden Town, and also became physician to the French and Spanish Embassies, his fluency in languages serving him in good stead. It was about 1823 that he first turned to account his studies in natural philosophy, by giving in his own house a course of lectures both on the general subject and on its applications to medicine. These lectures formed the basis of the "Physics," the first volume of which appeared in 1827, and gained for the author an instantaneous and wide-spread reputation. The first edition was sold in a week after being reviewed by the *Times*. In a few years five editions were exhausted, and the work was translated into all the languages of Europe. The freshness and popular character of his style recommended the book to the general public, and did not prevent its favourable reception by the highest scientific authorities; Herschel and Whewell both gave emphatic testimonies to its accuracy and originality. The author was thenceforth recognised as a man of science and an inventor of no mean order. His practice as a physician was extended, and he became a Fellow of the Royal Society. On the foundation of the University of London in 1836 he was nominated a member of the Senate, and in 1837 he was named Physician Extraordinary to the Queen.

In 1838 he published a treatise on warming and ventilating, and in this he described the stove since called by his name. He introduced the water-beds, and made many other useful applications of physics to medical and surgical practice. For many years he had withdrawn from medical practice. He had a large circle of friends in and out of the profession. His conversational powers, his large range of scientific knowledge, and his geniality of manner, will be long remembered by those who now regret his loss.

*OZONE**

II.

SOME of the properties of ozone have already been referred to. At the common temperature of the atmosphere, it may be preserved, if dry, for a very long time in sealed tubes, but by slow degrees it becomes changed again into ordinary oxygen. This conversion goes on more rapidly as the temperature is raised, and at 237° C. it is almost instantaneous ("Phil. Trans." for 1856, p. 12). The alteration of volume which occurs at the same time has been already sufficiently described. A similar effect to that of heat is produced by several oxides, such as the oxide of silver or the peroxide of manganese, which by contact, or, as it is termed, catalytically, instantly change ozone into ordinary oxygen. Ozone is also destroyed by agitation with water, provided the ozone is in a highly diluted state. But the most interesting fact of this kind is one which I have recently observed, and which I hope to be able to exhibit to the Society. Dry ozone, even if present in such quantities as freely to redden iodide of potassium paper, is readily destroyed by agitating it strongly with glass in fine fragments, although, as we have seen, it may be preserved for an almost indefinite period in sealed glass tubes. This experiment, as it appears to me, forms a new and closer link than any hitherto observed between a purely mechanical action and a chemical change.

Ozone is a powerful oxidising agent. It attacks metallic mercury and silver with great energy, and converts them into oxides. The experiment with mercury is very striking, and is a delicate test for ozone, either in the dry or moist state. A few bubbles

* An Address delivered before the Royal Society of Edinburgh on December 22, 1873, by Dr. Andrews, LL.D., F.R.S., Honorary Fellow of the Royal Society of Edinburgh. (Continued from p. 349.)

of oxygen containing not more than $\frac{1}{500}$th part of ozone will alter wholly the physical characters of several pounds of mercury, taking away the lustre and convexity of the metallic surface and causing the mercury to form an adhering mirror to the surface of the glass vessel in which it is contained. If ozone in a diluted state is slowly passed through a tube filled with silver leaf, the metal will be oxidised to the distance of 2 or 3 millimetres, but the oxidation will not proceed further, although the ozone reactions are wholly destroyed. This striking result is due to the catalytic action of the portions of oxide which are first formed. So small is the amount of oxide produced in this case that, in a glass tube through which many litres of electrolytic ozone had been passed, the increase in weight from the formation of oxide only amounted to a scarcely appreciable fraction of a milligramme.

Ozone is absorbed by oil of turpentine, oil of lemon, and other essential oils. These oils have also, like phosphorus, the power of changing oxygen into ozone, while they are slowly oxidising; so that if oil of turpentine is shaken for some time in a flask filled with air or oxygen, the oil will acquire ozone properties.

Ozone decomposes a solution of iodide of potassium, liberating the iodine, which may be discovered by its red colour, or its blue compound with starch. If the action is continued sufficiently long, the free iodine disappears from the formation of iodate of potassium and the solution becomes colourless. Reddened litmus paper moistened with a solution of iodide of potassium is turned blue, when exposed to the action of ozone, in consequence of the caustic alkali formed by the decomposition of the salt. In employing this test it will often be found advantageous to remove the free iodine by washing the paper with strong alcohol. This form of the iodide of potassium test has been proposed by Houzeau for the discovery of ozone in the atmosphere. Ozone produces other reactions of a similar character which it will be sufficient here barely to mention. Paper moistened with sulphate of manganese becomes brown when exposed to this agent from the formation of the hydrated peroxide. Solutions of thallous oxide are in like manner converted into the brown peroxide; the black sulphide of lead into the white sulphate, and the yellow ferrocyanide of potassium into the red salt. The action of ozone on tincture of guaiacum, which it turns blue, was made a subject of special study by Schönbein.

The bleaching properties of ozone are highly characteristic and have attracted a great deal of attention. It deprives indigo of its blue colour, converting it into isatin, and bleaches readily litmus and other vegetable colouring matters. Attempts have been made to apply this property of ozone in the arts, and particularly to the refining of sugar and the bleaching of linen. It has been even stated that these and other applications of ozone, as a decolorising or bleaching agent, have been successful; but the results of my inquiries on this point have, I regret to say, been unfavourable, and it remains yet to be seen whether this singular body can be made subservient to the useful purposes of life. For the preparation of ozone on the large scale from ordinary air, a modification of the tube-generator of Siemens has been proposed by Beanes, and is an efficient and powerful instrument.

I will not detain the Society by an account of the history or properties of the problematical body to which Schönbein gave the name of antozone. He considered this body to be oxygen possessing permanently positive properties, while ozone itself he regarded as negative oxygen. Ordinary or inactive oxygen, according to him, is formed by the union of ozone and antozone. These views have not been supported by recent investigations, which leave little doubt that the antozone of Schönbein is identical with the peroxide of hydrogen of Thénard. From ozone the peroxide of hydrogen can be readily distinguished by the solubility of the latter in water.

Soon after the discovery of ozone, Schönbein having observed that the air of the country frequently coloured a delicate ozone test-paper in the same manner as ozone itself, inferred that ozone is a normal constituent of our atmosphere. He concluded that the amount of this body present in the air is different in different localities, and in the same locality at different times, and with great boldness he attempted to connect its presence or absence with the prevalence or rarity of certain catarrhal affections. A new field for investigation was thus opened up, which has been assiduously cultivated by a large and zealous band of observers. Before referring however to their labours, it will be necessary briefly to allude to the present state of our knowledge regarding the existence of ozone in the atmosphere.

Schönbein always maintained that ozone is a constituent of atmospheric air, and his various papers on this subject alone would, if collected, fill a large volume. In his last memoir he observes that the active substance in the air acts in a parallel manner on iodide of potassium and sub-oxide of thallium papers, although more slowly on the latter; and that the thallium paper, which has been coloured brown by the air, behaves towards reagents in the same manner as that which has been exposed to artificial ozone. From these facts he infers that the active substance in the air is neither peroxide of nitrogen nor sulphuretted hydrogen. He further states that the atmosphere never contains free nitric acid, although nitrate of ammonium in small quantities is frequently present; and that neither chlorine nor bromine can be present in the free state in air, on account of their affinity for hydrogen. Houzeau also maintained that the existence of ozone in the air was proved by the alkaline reaction of iodide of potassium paper, which had been decomposed by exposure to the atmosphere. Although experiments and arguments of this kind were sufficient to give probability to the view that the active substance in the atmosphere which produces these reactions is ozone, they were at the same time far from conclusive, and some of the ablest chemists of Europe accordingly considered the question doubtful, while others attributed the effects observed to the presence of oxidising agents altogether different from ozone. I will only cite on this point the opinion of M. Frémy, whose researches in conjunction with M. Becquerel on ozone have already been referred to. "Without denying," he remarked at a meeting of the Academy of Sciences in 1865, "the importance of the indications given by the paper of M. Schönbein, or by that of M. Houzeau, I do not find that these reactions demonstrate with sufficient certainty the existence of atmospheric ozone. I am of opinion that the presence of ozone in the air must be established anew by incontestable experiments."

In 1867 I made a set of experiments which I had contemplated some years before for the purpose, if possible, of finally settling this important question. The method I proposed was to ascertain whether, in addition to the power of decomposing solutions of iodide of potassium and of certain other salts, the active body in the atmosphere possessed the other properties of ozone, some of which are highly distinctive. The inquiry was a delicate one, in consequence of the very minute quantity of the active body which is present, even under the most favourable conditions, in atmospheric air. The results of this investigation are given in a short note which was published in the "Proceedings of the Royal Society" for 1867. (1) By passing a stream of atmospheric air, which gave the usual reaction with iodide of potassium paper, for some hours over the surface of mercury in a U-tube, the metal was distinctly oxidised. (2.) The ozone reactions disappeared when the air was passed through a tube containing pellets of dry oxide of manganese. The experiment was continued till 80 litres of air had traversed the manganese tube without producing the slightest discoloration of a delicate test-paper. (3.) But the crucial experiment was to ascertain whether the active body in the air loses its characteristic properties, or is destroyed, at the same temperature (237° C.) as ozone. To determine this point, a stream of atmospheric air, which gave strong ozone reactions, was passed through a globular glass vessel (Fig. 5), covered with wire gauze, of 5 litres capacity, and afterwards through a U-tube 1 metre in length, whose sides were moistened internally with water, while the tube itself was kept cool by being immersed in a vessel of cold water. After traversing the globular vessel and the moistened U-tube, the air was blown over a slip of delicate test-paper, in order to ascertain the presence or absence of ozone. When the atmospheric air was drawn through this apparatus at a uniform rate by means of an aspirator raised by clockwork, the iodide of potassium paper was distinctly reddened in two or three minutes, provided no heat was applied to the glass globe. But on heating the air as it passed through the globe, to a temperature of about 260° C., not the slightest action was produced on the paper, however long the current of air continued to pass. On the other hand, when air free from ozone, but containing traces of chlorine or of the higher oxides of nitrogen, was drawn through the apparatus, the test-papers were equally affected, whether the globe was heated or not. These experiments have since been successfully repeated by Dr. C. Fox.

The identity of the active body in the atmosphere with ozone we may now assume to be established beyond dispute, and the accuracy of Schönbein's views on this subject to be fully confirmed. To determine, however, the actual amount of ozone in the atmosphere is a problem of surpassing difficulty, on account of the extremely small proportion in which it exists, even when at a maximum. Its presence can be easily discovered by any of the ordinary iodised starch-papers, or even more readily by white bibulous paper which has been moistened with a dilute solution of iodide of potassium, and allowed to dry spontaneously in a dark room. If a slip of this paper is exposed for five minutes to a current of air, which will be often supplied by the wind, or may be produced by walking briskly, it will be found to have acquired a delicate red tint, if ozone be present even in the smallest quantities. The tint will be best observed by comparing the slip after exposure with another slip of the same paper which has not been exposed. The action of the diffused light of day on the paper is rarely perceptible after so short an exposure, but this source of error can be easily avoided by enclosing the paper in a hollow cylinder of wood.

Although with the experimental resources now at our command, we can scarcely venture even to estimate the actual amount of ozone at any time present in the atmosphere, yet it may be possible, as Schönbein long ago proposed, by applying a chromatic scale to the indications of the test-papers, to ascertain approximately its relative amount in different localities, and its variations in the same locality. Such estimates must, however, be most uncertain, since the shades of colour produced on test-paper hardly admit of being defined by numbers; and in this particular case they are liable to a special source of error, as there can be little doubt that a large but unknown part of the ozone in

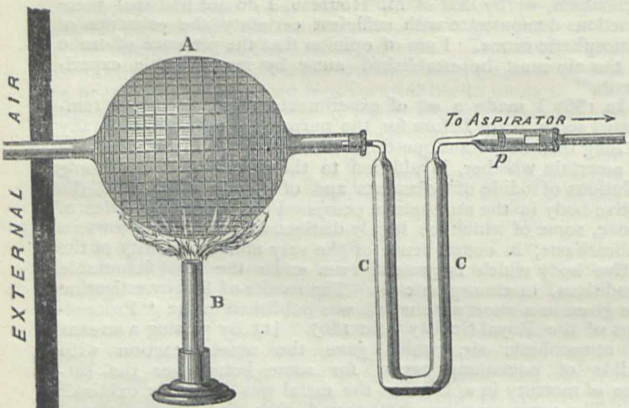

Fig. 5.

the air which comes into contact with the paper is catalytically destroyed, and produces no chemical effect whatever. At the same time the ozonometer, especially when used with an aspirator, does unquestionably give indications of value regarding the ozone states of the atmosphere, and till more accurate methods are devised these observations ought certainly to be continued.

Ozone is rarely found in the air of large towns, unless in a suburb when the wind is blowing from the country; and it is only under the rarest and most exceptional conditions that it is found in the air of the largest and best ventilated apartments. It is, in fact, rapidly destroyed by smoke and other impurities which are present in the air of localities where large bodies of men have fixed their habitation, and I have often observed this destructive action extending to a distance of one or two miles from a manufacturing town, even in fine and bright weather.

Ozone is rarely, if ever, absent in fine weather from the air of the country, and it is more abundant, on the whole, in the air of the mountain than of the plain. It is also said to occur in larger quantity near the sea than in inland districts. It has been found to an unusual amount after thunderstorms—a fact which is favourable to the view that the presence of ozone in the atmosphere is due to the action of the free electricity of the latter on the oxygen of the air. The amount of ozone in the air is greater, according to some observers, in winter than in summer, in spring than in autumn; according to others, it is greater in spring and summer than in autumn and winter. As regards the influence of day and night, the observations do not all tell the same tale. Ozone has usually been found more abundantly in the air at night than by day, but some careful observers have found the reverse of this statement to be true.

Schönbein was the first who attempted to connect the fluctuations of atmospheric ozone with the prevalence or absence of epidemic disease; and since this suggestion was first published, numerous observations have been made in different countries with the view of ascertaining whether there is really any connection between the indications of the ozonometer and the health of a district. It has been asserted, for example, as the result of observation, that an outbreak of cholera is accompanied by a marked diminution of atmospheric ozone; but this statement has been disproved by later and more trustworthy observations. On the whole, I think it may be safely asserted that no connection has yet been proved to exist between the amount of ozone in the atmosphere and the occurrence of epidemic or other forms of disease.

The permanent absence of ozone from the air of a locality may, however, be regarded as a proof that we are breathing, if I may venture to use the phrase, adulterated air. Its absence from the air of towns, and of large rooms, even in the country, is probably the chief cause of the difference which every one feels when he breathes the air of a town, or of an apartment however spacious, and afterwards inhales the fresh or ozone-containing air of the open country. It is, indeed, highly probable that many of the most important actions, by which the products of vegetable and animal waste are removed by oxidation from the air, are due to the action of ozone, and could not be effected by ordinary or inactive oxygen. If the amount of ozone in the atmosphere appear too small to produce such large results, we must remember that, from its powerful affinities, ozone is being continually used up, and must, therefore, be constantly renewed.

The physiological action of ozone on the animal system is a subject of interest, and I am able to state the general results of two independent inquiries—one conducted a few years ago, by Dr. Redfern, in Queen's College, Belfast, the other recently communicated to this Society by Mr. Dewar and Dr. McKendrick. Dr. Redfern's experiments have not been published, but he has kindly supplied me with the following note on the subject:—"The general results," he says, "I obtained from about forty experiments conducted from May to September, 1857, to find the effects of oxygen and ozone on different animals, are as follows. The respiration for a very short time of oxygen, containing about $\frac{1}{240}$th part of ozone, is certainly fatal to all animals. The same gas, when passed over peroxide of manganese and freed from ozone, is comparatively harmless, even when respired for long periods. Respiration of such a mixture of ozone for thirty seconds kills small animals, some dying after respiring it only fifteen seconds, whilst similar animals will live in good health for months after respiring oxygen alone for thirty-seven hours, the carbonic acid being removed during the experiment. Death is not due to the closure of the glottis, for it occurs when a large opening has been made in the trachea. Ozone causes death by producing intense congestion of the lungs with emphysema, and distention of the right side of the heart with fluid or coagulated blood, frequently attended by convulsions. If ozone be respired in a dilute form, the animals become drowsy and die quietly from coma, the condition of the lungs and heart being the same, except that the emphysema is less marked. Animals which have respired oxygen for more than twelve hours will now and then die suddenly from the formation of coagula in the heart, even after they have appeared in good health for some days."

The following are the conclusions which Mr. Dewar and Dr. McKendrick have deduced from their researches. Inhalation of an atmosphere highly charged with ozone diminishes the number of respirations per minute, and reduces the cardiac pulsations in strength, the temperature of the animal being at the same time lowered from 3° to 5° C. After death the blood is found to be in a venous condition. Neither the capillary circulation nor the reflex activity of the spinal cord is appreciably affected. The same remark applies to the contractility and work-power of the muscles. Ozone acts on the coloured and colourless corpuscles of the frog like carbonic acid. Ciliary action is not affected by ozonised air or oxygen, but if the layer of liquid be very thin, the cilia are readily destroyed.

The thermal changes which accompany many of the reactions of ozone are well marked, and their investigation, which has been undertaken by Mr. Dewar, promises to yield a valuable addition to our thermo-chemical knowledge.

THE COMMON FROG*

XI.

THE eye of the frog is a beautiful and brilliant object, and relatively large. It is furnished with two eyelids, but, unlike those of man, it is the inferior one which is the more movable. In addition to these it is defended by a third eyelid, called the victitating eyelid, which is similar to that one which may be seen (if watched for) so frequently and rapidly to cross the eye of birds, *e.g.* of a hawk.

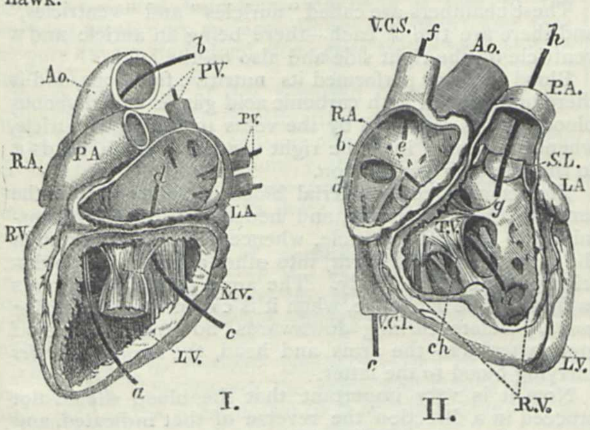

FIG. 74.—I. The left side; and II. the right side of the Heart dissected. I.—*LA*, the left auricle; *PV*, the four pulmonary veins; *cd*, a style passed through the auriculo-ventricular aperture; *MV*, the mitral valve; *ab*, a style passed through the left ventricle into the aorta; *RA*, *RV*, parts of the right side of the heart; *PA*, pulmonary artery.
II.—*RA*, the right auricle; *VCS*, superior vena cava; *VCI*, inferior vena cava, the styles *fe*, *cd*, being passed through them into the auricle; *ab*, style passed through the auriculo-ventricular aperture; *TV*, tricuspid valve; *RV*, right ventricle; *SL*, semi-lunar valves at the base of *PA*, the pulmonary artery, through which the style *gh* is passed; *LA*, *LV*, auricle and ventricle of the left side of the heart.

This structure, however, is no mark of affinity to birds, as it is one which reappears, when wanted, in widely different forms. Thus we find it in the whale, *i.e.* in the

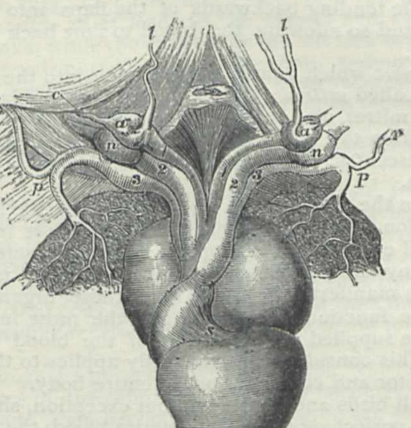

FIG. 75.—The Frog's Heart. The ventricle is below *s*, the aortic bulb is on the left of *s*, and ends in six aortic trunks, three on each side. The first of these (1), ends in the carotid gland (*a*), whence spring the lingual (*l*), and the carotid (*c*), arteries. The second trunk (2), is the root of the great dorsal aorta. The third trunk (3), ends in the pulmo-cutaneous artery (*r*), and the pulmonary artery (*p*), which is shown sending ramifications over each lung.

highest class of the Vertebrate sub-kingdom, and in certain sharks, *i.e.* in the lowest class of the same.

Eyelids do not exist in all members of the frog's class. Even in its order they are extremely minute, in *Pipa* and *Dactylethra*, which have very small eyes. In *Amphiuma* they are completely wanting, and in *Proteus* and in the *Ophiomorpha* the minute eyeballs are covered with the ordinary and unchanged skin of the head.

The ear of the frog's class presents us with the incipient condition of that part as an organ destined to respond to sonorous vibrations conveyed to it by the atmosphere.

In man the internal ear (enclosed in the densest bone

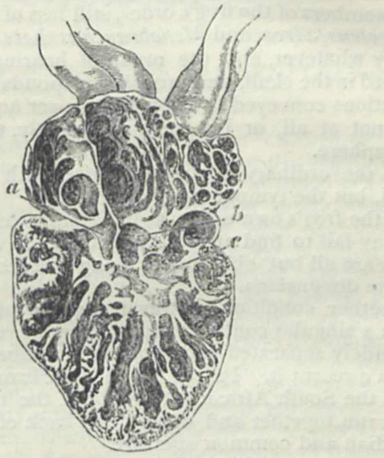

FIG. 76.—Section of heart. *a* and *b*, openings of the auricles into the ventricle; *c*, opening of the aortic bulb into the ventricle.

of the skull, named, from its density, "petrous") is a very complex organ. The aperture, surrounded by the folds of the external ear, leads by a canal towards a cavity called the tympanic cavity, which cavity is shut off from the exterior by the tympanic membrane (or drum of the ear), which stretches across the canal at a considerable distance from its external aperture. On the inner side of the tympanic cavity lie the convoluted tubes (richly supplied with nerves) which constitute the real organ of hearing or internal ear.

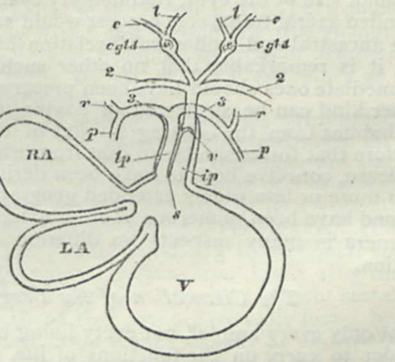

FIG. 77.—Diagram of section of Frog's heart. *LA*, left auricle; *RA*, right auricle; *V*, ventricle; *s*, movable septum dividing the left aortic passage *lp* from the right aortic passage *ip*; *v*, valve; 3, 3, aortic trunks leading to *p*, pulmonary artery and *r*, cutaneous respiratory artery; 2, 2, aortic trunks going to form the great dorsal aorta; *cgld*, carotid gland interrupting the flow of blood into *l*, the lingual artery, and *c*, the carotid artery.

Although the tympanic cavity is shut off from the exterior by the tympanum, it nevertheless is not altogether shut off from the exterior, since it communicates with the back of the mouth by a long and narrow canal termed the Eustachian tube.

It is the existence of these Eustachian openings into the

* Continued from p. 307.

ear from the mouth which causes people when intently listening to keep their mouth slightly open.

In the frog there is no such external canal, but the tympanum is plainly to be seen in the way already described, on the side of the head, covered only by a slightly striated portion of the skin of the body. The Eustachian tube, however, still exists in the frog, though it is short and wide, and the opening of each is to be seen on one side of the back of the mouth.

This condition of things, however, does not exist in all the members of the frog's order, still less of his class. But in *Proteus*, *Siren*, and *Menobranchus* there is no tympanic cavity whatever, and the organ of hearing is simply imbedded in the skull, and probably responds but to sonorous vibrations conveyed to it by the denser aquatic medium, and not at all, or but very imperfectly, to those of the atmosphere.

In the ordinary efts we still meet with an Eustachian canal, but the tympanum is absent.

In the frog's own order, as in *Pelotates* and *Bombinator*, we may fail to find any tympanum, while the Eustachian tubes are all but obliterated, being reduced to the most minute dimensions.

Another condition, however, may be presented which offers a singular contrast, and is the more remarkable from the widely separated geographical situations of the forms which present it. In the South American *Pipa*, as well as in the South African *Dactylethra*, the two Eustachian tubes run together and open at the back of the mouth, by a median and common aperture.

Strange to say, this is the very condition which exists in birds, though most certainly it cannot be taken as any sign of affinity. In the crocodile these tubes have also a common median opening, but, unlike birds, each tube has also its own lateral opening into the throat, so that there come to be three Eustachian openings.

Can the resemblance between *Pipa* and *Dactylethra* in this matter be taken as a serious indication of genetic affinity, in spite of the wide, deep, and probably ancient Atlantic which rolls between the two species now?

This is a question which cannot be confidently answered, seeing in how many other instances structural peculiarities have evidently had an independent origin. Nevertheless, the fact that these two genera agree also in the small size of the eyes, rudimentary eyelids, and vastly expanded sacral transverse process would seem to point to some ancestral and fundamental relationship. If so, however, it is remarkable that no other such forms, or no intermediate ones should have been preserved, seeing that neither kind can be suspected of having migrated to its own habitat from the existing habitat of the other; and therefore that forms similar to that from which we may, if we please, conceive both to have been derived must have had a more or less widely extended geographical distribution and have been numerous in order to have given origin to genera in many respects so different as the two in question.

The Circulation of the Frog

Not only every animal, but every living being, requires, in order to carry on the functions of life, to interchange some of the gaseous elements of its body with gases of the medium (air or water) in which it happens to live.

Another function of extreme generality is that of conveying to all the parts and organs of the body nutritious matter for their growth or for the repair of those destructive effects which the processes of life inevitably produce in them.

In all members of the highest sub-kingdom of animals (*i.e.* in all Vertebrata) these processes of gaseous interchange and nutrition are effected by means of closed vessels, along which the stream of nutritious fluid (the blood) is continually carried in a definite and constant course. During some or other part of that course the blood becomes exposed to conditions specially favourable to the gaseous interchange, the blood parting with carbonic acid gas and obtaining in its place an increased supply of oxygen.

This process of blood oxygenation is termed respiration, and the organs which subserve it are termed respiratory or breathing organs. Such organs in man are the lungs. The central organ of circulation in man is, as all know, the heart, which is a muscular organ, divided into four chambers, or cavities.

These chambers are called "auricles" and "ventricles," and there are two of each—there being an auricle and a ventricle on the right side and also on the left.

Blood that has performed its nutritive functions, and is therefore charged with carbonic acid gas, is called venous blood, and is conveyed by the veins to the right auricle, whence it passes into the right ventricle, which sends it to the lungs for purification.

The oxygenated, or arterial blood, is returned from the lungs to the left auricle, and hence it is directly transmitted to the left ventricle, whence it is driven through the great artery (the *aorta*) into other arteries, and so distributed all over the body. The aorta passes downwards in front of the backbone, when it is called the *descending aorta*. Before turning downwards, however, it gives off great arteries to the arms and head, the *carotid arteries* carrying blood to the latter.

Now it is very important that the blood should not proceed in a direction the reverse of that indicated, and to prevent such misdirection, or regurgitation, special valves are placed at different openings; these valves freely allowing the blood to flow in the proper direction, but instantly opposing an effectual obstacle to a contrary flux.

The openings of the auricles into the ventricles are guarded by valves, as also is the opening of the left ventricle into the aorta, and that of the right ventricle into the artery going to the lungs.

The valve which guards the entrance into the right ventricle is called *tricuspid*, and consists of three flaps attached by delicate tendinous cords in such a way as to hinder the tending backwards of the flaps into the right auricle, and so allowing the blood to flow back into that chamber.

The valve which guards the entrance into the left ventricle is called *mitral* (from a fancied resemblance to a bishop's mitre), and consists of two flaps. The aperture leading from the left ventricle to the aorta is guarded by three crescentric flaps—called the "*semilunar*" valves of the aorta.

In man the whole of the blood is sent to the lungs for purification during each circuit of this most important fluid, and every organ is supplied with oxygenated blood.

If in any animals the process of purification is incomplete it is manifestly desirable that these organs of the body, the functions of which are the most important, should be supplied with that part of the blood which is pure. This consideration eminently applies to the brain, the director and controller of the entire body.

Now all birds and beasts without exception, share with man this perfect aëration of the entire blood, the whole of the blood in the classes *Mammalia* and *Aves* being purified in the lungs before being distributed to the body.

The conditions by which the frog, at the various stages of its existence, oxygenates its blood and directs the purified stream in the most desirable manner, are curious and instructive.

It is generally known that the lower air-breathing Vertebrates (Reptiles and Batrachians) have the heart less completely divided than in the higher classes, so that the oxygenated (or arterial) blood and the unoxygenated (or venous) blood become mixed in the single or imperfectly divided ventricle.

It might well be supposed, and in fact has generally been so, that in animals with a heart so imperfectly divided, the blood sent to the lungs would be necessarily a mixture of venous and arterial fluid, and similarly that the blood distributed by it to all the organs and parts of the body is alike a mixture of pure and impure fluid.

In fact, however, this is by no means the case, and in the frog, in spite of the reception into a single chamber of both venous blood from the body, and of arterial blood from the lungs, special mechanical arrangements effect such a definite distribution of the two sorts of blood, that the unoxygenated fluid from the body is sent to the purifying respiratory surfaces (lungs and skin), and that the pure oxygenated blood alone goes to the head and to the brain.

For the detection of this beautiful mechanism, we are indebted to the careful investigations of Ernst Brücke.*

The heart of the frog consists of a right and left auricle (divided by a delicate septum), both opening into a single ventricle. From the latter proceeds an aortic root (bulbus aortæ) which gives rise to three arterial trunks on each side.

The first of these, or carotid trunk (1), ends in an enlargement (*a*) termed the carotid gland, of spongy structure, which gives rise to two arteries, one the lingual (*l*), the other (*c*), the carotid which goes to the head and brain.

The second, or systemic trunk (2) meets its fellow of the opposite side beneath the spine, and thence passes backwards as the great dorsal (in man descending) aorta, giving off arteries to all parts of the body.

The third, or pulmo-cutaneous trunk (3) ends by dividing into two arteries. The anterior of these (*r*) goes to the skin (which, as we have seen, is in the Frog an important agent in respiration), the posterior one (*p*) goes to the lungs.

The heart itself is of a more or less spongy texture, but the main cavity of the single ventricles open at its extreme right into that of the aortic bulb (*c*). In close proximity to the opening are the openings from the right (*b*) and the left (*a*) auricles respectively.

The aortic bulb is constitutionally divided by a movable septum (Fig. 77, *s*) in such a way, that the passage on the right side of it leads to the carotid and systemic arterial trunks, while the passage on the left side of it leads to the third pair of trunks—namely, those ending in the pulmonary and cutaneous arteries; moreover, there is a valve in the first of these two passages which tends to retard the flow of blood (*v*).

The consequences of these arrangements are as follows:—

When the auricles contract, the venous blood from the right auricle (*RA*) is sent into both right and left passages of the bulb, but by the action of the valve (*v*), and by the structure of the carotid gland, the blood is checked on the right side (*ip*), while on the left it runs freely into the pulmo-cutaneous trunks (*r* and *p*), and thus the respiratory structures receive unmixed venous blood for purification.

As the lungs get gorged with blood, the resistance on the two sides of the septum of the bulb becomes at first equalised and soon becomes the greater on the left side; then the septum is forced over to the left, and the blood, now mixed with pure blood, flowing in from the left auricle, flows freely along the systemic arteries (2 and 2). The obstruction of the carotid glands (*c gld*) being the greatest and the last to be overcome, the carotid and lingual arteries (*c* and *l*) receive the very last of the blood —that, namely, which coming from the left auricle is purely arterial—and in this way oxygenated blood only is supplied to the head, sense organs, and brain.

It should be borne in mind that in order to develop this most beautiful and complex apparatus, the co-ordinate development in due proportion of these beneficial obstructions and checks must have been simultaneously effected in order that their purpose should be duly served. In other words, to account for its formation by an indefinite series of minute happy accidents would seem to require such a successive occurrence of coincidences as to become an improbability so great as to be indistinguishable from impossibility.

ST. GEORGE MIVART

(*To be continued.*)

* "Beiträge zur vergleichenden Anatomie und Physiologie der Gefäss-Systemes." In the third volume of the "Denkschriften der Mathematisch-Natur-wissenschaftlichen classe der Kaiserlichen Akademie der Wissenschaften." Vienna: 1852.

THE "CHALLENGER" EXPEDITION

BERMUDA

FROM the two visits made by the *Challenger* to Bermuda we learn a good deal about the vegetation of that island. Along the coast, which in some parts is irregular and rocky, and in others of a sandy nature, frequently with heaps of drifted sand, may be seen in abundance a species of *Borrichia*, a low shrub belonging to the compositeæ, *B. arborescens* D.C. being common in the West Indian Islands, and noted for having both glabrous and silvery leaves on the same plant, as well as the two forms on separate plants. In close proximity to the *Borrichia* was seen *Tournefortia gnaphalodes* R.Br., a Boragineous shrub from 2 to 6 feet high, with white flowers and downy leaves, and *Ipomœa pes-capræ* Sw. with its long stem, which frequently creeps to 100 feet or more, and its purple flowers. In the crevices of the rocks grow *Euphorbia glabrata* V., a shrubby glabrous plant common to the West Indies, and on the shores of Florida, Honduras, &c. A species of Tamarix is also abundant, as well as *Conocarpus erectus* L., and *Coccoloba uvifera* Jacq., known in the West Indies as the seaside grape, from the violet-coloured, pulpy acid-flavoured peiranth; an astringent extract like kino is likewise prepared from the bark, and the bark itself is used for tanning leather.

Many trailing plants scramble about on the sand dunes, assisting to bind the loose sand together. Amongst the most important of these is a hard, prickly grass, probably a species of *Cenchrus*, *Cakile æqualis* L.'Her, a singular cruciferous plant allied to our Sea Rocket, and a species of *Scævola*. The Mangrove (*Rhizophora mangle* L.) occurs in swamps similar to those which have been so often described by travellers; but beside the true mangrove swamps, there are others occupied by trees of *Avicennia*, *A. nitida* Jacq. being known in the West Indies as the black, or olive mangrove.

In the peat bogs, or marshes, which are surrounded by low ranges of hills, the most striking character of the vegetation is the ferns; species of *Osmunda* are abundant, as well as *Pteris aquilina* L. Some of the marshes, however, have their special character of fern vegetation some species, as for instance *Acrostichum aureum* L. (*Chrysodium vulgare* Fee), being found only in particular spots. The Junipers (*Juniperus bermudiana* Lun.) also thrive in the marshes, but none of the trees at present standing approach in size those that are occasionally found below the surface. These large trunks usually lie at a depth of about two feet. The average diameter of the trunks of existing trees may be taken at from two to three feet, and these are mostly unsound in the centre owing to the marshy ground in which they grow. The largest known living trees in the island measure respectively fifty-nine inches and thirty-nine inches in diameter; the first is hollow, but the second is apparently sound. Amongst other noticeable marsh plants are *Myrica cerifera* L., a shrub the berries of which, in Central America, yield wax from which candles are made, and *Rhus toxicodendron* L., the Poison Oak of North America.

In the fresh-water ponds or lakes inland, some of which are a quarter-mile long, and often are in close contiguity to a peaty marsh, though the waters appear not to be affected by the peat but are said to be salt at certain periods, occur abundance of confervæ and minute algæ, as well as a species of *Ruppia*. In the shady damp hollows, at the entrances of the caves, is usually seen a rich growth of ferns, jessamine, and coffee trees of good size.

The general features of the indigenous vegetation of the islands are the Junipers, *Lantana camara* L., a verbenaceous shrub which grows in dense masses, and the Oleander, which also grows in abundance and is used for hedges. A few trees of the Date and Cocoa-nut palms may occasionally be seen, but their fruit produce is not sufficiently abundant to be of any importance. One of the greatest pests in the island in the form of a weed is *Leucæna glauca* Bth., which sends down its tap roots to a great depth, and is difficult to eradicate. It is a leguminous plant, and in its native state forms an ornamental tree.

The least cultivated part of the island is at Paynter's Vale, where orange and lemon-trees luxuriate in their wild state. From the prevailing dampness of the atmosphere all over the island, a species of Nostoc abounds not only in the caves and on the rocks near the sea-shore, but also amongst the roots of grass on lawns. Out of about 160 flowering plants collected in Bermuda *Morus rubra*, *Hibiscus arborea*, and *Chrysophyllum cainito* are the only three that do not occur in an absolutely wild state. Perhaps not more than 100 are true Bermuda plants. Many of the plants of the island were no doubt originally brought from the West Indies by the Gulf Stream, or the cyclones. The presence of American plants is perhaps to be traced more to the migrations of birds, which come in large numbers, more especially the American Golden Plover. Then, again, to account for the presence of other plants, there is the fact of the annual importation of large quantities of hay, and also of seeds, such as onion seed from Madeira and potato seed from America, with which other seeds are, no doubt, constantly introduced. Shipwrecks, also, which occur on the coast, are probably fruitful sources from whence new plants arise; as a proof of this, it is stated that a vessel with a cargo of grapes was recently wrecked and the boxes of grapes washed ashore, the seeds of which, being saved, were sown, and produced an abundance of young plants.

INDUSTRIAL CHEMISTRY

THE Society of Arts seems to be increasing its efficiency every year, "lengthening her cords and strengthening her stakes;" quite recently a Chemical Section has been added, which we believe will be productive of much practical benefit. At the opening of this Section on the 6th inst., the chairman, Dr. Odling, gave a valuable and interesting address, which, by the courtesy of the secretary of the Society, we are able to present to our readers :—

I have been desired by the Council to say a few words at this introductory meeting on the importance of Industrial Chemistry, but really to do so is to urge upon you a theme which requires no advocacy, I should think, on the part of anyone, and I am afraid it would be as tedious as thrice-told tales. If we look at the objects with which we are surrounded and consider how very few of them are in a state in which they are presented to us by nature, we shall find that the metamorphoses to which they have been subjected are essentially chemical ones; that is to say, wherever we find one kind of matter in nature, and somehow or other the matter is turned into another kind of matter, we submit it to a chemical change; and how very few indeed of the different kinds of matter with which we are surrounded are really in their primitive forms. When we have mentioned wood and stone, I mean building stone, we have mentioned almost all. When we consider the gas which, though now gas, was a short time ago in the form of coal, or the glass of our windows which a short time back was in the form of sand, soda, and limestone, or if we look at the plaster of our rooms, which was originally limestone, which has undergone varied metamorphoses, and more particularly I might direct your attention to the metallurgical industries, especially iron, which was a short time before in the ironstone—all these are instances of the chemical metamorphosis to which we subject the different natural objects, and so change one kind of matter into another.

Among all these metamorphoses which are of a chemical nature there are some to which we more particularly apply the name of chemical manufactures. In reality, a brick is as much a product of chemical change; it was not originally the same matter it now is, but was produced by a change of chemical composition of its elements. But among these more particularly called chemical manufactures, the production of which is conducted in works which are called chemical works, are those performed in so-called alkali works; and I think I need have no hesitation in saying that these works have proceeded to a far greater development in this country than in any other, notwithstanding the fact that among the constituents received and metamorphosed by these works are many which are of foreign extraction, more particularly the pyrites, or other sources of sulphur, and the manganese or other sources indirectly of the chlorine manufactured at these works. And we see, that in the course of lectures which has been provided for us, three have reference especially to these manufactures, which are conducted exclusively at works which are denominated chemical works. We have a process for the manufacture of soda by Mr. Vincent; another on pyrites, as a source of sulphur, copper, and iron, by Dr. Wright; and another on the manufacture of chlorine, by Mr. Weldon.

Starting from the crude substances, coal and limestone, and pyrites and common salt, we have a production of soda which will be treated of more particularly in Mr. Vincent's address. Then we have the further manufacture of copper, sulphur, iron, and chlorine, which are the necessary economical concomitants. It is indeed remarkable, at the present day, how much the production of chemical manufactures takes in the working up of what were formerly waste products. Perhaps we could not have a more singular instance of this than in the utilisation to which that class of refuse, which was formerly known as burnt pyrites, is now put. Not only do we obtain from the original pyrites sulphur in a form which was formerly thrown away on a very large scale, but, moreover, copper and iron, which were also formerly thrown away in the burnt pyrites. And we have also one very remarkable product now obtained from pyrites on a comparatively large scale, and I may say, with regard to the manufacture of copper from pyrites, that the amount now produced—as Mr. Wright will tell you—from a material which was formerly thrown away, constitutes a very large proportion of the entire quantity now manufactured in the United Kingdom.

But in addition to that there is a very considerable manufacture of silver now going on also extracted from these waste pyrites. This extraction of silver from these pyrites, in which it occurs in an exceedingly minute proportion, has an essential interest for chemists in this point of view, that the processes which are adopted for its extraction really resemble most closely the processes which purely scientific chemists adopt in the laboratory. The pyrites are first of all heated with common salt, whereby the copper is converted into chloride of copper soluble in water, and the silver into the state of chloride of silver, which is soluble in the common salt solution; and not only so, but in this process of removing the soluble copper and the soluble silver from these pyrites, the arsenic and the sulphur, which formerly prevented the burnt pyrites being put to any use, are got rid of, so that what remains is useful in a further stage of the iron manufacture. But with regard to the extraction of the silver, we find how important a knowledge of even delicate chemical processes is, in order to allow the extraction to be pursued with advantage. By the ingenious process of Mr. Claudet and Mr. Phillips, it is first of all examined by the nicest chemical means to see the exact amount of silver it contains, by a process rivalling in delicacy that which is pursued in laboratory research, and having ascertained exactly the quantity of silver contained in the solution, the exact quantity of extremely expensive reagent, iodide of potassium, which is required, is added to it to precipitate the amount of silver; and when the iodide of silver is thrown down the iodine is recovered to be used over and over again, and the silver itself is set free by means of metallic zinc, which forms iodide of zinc, thus setting free the silver. In this way, a considerable portion of silver is extracted.

I mention this as an illustration of the remarkably close association which is every day taking place between sure chemistry in the laboratory, and manufacturing chemistry in the factory. Now-a-days we have such out-of-the-way bodies, as they were formerly considered, as these different aniline products, as alizarine and chloral, which were formerly barely obvious in the laboratory, now made on a manufacturing scale. On the other hand, we find these different products of estimation, formerly confined to the laboratory, are now carried on in the manufactory, and thereby such an element as silver is produced by processes which are essentially laboratory processes. In this way it happens that we find many improvements in manufacturing chemistry are now produced by men who have obtained a reputation in other fields. For instance, I need scarcely refer to the names of Hoffmann, Perkin, and Nicholson, gentlemen known as scientific chemists and men of the highest eminence, before their attention was directed to manufacturing operations, and they realise on a manufacturing scale the results of their laboratory experience. In mentioning them, I ought not certainly to dissociate from them our lecturer this evening, Mr Field, who was so long and so highly esteemed in purely scientific circles for his admirable researches into a great number of compounds, more especially connected with mineral chemistry, before he devoted his great ability to the elucidation and improvement of the manufacture of aniline dyes, and subsequently to these metamorphoses of the bodies which we now use for illuminating purposes in the form of paraffine and ozokerit, and also the other candles which are composed of stearic acid, palmitic acid, and so on.

But while in this way manufactures derive a very great advantage from the light thrown on them by purely scientific chemists in one way or another, I do not think we ought to overlook the benefit which pure chemistry derives, on the other hand, from manufacturing operations. I do not mean the mere material gain that purely scientific chemists have enjoyed by the opportunity of examining minutely a great number of bodies, which previously it was almost impossible for them to obtain, but I think they have gained a very much greater knowledge of the especial subject of their studies — I mean chemical phenomena. We chemists take in our province every change by which one kind of matter becomes metamorphosed into another kind of matter, whereby that which was ironstone, for instance, becomes iron, whereby that which was sand, chalk, and soda becomes glass, and which takes place wherever one kind of matter is metamorphosed into another; but, after all, a great number of the metamorphoses which we must study take place in the test-tube and small vessels of similar character; and we are rather too apt, I say, to shut our eyes to those metamorphoses which take place on a large scale around us.

Those changes manifest themselves particularly in two forms. We have those by which the different forms of agricultural produce are furnished us by the vegetable kingdom, and by which they are metamorphosed into the animal kingdom. Here we have one great illustration of industrial chemistry—the chemistry by which crops are produced, and by which stock is fed and flesh is made. This feeding of stock and production of crops is one very large function of industrial chemistry, and I would venture to say that any scientific chemist who devotes his attention entirely to what takes place in the test-tube, and who neglects those changes which are constantly taking place around him, has a very imperfect notion of the subjects which he professes to investigate. And in addition to these changes thus taking place in natural processes, modified to a certain extent by art, we have three other processes which take place on a grand scale, by which from such substances as ironstone we produce metallic iron, from common salt, on the one hand, carbonate of soda, applied to the manufacture of glass and other useful purposes, and by which we provide also chlorine in its different combinations, applicable to so many purposes, more particularly in the preparation of our wearing apparel, and in our linen and fabrics of every description.

I think, then, that when we have the advantage of having these industrial subjects brought under our notice by men like our friend here, who are familiar, on the one hand, with the most recondite points of theoretical chemistry, and, on the other hand, with the greatest practical achievements which have been obtained in manufacturing chemistry, it will be of immense benefit to those who wish to study chemistry in its pure aspect, as they will see what can be done on a large scale, and what habitually is done, and what perseverance, assisted with chemical knowledge, has obtained for us. It must also be interesting to practical men, by throwing out suggestions capable of improvement in various branches of manufacturing art. I think, then, that the Society of Arts has really done a very useful work in bringing together men engaged in the purely scientific pursuit of chemistry on the one hand, and, on the other, men who are pursuing the application of the science with a view to the practical good of their kind. I do not know that I need trouble you with any further remarks, but I have attended here this evening with the greatest pleasure, because I feel how much advantage is likely to be derived by all classes of the community by the discussion of these problems which are so interesting to all, and I would venture to say as much in a purely scientific as in a practical point of view.

NOTES

SUFFICIENT attention has not been attracted to the fact that one of the recommendations of the Committee on Scientific Instruction has borne early fruit. Mr. Phillips Jodrell, desirous to promote research in physiology, has attached to the professorship of that science in University College, London, an endowment of 7,500*l.* to enable the professor to devote to biological investigation whatever time is not needed for the discharge of his duties as lecturer. This endowment is accompanied by the further sum of 500*l.*, to be expended in the purchase of the necessary apparatus. It is difficult to speak in terms sufficiently high of Mr. Phillips Jodrell's intelligent munificence, which, we have no doubt, will bear good fruit. It is gratifying that the recommendations of the Commission have so far had such an excellent result, and we only hope that Mr. Jodrell's handsome example will be largely followed by others who have enough and to spare.

OUR readers will no doubt learn with surprise and regret that M. Alglave, editor of the *Revue Scientifique*, and Professor of

Law in the faculty of Douai, has been suspended from his professorial duties for one month, and has received notice that he must either resign his position as professor or give up the editorship of the *Revue Scientifique*. The reason for this vexatious proceeding we have not learned; but to outsiders it must seem a wanton and mischievous exercise of authority, although the fearless way in which the *Revue* states scientific facts and conclusions may have something to do with it. The *Revue Scientifique* holds the first rank among French scientific journals, contains from week to week the cream of scientific work both French and foreign, and any interference with its efficiency would be a great blow to the cause of Science in a country where a knowledge of the methods and solid results of Science is much needed. If the threat with which M. Alglave is menaced be carried out, those who thus abuse their little brief authority will be despised by the whole educated world. We read in the *Progrès du Nord* that M. Terrat has been appointed to take M. Alglave's place, and that when the former entered the class-room the students retired silently and in perfect order, leaving M. Terrat to lecture to the walls of the amphitheatre and two members of the *Cercle Catholique* who did not deem it prudent to join in the protest of their class-fellows; the students, we believe, have presented to their professor a unanimous address of sympathy. Let us hope that before the expiry of the month those who are responsible for this treatment of M. Alglave will think better of it, and restore the professor to the position he appears to have filled so well, permitting him at the same time to retain charge of the journal which is among the things that reflect the highest credit on France.

THE Chimpanzee, which during the last two and three-quarter years has been an endless source of instruction and amusement to visitors at the Zoological Gardens, after an illness of two months' duration, died on Friday last. The post-mortem examination showed that the cause of death was acute tuberculosis of the peritoneum, almost exclusively confined to the serous membrane covering the liver and spleen, the omentum and small intestine being slightly affected. A large bronchial gland was on the verge of suppuration, but the lungs were healthy. There were no symptoms of hectic during life, and much subcutaneous and omental fat were found after death.

THE French Meteorological Society has resolved to hold an extraordinary *réunion* during Easter-week, a time when a considerable number of French and foreign meteorologists are in Paris. This meeting has for its object to strengthen the relations which exist between the Society and provincial observers, and to study in common questions of general interest in meteorology.

THE Meteorological Office has resolved, in compliance with the wish of the majority of subscribers to the lithographed sheets of hourly readings from their observatories, which are about to appear, to issue the sheets in monthly, not quarterly parts.

IN addition to the *Bulletin Météorologique du Nord*, of which we lately announced the publication, we are glad to learn that Capt. Hoffmeyer, the Director of the Meteorological Institute of Denmark, has commenced the issue of a daily lithographed chart, for his own country, Norway, Sweden, and North-west Russia. He has also published an explanation of the chart for the use of subscribers. This chart is most valuable, as it supplements our own daily weather charts and those of the *Bulletin International*, for a district whence accurate information is seldom obtainable by telegraph in Western Europe.

IN a recent number we intimated that the Perthshire Society of Natural Science had interrogated the Parliamentary candidates for the county and city of Perth as to their opinions on the questions of State help to Science, a responsible Minister of Education, and the promotion of Scientific Exploring expeditions. Answers—favourable, we are glad to say—were returned at the time only by the two Conservative candidates, one of whom, Sir W. Stirling Maxwell, is now M.P. for Perthshire. We are now glad to give place to the somewhat tardy reply, addressed to the secretary, of the Hon. Arthur Kinnaird, Member for the City of Perth:—"1, Pall Mall East, 18th Feb. 1874.—Dear Sir,—I was surprised to find copied into a London paper from a Scotch journal the questions put in your letter of the 29th January last, with the statement that they had not been answered by me. The fact of my being, as I believe I am, one of the patrons of the Perthshire Society of Natural Science should have been, it appears to me, a sufficient guarantee of my approval of the objects of your institution; and my active co-operation with Capt. Wells in his efforts during the last session of Parliament to obtain the sanction of Government to a proposed grant for the furtherance of Arctic exploration, further approves my appreciation of the objects you advocate, in my willingness to support State expenditure for well-devised schemes of scientific research and educational purposes.—Yours truly, A. Kinnaird."

H. N. MARTIN, B.A., Cantab, D.Sc. Lond., has been appointed Lecturer on Physiology at Christ's College, Cambridge. Dr. Martin obtained an open scholarship for Natural Science at Christ's College, and graduated in the Natural Sciences Tripos, obtaining the first place. Lately he has acted as assistant to Dr. Michael Foster in the Physiological Laboratory of the University. A paper by Dr. Martin on the "Structure of the Olfactory Mucous Membrane" appeared in the last number of the *Journal of Anatomy*, and was reprinted in the Studies from the Physiological Laboratory of the University, Cambridge, edited by Dr. Michael Foster.

THERE will be offered, at the Matriculation exhibition at New College, Oxford, beginning on Wednesday, May 21, at 9 A.M., two Exhibitions, tenable for three years, of the annual value of 50*l*. each. These Exhibitions are open to all persons who have not already been matriculated at another College. In the election to one of the Exhibitions a preference will be given to proficiency in Natural Science, if there is any candidate of sufficient merit in the judgment of the examiners. Further account of the examination will be supplied on application to the Warden.

THE Science and Art Department has published a catalogue of apparatus for teaching chemistry, containing 112 items, with prices from which a deduction of 50 per cent. is given. We should advise all our readers who are interested in the subject to obtain the catalogue. The same Department has also formed a collection of travelling apparatus for illustrating instruction in Physical Geography, which will be lent, for a short time, to teachers of the subject referred to. The apparatus consists of a set of physical maps of the world and the various continents, by Prof. Sydow, models of Mount Vesuvius, of Mont Blanc, and of the Thames Valley.

WE regret to record the death of Dr. Forbes Winslow, which took place at Brighton on the 3rd instant, at the age of 63 years.

WE formerly announced the proposal for an international memorial to Captain Maury, which is to take the shape of a Lighthouse on the Rocos, to the importance of which Maury called attention in his "Sailing Directions." We learn from *Ocean Highways* that the President of the Board of Visitors of the Virginian Military Institute addressed a letter to the Governor of Virginia on January 23, requesting him to lay the question of the Maury memorial before the General Assembly, for such moral support as may fitly be given by the representatives of a State which gave Maury to the world. A joint committee of members of the Senate and House of Delegates has since been appointed; and the hearty co-operation of the Governments and Scientific Societies in Europe is confidently expected; for Maury's services have benefited not his own country only, but the maritime interests of the whole world.

ON the 19th of February, Dr. Peters, of Hamilton College, New York, discovered a planet in 11^h 19^m right ascension. plus 4 deg. 25^m declination.

M. CHARLES SAINTE CLAIRE DEVILLE, the meteorologist, announced publicly before the French Institute, that the week from March 9 to 16 would be a very cold one. The prognostication is in a fair way of being fulfilled.

THE last scientific letter written by the lamented M. Quetelet was to General Myer, the Director of the American Meteorological Service. Its purpose was to inaugurate the daily intercommunication of meteorological news between the States and Belgium. The scheme so originated is working regularly and was not interfered with by the death of the learned and respected Belgian astronomer.

THE *Lancet* says that the authorities of the University of Aberdeen have now under consideration a proposal to institute a new degree in arts—that of Bachelor of Science.

HERR VON DEM BORNE writes to the *Deutsche Fisherei Verein*, in Berlin, that he is at present occupied upon an exhaustive treatise, on the most recent and best methods and implements of fishing with the hook and line, especially as used in England and North America, and is desirous of receiving information on these subjects from dealers and others, to be embodied in his proposed work.

VELOCIPEDES are becoming an institution in Paris for forwarding messages from the Exchange (Bourse) to the central telegraphic office, rue de Grenelle. The rates charged by "velocemen" are two shillings. The run there and back, including delivery of messages, takes about 25 minutes for a distance of 3 miles 1,320 yards. It is contemplated by some speculators to establish a public company. When Marshal Bazaine's trial was going on, velocipedes were used for conveying messages from Versailles for the *Moniteur*, one of the Parisian papers. The single run was charged a pound sterling, and was accomplished in 45 minutes for a distance of 12½ miles, at a quicker rate than the railway trains. But the road descends all the way, Versailles being on a higher level than Paris, and the railway is circuitous; stoppages are also very frequent on the line.

CARRIER-PIGEONS are largely used by Parisian periodicals for carrying latest intelligence. They start from Versailles from two o'clock in the afternoon till three. The average number is thirty pairs, and the charge four shillings each pair. The journey is accomplished in twelve minutes when fogs are not frequent. It is not legal for newspaper editors to hire a wire for their private use.

M. HENRY GIFFARD, the inventor of the *Injecteur*, has constructed a railway carriage with a patent suspension of his invention, which prevents the passengers from feeling any inconvenience from oscillation. The first public experiments will be on the Versailles railway, just after the impending parliamentary holidays.

THE election of a successor to the late Dr. Nelaton has given rise to a severe contest in the Secret Committee of the French Academy of Sciences; for more than a month it has obstructed the usual routine of the Academy. The reports for yearly prizes, which are ready for adoption, were not read over. The number of competitors is greater than usual, amounting to seven.

THE Parisian Municipal Corporation has decided upon the building of a large bridge on the Seine, which in point of length will be equal to Blackfriars or Waterloo Bridge, London; but instead of being placed at right angles to the current, it will be placed in an oblique direction. This extraordinary step is taken to connect the rue des Etats on the left bank with the old arsenal quarter on the right bank.

M. FIGUIER has issued through Hachette his *Année Scientifique*. It is the 17th volume of the whole series.

AN International Agricultural Exhibition is to be held on a grand scale at Bremen, under the patronage of the Crown Prince of Germany, from June 13—21 next. The North German Lloyd will grant special facilities to the English exhibitors for the conveyance of implements from London, Southampton, and Hull.

THE enormous extent of the destruction of buffaloes on the Western plains of the United States seems to have undergone no diminution during the present winter, and there is every reason to fear that, should this continue a few years longer, the animal will become as scarce as is its European congener at the present day. At present, thousands of buffaloes are slaughtered, every day, for their hides alone, which, however, have glutted the market to such an extent that, whereas, a few years ago, they were worth three dollars apiece at the railroad stations, skins of bulls now bring but one dollar, and those of cows and calves sixty and forty cents, respectively. A recent short surveying expedition in Kansas led to the discovery of the fact that, on the south fork of the Republican, upon one spot, were to be counted six thousand five hundred carcases of buffaloes, from which the hides only had been stripped. The meat was not touched, but left to rot on the plains. At a short distance hundreds more of carcases were discovered, and, in fact, the whole plains were dotted with putrefying remains of buffaloes. It was estimated that there were at least two thousand hunters encamped along the plains, hunting the buffalo. One party of sixteen stated that they had killed twenty-eight hundred during the past summer, the hides only being utilised.

A COPY of the Calender for 1873-4, of the Imperial College of Engineering, Tokei, Japan, has been forwarded us. The course of study prescribed, both general and special, theoretical and practical, and the regulations for the government of the College, appear to us to be all that at present could be desired.

WE are asked to state that the Annual Dinner of the members of the Institution of Civil Engineers has been appointed to take place at Willis's Rooms, St. James's, on Saturday, March 21. Mr. T. E. Harrison, the president, will occupy the chair.

WE are glad to see that Guido Cora's well-conducted Italian geographical journal, *Cosmos*, is to be henceforth issued monthly, instead of every two months.

AN aëronautical society of Paris, the "Aërial Sport," has published a programme of an aërial spring meeting to be held in the neighbourhood of Paris, very likely Vesinet. The object is to send in the air small fire balloons carrying *des mèches illumées*, whose length has been calculated so that the cargo of the balloon may fall close to a post chosen. Every champion is to choose his own wind; but nobody has a right to approach closer to the post than three miles. It is a kind of drill for shelling a place with balloons by taking advantage of the wind.

THE additions to the Zoological Society's Gardens during the last week include a Javan Rhinoceros (*Rhinoceros sondaicus*) from Java, purchased; a Negro Tamarin (*Midas ursulus*) from North Brazil, presented by Mr. W. Thomson; two Goshawks (*Astur palumbarius*), European, one presented and the other deposited by Mr. G. Lascelles; a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mr. S. Waight; two Verreaux, Guinea Fowl (*Numida eduardi*) from East Africa; two Crowned Pigeons (*Goura coronata*) from New Guinea, and a Common Cassowary (*Casuarius galeatus*) from Ceram, purchased.

SCIENTIFIC SERIALS

Ocean Highways, March.—The following are the original articles in this number:—"Dr. Livingstone and the Cameron Relief Expedition;" "Francis Garnier—In Memoriam," a highly and deservedly eulogistic memoir (by Colonel Yule, C.B.) of this brave and high-minded soldier and explorer, whose untimely death we recently noticed; "Bhawalpur;" "An Account of the Early Jesuit Missions in the La Plata," by A. A. Geary; and "The British India Steam Navigation Company."

THE *Geological Magazine*, March.—The following are the original articles in this number:—"The Leinster Coal-field," by J. M'C. Meadows (with a page map); "On a new Species of *Dithyrocaris* from the Carboniferous Limestone, &c.," by Henry Woodward, F.R.S., and Robert Etheridge, jun. (with a plate); "Glacialoid or Rearranged Glacial Drift," by G. H. Kinahan; "On some new Devonian Fossils," by Prof. H. Alleyne Nicholson (with a woodcut and plate); "Reply to Mr. Poulett-Scrope," by Robert Mallet, F.R.S.

Quarterly Journal of the Meteorological Society, January.—This number contains the following papers:—"Notes on Meteorology of Vancouver Island," by R. H. Scott, F.R.S.; "The Thunderstorm at Brighton on October 8, 1873, and its effects," by F. E. Sawyer; "Some of the Considerations suggested by the Depressions which passed over the British Islands during September 1873," by F. Gaster; "On an improved form of Aneroid for determining Heights, with a means of adjusting the Altitude Scale for various Temperatures," by Rogers Field; "On the Hurricane of August 1873, which moved in a curved track round Bermuda between the 20th and 23rd, and passed on to Nova Scotia and Cape Breton on the 24th, doing extreme damage both at sea and on land," by Capt. H. Toynbee (with a plate); "On a Mercurial Barometer for the use of Travellers, filled by the spiral cord method," by Staff-Commander C. George, R.N.; also an account of the discussion on the best form of Thermometer Stand, which took place at the meeting of November 19, 1873.

Archives des Sciences Physiques et Naturelles, Jan. 15, 1874.—The principal article in this number is an exhaustive study, by Prof. Forel, of the *seiches*, or peculiar tidal phenomena, which have long been observed on the lake of Geneva. The subject is treated in five sections, as follows: the seiches at Geneva and at Morges compared; oscillatory movement in the harbour at Morges, analogous to seiches; the movement of oscillation of seiches; experimental study (with special apparatus) of the laws of oscillation of libration; and lastly, comparisons and conclusions. Prof. Forel adheres to the theory generally accepted in explanation of the phenomenon, viz., that it is due to variations of atmospheric pressure; the pressure diminishing at one part and increasing at another, the surface of the water rises in the former case and sinks in the latter. Thus a swinging undulation is produced. Some of the larger seiches are attributed to earthquakes. The amplitude differs in different seiches; and in the same seiche it varies from one point of the lake to another. The duration of different seiches also varies in the same locality; and the duration of seiches is longer at Geneva than at Morges. These and other effects the author seeks to explain, harmonising them with physical phenomena studied in his apparatus.—In a note on the surface of waves, by M. Charles Cellerier, it is sought to show that there is no real disagreement between the laws of double refraction, as furnished by observation, and the theory based on molecular movements. It is probable, he thinks, that the ordinary ray, whether in uniaxial crystals, or in principal sections of crystals with two axes, has not quite the direction generally assigned to it; though the deviation, without disagreeing with theory, may be so small as to escape observation.—In the department of zoology, we may notice a review of recent researches by Haeckel, Bütschli, and others, on Infusoria.

Memorie della Soc. degli Spectroscopisti Italiani, September, 1873.—Prof. Tacchini contributes a paper on his observaions on the magnesium lines and 1,474 line seen bright on the sun's limb, from which it appears that the 1,474 line is always visible in a magnesium region; and further, that it frequently appears by itself where no magnesium is seen. Two beautifully-executed chromolithographs of the chromosphere on the 15th and 16th of July last accompany the paper, showing the relative intensities of the magnesium and 1,474 lines, together with their positions. The intensity of the magnesium lines seems the greater of the two, though not covering so extensive a region.—Father Secchi gives a note on the spectrum of iron, and other metals, obtained by volatilisation with fifty Bunsen's cells. He appears to find that the 1,474 line is not due to iron, and that different kinds of iron give slightly different spectra. He also gives a drawing of the carbon spectrum from the electric light, which appears similar to that of cyanogen, with the addition of five equidistant bands in the yellow and red.—The tables of Mr. E. Loomis, containing the maximum years of sun-spots, the maximum years of magnetic declination, and the maximum years of auroral display from 1778 to 1870, are given, from which, at a glance, it is seen that the maxima of all three occur in the same years with very small exceptions, and the years of minima correspond even better.

Justus Liebig's Annalen der Chemie u. Pharmacie, Band 170, Heft 3. This number contains the following papers:—"Communications from the Chemical Laboratory of the Polytechnic School at Delft: iv. Researches upon Podocarpic Acid," by A. C. Oudemans, jun. This acid is obtained from the resin of *Podocarpus cupressina var. imbricata* Blume.; a tree growing in Java. The formula assigned to the acid is $C_6H_2 \left\{ \begin{array}{l} OH \\ COOH \\ CH_3 \\ C_9H_{15} \end{array} \right.$ $= C_{17}H_{22}O_3$. Some of the salts are described, and also the mono- and di-nitro substitution products. A sulpho-acid, amidated, and brominated derivatives have been obtained, likewise an acetyl derivative. The author has studied exhaustively the decomposition products of the new acid, and these have led him to the constitutional formula above given.—Upon Cymene, by F. Beilstein u. A. Kupffer. The authors have examined cymenes from cumin-oil and from camphor, and find them to be identical. The same authors contribute a paper on oil of wormwood. This oil yields by distillation a terpene, absinthol ($C_{10}H_{16}O$), and a deep blue oil.—"Crystallographic researches on the calcium salts of cymene-hyphersulphonic acid," by M. Jerofejew.—"Cumic acid," by F. Beilstein u. A. Kupffer. The authors obtain the potassium salt of this acid by acting on cumin-oil with fused potash.—A lengthy paper on the salts of ethylaldehyde-sulphurous acid and the action of the sodium-sulphites upon ethylidene chloride, by Hans Bunte.—On the formula of silicates, by Prof. V. Wartha.—The concluding paper is by Otto Sigel, on the constituents of arnica water and of the essential oil of arnica.

SOCIETIES AND ACADEMIES

LONDON

Linnean Society, March 5.—Special General Meeting, G. Busk F.R.S., vice-president, in the chair. After the chairman had, in a short conciliatory address, stated the reasons which had induced the Council to summon the present meeting, he called on Mr. W. Carruthers, F.R.S., who moved "That a Committee be appointed to consider the Bye-laws and to suggest to the Council such alterations, omissions, or additions as they may think desirable." The motion having been seconded by Mr. W. S. Dallas, Major-General Strachey, F.R.S., moved as an amendment, which was seconded by Mr. C. J. Breese, "That, inasmuch as it appears that there are differences of opinion in the Society as to the legality of the alterations of the Bye-laws made at the meeting of January 15 last:—(1) This meeting, retaining complete confidence in the President and Council of the Society, requests them to obtain the opinion of some legal authority, whether these alterations are legally binding on the Society or not; (2) That if the opinion be that the said alterations are legally binding, no further steps be taken in reference to them; (3) That if the opinion be that the said alterations, or any of them, are not legally binding, the Council be requested to take the necessary proceedings for setting aside the vote of January 15."—A second amendment was moved by Mr. J. E. Harting;—"That the case having been already submitted to Council, the opinion thereon be read for the information of the meeting." After much discussion, in which Sir John Lubbock, Dr. Thos. Thomson, Dr. Trimen, Prof. Thiselton-Dyer, Mr. H. G. Seeley, and others took part, Mr. Harting's amendment was withdrawn, and the vote taken on Major-General Strachey's amendment, which was carried, and was afterwards adopted as a substantive resolution.—Sir John Lubbock, Bart, F.R.S. then moved and Mr. W. Carruthers, F.R.S. seconded a resolution expressive of the high sense entertained by the meeting of the eminent services both to the Society and to Science rendered by the President during his long tenure of the chair, which was carried unanimously by acclamation; and the meeting closed with a vote of thanks to the chairman.

Zoological Society, March 3.—Dr. E. Hamilton, vice-president, in the chair.—The Secretary read a report on the additions that had been made to the Society's Menagerie during the month of February, 1874, and called especial attention to a Malayan Hornbill (*Buceros malayanus*) new to the Society's collection, acquired by purchase; a Python, presented by Mr. C. J. Noble, of Hong Kong, having been captured in his garden on the Chinese mainland; and a young male of an undescribed species of Deer from Northern China.—A letter was read from Sir Henry Barkly, K.C.B., Governor of the Cape Colony, announcing that he had obtained a pair of young Eared Seals (*Otaria pusilla*) for the Society's collection.—A communication was read from Mr. W. H. Hudson, of Buenos Ayres, describing the parasitical habits of the three species of *Molothrus* found in Buenos Ayres, namely, *M. bonariensis*, *M. badius*, and *M. rufoaxillaris*.—Mr. Sclater read an account of a small collection of Birds obtained by Sir Graham Briggs in the island of Barbados, West Indies.—A second paper by Mr. Sclater contained the description of an apparently new form of the family *Icteridæ*, which he proposed to call *Centropsar mirus*.—A communication was read from Dr. J. E. Gray, F.R.S., containing some remarks on *Crocodilus johnsonii* Krefft, from Northern Australia, of which he proposed to form a new genus, *Phylas*.—Mr. W. Saville Kent, F.L.S., read a paper on a huge Cephalopod or Cuttle Fish, announced by the Rev. M. Harvey as lately encountered in Conception Bay, Newfoundland, and of which a tentacle 16 feet long has been secured for the St. John's Museum (NATURE, vol. ix. p. 332). Mr. Saville Kent contributed the additional evidence of an arm 9 feet long preserved in the British Museum, in proof of the gigantic dimensions occasionally attained by certain members of this order of the Mollusca, and proposed to institute the new generic title of *Megaloteuthis* for their especial reception; he further suggested distinguishing the Newfoundland example as *Megaloteuthis harveyi*, in recognition of the service to science rendered by Mr. Harvey, in his record of and steps taken to preserve so valuable a trophy.

Geological Society, Feb. 25.—John Evans, F.R.S., president, in the chair. The following communications were read:—Geological Notes on a Journey from Algiers to the Sahara, by George Maw. The author commences by describing the details observed on his journey from Algiers to L'Aghouat, on the borders of the Sahara. The distance traversed was 285 miles, or about 210 miles in a straight line, and in a direction nearly north and south. No eruptive rocks were observed. The oldest rock is a boss of mica-schist and gneiss behind the city of Algiers; it forms a low anticlinal, with a north and south strike. The pass through the gorge of the Chiffa in the Lesser Atlas shows hard slaty rocks dipping south at a high angle; they are repeated as an anticlinal on the south side of the higher part of the Tell plateau, and are probably Mesozoic. In the plain separating the Tell from the Hauts Plateaux, and on the south side of the latter, red and yellow sandstones form anticlinals; these rocks resemble the Bunter in mineral characters, and are overlain by red marls resembling the Keuper. In the northern escarpment of the Hauts Plateaux saliferous marls are exposed, interstratified between the sandstones and below the red and grey marls. Crystals of salt and gypsum are intimately mixed with the grey marls, and the so-called "Rochers de Sel" are capped with great blocks of rock tumbled about in confusion, the position of which the author ascribes to the failure of support due to the solution of the salt in the underlying salt-marls. A thin series of bright red and green marls is seen to overlie the red sandstones in several places; and above this is an immense series of dark grey marls, interstratified with argillaceo-calcareous bands, forming a great synclinal of the Hauts Plateaux, and a contorted mass on the Tell plateau. These are probably cretaceous. At L'Aghouat they are overlain by fossiliferous beds, probably of Miocene age. Other Tertiary beds observed are soft yellow calcareous freestones on the flanks of the promontory of Algiers and of the Lesser Atlas, and some red and grey marls and ferruginous freestone capping the Tell plateau, the former at a height of 100–900 feet, and the latter of 2,500–4,000 feet above the sea-level. The plain of the Mitidja, between the Lesser Atlas and Algiers, consists of grey loam with shingle-beds, of post-tertiary age. A similar loam covers the great plain of the northern Sahara, and rises to a height of 2,700 feet. Raised beaches occur on the coast up to an elevation of 600 feet above the sea-level; and similar beaches are found inland, south of the Tell plateau, at a height of 2,000 feet. The oldest land in the line of section is the anticlinal of mica-schist near Algiers, the strike of which is nearly at right angles to that of the other rocks. The upheaval of the Mesozoic rocks was contemporaneous with the first upheaval of the Lesser Atlas; it was followed by a long period of denudation, and this by a subsidence of at least 3,000 feet in Tertiary times, during which the Miocene deposits were formed. The Tell plateau was thus elevated at least 4,000 feet, and the district north of the Lesser Atlas at least 1,000 feet, the north face of those mountains probably marking a post-tertiary line of fault of 3,000 feet. This operation was followed by a long period of denudation, and this by a post-tertiary depression, which the author terms the "Sahara Submergence," after which the land was re-elevated at least 3,000 feet, but perhaps considerably more. A gradual subsidence appears to be still taking place.—On the Trimerellidæ, a Palæozoic family of the Palliobranchs or Brachiopoda, by Thomas Davidson, F.R.S., and Prof. William King. In this memoir the authors describe in detail certain Brachiopoda, for which they propose to establish a distinct family, discuss the characters and affinities of the family, and indicate certain geological considerations which arise from their study of its numbers.—Note on the occurrence of sapphires and rubies *in situ* with Corundum, at the Culsagee Corundum Mines, Macon Co., North Carolina, by Col. C. W. Jenks. Communicated by David Forbes, F.R.S.

Chemical Society, March 5.—G. C. Foster in the chair.—A paper on the spontaneous combustion of charcoal, by Mr. A. F. Hargreaves, in which he pointed out the best wood for charcoal for the manufacture of gunpowder, and also the best method of charring it. It appears that if it is ground too soon after being burnt the charcoal is liable to take fire spontaneously.—The other communications were—Researches on the action of the copper-zinc couple on organic bodies: Part V. On the bromides of the olefines: Part VI. On ethyl bromide, by Dr. J. H. Gladstone and Mr. A. Tribe.—Researches on the preparation of organo-metallic bodies of the C_nH_{2n} series of hydrocarbons, by Dr. D. Tommasi.—Note on the action of trichloracetyl chloride on urea, by Messrs. R. Meldola and D. Tommasi; and the agglomeration of finely-divided metals by hydrogen, by Mr. A. Tribe.

Royal Microscopical Society, March 4.—Chas. Brooke, F.R.S., president, in the chair.—A paper was read by Mr. Alfred Sanders, entitled "A Contribution towards a Knowledge of the Appendicularia," in which he minutely described specimens found at Torquay and Weymouth, and illustrated the subject by diagrams. A short discussion ensued as to the best methods of observing and preserving these delicate organisms.—Two papers by Dr. Royston Pigott were afterwards read by the secretary, the first "On the Verification of Structure by means of Compressed Fluid," the second being entitled "A Note on the President's remarks on Dr. Pigott's Aplanatic Searcher."—Dr. Pigott subsequently gave an extended explanation of the contents of his papers, and also detailed a new method of determining the refractive index of covering glass.

Entomological Society, March 2.—Sir Sidney S. Saunders, president, in the chair.—Mr. M'Lachlan exhibited two male examples of an Orthopterous insect belonging to the family *Locustidæ*. They were said to be sold in the streets of Shanghai, confined in ornamental wicker cages, and bought for the sound they produced. The species appeared to be undescribed, and to pertain to a new genus allied to *Xiphidium*. Mr. M'Lachlan also exhibited a series of examples illustrating the natural history of *Oniscigaster wakefieldi*, from New Zealand, described and figured by him from the female imago in the *Entomologist's Magazine* for October 1873. The series now exhibited comprised the male imago, female sub-imago, adult nymph, and larva. The lateral wing-like horny expansions of the terminal segments of the abdomen in the imago and sub-imago are continued in the aquatic conditions on each segment of the abdomen, and in addition there are similar formations along the back of the abdomen, placed longitudinally and vertically. The adult nymph appears to possess no external gills or laminæ, but they are conspicuous in the less mature larva on each side of the ventral surface of the abdomen.—The Rev. A. E. Eaton exhibited some Arctic insects which he had brought from Spitzbergen; and also some excellent photographs illustrating the scenery of the country.—A further communication was received from Mr. Gooch respecting the injury to the coffee-trees in Natal from the Longicorn beetle, *Anthores leuconotus* Pascoe.—Papers were communicated, "On some new Species of South African *Lycænidæ*," by Mr. Roland Trimen, and "Descriptions of new Species of *Lycænidæ*," from his own collection, by Mr. W. C. Hewitson.

Society of Biblical Archæology, March 3.—Dr. Birch, F.S.A., president, in the chair.—The following papers were read:—Translation of an Egyptian fabulous romance, "The Tale of the Doomed Prince," from the Harris Papyri, by C. W. Goodwin. The translator drew attention to the peculiar features of this ancient story, resembling in so many points the romances of the mediæval period, which may have had a common origin.—Translation of an historical narrative belonging to the reign of Thothmes III., by C. W. Goodwin.—Observations upon the Assyrian verbs *Basu* and *Qabah*, by Prof. William Wright. This paper consisted of a critical analysis of the roots of the above verbs, and their cognate analogues in other Semitic languages.

Geologists' Association, Feb. 6.—Henry Woodward, F.R.S., president, in the chair.—On the probability of finding Coal in the Eastern Counties, by John Gunn, F.G.S. Mr. Gunn gave the preference to a boring on the south of Essex, and proceeded to state the grounds on which he recommended another boring at Hunstanton, or along the outcrop of the Kimmeridge clay, in Norfolk. He detailed the several papers which he had read at the meetings of the British Association at Nottingham, Brighton, and Bradford, in proof of the existence of a forest bed in Norfolk and Suffolk, which he called the Anglo-Belgian basin, or a succession of growth of forests, and of alternate elevations and depressions which have taken place in that region, and argued thence, by analogy, the extreme probability that such existed in the carboniferous epoch. Mr. Gunn represented that if the southerly dip of the Harwich slaty rocks extended in a northerly direction it must have been reached at tke Norwich boring, which was sunk considerably lower than that at Harwich, and did not pierce through the gault. Mr. Gunn dwelt especially upon this as the most serious objection to the prospect of reaching coal at Hunstanton, or rather carboniferous beds, expressed so strongly by Prof. Hall at the Brit. Ass. meeting at Brighton. Mr. Gunn also referred to the evidence of local subterranean movements in proof of the proximity of disturbances acting upon what he regarded as a thin envelope of tertiary or secondary deposits probably not exceeding 1,000 feet, and perhaps much less. He referred to the evidence of boulders, which he hoped to adduce on a future occasion.—On the Geology of Nottingham, by the Rev. A. Irving, F.G.S. Part 1.

EDINBURGH

Geological Society, Feb. 26.—David Milne Home, F.G.S., vice-president, in the chair.—The following papers were read:—Notice of large striated boulder in Tynecastle Sandpit, a quarter of a mile west of Dalry Cemetery, Edinburgh, by D. Milne Home.—On glacial phenomena in the neighbourhood of Edinburgh—(1) the Pentland Hills; (2) Bruntsfield Links; (3) Blackford Hill; (4) Tynecastle—by D. J. Brown.—Notice of a section in the building excavations at Tynecastle, by Ralph Richardson.—On glacial phenomena in the Pentland Hills and neighbourhood of Edinburgh, by John Henderson.—Mr. Milne Home's paper, which was illustrated by diagrams, described the boulder as being well rounded on the sides, and its greatest length as 4½ ft., its greatest width 4 ft., its thickness about 2 ft. Its upper and under surfaces were distinctly grooved, and most deeply in the line of the longer axis, which lay N.E. by E. There were some fainter striæ oblique to that line. From a comparison of the striations, he concluded that the superior and lateral striæ had been made after the stone was laid in the bed where found. The stone, which was of greenstone, lay on a bed of compact muddy sand, containing stones which were mostly angular. Above the stone was a considerable deposit of sand, and over that a series of gravels with clayey and sandy beds, all stratified, above which was the soil—the whole deposit being a bank from 20 to 30 ft. thick. This great bed of sand and gravel, in the upper part and west side of which the boulder was found, had been originally a submarine bank. Its height above the present sea-level was about 200 ft. How much above this level the sea stood when this bank was formed was, of course, only matter of conjecture. The nearest rocks similar to the boulders were situated to the westward; most probably, therefore, it had been rafted on ice from that quarter; and, by reason of the ice stranding on this sandbank, the boulder had been deposited there. The deep striæ on the under side showed that the boulder after being deposited on the sea bottom, had been pushed forward easterly. After it had stuck fast it had been striated on the top and exposed sides, by hard and sharp rocks pushed over it, probably by icebergs. The under striæ evidently indicated that they were begun to be formed from the east side, whilst the upper striæ indicated that they had been begun to be formed by some agent passing over from the westward by the pressure of floating ice. Mr. Milne Home stated that a boulder had been recently found on Sir Thomas Hepburn's property in East Lothian which also bore evidence of having been at one time subject to the action of floating ice.

PARIS

Academy of Sciences, March 2.—M. Bertrand in the chair.—The following communications were read:—On the proper nature of the principle of correspondence, by M. Chasles.—On the descending motion of solar and terrestrial cyclones, and on the formation of their opaque envelopes, by M. Faye. This is a reply to a paper by Dr. Reye, and is a defence of the cyclone theory of sun-spots.—On the acid waters which rise in the volcanoes of the Cordilleras, by M. Boussingault. The author considers the simultaneous occurrence of chlorides and sulphates in the igneous rocks the cause of the formation of hydrochloric, sulphurous and sulphuric acids in volcanic emanations, thermal waters, &c.—Meteorology of the month of January 1874 at Tougourt, by M. Ch. Sainte-Claire Deville.—Observations on solar prominences during the last quarter of the year 1873. Results furnished by the employment of diffraction gratings instead of prisms in the spectroscopic observation of the prominences, by P. A. Secchi. The author has observed the coincidence of spots with eruptions on the sun's limb on eighty-nine occasions. Eight times only were spots seen without an eruption. A remarkable case is recorded of the outburst of an eruption during the course of an observation.—On the reduction of bilinear forms, by M. G. Jordan.—On the refraction of gases, by M. Mascart.—Organogenesis compared with androgenesis in its relations to natural affinities (*class Personatæ*), by M. Ad. Chatin.—New species of the genus Dipterocarpus, by M. J. Vesque. Twelve species are described, all from Borneo.—Gnomonic projection of the terrestrial surface upon an octohedron and upon a cube circumscribing the sphere, by M. J. Thoulet.—On a new symptom of death derived from the pneumatosis of the veins of the retina, by M. E. Bouchut.—Geometrical demonstration of some theorems, by means of the consideration of an infinitely small rotation, by M. A. Mannheim.—Apparent orbit and period of revolution of the double star η Coronæ, by M. G. Flammarion.—On the mode of production of certain induction currents, by M. A. Gaiffe.—On the influence of albuminous substances upon electro-capillary phenomena, by M. Onimus.—New researches upon the physiological decomposition of beer-yeast, and remarks on a recent communication by M. Schutzenberger, by M. A. Béchamp.—On the action of chloral upon albumen, by M. H. Byasson.—Of the anæsthesia produced in man by the injection of chloral into the veins, by M. Oré.

CONTENTS

PAGE