THURSDAY, JANUARY 5, 1882

ON THE GEOLOGICAL IMPORTANCE OF THE TIDES

IT has naturally been a source of much satisfaction to me that a man as able and eloquent as the Astronomer-Royal for Ireland should have come forward as an exponent of the theory which I have advanced concerning the part played by tides in the history of the earth and the other planets. I cannot but feel therefore that it may seem ungracious on my part to appear as a critic, and to ask Mr. Ball to reconsider some of the deductions which he has made in his Birmingham lecture (see NATURE, vol. xxv. pp. 79, 103). I refer to the geological aspects of the theory. The interest of the subject will, I feel sure, prove a sufficient excuse for my being thus critical.

There is I believe a growing feeling amongst geologists that the extreme uniformitarian view as to geological action requires modification. We find on the one hand the physicist demanding of the geologist that he should hurry on the rate of action, and on the other hand the geologist telling the physicist to moderate his demands. A theory, therefore, which receives much support from purely astronomical considerations concerning the observed configurations of planets and satellites, and which enables geologists to perceive *how* the rate of geological action may have been more rapid in the past, is valuable as a means of reconciliation between two apparently opposed branches of science. All this has been admirably insisted on by Mr. Ball, but I think that in the revulsion from uniformitarianism he has passed considerably too far into the ranks of the opposite school.

Accepting the truth of the tidal mode of evolution of the earth and moon, the question at issue is as to what portion of the series of changes, since the birth of the moon, falls within the region of geological history.

In my own paper in discussing this point, I said:

"There are other consequences of interest to geologists which flow from the present hypothesis. As we look at the whole series of changes from the remote past, the ellipticity of figure of the earth must have been continually diminishing, and thus the Polar regions must have been ever rising and the equatorial ones falling; but, as the ocean always followed these changes, they might quite well have left no geological traces.

"The tides must have been very much more frequent and larger, and accordingly the rate of oceanic denudation much accelerated.

"The more rapid alternation of day and night would probably lead to more sudden and violent storms, and the increased rotation of the earth would augment the violence of the trade winds, which in their turn would affect oceanic currents. Thus there would result an acceleration of geological action."[1]

At the time when I wrote this I contemplated the possibility of the tides having been, in the earliest geological times,[2] perhaps twice or thrice as high as at present, and I now feel inclined to consider this estimate rather as excessive than deficient. But Mr. Ball speaks of tides of over 600 feet as having perhaps occurred within geological times, and I would now ask him to reconsider the probability of this view.

The older geologists attributed the larger part of denudation to the action of the sea, but according to the modern, and undoubtedly the more correct opinion, the denuding action of air and rain, with the aid of rivers and their countless affluents, is of far greater importance. Mr. Ball does not allude to the probable increase of rainfall, but it would, I conceive, be quite as important as the direct tidal action.

If the ordinarily received theory of the trade and anti-trade winds be correct, it follows that in similar planets, at equal distances from the sun and with the same depth of atmosphere, the velocity of the wind should vary as the linear velocity of a point at the planet's equator. The planet Jupiter rotates 2·4 times as fast as the earth, and has a radius $10\frac{1}{2}$ times as great; hence if it were not for the greater distance from the sun the trades should blow with 25 times the violence which we observe on the earth. But solar radiation at Jupiter is about $\frac{1}{27}$ of that at the earth. Hence if Jupiter had an atmosphere of the same depth as that of the earth, the trade-winds might blow with about the same violence. If however there be a much deeper atmosphere on that planet, then the amount of solar heat absorbed might be much greater, and the violence of the winds increased. The bands on Jupiter, which are due to the trades and anti-trades, thus afford some evidence that the atmosphere of Jupiter is very deep. It seems, however, quite possible that the violence of the Jovian trades is due partially, or to a great extent, to the heat of the Jovian nucleus.

But now let us return to the case of the earth. The table of numerical values which I have computed (*Op. cit.* p. 494) shows that, when the lunar distance was ten earth's radii (which gives Mr. Ball's tide of 648 feet), the earth must have been rotating in about seven hours. Accordingly it is probable that the trades and anti-trades blew with about $3\frac{3}{7}$ their present velocity. This violence of the general atmospheric circulation to and from the equator, coupled with the rapid alternations of day and night, would undoubtedly give rise to vortical storms of prodigious violence.

Now if this state of things existed in geological history we should expect to find the earlier sedimentary rocks of much coarser grain than the modern ones; but I am not aware that this is the case. Again to withstand such blasts, the earliest trees should have trunks of enormous thickness, and their leaves must have been very tough, or they would have been torn to shreds. There seems to be no reason to suppose that the trees of the carboniferous period present marked peculiarities in these respects.

It is on these grounds that I venture to dissent from Mr. Ball in the geological interpretation to be placed on the tidal theory, and I think we must put these violent phenomena in pregeological periods.

The dispute is, however, only as to the amount of influence, and I cannot learn that geologists are in a position to affirm that in early periods the storms were not say twice as frequent, and the tides twice as high. The

[1] "Precession of a Viscous Spheroid. &c.," *Phil. Trans.* Part 2, 1879, p. 532. It would occupy too much space to reproduce the other comments on the Geological aspects of the theory.

[2] A double tide would (in round numbers) correspond to a lunar distance of 48 earth's radii, instead of the present 60, and to a day of about 16 hours. A double tide gives a quadruple rate of retardation of the earth's rotation.

acceptation of the view, that they were so, would go far to reconcile the discrepant opinions of the geologists and physicists.

There is, as I learn, some slight geological reason for supposing the tides to have been higher in early times, although this interpretation does not seem to have been hitherto attributed to the fact to which I allude. It appears that in the oldest formations there are beds many feet in thickness covered with ripple marks. The preservation of ripples is due to a fortuitous concurrence of causes, and it therefore cannot be asserted positively that if many ripples are preserved the number of ripples formed was great. Such a deduction possesses, however, a considerable degree of probability, and one of the conditions for the formation of many ripples is a great ebb and flow of the tides.

Lyell's interesting observations on the sands in the Bay of Fundy ("Travels in North America," vol. ii. p. 166), where the tide rises through about seventy feet, seem to show that the preservation of superficial marks on sand occurs principally at neap tides, when large areas of sand are exposed for a long time to the sun, after having been covered with water at the spring tide. Now when the tides were twice as high as at present, there must have been 19 or 20 of our present days in the month instead of 27⅓ as at present, and there would be about 38 neap tides in the year instead of about 26.

Since writing the above I have seen Mr. Hull's paper on this subject in NATURE (vol. xxv. p. 177). The evidence which he adduces is of much interest, and if geologists should generally come to recognise the necessity of a powerful denuding agency in order to explain the earlier geological phenomena, such an opinion will stand in direct confirmation of the theory which I have advanced. Notwithstanding what Mr. Hull says, I am still inclined to adhere more to the moderate views maintained above, rather than to admit the extended application of the tidal theory to geology for which Mr. Ball contends. I conceive that a very great acceleration of geological action would result from tides of even one-hundredth of the height portrayed by Mr. Ball, when such tides are accompanied by an intensification of meteorological action.

If Mr. Hull had read my papers, he would have seen that a necessary concomitant of these changes has been a secular diminution of the ellipticity of the earth's figure. For example, when the tides were 600 feet in height, the ellipticity must have been about twelve times as great as at present. Now Sir William Thomson will not allow that there can have been any great change in the ellipticity of the earth's figure since the consolidation of the earth (Thomson and Tait's "Nat. Phil." § 830).

If this opinion is correct, extended geological action, as resulting from the present series of causes, is absolutely excluded. For myself I am not at present able to see the force of his argument, for various reasons on which it is useless to enter here. But it must be admitted that in any contest between him and me the chances of correctness are enormously on his side.

In conclusion I wish to add that in my first paper I probably attributed too much of the changes in the configuration of the earth and moon to the effect of bodily tidal deformation of the earth's mass. The evidence is strong that such tides are now but small, or even scarcely sensible in amount, and accordingly in all probability the later part of the changes must be attributed almost entirely to the effects of oceanic tidal friction, whilst in the earlier part the tides of the solid or semi-solid matter constituting the planet were the more important. It is remarkable that this view enables us to give a satisfactory account of the inclination of the lunar orbit to the ecliptic, as is shown in a later paper.[1]

G. H. DARWIN

EXNER ON CEREBRAL LOCALISATION

Untersuchungen über die Localisation der Functionen in der Grosshirnrinde des Menschen. Von Prof. Sigmund Exner. (Wien, 1881.)

THIS work is an attempt to determine the functions of different parts of the cerebral hemispheres by an examination of the facts of disease alone, independently of physiological experiment. The difficulties which have to be encountered in the solution of the problem by this method are great, and the sources of fallacy numerous. The facts, collected as they must be from the most diverse sources, are not all of the same value, and errors of observation on the score of inaccuracy or incompleteness have to be taken into account and allowed for. The experiments of disease are as a rule rude, and the conditions highly complex. Certain parts of the brain are more liable to disease than others, and one hemisphere more than the other. Besides the lesion actually discovered after death, there may be others not discovered or not discoverable by our present methods, either coincident merely or indirectly connected with the visible lesion; for morbid anatomy and morbid physiology are by no means coextensive. Exactly symmetrical bilateral lesions are extremely rare in disease, and yet such facts are absolutely necessary for the decision of many important questions.

These and many other circumstances render the determination of the functions of the brain from the data of disease alone extremely uncertain, if not impossible. Until the discovery of new experimental methods a few years ago cerebral pathology, except in one or two particulars, chiefly speculative or purely empirical, was practically in a state of chaos. It is only since the introduction of the new doctrines founded on experimental research that the facts of cerebral disease have begun to be investigated and recorded with any approach to scientific accuracy, and order has begun to show itself where formerly all seemed confusion.

Prof. Exner is of opinion that his predecessors have examined the facts of cerebral disease merely with a view of confirming preconceived theories, and have not exercised sufficient discrimination in the selection of the cases they adduce in favour of the propositions they maintain. In this respect particularly he claims superiority over all who have treated the subject before him.

Out of several thousand cases of cerebral disease on record, he has been able to find only 168 instances of

[1] "On the Secular Changes in the Elements of the Orbit of a Satellite, &c.," (*Phil. Trans.*, part ii., 1880, p. 731).

lesion of the cortex capable of being made the basis of reliable inductions.

He has represented together on a series of figures of different aspects of the cerebral hemispheres the position and extent of the lesion recorded in each case; and he has carefully tabulated the symptoms observed, whether positive or negative. In determining the functions of the parts he follows three methods mutually complementary. First, the method of negative instances;—all the lesions being taken together in which a certain function was not affected. Secondly, the percentage method;—the proportion of cases being indicated in which a certain region was diseased, and the relative frequency of the symptom in question. Thirdly, the method of positive instances, *i.e.* all the cases of disease in which a particular affection was observed;—a method used mainly as an adjunct to the other methods, and not of itself of great force. By these methods he arrives at the determination of certain areas or centres which he terms *absolute*, lesion of which always causes the same symptom. He defines more or less vaguely absolute centres for the upper and lower limbs more especially. In addition to the absolute areas he defines a number of *relative* areas, or centres, for other movements, and different forms of sensibility; the relative areas being those in which lesion does not always, but only *frequently*, cause affection of the function with which they are supposed to be in relation.

The elaborate and carefully prepared figures which accompany the work indicate clearly the areas of latent lesions, as well as the position and extent of the absolute and relative areas which the author describes.

Apart altogether from Prof. Exner's deductions, one thing clearly brought out by the facts is the comparative impotence of the fortuitous experiments of disease as regards the determination with any degree of accuracy of the exact position and limits of any centre whatever. Prof. Exner has a deservedly high reputation as a physiologist, but the manner in which he has handled the facts of disease as set forth in this work is not one on which he can be congratulated.

In his selection of instances he has excluded, without assigning valid reasons, many cases of the utmost importance; and he has included, as instances of localised cortical disease, a large number of cerebral tumours, which by the general consent of pathologists, are excluded, owing to the indirect effect which tumours exert on other parts—effects which can never be estimated with any degree of certainty. In his meagre "sammlung" of 168 instances he has included over thirty cases of tumour, thereby introducing such a large percentage error as to vitiate the whole of his deductions however accurately they may be drawn from his premises. Causal relationship is too readily assumed when none is proved. Mere frequency of occurrence, on which alone he founds his peculiar notion of relative centres, by no means justifies the assumption of causal connection. These so-called relative areas are seen to be capable of destruction without discoverable symptoms, and the same region seems to play many parts, being indifferently a centre for the leg, or the arm, or the face, speech, sight, and so forth. Our author's arguments in favour of his relative centres are in reality not more cogent than would be the inference that because injuries of the foot are frequently associated with disturbance of the circulation, therefore the foot is a relative centre of the circulation, whatever that may mean. If Prof. Exner's localisation of relative centres had any foundation in fact, it would be nothing short of a *reductio ad absurdum* of the whole doctrine of localisation. It is a marvel how a believer in localisation, as Prof. Exner declares himself, can see no incongruity or inconsistency in admitting that the absolute centre for the leg may also be a relative centre of vision. A consistent advocate of localisation might as well admit that the leg may frequently, relatively, or in some way or other be used as an organ of vision.

Among other strange things in this book is the kind of evidence on which our author seeks to establish differences between the hemispheres as to the extent and relation of the sensory and motor centres. In one of his figures of the left hemisphere there is an area in the occipital lobe so coloured as to indicate the position of an absolute centre for the arm, meaning that lesion of this area causes paralysis of the arm in 100 per cent. of the cases. On referring to the evidence we find that the 100 per cent. means only *one* case, a case, moreover, in which there was profound impairment of all the cerebral functions, and extensive lesion elsewhere of the left hemisphere, invading also what is generally recognised as the motor area proper. It is true that in his remarks on this case our author doubts its conclusiveness as regards the arm centre; but inasmuch as his instances give him a case of lesion of the same region in the right hemisphere without any symptoms whatever, he considers it beyond all doubt that this area has a more intimate relation with the upper extremity in the left hemisphere than in the right. It would be difficult to believe that this was written seriously, were it not that a similar style of reasoning is so prevalent throughout the book. Though Prof. Exner advocates the localisation of function in the cerebral hemispheres, the support he gives it is of the most equivocal description. DAVID FERRIER

THE ROD IN INDIA

The Rod in India. Being Hints how to obtain Sport, with Remarks on the Natural History of Fish, their Culture and Value, and Illustrations of Fish and Tackle. By H. S. Thomas, F.L.S., of the Madras Civil Service. Second Edition. (London: Hamilton, Adams, and Co., 1881.)

THIS is a very much enlarged edition of a very excellent and pleasant book, the first edition of which appeared not quite eight years ago. The author asserts that there is as good fishing, in the angler's sense, of course, of this word, to be had in India as in England; and to prove it we have this goodly royal octavo volume, of over 400 pages and 25 plates. Now, though the fishing is good, it soon becomes apparent that it is something quite peculiar; for though our author himself knew thoroughly well how to "circumvent" a trout in England, and had often done successful battle with the lordly salmon in more northern climes, yet at first he could make nothing of the Mahseer in India, and lost a frightful lot of time in learning the manners and the customs of this Oriental gentleman. The reader of this volume should not certainly be in such a plight, for he will find in it the minutest instructions for his guidance, and there seems not a *trait* in the character of this and the other freshwater fishes to be ordinarily met with in India that has not been scanned and studied by its author with the intent of beguiling these fishes to their own destruction.

Of the fish to be caught in Indian waters the best is the Mahseer (*Barbus tor*). It is the best from the sportsman's point of view, as it gives him most to do; for who that is a sportsman cares to haul up a dead pike on a night-line? and who that is a sportsman but must care for a fish that can attack as follows?—

"The Mahseer has a greater means than our salmon of putting on steam, and has the habit of always putting it on at once, energetically and unsparingly. His first rush is a mighty one, no doubt; that once made, his strength is, in comparison with the northern fish, comparatively soon exhausted. Other rushes he will make, but his first is the dangerous one; then it is that the final issue of the campaign is practically decided. Be one too many for him then, and you may be grimly satisfied that all else he can do will not avail him; you may count on making him your own. Then it is that you must wait upon him diligently. If you have not got all free, the connection between you and your new friend will be severed within a moment of your making each other's acquaintance. If you should have carelessly allowed the line to have got a turn around the tip of your rod, or have let any slack near the hand become kinked ever so little, or twisted over the butt or hitched in the reel or a button, then it is that not one moment's law is given you for the readjustment of such little matters. There is one violent tug, and an immediate smash:

"'The waters wild go o'er your child,
And you are left lamenting.'

Reader, it takes an eye and a hand, and tact and readiness of mind, as well as a rod and a line and a fly, to catch a salmon; but it takes all these, and something more, to catch a Mahseer."

Although it is well known that a fisherman does not catch his fish for the pleasure of eating them—this being quite a secondary matter—still it is fair towards the Mahseer to mention that when in good condition they are excellent, so rich that one needs no condiment with them, so well flavoured as in this respect to occupy a rank between a salmon and a trout. The best size for flavour is between six and seven pounds; but they are good eating when from two to ten pounds in weight; under the former size they are too bony, over the latter too oily.

The chapter on the natural history of this fish is one of the most interesting in the volume, and it is scarcely necessary to add that there are minute details of how to "circumvent" him, of how to spin for him, and of how to tempt him with a fly, and of how, when, and where to fish for him. When we add that over one quarter of the volume is taken up with this fish, it will be evident at once that he ranks as a lord among the freshwater fishes of India; but we have full details also of the Carnatic Carp (*Barbus carnaticus*), a nearly allied species to the Mahseer, running to twenty-five pounds in weight, taking a fly, having a fancy for a No. 5 or 6 Limerick, and giving good sport.

There are also excellent chapters on many much smaller fishes than these—fishes for light rods, and giving very enjoyable sport; several, like the Black Spot, being dwellers in ponds.

Some information is also given as to the attempts made to stock ponds in India, and there is a very full list given of fishing localities. The lithographs which accompany the volume are very good, and several of them are coloured. To the sportsmen of India this work will be quite indispensable and quite a boon, and further, to all interested in the resources of an Empire presided over by our Queen, the volume will afford an insight into the importance of its freshwater fishes that they will find, we believe, nowhere else.

OUR BOOK SHELF

Book of the Black Bass: comprising its Complete Scientific and Life History; together with a Practical Treatise on Angling and Fly-Fishing, and a Full Description of Tools, Tackle, and Implements. By James A. Henshall, M.D. Illustrated. (Cincinnati: Robert Clarke and Co., 1881.)

THE author in this volume endeavours, and we think succeeds, in giving to the Black Bass its proper place among the freshwater game fishes of North America; and undoubtedly the reader will find himself taking an interest in this fish as he reads this enthusiastic account about it. No doubt the first and second chapters will be most tedious reading, and yet they are full of interest as showing how tangled may become the scientific nomenclature even of a well-known fish. As the sum and substance of these chapters we find the two species of the genus Micropterus, standing, the one as *M. dolomieu*, and the other as *M. salmoides*, and it is of these two respectively —the small-mouthed Black Bass and the large-mouthed Black Bass—that the author writes. Both species are very active, muscular, and voracious, with hard and tough mouths, are very bold in biting, and when hooked exhibit gameness and endurance second to no other fish. Both give off the characteristic musky odour when caught. They generally inhabit the same waters. These Black Bass are wholly unknown in the Old World, except where quite recently introduced. Their original habitat is remarkable for its extent, for with the exception of the New England States and the Atlantic seaboard of the Middle States, it comprises the whole of the United States east of the Rocky Mountains, Ontario, and, last, Mexico. Of late years this distribution has been greatly extended. These fish are very prolific, and rapid growers where food is plentiful. In northern waters six to eight pounds is about the limit of their weight, but in Florida they are sometimes met with up to twelve and fourteen pounds. They have been several times imported into England, and we believe that those brought over in 1879 at the expense of the Marquis of Exeter have succeeded well. The fisherman who reads the latter portion of this volume will find many pleasant anecdotes and stories in connection with the gentle art, and should he happen to frequent those waters where the Black Bass are to be found, he will get many a precious wrinkle which he might have otherwise not known. The author's parting injunction is, "Always kill your fish as soon as taken from the water, and *ever* be satisfied with a moderate creel. By so doing your angling days will be happy and your sleep undisturbed, and you and I and the fish we may catch can say—

"'The lines are fallen to us in pleasant places.'"

An Introduction to Determinants, with numerous Examples. By William Thomson, M.A., B.Sc. (Edinburgh: Jas. Thin, 1882.)

THIS text-book is very accurately described by its title. It belongs to a class of which many examples have appeared on the continent for use in the secondary schools, and of which the object is to give the more common properties of determinants, illustrate the said properties copiously with examples of the second, third, and fourth orders, and give additional examples of the same kind for practice. The object is here on the whole well attained, there being more examples for the pupil than is usual. For a "beginner's text-book," however, it is unquestionably long-drawn-out and expensive. A book (*e.g.* Dölp's, Bartl's, &c.) with very much more matter and, to say the least, as good in quality, would be got in Germany for two shillings, and this costs five. The object of the author "to render an interesting and beautiful branch of mathematical analysis more accessible to junior students" is thus somewhat frustrated at the outset.

LETTERS TO THE EDITOR

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

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

A Glimpse through the Corridors of Time

THE eloquent and exceedingly interesting lecture by Prof. Ball, F.R.S., under the above title, reported in your journal, has brought to my mind a short, far too much forgotten paper by Immanuel Kant. With your permission I will give a few extracts from this paper, which cannot but be interesting to many of your readers. Kant became subsequently very celebrated in a sphere of human knowledge usually considered far removed from natural science, in consequence of which his papers relating to this science are now almost universally overlooked. Nevertheless some of them contain extraordinary glimpses of truth a century or more in advance of this time, glimpses possible only to genius.

The paper to which I wish more particularly to draw attention was published in 1754, when Kant was thirty years of age. It will be found in the collected works edited by F. U. Schubert and K. Rosenkranz (Leipzig, Leopold Voss, 1839, vol. vi. p. 4). The paper relates to the question whether the length of day has altered, and through what cause. In this paper Kant states: "If the earth were a perfectly solid mass, without any liquid, the attractions of the sun and moon would not alter the rate of rotation round the axis. . , . If, however, the mass of a planet includes a considerable amount of liquid, the united attractions of the sun and moon, by moving this liquid, impress upon the earth a part of the vibrations thus produced. The earth is in this condition." He then goes on to state that the moon produces the greatest effect, and, the tide running round the earth in a direction opposed to that of rotation, "we have here a cause, on which we can count with certainty, incessantly reducing this rotation by as much as it may be capable of." A little further on he says: "When the earth steadily draws nearer and nearer to the end of its rotation, this period of change will be completed when its surface is, relatively to the moon, at rest; *i.e.* when it rotates round its axis in the same time in which the moon revolves round it, and will, consequently, always show the same face to the moon. . . . If the earth were entirely fluid the attraction of the moon would very soon reduce its rotation to this minimum. Herein we at once see a cause why the moon always shows the same face to the earth. . . . From this we may conclude with certainty that when the moon was originally formed, and still fluid, the attraction of the earth must, in the manner above described have reduced the speed of rotation, which then in all probability was greater, to the present measured limit." I have given only a few short abstracts, and I have no doubt that mathematicians may find many faults in the paper, but it is nevertheless clear that Kant had recognised the influence of tidal action, both on the earth and on the moon, and has given a glimpse through the corridors of time a century earlier than any of the authorities mentioned by Prof. Ball.

After Kant it was, I believe, R. T. Mayer, of Heilbron, who, long before Prof. Helmholtz drew attention to the influence exerted by the tidal wave on the rotation of the earth.

Westminster Hospital, December 5, 1881 A. DUPRÉ

Dante and the Southern Cross

I HAD supposed the query—in reply to which I ventured to offer the very brief note which was printed in NATURE (vol. xxv. p. 173)—to have proceeded from some English reader, unacquainted with the various solutions of the difficulty involved in the question, which have been suggested, and who might have been satisfied with a reference to such a discussion of the matter as that in the "Cosmos," by a critic in whom were united all the needful qualifications to a degree which can hardly be looked for elsewhere.

Dr. Wilks appears to have written with a similar impression in referring the querist to the commentary of the late distinguished Dantophilist, Dr. H. C. Barlow, whose fervid belief in the extent of Dante's knowledge ("ottimo Astronomo, summo Teologo") could not be exceeded by the most ardent patriotism, and was never qualified by the judicious reservation which Signor N. Perini admits. What I venture to add, refers to the notes which have appeared, rather than the original query as I understood it.

For a solution of the apparent paradox in Humboldt's retaining the old view of the sense of "prima gente" while accepting —not Galle's "opinion," but—the result of his computations as to the visibility of the stars of the Southern Cross to the earlier inhabitants of Europe, I would refer Signor N. Perini to the earlier and much fuller development of Humboldt's views, contained in the last twenty pages or so of vol. iv. of the *Examen Critique de l'Histoire de la Geographie Moderne*, where, at the same time, will be found a great deal of valuable and suggestive information relative to the Arabian celestial globe theory, and also to the probability (the words "non viste mai . . ." notwithstanding) of Dante having derived some knowledge of the constellations of the southern hemisphere from the description of "Les voyageurs pisans ou vénitiens qui visitaient l'Egypte, l'Arabie et la Perse." But I would at the same time urge that the whole of what is said in the "Kosmos" on the subject of the Southern Cross is not intended to be applied to the Dante question, but to the larger one of the progress of oceanic discovery, and that it was in connection with this larger topic that Humboldt availed himself of Dr. Galle's computations. Dr. Barlow appears to have been misled by failing to notice this distinction in his enthusiastic letter to the *Athenæum* (September 1860) of which the article quoted by Dr. Wilks from the volume of "Contributions to the Study of the Divina Commedia" is a condensation.

Count St. Roberts's essay, to which Signor N. Perini refers, is probably little known, and not easily obtained, in England; but we may conjecture that its object was to argue against the supposition of the element of ecclesiastical mysticism—hateful to modern Italian liberalism—as entering into the Divina Commedia and affecting its imagery and modelling. If the essay had thrown any new light on the subject of the query, we may conclude Signor N. Perini would have imparted it to us. However, I believe that everything that can be found to throw light on this interesting question has been adduced and weighed with the dispassionate calmness of a master mind, as it is set forth with candour and perspicuity in the exhaustive discussions to which I have referred. In conclusion may I remark on the importance, in such correspondence as we have been engaged in, of quoting the original words of an author—with or without translation, as may be thought proper. In the quotation, as from "Cosmos," by Dr. Barlow, given by Dr. Wilks and the passage is re-quoted by Signor Perini—nonsense is made of a sentence by "da" being rendered "since," instead of "whereas." In the same translation "mit vieler Orientalischen Reisenden aus Pisa" is improved into "with many *learned* Oriental travellers of Pisa." Such changes might sensibly affect any argument founded on the passages. For the same reason I would have preferred heading this correspondence "Dante and the quattro stelle." J. J. WALKER

University Hall, December 31

A Pet Baboon

I KNOW not if the inclosed account, written by a friend of mine now resident at Zanzibar, for whose accuracy and truthfulness I can answer, is worthy of a place in your columns.

JULIA WEDGWOOD

"You ask after my quaint little pet baboon, and I really must give you the history of her end. She grew and she grew till she got to be half as tall as I am, and then, sad to relate, with advancing age her temper did not improve; I am afraid if I spoke the truth I should have to describe it as savage. She became a perfect terror to many people, and she even attacked me once or twice. She was playful to the last when I had her alone, and often resumed many of her old quaint caressing ways that were indescribably fascinating from their childlikeness. But the funny thing was, that if the Bishop was near she would immediately turn upon me and scratch and bite me, and he had only to go out of sight for her good temper to return. At last, however, I felt she was becoming a nuisance to other people, by her habit of grabbing at everybody that passed, and her savage gesticulations; so, seeing also how she longed to exercise those active wiry little limbs of hers—inventing all sorts of ludicrous games and gymnastics—I made up my mind to let her loose. There is a charming little island not far from the shore, which we thought would be just the place Judy would revel in. Mr. —— and Miss ——, and a number of our little boys, escorted her there. She came down to the shore to watch them off, and gave one cry of dismay at being deserted; but we hope that the sweets of liberty have more than consoled her for the loss of society. I missed the creature dreadfully at first. She was a constant amusement and interest with her quaint ways, and even her naughty tempers were ludicrous. Really if Mr. Buckland had been alive I think I should have sent her to him. I think he would have appreciated her intelligence and love of a romp, and she would never have been savage with him. She never once attempted to bite our Bishop; she always preferred him to any one else, and was always affectionate with him. I want very much to know whether other people have noticed that these baboons really laugh; I have heard somewhere, I am sure, that the power of laughter is the distinction between man and animals. But Judy certainly used to laugh—not at a joke I confess; and nothing made her so savage as being laughed at. But when she romped with me she used to open her mouth and show all her white teeth, and regularly laugh like a child, especially when she was tickled. I shouldn't have parted with her if I had been living alone, but living with others, as one does here, it did not seem fair to keep a creature that really did frighten some of the household."

"Tanganyika Shells"

UNDER the above heading a paragraph appeared in NATURE, vol. xxv. p. 101, in which Mr. C. A. White, of Washington, states that certain species described by me in the *Proceedings* of the Zoological Society, 1881, pp. 558-560, from the great African Lake Tanganyika, "are without doubt, generically identical with the *Pyrgulifera humerosa* of Meek," a fossil form from the Bear River Tertiary of North America. Mr. W. H. Dall, of the Smithsonian Institution, had previously, in a letter to me, dated October 24, expressed a similar opinion. I have been unable to procure for examination and comparison a specimen of the North American shell, and am consequently compelled to arrive at a conclusion from a study of Mr. Meek's figure and description in the report upon the "United States Geological Exploration of the Fortieth Parallel," vol. iv., pp. 176-178, woodcut 6, and plate 17, figs. 19-19*a*. As a result I find it decidedly unadvisable at present to locate the two forms in question in the same genus. I admit that in regard to general outline and character of "sculpture" there is no distinction of any importance. However, when the aperture (which in univalve shells most frequently exhibits the main generic characters) is closely scrutinised, features present themselves which incline me, until actual comparison is possible, to hold these two types generically distinct. The outer lip of *Pyrgulifera* is said to be "subsinuous at the termination of the shoulder of the body volution above," and the basal margin of the aperture is described as "faintly sinuous." On the contrary, in *Paramelania* no trace of the latter character is present, and the upper extremity of the labrum where it joins the volution, instead of being "*subsinuous*," is actually *prominent*. But another equally important distinction is the prolongation of the body-whorl below the aperture, together forming a more or less basal effusion. Independent of these actual differences, we must take into consideration certain probabilities and improbabilities. In the first place the difference in geographical position militates to some extent against the identity of these two forms. Then the vast lapse of ages surely must have evolved some differences in the animals as indicated by the dissimilar apertures, and again the operculum of *Paramelania* is very peculiar, and who shall say that this appendage was of a like nature in the Bear River shell. In conclusion, I should observe that the African form was considered of sub-generic rank by me, and not as a distinct genus, as stated by Mr. White.

EDGAR A. SMITH

The Growth of Trees

JUST fifty years ago I was at school in Salisbury. I have only visited it once since until last week, when I had the unique pleasure of rambling over the old but familiar haunts, of course including Old Sarum. On mounting the outer ring of the well-known mound from the Stratford side, a beech tree in the bottom of the ditch reminded me that it was just there our usher carved with his knife on such a tree "Tempus Fugit." On going down to look for the motto, I only found unreadable abrasions on the bark, but on the north side of the same tree "1817" was distinctly engraved. On examining a tree near, I found on the bark "Carpe Diem, 1831." This recalled to my memory the fact that our usher's "Tempus Fugit" was suggested by some such motto carved by the usher of another school. Is it worth recording that this carving on the bark of a beech tree is quite legible after an interval of fifty years, while the date "1817" on another is also probably genuine? If so, perhaps it is worth noticing that both legible carvings are on a north aspect not reached by the sun, while the lost motto "Tempus Fugit" would be exposed to the sun with an easterly aspect.

Barnstaple, January 2 W. SYMONS

INDIAN FOSSILS.—Mr. Richard Lydekker, of the Geological Survey of India, asks if any of our readers can give him information as to the whereabouts in England of collections of fossil bones from the Siwaliks of India. He is aware (beside the British Museum collection) of collections at Ludlow, Cambridge, and Edinburgh, but he believes there are others in the country. A large collection was sent home some years ago by a Major Hay, the destination of which is unknown to him. Mr. Lydekker is now engaged in working at Siwalik fossils, and as he intends spending some months in England next summer, he wishes to look up all the collections then.

OUR ASTRONOMICAL COLUMN

COMET 1881 *b*.—Notwithstanding some statements to the contrary, the orbit of this comet when the later observations are brought to bear upon it, is sensibly different from a parabola, and from two independent investigations, the first by MM. Dunér and Engström, the second by M. Bossert (from eight normal places, based upon 423 observations), the period results about 2955 years. An observation at Marseilles on October 24 gave at 9h. 39m. 4s. mean time, R.A. 18h. 44m. 58·12s., N.P.D. 20° 24′ 23″·2, corrected for parallax.

The following positions are given by Dr. Dunér:—

At 12h. Berlin M.T.

	R.A. h. m. s.	Decl. N. ° ′	Distance from Earth.
January 10	22 58 11	57 28·3	3·118
12	23 3 4	57 15·5	
14	— 7 53	57 3·3	3·195
16	— 12 39	56 51·5	
18	— 17 22	56 40·3	3·274
20	— 22 1	56 29·5	
22	23 26 38	56 19·2	3·354

The student of this branch of astronomy will be aware that comets have been followed to greater distances; the extraordinary comet of 1729, which never approached the earth, indeed could not approach her, within three times the earth's mean distance from the sun, and yet was visible with small telescopes, still affords a unique case, it must have been a body of an altogether exceptional character.

THE MINOR PLANETS IN 1882.—The supplement to the *Berliner Astronomisches Jahrbuch* for 1883, containing ephemerides of the small planets for 1882 has been circulated in advance of the publication of the volume as usual for some years past. Of the two hundred and twenty members of the group detected up to the present time, we find approximate places for every twentieth day of 217, and accurate opposition ephemerides of 41. The approximate ephemerides include No. 220. Three only of the planets approach the earth at opposition, within the earth's mean distance from the sun, viz. No. 12, *Victoria*, in

August, distance 0·891; No. 80, *Sappho*, in September, distance 0·847; and No. 27, *Euterpe*, in December, distance 0·980. No. 157, *Dejanira*, comes into opposition and aphelion about the same time, and the magnitude descends to 15·7. The last of the minors discovered is in opposition in December, mag. 14·6, but No. 216, also a recent discovery, is as bright as 8·4 at opposition on October 7. There is perhaps not much hope of recovering *Medusa* (which from the best orbit obtainable from the short course of observation in 1879 would appear to have the least mean distance amongst the small planets) in the present year, the magnitude being only 13·5, and the computed places necessarily liable to considerable error. Nos. 205, 207, 208, 210, 212, 216, 218, 219, and 220 are still without names.

MR. W. R. BIRT.—Mr. Birt, so well known in connection with lunar work, died at Leytonstone on December 14 in his seventy-eighth year. He had occupied himself some fifty years since with the variable stars, and announced in 1831 the variability of α Cassiopeiæ, a difficult case, for the fluctuation in its light would appear not to exceed a half-magnitude, and indeed has been doubted by no less an authority than Prof. Julius Schmidt. Sir John Herschel, however, supported Mr. Birt's conclusion, and we were once shown by the late Prof. Heis a series of curves exhibiting the results of several years' observations, which indicated sensible though very irregular variability. Much of Mr. Birt's lunar work was undertaken under the auspices of a Committee of the British Association, and his maps of various parts of the moon's surface, extending to great detail, are well known.

M. ALFRED GAUTIER.—In the death of M. Alfred Gautier, at Geneva, on November 30, at the age of eighty-eight years, as already announced, the Royal Astronomical Society have lost the oldest Associate upon their list; he died in full possession of his faculties after a very short illness. M. Gautier was elected into the above Society in January, 1822, or two years after its formation. M. Plantamour of Geneva now heads the list of Associates.

THE SMOKE ABATEMENT EXHIBITION

THIS Exhibition originated, as explained in the introduction to the Catalogue, in the action of the Committee of the National Health Society, with whom the Kyrle Society afterwards joined in appointing a Joint Committee to consider how action could be taken which should tend to the abatement of the smoke produced in the metropolis. In the words of this introduction, "The first proceeding of the Committee was to communicate with colliery owners and manufacturers of heating apparatus as to the means available for the reduction of smoke, and next with the metropolitan parochial authorities and public bodies, directing their attention to the serious and increasing evil, and asking their co-operation in abating it." Public meetings were held at the Mansion House and other places in different parts of London; and the public interest in the subject appearing to be sufficient to justify such an experiment, the Committee determined to hold an exhibition of appliances for the reduction of smoke both in manufacturing and domestic fires.

The idea entertained by the promoters of the Exhibition has been that, in order to effect a reduction in the quantity of smoke poured out of chimneys of different kinds in large towns, it was first necessary to convince people that appliances exist which will tend to this result, and it was therefore determined to invite an exhibition of smokeless fuels, and apparatus for burning them, as well as of appliances for lessening the amount of smoke given off by bituminous coal. The call has been very readily responded to, and the catalogue shows a list of over 230 exhibitors.

Tests are being made by experts of the performances of the different apparatus, which, in the case of the domestic grates, &c., are carried out in specially constructed rooms; the fumes passing up the chimneys being carefully examined to determine the quantities of carbon (other than carbonic acid) and other unconsumed matter passing away from the fire; the consumption of fuel and the temperatures maintained being also carefully noted. A jury has been appointed to award prizes, medals, &c. to those appliances which they consider best adapted to fulfil the purposes in view.

The Exhibition is naturally divided into two great divisions: appliances for trade purposes, and those for domestic purposes. In the first division the economic use of gas instead of solid fuel is illustrated in a small kiln for burning pottery and glass, and its use, instead of steam, is shown in several different kinds of gas-engines. The means of producing steam, however, occupies the principal place in this division. Several mechanical stokers and other appliances for firing boilers, so as to produce no visible smoke, are shown, and those which are at work demonstrate that—at least after steam has once been got up—it is easy to raise any quantity of steam without the production of smoke at the top of the chimney. Moreover, as these appliances are stated, on apparently good authority, to effect an economy in the expense of raising steam, it is to be hoped that their adoption is rapidly becoming general.

It is with the second division, however, that most individuals are more particularly interested, and it is from fires of this kind that the bulk of the smoke is produced, at all events in the west end of London.

Domestic fires, again, may be divided into two classes, those for cooking and those for warming rooms. It is with the latter that we propose to deal in this article. And first we will consider what it is that we want in our living rooms. We are strongly of the same opinion as Sir F. Bramwell, that we must have an "open, pokeable, companionable fire."

We believe that the value of an open fire for warming living rooms cannot be too strongly insisted on; Dr. C. W. Siemens has lately pointed out why a room in which the air is comparatively cool, and the walls, furniture, &c., are warmed by rays from the fire, as is the case when an open fire is used, is so much more pleasant and healthy than one in which the air is warmed by contact with hot surfaces of the stove or heating apparatus, and the walls, furniture, &c., are at a lower temperature, and we believe it is to the use of open fireplaces that the general freshness of complexion of the inhabitants of these islands, and the absence of the use of spectacles among the young, are in a very large measure to be attributed.

One disadvantage in open fires, which has been much dwelt upon—the waste of fuel—is we believe considerably exaggerated. Doubtless a small proportion of the coal used in an open fire-place would be sufficient to maintain the temperature of a room if a close stove were used. But is the rest so entirely wasted as some would have us believe? The greater part of the heat, as they say, "goes up the chimney." Is it therefore wasted? We think not. It performs work in ventilating the room, and it is at least doubtful whether in an ordinary dwelling room the same quantity of vitiated air could be removed (and therefore the same quantity of fresh air be introduced) as cheaply and conveniently by any other means; at all events, the so-called "waste heat" could not be made use of to any large extent as radiant heat, and open grates are shown in the exhibition in which a part is utilised in warming air for admission to the room, or heating water-pipes, &c.

The problem of how to have an open fire without smoke, or with considerably less smoke than we have at present, is one towards the solution of which we hope this exhibition will give valuable assistance. Fires are shown in which gas, coke, these two together, anthracite, or Welsh coal, and bituminous coal, respectively are the fuel. Several different kinds, both of gas stoves and open gas fires are shown. There seems to be no novelty in any of them, and we believe that they are generally so well known as to need no description here; they have the merit of being extremely handy and cleanly; they are not "pokeable" nor very "companionable," and we are afraid that the very unpleasant fumes of burnt gas—caused, we suppose, by so many of the gas fires shown not being provided with flues—which pervade this portion of the exhibition when the gas apparatus is shown, must prejudice visitors very much against the use of these very valuable appliances.

Dr. Siemens' coke and gas fire, which has been so recently described in these columns, is shown by several exhibitors. It is necessarily free from visible smoke, and almost so from dirt and dust, and it is very manageable; that is to say, by altering the supply of gas the heat may be easily and quickly regulated. How far it is free from the noxious fumes which usually seem to accompany the combustion of coke or smokeless coal in a room cannot be judged in the exhibition.

The same remark applies to the many grates shown for burning anthracite and smokeless coal. Many of these look very nice; a bright, hot fire is obtained which almost comes up to Sir F. Bramwell's standard. It seems to us, however, that anthracite fires are not very manageable; the fire must burn at one rate, and the fuel must be supplied accordingly; you cannot quickly get up a hotter fire by the use of a poker, as is so easy with bituminous coal, nor can you so easily reduce the fierceness of the fire as can be done with so many grates in which bituminous coal is burnt. The absence of smoke is, however, a very great advantage, and unless this can be attained, or nearly so, with bituminous coal, we ought to be prepared to give up the luxury of its use.

There are two methods by which it appears possible to reduce very considerably, if not to prevent entirely, the production of smoke in domestic grates. One is to supply the coal to the fire in such a way that the smoke and gases escaping from the portion last supplied may pass through the live coals and so be consumed; the other is to introduce a draught of hot air at the top of the fire, there to meet and consume the smoke and gases given off by the newly-supplied coal.

Dr. Arnott's stove is a type of the first method. In it the coal for the day's use is put into a box underneath the grate, which latter has no bottom; by means of a lever the bottom of the box is raised, and fresh coal pushed into the fire as required. There is thus no escape for the gases given off by the fresh coal but through the hot part of the fire. These stoves, however, have never come into very common use. We believe that they are not found to be pleasant in a room, and that the reason of this is that although little or no smoke is given off, there is not sufficient air admitted to the fire to burn the carbonic oxide produced, the grate being closed at the bottom, sides, and back, and the front being narrow. No stove of exactly this description is shown in the exhibition, though there are several in which the principle for getting rid of the smoke is adopted. Messrs. Brown and Green, of Luton, Bedfordshire, show a register stove for bituminous coal (and a kitchen range on the same principle), in which the coal is supplied to the fire by a kind of trough or shallow hopper placed in front of the bottom bars, from which the coal can be pushed into the fire, to facilitate which operation the bottom of the grate is made to slope upwards towards the back. Mr. Engert places a box for the fuel at the back of the grate. This box has a sliding back worked by a screw underneath, by which means the fuel is pushed forward into the fire as required. He thus secures a wide front for his fire, and less depth of live coal than in Dr. Arnott's stove. By means of a kind of baffle plate hung at the back of the grate the gases issuing from the coal-box are deflected into the fire instead of going up the chimney. The coal-box can be recharged if necessary without actually putting out the fire. It appears possible to adopt this arrangement to an existing grate of ordinary form at comparatively small expense.

Messrs. Martin and Co. seek to attain the same object by having movable cheeks to the grate, which work horizontally inwards by levers. The coal being put on at the sides is gradually pushed in by this means towards the more active part of the fire. The back plate of the grate has a space behind, and is perforated in the centre so that heated air is thus admitted at the centre of the back of the fire to assist in the combustion.

Thompson's patent consists in having the front of the grate made so as to slide upwards a few inches. The bottom of the grate consists of a plate of iron and is fixed. For the purpose of putting on fresh coals a tool is used consisting of a sheet of iron of the same shape and size as the bottom of the grate, hinged to a rod somewhat like an ordinary poker at a distance from its end equal to the height from the hearthstone to which the front of the grate rises. The iron plate being pushed in between the coals and the bottom of the grate with the rod in an inclined position, the handle of the latter is pushed forwards, the whole body of the fire and the front bars are thus lifted a few inches, and the fresh coal is put in between the two plates; the implement being withdrawn, the front of the grate falls again to its proper place, and the live coals come in immediate contact with the fresh coal underneath it. The back of the grate is perforated, so as to admit heated air to the fire. This arrangement could probably be adapted to many existing grates, without very great expense.

Saxon Snell's patent consists of a cylindrical grate mounted on a very strong horizontal pivot at the back, and in the line of its axis. At opposite sides of the perpihery are two grated doors which are hinged to the back edge of the grate; the uppermost one is opened, and lies back against the chimney-back. When fresh coal has been put on, the upper door is shut and fastened, and the grate turned half round, so as to bring the other door to the top, and the live coal above the fresh coal. We believe that the combustion in this grate would be improved by some holes in the back through which heated air might be admitted near the top of the fire, and these could easily be made.

The grate shown by E. R. Hollands, of Newington Green, is rather more complicated than some of those which we have described; but its performance appears to be good. A movable set of bars fit in between the fixed bottom bars of the grate; and the lower part of the front is made to open forwards and downwards. A neatly-devised motion worked by a lever at the side of the fire-place raises the movable bottom bars, and with them the fire, and opens the lower part of the front, the fresh coal being then placed between the two sets of bars, the return of the lever to its place causes the front of the grate to shut and the movable bottom bars first to recede through the back, and then, having fallen below the level of the fixed bars, to come forward and up again into their original place. The back of this grate is hollow and is pierced with small holes at about the level of the top of the fire. The combustion effected by the hot air passing througb these holes is clearly visible.

In the slow combustion grate of Fredk. Edwards and Son, which is shown in action, the "Arnott" principle is made use of, but instead of the bottom being movable, a counterbalanced shutter works vertically in front of the grate, which is very deep. The latter being filled and the fire lighted from the top, the shutter is adjusted from time to time, so as to obtain the requisite amount of fire, by exposing more or less of the front of the grate.

Messrs. Musgrave and Co., of Belfast, besides several of their well-known "slow-combustion" stoves, show a fire-place which they call the "Ulster." In this the coal is fed into the back of the fire from a hopper placed behind the chimney-back, in which is a close-fitting door for closing the opening through which the hopper is filled. The coal is pushed forward into the fire by an arrangement worked by a lever at the side of the grate. The coal is thus coked before it comes into the fire, the only escape for the gases being through the glowing coals. Somewhat similar in some respects to this is the "Wonderful" grate of Archibald Smith and Stevens. In this the fireplace is closed by an iron plate, in which are three rectangular openings one above the other. To the lowest, which is about the floor-level, the grate is fitted; this, made of a basket shape, can be mounted on a pivot in the plane of the plate, so that more or less of the grate may project into the room. Between the top hole in the plate and the upper half of the bottom hole is a flat-sided tube, which curves backwards into the fireplace. This is the hopper for the fuel; it is shut at the top by a close-fitting door, and the curved shape causes the fuel to descend easily into the fire. The centre opening of the plate is provided with a register door, and in some instances is covered with a hood. The arrangement of the hopper causes the gases evolved by the fresh coal to pass through more or less of the live coal before they can escape, and by closing the centre opening the whole draught is made to go down through the lower half of the bottom opening, causing a rapid combustion. Four of these grates are shown in action, with different sorts of fuel. They seem to require little or no attention for hours together, as the feeding arrangement appears to act well.

A grate of the pattern which has been in use in barracks for the last two or three and twenty years is exhibited. This grate was devised by Capt. Douglas Galton. It consists of a cast-iron stove, entirely open in front, which is fitted to the chimney opening, leaving a considerable space between the stove and the brickwork at the back. Into this space air is admitted from the outside of the building. From the top of the fireplace recess proceed two flues; one, the ordinary chimney-flue, receives the covered smoke pipe from the stove, the other delivers into the room through a lowered opening a little below the ceiling level, the air which has been warmed in the chamber behind the stove, the back of which has iron plates projecting from it, so as to increase the heating surface. The cast-iron stove is entirely lined with fire-brick, in the manner to be described, so that the air does not get unduly heated.

A little above the level of the fire the stove is gathered in towards the room so as to form a kind of baffle. The actual grate is formed as follows:—two fire lumps are placed on the hearthstone with a space between them of six inches or so, over which is a cast iron grid; the cheeks and back, all of fire-brick, rest on these first lumps; another lump of fire-brick of curved section underneath fits on the top of the back and cheeks, and underneath the gathered in part of the stove. Between the back fire-lump and the iron back is a space, and there is also a small opening between the back piece and the top piece, through which air heated at the back plays on the top of the fire and helps to consume the smoke. This stove is, we understand, found to be very economical in action, and is very highly spoken of in the work of the late General Morin on Heating and Ventilating. It will not, however, be tested in this Exhibition, as it is not shown in competition.

Messrs. Barnard and Bishop, of Norwich, have pushed the "baffle" principle still farther in their "glow" stove. Instead of coming only about half over the fire as in the Galton grate, the baffle consists of a fire-brick which projects nearly to the plane of the front bars of the grate, and slopes down slightly towards the front. The bottom of the grate, which slopes upwards, and the back which slopes backwards, are made of fire-brick in one piece, the front bars being the only ironwork about the grate. A flue which goes up behind the back opens to the fire just under the back edge of the baffle, the space under which and over the fire is thus converted into a combustion chamber in which the gases from the coals are burnt, and as these have to pass over the front of the baffle before going up the chimney the radiant heat from them comes into the room.

Several grates are shown by different makers, in which the combustion of the gases is accomplished with a down draught. But in these cases the radiant heat evolved in the process cannot come into the room directly, as it does in the case of the "glow," it is therefore lost in the case of a grate set in a fireplace unless it be utilised to heat air which is admitted to the room. A small open-fronted stove on this principle is shown by Mr. T. E. Parker, in which the combustion appears to be very perfect. The internal arrangement is too complicated to describe without a drawing, but the essential point is that the draught from the fire is led away at the back of the bottom of the grate into a flue lined with fire-brick, where it meets a draught of fresh air which has been warmed by contact with the underside of a ribbed plate which forms the bottom of the grate.

Several examples of grates with down draught and chambers for heating air to be admitted to the room are to be found in the exhibition, as well as some in which the heating chamber or flues are applied to grates with ordinary up-draught. The warm air inlets are usually placed close to the fire, which is, in our opinion, a mistake, as the general circulation of air in the room is not so much promoted by this arrangement as when the inlets are at some distance from the fire; there are, however, difficulties in so placing them in an ordinary living-room.

A stove of a peculiar, and we believe quite novel, construction is shown by Mr. James B. Petter. The recess of the fireplace is lined with white marble; in each jamb is a circular hole from which a pipe leads round to the chimney. The fire-box is mounted on legs with castors, so that it can easily be rolled in or out of the fireplace, and is provided with horizontal exit flue pipes at the sides which are connected with the openings in the jambs by sliding pieces. A vertical section of the fire-box from front to back is of open spiral or Nautilus form. The box is made of iron and lined with fire-brick from the lip to the top of the back, there being no bars either in the front or bottom. The coal is put on thinly at the lip, and gradually pushed back, as in stoking a steam-boiler. A rather sharp draught is produced over the red hot fuel towards the back, and the convolution of the box appears to form a kind of combustion chamber. It would seem that the difficulty of lighting the fire would be considerable, but it appears to work well.

We have endeavoured in this notice to give a slight sketch of such grates, &c., as present any salient features. We may have overlooked some which were deserving of notice, but we would earnestly recommend our readers to pay a visit to this very interesting exhibition, and to form their own opinion of the merits of the various apparatus shown.

We may mention that representatives have been accredited to the Exhibition by the Governments of Austria-Hungary, France, Prussia, Saxony, and the United States; and that the interest taken in it has encouraged the Committee to entertain the idea of holding an International Exhibition in about three years' time of such further developments of smoke-abating appliances as may be produced either in this or other countries during the interval.

THE CHEMISTRY OF THE PLANTÉ AND FAURE ACCUMULATORS

PART I.—*Local Action*

AMONG the important discoveries of late years, few have claimed so much attention, or have been so full of promise for practical use, as the accumulator of

Planté and its modifications. Our attention was very naturally directed to the chemical changes that take place in these batteries, especially as it appeared to us that there must be certain analogies between them and some actions which we had previously investigated. In the present communication we propose to treat merely of one point—that of local action, leaving the fuller discussion of the subject to some future occasion.

It is well known that metallic zinc will not decompose water even at 100° C., but we found that zinc, on which copper had been deposited in a spongy condition, was capable of splitting up the molecule even at the ordinary temperature, oxide of zinc being formed and hydrogen liberated. If placed in dilute sulphuric acid, it started a very violent chemical action, sulphate of zinc and hydrogen gas being the result. We termed the two metals thus conjoined, the *copper-zinc couple*, and this agent was fruitful in our hands in bringing about other chemical changes which neither metal singly would effect. Electricians will readily understand the nature of this agent, and will recognise in its effects only a magnified form of what we are all familiar with under the name of *local action*. Now the negative plate of a Planté secondary battery is a sheet of lead, upon which finely-divided peroxide of lead is distributed. It is well known that the electromotive force of lead and lead peroxide in dilute sulphuric acid is nearly three times that of zinc and copper in the same liquid. We were therefore induced to think that the plate must act in the same way as our copper-zinc couple. We found such to be the case. If a plate so prepared be immersed in pure water, the decomposition of the liquid manifests itself by the reduction of the puce-coloured peroxide to the yellow monoxide. There could be little doubt therefore that the lead peroxide couple, if we may call it so, would decompose sulphuric acid, with the production of sulphate of lead. This also was found to be the case.

As the destruction of peroxide of lead means so much diminution of the amount of electric energy, it became interesting to obtain some definite knowledge as to the rapidity or extent of this action.

When the peroxide of lead on the metal is very small in quantity, its transformation into the white sulphate goes on perceptibly to the eye, but when the coating is thicker, the time required is, as might be expected, too long for this kind of observation. In one experiment, following the procedure of Planté, we formed the peroxide on the plate by a series of seventeen charges and discharges, or reversals, each operation lasting twenty minutes, and the time was further broken up by seven periods of repose, averaging about twenty-four hours in length. After the last charge we watched the local action taking place, and found that the whole of the peroxide passed into white sulphate within seventeen hours. In another experiment the two plates formed according to Planté's method were immediately joined up with the galvanometer, and the deflection noted. They were then at once disconnected. After the repose of one hour they were joined up again, and another observation taken with the galvanometer. This was repeated several times, with the following results:—

Initial strength of current	100
After 1 hour's repose	97
,, 2 ,, ...	40
,, 4 ,, ...	14
,, 17 ,, ...	1·5

It results from this that during each of the long periods of repose recommended by Planté the peroxide on the lead plate is wholly, or almost wholly, destroyed by local action, with the formation of a proportionate amount of sulphate. But this is not, as it would seem at first sight, a useless procedure; for, in the next stage, the sulphate is reduced by electrolytic hydrogen, and, by a process which we hope to explain when discussing the complete history of the reaction, the amount of finely divided lead capable of being peroxidised is increased. That this is actually the case is shown by the following experiment. The peroxide formed on a lead plate by first charging was determined and called unity: it was allowed to remain in a state of repose for eighteen hours, charged a second time, the peroxide again determined, and so on:—

Separate periods of repose.	Charge.	Amount of peroxide.
—	First	1·0
18 hours	Second	1·57
2 days	Third	1·71
4 ,, ...	Fourth	2·14
2 ,, ...	Fifth	2·43

In other trials, following the procedure of Faure, we employed plates in which the peroxide was formed by the reduction of a layer of red lead (containing 51 grains to one square inch of metallic surface) and subsequently completely peroxidising the spongy metal so produced. In one series of experiments we left the peroxidised plates to themselves for various periods and determined the amount of sulphate formed. This gave us the amount of peroxide consumed.

Experiment I.	after 2 hours	7·2	per cent.
,, II.	,, 3 ,,	15·1	,,
,, III.	,, 4 ,,	19·8	,,
,, IV.	,, 5 ,,	30·0	,,
,, V.	,, 24 ,,	36·3	,,
,, VI.	,, 7 days	58·3	,,
,, VII.	,, 11 ,,	67·3	,,
,, VIII.	,, 12 ,,	74·3	,,

The last experiment was tested with the galvanometer during its continuance, as in the case of the plate formed by Planté's method, with the following results:—

Initial strength of current	100
After 1 days' repose	92
,, 3 ,, ,, ...	79
,, 4 ,, ,, ...	34
,, 5 ,, ,, ...	24
,, 7 ,, ,, ...	11
,, 9 ,, ,, ...	8
,, 12 ,, ,, ...	1

It is evident from these observations that a lead-peroxide plate gradually loses its energy by local action, and that the rate varies according to the circumstances of its preparation.

Two difficulties will probably present themselves to any one on first grasping the idea of this local action:—1. Why should a lead plate covered with the peroxide and immersed in dilute sulphuric acid, run down so slowly that it requires many hours or even days before its energy is so seriously reduced as to impair its value for practical purposes? In the case of the copper-zinc couple immersed in the same acid, though the difference of potential is not so great, a similar amount of chemical change would take place in a few minutes. 2. In a Planté or Faure battery the mass of peroxide which is in contact with the metallic lead plate expends its energy slowly. How comes it to pass that if the same mass of peroxide be brought into connection through the first lead plate with another lead plate at a distance, it expends its energy through the greater length of sulphuric acid in a tenth or a hundredth part of the time?

The answer to these two questions is doubtless to be found in the formation of the insoluble sulphate of lead, which clogs up the interstices of the peroxide and after a while forms an almost impermeable coating of high resistance between it and the first metallic plate.

The following conclusions seem warranted by the above observations:—

In the Planté or Faure battery local action necessarily takes place on the negative plate, with the production of sulphate of lead.

The formation of this sulphate of lead is absolutely requisite in order that the charge should be retained for a sufficient time to be practically available.

The rapidity of loss during repose will depend upon the closeness of the sulphate of lead and perhaps upon other mechanical conditions. These are doubtless susceptible of great modifications. We do not know how far they are modified in practice, but it is conceivable that still greater improvements may yet be made in this direction.

J. H. GLADSTONE
ALFRED TRIBE

STEUDEL'S NOMENCLATOR

ALL working systematic botanists use Steudel's "Nomenclator botanicus seu Synonymia plantarum universalis" as an indispensable book of reference. It is an alphabetical list arranged under genera of published names of plants, giving their native countries and the authors who published their descriptions. Synonyms are as far as possible given under the species to which they belong. The second volume of Steudel's work was published in 1841, and it is probably not far wrong to assume that the existing mass of described plants has since doubled.

Mr. Darwin has with equal kindness and generosity expressed the wish to aid in some way the scientific work carried on at the Royal Gardens, Kew. The attempt has been made for many years to keep up in the herbarium there a copy of Steudel with manuscript additions, for the use of persons engaged in the study of any particular group of flowering plants. By reference to the Kew Steudel it is possible to ascertain to a large extent what has been done, and so avoid the risk of describing and naming the same material twice over. But the Kew Steudel has only hitherto been posted up by the aid of funds privately supplied on intermittent occasions, and is not absolutely complete.

Mr. Darwin having had occasion to appreciate the usefulness of such a work in the botanical investigations which have of late years engaged his attention, has determined to supply the funds for preparing a new edition of Steudel's "Nomenclator," brought up to date. The work, which it is estimated will extend over about six years, will be carried on at Kew, and will be based on the limitations of genera laid down in Bentham and Hooker's "Genera Plantarum," to which it will in fact form a kind of complement. The editorial work has been entrusted to Mr. Daydon Jackson, Secretary of the Linnean Society. Mr. Darwin's munificent aid does not extend beyond supplying the means for preparing the work. The form and manner of publication will be reserved for consideration on its completion.

The Royal Gardens, Kew, have been very fortunate in from time to time receiving sympathetic aid from the outside world on behalf of the various branches of scientific work carried on in connection with them. The gifts of Mr. Bentham's library and herbarium, of the Jodrell Laboratory, of the North Gallery, and now of the means of preparing a new Steudel, are conspicuous examples.

FIRE RISKS OF ELECTRIC LIGHTING

IN an article published originally in the United States, and reprinted in our contemporary, the *Chemical News*, Prof. Henry Morton has called attention to the risks to which property is exposed from the increasing employment of powerful currents of electricity for electric lighting. The caution and the remedies suggested are assuredly timely when preparations are being made on so many hands for a vast extension of electric lighting. No fewer than five times did fire break out in the late Paris Exhibition, and in each of these cases the cause was the same, namely, defective insulation of the conducting wires. Prof. Morton divides the dangers into two kinds—those arising from the conductors, and those arising from the lamps. When naked wires are used as conductors, and when both are, as is sometimes the case, merely nailed or stapled to wall or floor side by side, there is a great chance that some stray scrap of wire, a falling nail or pin, may short-circuit the line and become red-hot in an instant. Loose wires are again a source of danger, as they may be momentarily short-circuited, and arcs set up of a dangerous nature at the point of contact. These remarks are specially cogent in such cases as those where many arc lights are being worked on a single circuit, and where there is of necessity a very high electromotive force employed. On such circuits, moreover, should some of the arcs go out, there is a risk of the others becoming excessive in power, risking the metalwork of the lamps, and thereby endangering a conflagration. Moreover, the lamps themselves are not free from danger, if so constructed that fragments of red-hot carbon can fall from them, as was the case not many months ago with one of the Siemens' lamps in the reading-room of the British Museum.

As a remedy to diminish such risks, Prof. Morton makes the following recommendations, every one of which we can heartily indorse. Firstly, that both the conductors—the outgoing main and the return wire as well—should be completely insulated; and that the machines and fixtures of the lamps should also be insulated, so far as regards all ground connections. Secondly, that the outgoing and return wires, instead of being laid side by side, should be separated as widely as possible. And he also recommends that, in the case of arc lamps in series, there should be automatic adjustments, to short-circuit a part of the current in case the arc in the lamp becomes too powerful, and to diminish the electromotive force of the generators in proportion to the actual resistances in circuit. Even on those systems of electric lighting which apply the principle of incandescence, where the electromotive forces employed are, as a rule, smaller than with arc lighting, there is need of caution. And one cannot too highly admire the ingenious device with which Mr. Edison has met most of the possible obtions beforehand, by interposing automatic "cut-off" joints of lead wire at every branch of the ramified circuit of his system of supply; the thickness of the wire being adjusted according to the circumstances of each case. It would be well for Fire Insurance Companies to lose no time in laying down a code of reasonable conditions to be complied with in case of buildings lit by electric lights. Without such precautionary conditions electric lighting is at least as unsafe as lighting by gas, and that is saying a good deal. But where proper precautions are taken, we think it should be a far safer mode of lighting; and should be recognised as such by the imposition of a lower insurance premium than is fixed in the case of lighting by gas.

THE MARKINGS ON JUPITER

DURING the present winter months Jupiter will doubtless attract a large amount of attention from the possessors of telescopes. Displaying a large and varied extent of detail clearly indicating that atmospheric phenomena of stupendous character are in progress on his surface, this planet at once claims notice on account of the ease with which his chief features may be discerned, and their singular anomalies of motion and appearance made manifest.

The large red spot situated immediately south of the great southern belt, and lying parallel with it, continues to present a well-defined boundary, indeed we must attribute to this remarkable formation a good deal of the interest which has been accorded to this planet since the first apparition of the spot in the summer of 1878.

It has now been visible for a period exceeding three years, and its conspicuous and decided aspect as it nightly crosses the central meridian of Jupiter, sufficiently predicates that its existence is likely to be prolonged a considerable time yet. The spot is elliptical in form with tapering ends; it occupies about fifty-five minutes in its entire transit over the centre of the illuminated disc. No distinct alteration in its appearance has been recorded during the last two years. Minor changes have probably occurred, though too minute to be appreciable, for when we consider the perpetual state of commotion under which the other markings exist, we cannot regard this particular object as absolutely free from similar influences, though they may have hitherto eluded detection. One of the most recent measures of the spot give it a length of 29,000 miles, and a breadth of 8,300, so that the length is to the breadth as 7 to 2.

The telescopic history of this planet contains many instances of fairly persistent spots having been observed and utilised as a ready means of determining the period of the planet's rotation. But the records of former years can furnish no parallel to the extent and accuracy of the modern observations. The old observers were in a measure isolated, and their work often lacked corroboration. Circumstances are now changed entirely. Observers have become far more numerous, astronomical appliances have been greatly improved, and the science has become more popular with increased facilities, so that where one powerful telescope was found half a century ago, there are at least ten at the present day. The result is that all attractive phenomena, such as planetary markings, are eagerly watched and recorded, so that interesting comparisons and confirmations, impossible in former times, are often the natural outcome. In regard to the large spot on Jupiter it is certain that no previous observations can vie with it either in completeness or precision, and it must obviously supply the data for determining the rotation period of Jupiter with a degree of reliance beyond all parallel.

Proper motion in the spot itself originates a slight difficulty in adopting a period to satisfy the observations, and there is no doubt that similar independent movements in the objects observed were the cause of the differences in the periods assigned by various former authorities for the rotation which has varied from 9h. 49m. to 9h. 56m., and in truth it is doubtful whether we shall ever obtain the means of deriving the value with conclusive satisfaction. We can of course compute with nicety the periods of individual markings, but different ones have different periods. It is doubtful whether we can select the markings which are representative of the real period, for the spots are evidently influenced by a series of atmospheric currents which displace their relative positions on the disc in a very short interval of time. In the case of the great red spot, it has been surmised from its permanence and regularity of apparition that it very nearly represents the true rotating period of the planet's sphere, and it is gratifying to note that this element has been determined by several observers with excellent corroboration as follows:—

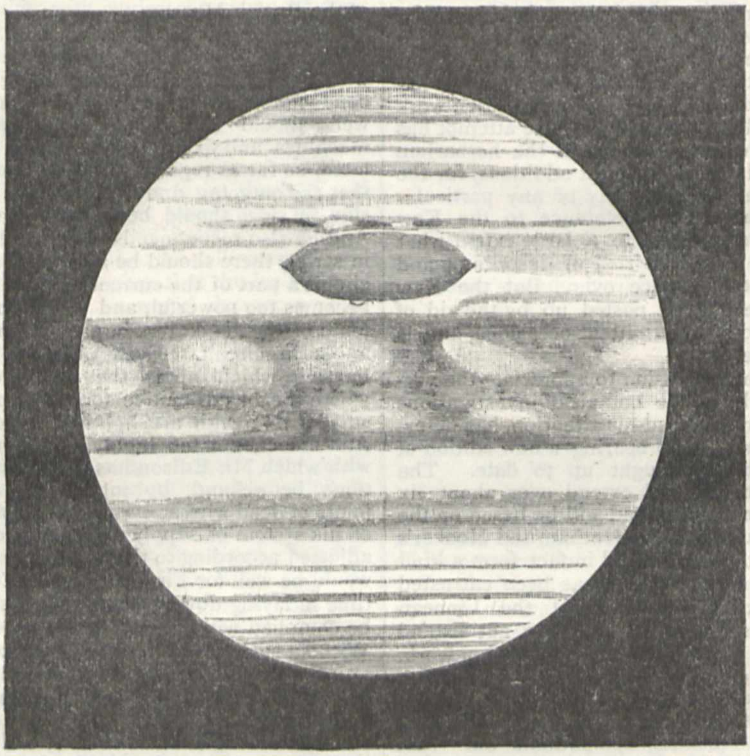

FIG. 1.—The great red spot in Transit, December 7, 1881, 10h. 40m. There was a large white patch near the equator under the following side of the red spot. Immediately south of the red spot is a narrow belt with light and dark ovals upon it.

	h. m. s.	
Prof. G. W. Hough	9 55 35·2,	Sept. 79 to Jan. 27, 1881
A. Marth	9 55 34·47,	1878–81
J. F. J. Schmidt ...	9 55 34·42,	1879–80
H. Pratt...	9 55 33·91,	1879, July to December

These values are all within one second of the mean =9h. 55m. 34·5s. Several observers have remarked that the motion of the spot has slackened somewhat since 1879.

Turning now to the equatorial region of Jupiter, we shall find here not only a large extent of detail, but marked evidences of great and rapid changes. Immediately north and south of the equator there is a very well-defined dark belt, and between these are a series of curious irregular shadings interspersed with brilliant white spots and light patches, which seem to be influenced by some abnormal phenomena. Watched from night to night, and their relative positions carefully determined, they are seen to vary considerably, and to travel much swifter than the red spot. The bright spots, which generally lie very slightly south of the equator and on the north border of the great south belt, are influenced by a rapid proper motion on the surface of the planet. In a single rotation of Jupiter they are displaced relatively to the red spot, to the extent of $3\frac{1}{4}°$, their period being $5\frac{1}{2}$ minutes less. In 1880 these white and generally oval spots were observed with a good deal of attention, and in a few marked cases the times of rotation were derived as follows:—

	h.	m.	s.
J. F. J. Schmidt	9	50	0
A. Marth	9	50	6·6
Prof. G. W. Hough	9	50	0·56
" "	9	50	9·8
W. F. Denning	9	50	5

One bright spot in particular arrested attention as the most conspicuous of its class, and this object continues visible at the present time. Its independent motion enables it to make a complete circuit of Jupiter, relatively to the red spot, in $44\frac{1}{2}$ days. One of the most interesting points of observation is to note the changes in the relative positions of the spots on successive nights, and to watch the bright equatorial markings as they overtake and pass the red spot. In four days the white spots traverse an equivalent extent of longitude to that covered by the red spot, so that during this interval they travel from the *f.* end to the *p.* end of the latter object. The independent motion of the equatorial markings is the same in direction as that of the satellites and of the planet on its axis, namely, from west to east.

In the southern hemisphere of Jupiter there are several narrow dusky bands outlying the red spot, and a few dusky streaks or short belts of distinct form are manifest. In the north hemisphere there is a conspicuous double belt in about lat. 25°; the south side of this belt was

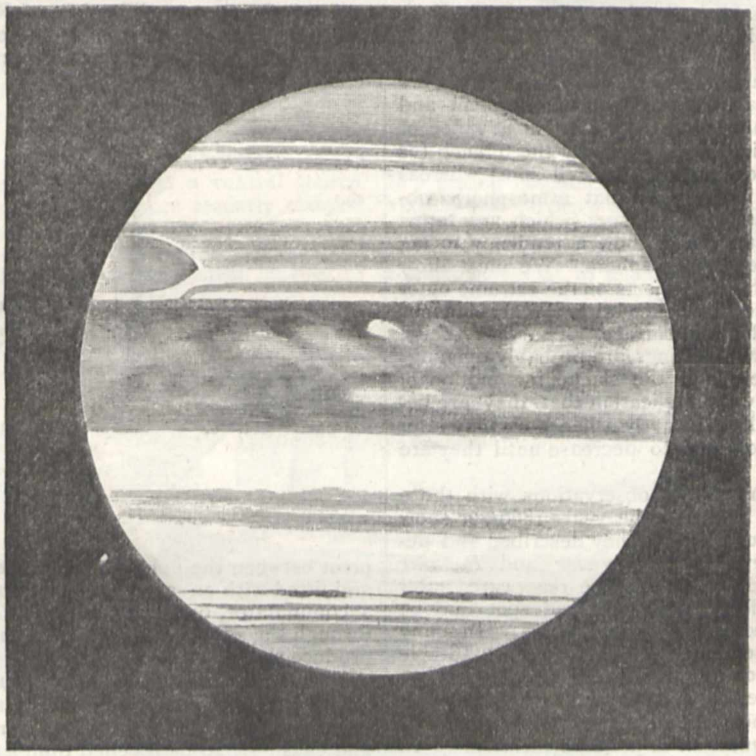

FIG. 2.—The bright spot in transit, December 18, 1881, 6h. 12m. The following side of the red spot is seen on the western limb. To the east of the light spot, and in nearly the same latitude, is a dark mass emerging from the great southern belt.

formed by the outbreak and subsequent rapid development and dispersion of a series of dark spots during the months of October, November, and December, 1880. At first appearing as well-defined and almost as plain as the shadows of satellites in transit, they increased in numbers, or became greatly extended longitudinally, but gradually lost their decided character until they were eventually dispersed around the planet, and formed a dusky girdle considerably north of the equator. In fact the formation of a new belt on Jupiter had been going on under the eyes of observers.

As to the bright equatorial spot, it came to conjunction with the red spot on November 10, 1881, and the same objects were noted in conjunction on November 19, 1880, at 9h. 23m.. when crossing the central meridian of Jupiter. In the meantime the behaviour of the two objects has been very remarkable, for the red spot during the interval of 356 days has performed 861 rotations, while the light spot has completed 869, and has in fact travelled round the sphere of Jupiter eight times relatively to the position of the red spot! The two objects were again observed in the same longitude on December 24, 1881, at 9h. 43., having completed 967 and 976 rotations respectively. The next two conjunctions will occur on February 6, 1882, and March 23, 1882, after which they will not be well seen until the ensuing summer, when Jupiter again becomes visible in the morning sky, and the two spots, should they continue to be presented on the disc of the planet, will occupy nearly the same longitude on August 3, September 17, October 31, and December 14, 1882.

The diameter of the white spot is very variable, sometimes it is fully 2″, which corresponds to more than 4600 miles, but it is occasionally much contracted by encroachments of the dark masses on the great northern belt. The spot is also liable to become very faint. I have carefully noted these variations, and though the observations are not sufficiently full to determine the period, if any, they show that the spot becomes faint almost to invisibility at intervals of about 56 days, and that increased brightness of the spot is accompanied with accelerated motion. I believe this particular object is a permanent feature on the planet, and that it lies far below the level of the dusky belts. Mr. Marth has determined from a discussion of the observations of 1880 and 1881 (to November) that the mean motion of the spot has been uniform, and this is important as a proof of its stability. My own numerous observations have led me to conclude that:—

1. It is self-luminous and light-emitting.
2. That it is a part of, or projection from, the actual surface of the planet.
3. That therefore it indicates the real rotation period of Jupiter, which is 9h. 50m. 6·6s. (= daily rate 878°·48), as deduced by Mr. Marth. The motion of the red spot shows a decided slackening, so that we cannot accept it as a reliable and invariable indication of the motion of the Jovian sphere with which probably it has no material connection.

These conclusions are supported by the fact that we cannot admit the idea of an object as permanent and conspicuous as the white spot, rushing on in advance of the already swift axial movement of the planet (as computed from the positions of the red spot) whereas we can more readily understand that atmospheric objects, such as the belts and red spot (which are forms of identical phenomena), would show a tendency to lag behind the rapid motion of the sphere. We must allow that there will be a failure of objects on the extreme outer envelopes of Jupiter, to keep pace with the tremendous velocity of objects on his real surface. The dusky belts, the red spot, and similar markings, are probably openings in the Jovian atmosphere, and the slackening motion of these objects is simply the indication that they are becoming more shallow than formerly, whence we may infer that the motion will continue to decrease until they are finally dissipated.

A comparison of my recent observations with those made by Gledhill and Welb in the years 1869-72, show that many of the features which they described and delineated (in the *Astronomical Register* and *Popular Science Review*) are still visible or have reappeared after an interval of obscuration. The great red spot may be the same object as Gledhill's ellipse of 1869-71. In many of the details visible then and now there is a remarkable similarity both in aspect and position, and the observers of Jupiter should further carefully investigate the physical appearance of the planet with a view to obtain more distinct evidence on the question of periodic variations. In this connection I may quote a remark by the late Mr. Lassell (*Monthly Notices*, vol. xxxiv. p. 310), where, in referring to round light spots he saw on Jupiter in March, 1850, and March, 1874, he says: "I believe the appearance of these spots is very rare, as I have not seen them for many years, and the general similarity of the aspect of the planet now [1874] and then [1850] suggests the idea that the various phases return in cycles, which I think more probable than that absolute secular changes occur in the heavenly bodies within the limit of time of any human records."

W. F. DENNING

LITTLE ELECTROMOTORS

THE probability that within a few months almost every large town and city will be supplied with electricity on a large scale for the purpose of lighting, has brought into prominence the question of utilising the same supply for the purpose of producing power on a small scale for sundry domestic purposes. There are a number of objects for which machinery is employed, though on so small a scale that it would not be worth while to set up a steam-engine or gas-engine to drive it, to say nothing of the inconvenience of a steam- or gas-engine in a private house. To drive a sewing-machine, for example, or to work a light turning-lathe, requires a comparatively small power, and usually only for a limited time. It is natural then to think that when the power of electricity is available in the wires which supply electric light, such a power, especially as it is so simply and readily controlled, might be economically employed for such purposes.

But to drive machinery by electric currents necessitates the employment of the appropriate electric engine or "electromotor," which, as its name implies, is an engine which, by the expenditure of electrical energy, does mechanical work. Such engines have been known since 1831, when Prof. Henry first constructed a rotating engine driven by electromagnets. Ritchie, in 1833, independently constructed an electromagnetic apparatus for producing continuous rotation. Fig. 1, which we borrow from Prof. S. Thompson's "Lessons in Electricity and Magnetism," shows a modification of Ritchie's electromotor frequently found in collections of electrical apparatus. It consists simply of an electromagnet, C D, poised upon a

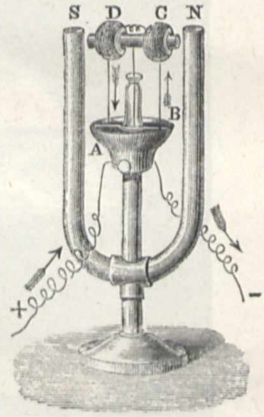

FIG. 1.

pivot between the poles, N S, of a steel horseshoe magnet, and fitted with an arrangement of mercury cups, A B, as a commutator, by means of which the current arriving through the wires is so directed through the coil as to produce motions, in one sense, only round the axis. The pole C of the electromagent is attracted round toward S until, just as it nears S the wire beneath C passes from one mercury-cup to the other, so reversing the current and causing C to be repelled from S and attracted to N.

To speak of the further developments of these machines in the hands of Jacobi, Sturgeon, Froment, and others, would be to traverse ground too wide for the scope of an article like this. Paccinotti's discovery of the ring-armature, which in 1869 he applied to the construction of an electromagnetic motor which was also capable of being used as a generator of currents, dropped strangely out of sight. And the subsequent discovery of M. Gramme that his generator would work as a motor was only the beginning of a new epoch in the history of electromotors. We know that all the magneto-electric and dynamo-electric machines used to generate continuous currents of electricity, whether of Gramme, Siemens, Brush, or Edison are *reversible*. If we drive them by mechanical power they yield electric currents, and if on the other hand we supply them with currents of electricity, they can run backwards and do work for us. Sawing and ploughing are now done every day by this means. We have Siemens' electric railway and tramway, and many other useful applications of the same principle, of which one of the newest and most interesting is Dr. Hopkinson's electric elevator or "lift."

But to come back to the application of power on the very small scale adapted for domestic purposes; several *small* motors exist, each of which can do excellent work. The earliest of these small modern motors is that of M. Marcel Deprez, invented about three years ago, and which consists (see Fig. 2) of a single Siemens armature, A B, of the old well-known type, placed longitudinally between the poles of a horse-shoe, or rather a U-

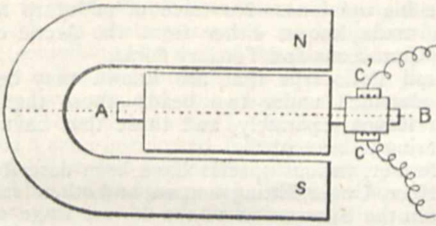

FIG. 2.

shaped steel magnet. The advantage of this arrangement is that the position of the armature utilises the whole field of force which lies between the limbs of the magnet. A large number of these little motors were set up by M. Marcel Deprez at different points of the galleries of the late Paris Exhibition in illustration of the possibility of distributing power from a central source. Two other forms of motor have more recently claimed attention. The first of these is the invention of M. Trouvé, and differs from that of M. Marcel Deprez in having an electromagnet instead of a permanent steel magnet to produce the field of magnetic force within which the armature is placed. The armature is also longitudinal and of the Siemens' type, with a slight modification, suggested by M. Trouvé, with the purpose of getting a more continuous action.

Fig. 3 shows how such a little motor may be attached

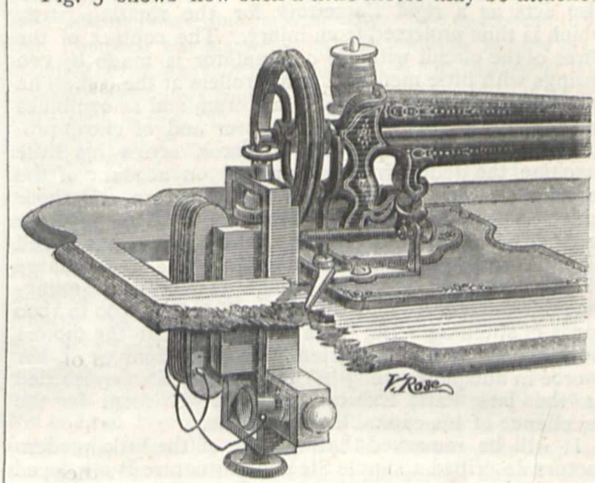

FIG. 3.

to a sewing machine. The axis of the armature is here vertical and carries a small disk or wheel of india-rubber which, when the motor is clamped in position, presses against the driving wheel of the sewing machine with a contact sufficient to enable it to drive the machine; a

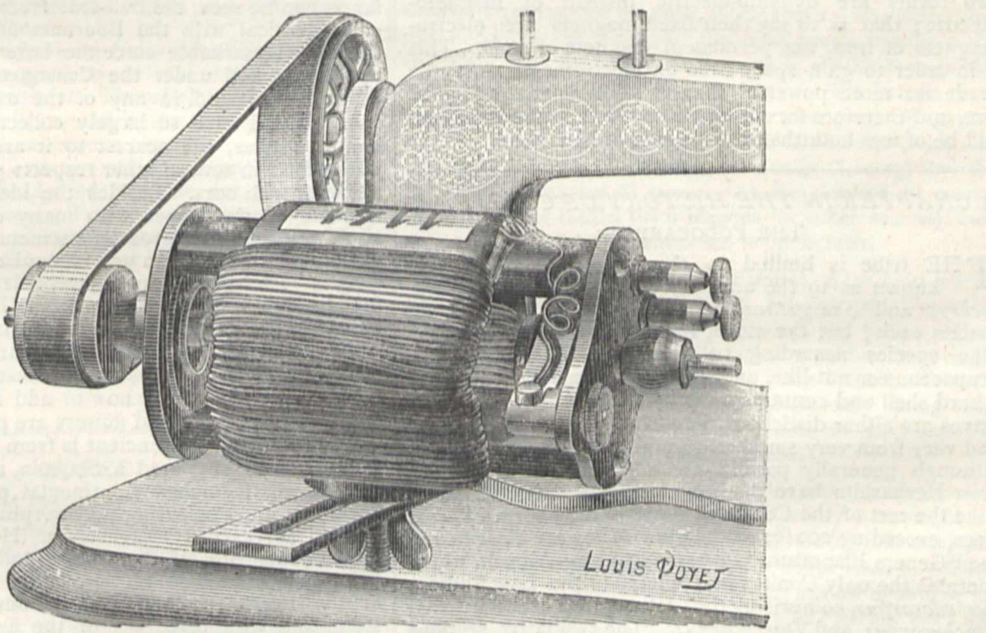

FIG. 4.

work which in spite of the small dimensions of the motor it accomplishes readily, on account of the high speed with which it runs. No steam-engine so small could possibly do the work without great loss, since steam will not give up its heat at an indefinitely great rate. It is said that three of Faure's accumulators weighing 50 lbs. each may, when fully charged, drive a sewing machine by a Trouvé motor for a whole week, working five or six hours every day. Motors similar to this have been fixed by M. Trouvé in his little electric canoe, and are suggested by M. Tissandier for balloon steering.

The favourite motor, however, at the present time appears to be that of Griscom, an American electrician, whose English agent is Mr. Paterson of Little Britain, and which we depict in Fig. 4. This elegant little machine is only $4\frac{1}{2}$ inches long, and weighs a little over two pounds only. But it is remarkably powerful and steady in its action. It can, when fed with a current of requisite strength, rotate at a speed of 500 revolutions a minute, and in that time will do from 22 to 29 foot pounds of work. The construction is extremely simple. There is a Siemens' armature on a horizontal axis, within, and entirely surrounded by, the fixed electromagnet which not only serves to produce a powerful magnetic field, but also acts as a rigid framework for the rotating parts, which is thus protected from injury. The contact of the wires of the circuit with the commutator is made by two springs with little metallic friction-rollers at the end. The ironwork is made of malleable cast-iron, and so combines the advantage of high magnetic power and of cheap production. Mr. Griscom, the inventor, styles his little machine the double-induction motor on account of the reaction between the currents in the armature and those which supply the outer field-magnets. The inventor originally intended his motor to be used with a 6-cell bichromate battery, and he claims that one single charge of acid liquid will last long enough to enable a sewing-machine fixed to a motor to accomplish from 500 to 1000 yards of stitching. But there is no doubt that the motors work equally well with currents supplied from any other source in adequate strength. A gold medal was awarded at the late Paris Exhibition to Mr. Griscom for the excellence of his capital little machine.

It will be remarked that in each of the little modern motors described a simple Siemens' armature is employed in preference to one in the form of the Gramme ring or other complicated pattern. This is simply a consequence of the difficulty of constructing these more complex kinds of armature cheaply on a small scale. If they could be as cheaply constructed they would doubtless be preferable as having no dead points, and therefore not being liable to stick at starting, though this rarely happens with these little electric engines. It will also be noted that the last two forms are dynamo-electric instead of magneto-electric; that is to say their fixed magnets are electro-magnets of iron, not permanent magnets of steel. This is in order to gain space; for an electromagnet may be made far more powerful than a steel magnet of equal size, and therefore for an equal power the electromagnet will be of less bulk than the magnet of hard steel.

A CHAPTER IN THE HISTORY OF CONIFERÆ

THE PODOCARPEÆ

THE tribe is limited to three genera. Nothing is known as to the ancestry of two of these—*Microcachrys* and *Saxegothea*, represented now by a single species each; but the third, *Podocarpus*, comprises fifty-nine species according to Gordon.[1] The fruits are drupaceous or nut-like, and the seed generally possesses a hard shell and contains a dicotyledonous embryo. The leaves are either distichous, like the yew, or imbricated, and vary from very small to several inches in length; and although generally parallel-nerved, two species in the Kew Herbarium have distinctly dicotyledonous venation. Like the rest of the Coniferæ, some species form colossal trees, exceeding 200 feet in height. They are classified in the "Genera Plantarum" into four groups—*Nageia*, which contains the only Conifer indigenous to the East Indies; *Eupodocarpus*, comprising the vast majority of the species; *Stachycarpus*, and *Dacrycarpus*. The two latter sections are represented in the Eocene, and are at present limited to the Malay Archipelago, Australia, New Zealand, and South America. Notwithstanding their immense distribution and the evidence of vast antiquity which the genus presents, scarcely anything is known of their past history. In most cases the foliage when detached has little to distinguish it from better-known Coniferæ, and the fruits, in the fossil condition, seldom present anything by which their gymnospermous origin can be inferred. Except a doubtful and undescribed species from Aix-la-Chapelle, no podocarp is known of earlier age than Eocene, and they disappear from temperate Europe with the Oligocene. Like the Araucaria and other genera innumerable, they seem to oppose the theory that all plants have originated in northern regions, and passed south by way of existing continents; and unless it is supposed that their present distribution was accomplished prior to the Cretaceous, we are forced to admit, in order to explain their presence in Chili and other parts of South America, a land connection far to the south of that admitted by Wallace and those who share his opinions. No trace of podocarp has in fact been made known either from the Arctic or the American Cretaceous and Tertiary floras.

The fossil Podocarps that are known may be conveniently classified under two heads—those that have shed their leaves separately, and those that have shed them adhering to branchlets.

Of the former, various species have been described by Saporta, Heer, Unger, Ettingshausen, and others, ranging in time from the Suessonian to the lowest stage of the Aquitanian. They therefore form a group in Central Europe essentially characteristic of the Eocene, and are quite unknown in the Miocene, except in Italy. They occur at Aix, Lat. 43°, and extend up to about Lat. 48°, which represents their Eocene distribution as at present published. It may therefore emphasise the importance attaching to a proper examination of our British Eocene floras, when I state that they have now been found not only at Bournemouth, but in Antrim and in Mull, or as far north as about 56½°. The British species differs from all those previously figured, for it has a broadly sessile and articulated base, whilst the others are represented as tapering to a fine point. The leaves, though scarcely 2 mm. broad, sometimes reach 5 inches in length. Those from Mull, and, as far as can be seen, the half-leaf from Antrim, are specifically identical with the Bournemouth form, and this is the more remarkable since the latter is confined to the uppermost bed under the Coastguard Station, and has never been found in any of the other numerous beds from which I have so largely collected. Of the Continental species, the nearest to it are mostly from Aix, whose flora in several other respects presents the greatest affinities with ours. Besides the identity in appearance of some of the leaves with many existing Podocarps, as *P. andina*, the microscopic structure of the leaves and wood peculiar to them was recognised and explained by Unger. I have not seen any records of the fruits being found, and although some from Bournemouth might belong to the species, no essential character is preserved.

Of the Podocarps whose leaves are shed attached to branchlets, only the most insignificant traces have been hitherto known. I have now to add at least two species whose foliage, fruit, and flowers are preserved.

The first and most ancient is from Alum Bay, and has hitherto been supposed a Sequoia, a Taxus, a Cypress, &c., by distinguished Continental professors who have examined it. Possessing polymorphic foliage, it falls into the "Dacrycarpus" division of Hooker. By far the larger proportion of the foliage collected is distichous, being much smaller than that of the yew, with the bases of the leaves prolonged down and adhering to the stem, and with three out of the five rows, though still recognisable, reduced to small dimensions. This abortion of some of the leaves, in order to permit the remainder to expand into two lateral rows, is exceedingly characteristic of ancient Coniferæ, and still survives in Sequoia, being probably the precursor of the truly distichous arrangement seen in Taxus, Taxodium, Toveya, and other existing Conifers. The fruit is small, petiolated, and remarkable as occurring on the distichous branches. The fossils of Alum Bay were, unfortunately, collected principally for sale, and the unattractive imbricated branchlets and the insignificant-looking fruit were doubt-

[1] Sir Joseph Hooker believes they may eventually be reduced to less than forty, since several are very imperfectly known.

less passed over. The fruit I possess is attached to a branch, and was found during the last visit to Alum Bay on which I was able to collect any fossils, for within a few months of that time the leaf-bed disappeared with the recession of the cliff. It is the only Conifer known from Alum Bay, or even from the Lower Bagshot formation, and all others should be erased from the list.

The second species is from Bournemouth, and is known from even more ample material. The foliage is also dimorphic, the distichous type being however very subordinate and confined, as in *P. cupressina* and other living species, to short, simple branchlets. A complete seedling plant with its roots possesses an irregular distichous foliage something like that of the Alum Bay species, but becomes imbricated towards the root. The young plant seems to have retained this character for some time, as shown by several branchlets. It then appears to have assumed a semi-imbricated foliage, which is exceedingly graceful. The full-grown tree principally possessed imbricated foliage, and the position the distichous branchlets occupied can only be inferred from existing allies. The largest branch is about fifteen inches long, and is composed of about thirty branchlets; but this is surpassed in elegance by another seventeen inches long, whose stem is still imperfect. The simple branchlets are very slender, about six inches long, and were often shed singly, but both branches and branchlets, as I here term them, were, I think, articulated and shed naturally, and not broken off by wind. The fruit is a berry of about half an inch diameter, clustered in three, shortly stalked, and borne on an imbricated branch, and the male catkins are in pairs and terminal. The tree was probably of large growth, and pendulous. A third form, which I cannot assign with equal reason to any genus but Podocarpus, has larger foliage. Both of these types seem extinct, with their nearest allies in the Australian region and the Oriental Island region of Wallace.

In addition to these there are fruits from Sheppey which I believe to be podocarpous, one at least seeming identical with *P. elata* of Queensland. The whole of the forms will be published and fully illustrated by the Palæontographical Society in their usual exhaustive manner.

The study of the Tertiary Coniferæ, together with that of the ferns, has already led to some not unimportant rectifications. The Bovey Tracey beds have been exactly correlated with those of Bournemouth, and now the Mull, and I believe also the North of Ireland beds, can be clearly shown to be Eocene. I also hope in my next journey to Iceland to complete the correlation of the Tertiary beds there, and of Scotland and Ireland, with those of Greenland, which I cannot but regard, from whatever aspect they are viewed, as of considerably earlier age than Miocene.

J. STARKIE GARDNER

NOTES

WE are glad to see in the recently published number of the *Journal* of the Linnean Society Mr. Bentham's important paper on the *Gramineæ*, giving the critical results of his examination of the leading groups and genera of that important family. Having been read so recently as November 3, 1881, it has been printed and issued to the Fellows with commendable rapidity. We understand that our distinguished English botanist is, notwithstanding his recent severe domestic affliction and his advanced age, in excellent health, and that he is daily engaged in the Herbarium of the Royal Gardens, Kew, in the continued preparation of the *Genera Plantarum*—the monumental work on the genera of all known flowering plants, of which the first instalment was published in 1862. Sir Joseph Hooker and Mr. Bentham have been occupied with its elaboration for the last quarter of a century, and it will be with feelings of no small satisfaction that all students of systematic botany will learn that the printing of the third and concluding volume will shortly be commenced.

MESSRS. MACMILLAN AND CO. will shortly publish an account of the late Prof. James Clerk Maxwell, by Prof. Lewis Campbell, of St. Andrews, and Mr. William Garnett, late Fellow of St. John's College, Cambridge. We understand that Prof. Campbell was Maxwell's intimate associate in early life, and Mr. Garnett was associated with him as demonstrator at the Cavendish Laboratory from its opening in 1873 until Prof. Maxwell's death in 1879. The work will consist of (1) a biographical outline by Prof. Campbell, with selections from correspondence; (2) by Mr. Garnett, a popular account of Maxwell's chief contributions to science; and (3) a collection of his poems, a few of which are already known to the public, while the greater number of them will now be published for the first time. The book will be illustrated with one or more steel plates of portraits, and a series of outline sketches of early scenes, done by Prof. Maxwell's cousin, Mrs. Hugh Blackburn (J.B.), from drawings made by herself at the time; also with coloured and other diagrams explanatory of his scientific work, some of which are taken from original water-colour sketches of his own. Not to dwell here on Prof. Maxwell's eminence as a man of science—the originality and depth of his character, his religious earnestness, his amiability, and his quaint ironical humour, may be expected to render this presentation of him by intimate friends more than ordinarily attractive to many readers outside the scientific world. The whole will be comprised in an octavo volume of about 500 pages.

UNDER the direction of the Trustees of the Gilchrist Educational Trust a course of scientific lectures by Mr. Lant Carpenter has just been given in five Lancashire towns. The total audiences were from 3500 to 4000 per week, chiefly artizans, who maintained their interest to the very end—the same people coming night after night—and in some instances going to another town in the same week to hear the lecture over again. The lectures were well illustrated by experiments and by the photographic diagrams, &c., in the oxhydrogen lantern. The latest developments of science were treated of, including the storage of energy and the electrical transmission of power. At the close of the course, hearty votes of thanks (with requests for other courses) were passed to the Gilchrist trustees and to the lecturer.

THE staff of the Russian observing station on the Lena left St. Petersburg on December 27. MM. Yurgens and Eigner are intrusted with the astronomical, magnetical, and meteorological observations, and Dr. Bunge will make researches in zoology, botany, and geology. They expect to reach Irkutsk with their instruments, in two months, and to begin next spring their journey to Yakutsk, so as to be able to open the polar station at the mouth of the Lena, on August 1, 1882.

THE rate of the cricket's chirp varies with the temperature, becoming faster as the latter rises. Recently a writer in the *Salem Gazette* (Mass.) gave the following rule for estimating the temperature of the air by the number of chirps made by crickets per minute:—"Take seventy-two as the number of strokes per minute at 60° temperature, and for every four strokes more add 1°; for every four strokes less deduct the same." In a letter to the *Popular Science Monthly*, Margarette W. Brook gives an account of observations she made with a view to testing this rule, on twelve evenings, from September 30 to October 17. Her column of temperatures as computed by the rate of vibration shows a close agreement with that of temperatures recorded by the thermometer.

THE industrial manufacture of oxygen has engaged much thought, while the uses, on a large scale, of that agent have not been very exactly determined. At Passy there are now works for producing the gas according to an improved method of MM. Brin frères, who attach the highest value to oxygen as an industrial agent, and indicate various applications of it. The process is the well-known one in which caustic baryta absorbs oxygen from the air, and gives it up under heat. By a special way of preparing the baryta, however (described in *Annales Industrielles*), they render it highly retentive of its absorbent power, obviating the necessity of frequent renewal. After 400 operations there was (on microscopical examination) no appreciable change. The baryta is placed, at Passy, in metallic retorts connected, in groups of fifteen, in two furnaces heated with gaseous fuel. A locomotive engine drives Root blowers, which force air into the retorts; after peroxidation the oxygen is liberated by heat, and pumped into the gasometer through an apparatus which removes traces of carbonic acid. As it is found that the peroxidation takes place better with moist than with dry air, the air is passed through a saturator on its way to the retorts. For production of 5000 cubic metres of oxygen a day in Paris, it is estimated (from the data at Passy) that the cost per cubic metre would be from 0·12 to 0·15 franc, according as coal or coke was used for fuel. The price of 100 kilogr. of baryta prepared by the new method is about 250 francs.

MILITARY surgeons are familiar with the remarkable attitude retained by soldiers who have died on the battle-field. Recent experiments by M. Brown-Séquard (*Comptes rendus*, December 26) throw some light on the phenomenon. It is proved (1) that a true muscular contraction may occur a certain time after as well as before death, and that this contraction may last long, and pass into the state of cadaveric rigidity, or disappear completely, so that one may then recognise the persistence of muscular irritability; (2) that of the different parts of the brain, the cerebellum has most power of producing contraction after death; (3) that the retention, by soldiers killed on the battle-field, of the attitude they had before death, depends not on a sudden occurrence of cadaveric rigidity, but on the production of a true contraction.

IN a paper lately read before the Royal Society of Tasmania, Sir J. H. Lefroy gives a new determination of the magnetic declination—8° 49′·3 E.—at Hobart for the year 1881, which he had made on the site of the old magnetical observatory of 1840-48. He notes the observation of Tasman in 1642, that "near the coast here" (Tasmania) "the needle points due north," and comparing this with the values obtained by some modern observers since 1840, he concludes that the declination which had been increasing up to the time of the magnetic survey made by Dr. Neumayer in 1863, is now decreasing. At Melbourne it has also been observed that the declination has been decreasing since 1865.

THE University of St. Petersburg has had added to it an astronomical observatory for the students. Until now the students who wished to learn practical astronomy have been reduced to make use of the very old observatory of the Academy of Sciences, with its old instruments and a complete want of any accommodation for study, or to find some friend among the officers of the Military General Staff Academy, who study at Pulkovo. Now St. Petersburg has a fine observatory, and will have an assistant-professor especially for this subject.

ST. PETERSBURG is to have its Electrical Exhibition, organised by the Technical Society. Several manufacturers of electrical apparatus and several Russian inventors have already promised their co-operation.

A VOLUME of considerable interest has recently been published by Friedenchsen and Co. of Hamburg—"Dr. Ludwig Leichhardt's Briefe an seine Angehörigen," edited by Dr. G. Neumayer and Otto Leichhardt, a nephew of the unfortunate Australian explorer. These letters are of special interest at present, when rumours come from Australia that the journals and other traces of Leichhardt have at last been found. The letters extend from 1834 (Göttingen) to April 3, 1848 (Macpherson's Station, Fitzroy Downs). These letters give one a high opinion of Leichhardt's qualifications for the work of exploration. He had an excellent education not only at home, but during lengthened residences in London and Paris. He had a strong love for natural science, was a shrewd and accurate observer, and a writer of considerable graphic power. His account of life in London and Paris is decidedly interesting, and his letters from Australia during his exploring work lead one to feel that the death of the writer was a real loss to science. These letters were quite worth publishing. Appended is a long paper by Dr. Neumayer on Leichhardt as a naturalist and explorer, in which the writer justly gives a high estimation of his qualifications and character.

THE Association for the Improvement of Geometrical Teaching will hold its annual meeting at University College, Gower Street, W.C., on Wednesday, January 11, at 11 a.m., when amongst other business the Code of Rules drawn up last April will be submitted for confirmation. The following resolutions will be proposed: That the proofs of the propositions contained in Book I. of the Syllabus will be received by the Association; and that the Committee for Elementary Plane Geometry be instructed to add a collection of exercises to the proofs of the propositions of the Syllabus. All persons interested in the objects of the Association are invited to attend.

THE number of visitors to the Royal Gardens, Kew, during the year 1881 was 836,676, the largest hitherto recorded.

AMONG the special articles in the *Annuaire* of the Brussels Observatory for 1882 are the following:—A list of 2000 communes in Belgium with their altitude according to the official survey; a paper on the conformation of the terrestrial globe; a series of studies of sun-spots in their various relations, by M. R. Tamene; tides on the coast of Belgium, by F. Van Rysselberghe; asteroids and comets discovered in 1881, by M. L. Niesten.

MR. E. C. OZANNE, of the Indian Civil Service, at present a student at the Royal Agricultural College, Cirencester, has been appointed Director of Agriculture in the Presidency of Bombay.

A SCHEME is on foot, having been approved by the Municipal Council of Paris, for extensively lighting with electricity the quarters of the Prefecture of the Seine, in the Tuileries. It is the work of M. Cernesson, and comprises lighting the Salle des Séances with eighty Swan lamps (in place of eighty Carcel lamps), and six Siemens' arc-lamps; lighting the library with forty-eight Maxim incandescent lamps (on the present lustres); another room with twenty-four Lane-Fox incandescent lamps; another with twenty Swan lamps; the Salle des Pas Perdus with two Werdermann lamps; a lobby with two Siemens' lamps, and a staircase with four Brush lamps. The whole will require an outlay of 75,000 francs. The horse-power necessary is 44, and while the idea of obtaining this from the Seine has been considered, it has been decided to set up a gas-engine in the court of the Tuileries. A portion of the motor force is to be employed for electric hoists, for driving ventilators, and other uses.

FROM the Annual Report of the Government Botanical Gardens at Saharunpur and Mussooree for the year ending March last, we gather the following facts:—On the collection and preparation of drugs, which seems to be an important item in the work of the establishment, it is stated that an indent for 200 lb.

of Taraxacum extract from the root of the Dandelion (*Taraxacum officinale*) was received from Calcutta. To supply this demand, which was the first occasion on which Taraxacum extract was supplied from the Saharunpur Garden, the seeds were sown over about half an acre of land in August, and the roots were dug up during the month of March and thoroughly dried in the sun, after which they were reduced to fine powder, this powder was then put into water and allowed to stand one night. The mixture was strained through fine cloth, and the clear liquid was then heated in a water bath until it had acquired the proper consistency. During the heating process a certain quantity of rectified spirits of wine was added to the extract. The heating process being finished, the extract on becoming cool was put into suitable jars and despatched. Of the Chuffa or Earth Almond, the tubers of *Cyperus esculenta*, a native of South Europe and North Africa, Mr. Duthie reports that about two dozen tubers have been received from Dr. Schomburgk, of Adelaide, and of this number about one-half had started into growth and were thriving luxuriantly. The tubers of this plant are used as an article of food in Egypt and in some parts of Europe, and they are now recommended for feeding sheep, hogs, poultry, &c., for which purpose they are largely used in the Southern States of America. Of Lucerne (*Medicago sativa*) it is stated that the demand for seed is every year increasing. "In addition to its good qualities as a fodder plant for horses and oxen it has the further advantage of being a perennial, which is very little affected by the extremes of heat and moisture it has to endure in North India. The Argan (*Argania sideroxylon*), a valuable oil-producing tree of Morocco, has been received at Saharunpur, and every care will be taken with the plants should the seeds germinate. Mr. Duthie says, "I find from a list published in 1854 by the late superintendent, that the tree then existed in the Saharunpur Garden. As none of the original trees are now to be found it would appear that the climate of this part of India is not altogether suitable."

UNDER the title of a "Catalogue of the Phænogamous and Vascular Cryptogamous Plants of Indiana" we have received a small octavo pamphlet, giving as we believe the first complete catalogue of the flowering plants and ferns of the well-known State of Indiana. The flora numbers 1432 species referred to 577 genera, and no doubt further additions will from time to time be made. The authors of the useful flora are the editors of the *Botanical Gazette* of Crawfordsville (J. M. and M. S. Coulter) and Prof. C. Barnes.

THE last number of the *Zapiska* (Memoirs) of the Caucasian branch of the Russian Geographical Society contains a valuable paper by the late P. K. Ushar, on the "Oldest Traditions on Caucasus."

WE have just received the first part of a second series of Dr. C. Fr. W. Krukenberg's "Vergleichend-physiologische Studien," Heidelberg, 1882. This part, of over 180 pages, is taken up with a number of very important and interesting memoirs, on such subjects as "On the Temperature at which the Lymph of Invertebrates Coagulates," "On the Colour Substance of Feathers," "On the Protective Coverings of the Echinoderms," &c.

THE Polytechnic has at last been sold, and will finally close on January 21. Until then a varied programme will be presented daily, including new musical, optical, magical, and popular scientific entertainments, as well as a *réchauffé* of very many of those that have been characteristic of the place during the last twenty years.

A VERY favourable Report is to hand of the Sheffield Free Public Libraries and Museum. Many additions have been made to the latter, and the small observatory attached, and which is open to the public, was visited during the year by about 3000 people.

ON December 29, 1881, two strong shocks of earthquake were felt at Kiangari, in the province of Kastamoumi. The movement was from east to west. Considerable damage was done to the village, but no details have yet been received at Constantinople.

WE have received from the Society of Telegraph Engineers a list of the additions to their library during the past year; this library, we may remind our readers, is now open to the public.

THE Waterford Literary and Scientific Association have begun to publish their Proceedings. The part for 1880-81 contains abstracts of various lectures and papers, and the fifth Annual Report records the steady success of the Association.

THE additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus erythræus*) from India, presented by Mr. Wm. Trent; a Marsh Ichneumon (*Herpestes galeri*) from South Africa, presented by Mr. Ernest Wells; an Indranee Owl (*Syrnium indranee*) from Ceylon, presented by Commander Burkitt; a Short-toed Lark (*Calandrella brachydactyla*), British, presented by Mr. H. A. Macpherson; a Pike (*Esox lucius*), British fresh waters, presented by Mr. George Seaton; a Malbrouck Monkey (*Cercopithecus cynosurus*) from West Africa, a Kinkajou (*Cercoleptes caudivolvulus*) from Brazil, a Black-footed Penguin (*Spheniscus demersus*) from South Africa, deposited; a Kusimanse (*Crossarchus obscurus*) from South Africa, a White eared Conure (*Conurus leucotis*) from Brazil, a Blue crowned Parrot (*Tanygnathus luzonensis*) from the Philippines, purchased; a Molucca Deer (*Cervus moluccensis*), born in the Gardens.

PHYSICAL NOTES

THE vapour-tension of liquid mixtures has been lately investigated by Herr Konowalow (*Wied. Ann.*, No. 9) in the case of the first four members of the alcohol and the acid series, each mixed, in various proportions, with water. Curves were obtained by taking the percentages as abscissæ and the tensions as ordinates. The author finds that each mixture, to which a maximum or minimum of tension corresponds, has, at the temperature indicated, the same composition as its vapour. Thus liquid mixtures, with reference to distillation, are divisible into three groups—(*a*) Those whose curve of tension has neither a maximum nor a minimum; (*b*) Those whose curve has a maximum (*e.g.* propylic alcohol, butyric acid); (*c*) Those whose curve has a minimum (*e.g.* formic acid). Herr Konowalow shows, from a table of all the constant boiling mixtures known to him, that in all the boiling temperature of the mixture is either greater or less than those of both constituents, *i.e.* all the tension-curves have a maximum or a minimum. The existence of such a point seems, thus far, to be a necessary condition of the existence of a constant boiling mixture. These mixtures have not, apparently, a simple molecular constitution.

IN his study of sulphur Saint-Claire Deville obtained (from flowers of sulphur) a variety more stable than those known, and insoluble in sulphide of carbon; its form being that of a fine powder, each grain a hollow vesicle. He failed to find the specific gravity of this vesicular sulphur, and suggested to M. Spring, about a year ago, to subject the material to the powerful compressing apparatus used in his recent noteworthy experiments. This has been done (*Bull. Belg. Acad.* No. 8), with a pressure of 8000 atmospheres for a few seconds and temperature of 13°, producing hard pale yellow blocks. Treatment with sulphide of carbon showed that 4·21 per cent. was transformed into octahedral sulphur, so that the density of the vesicular variety is less than that of the other. M. Spring further directly determined the specific gravity of those blocks at different temperatures, measuring the expansion; and by calculation he reaches the result that vesicular sulphur has probably the same specific gravity as prismatic sulphur (1·960). It was also observed that vesicular sulphur dilates regularly under heat up to 43°, beyond which it contracts continuously, till at 80° it has the same specific gravity as at zero. This contraction M. Spring thinks probably due to transformation of vesicular into octahedral sulphur [1]

IN another paper to the Belgian Academy (*Bull.* No. 8) M. Spring concludes that there is a relation between the dilatation and the atomic weight of simple substances; for certain of them, as sulphur, selenium, and tellurium, nickel and cobalt, iron and aluminium, the former is inversely proportional to the latter. Otherwise expressed, the dilatation per atom (in the groups specified) is constant. The possibility is thus suggested of determining the number of atoms contained in a molecule of a solid substance. · M. Spring is investigating this.

PROF. W. HOLTZ, inventor of the well-known Holtz electrical machine, has recently studied the various possible ways of arranging the inductors and armatures of his machine. This research was undertaken with a view partly to investigate the action of the analogous machine of Töpler, in which the fixed plate is not pierced as in the Holtz machine, and partly to ascertain the reasons for the shifting brushes of light to be observed in the ordinary Holtz machine. The research, which is too lengthy to reproduce here, led to the conclusion that there is an advantage in the apertures of the fixed plate.

To charge the electrodes of a secondary battery to their maximum potential requires a quantity of electricity roughly proportional to their surface. But if the source from whence the charge is derived is of an electromotive force inferior to this maximum, then the polarisation-charge is limited, not by the surface of the electrodes merely, but by the fact that the opposing polarisation completely stops the current. M. Blondlot has lately determined the quantities of charge required to polarise to such a limit a voltameter of given electrodes, when the electromotive forces are also of given magnitude. This was done by using a voltameter with very small electrodes, and including in the circuit with it a battery, a ballistic galvanometer, and an apparatus for closing circuit during a determinate fraction of a second. By the device of increasing the area of one or other of the electrodes, M. Blondlot was able to study independently the two cases of polarisation by oxygen and of polarisation by hydrogen. The author further shows (*Journal de Physique*) that the elementary capacity of an electrode for a given electromotive force does not depend on the nature of the electrode. The latter is also proved by a single qualitative experiment. It follows that to charge, by an instantaneous polarisation, the electromotive force between an electrode and electrolyte of value e_1 to a value e_2, the same quantity of electricity is always required, whatever the chemical nature of the electrolyte. Further, the charge of the double electric layer at the surface of contact of an electrode and electrolyte does not depend on the nature of the electrolyte if the electric difference remains the same. M. Blondlot has also given an absolute measure of the initial capacity of platinum in water acidulated by sulphuric acid, and shows that this capacity may vary under different influences.

GEOGRAPHICAL NOTES

THE *Journal* of the Geographical Society of Tokio for the year 1881 has just been published. It is printed wholly in the Japanese character, and its contents are therefore inaccessible to all but a very few European readers. Besides reports of the meetings, and some other official information, it contains a paper on Saghalin and the Kurile Islands, and one on the historical geography of Japan. Some Japanese who have travelled in China have formed themselves into a society for publishing a topographical description of that country. This will contain little that will be new to English readers, as no Japanese has, we believe, penetrated into Central Asia from the side of China. The Japanese have given us much new information respecting Corea, but they have as yet added little else to our geographical knowledge.

MR. E. C. HORE's paper on Lake Tanganyika forms the staple of the January issue of the Geographical Society's *Proceedings*. The two maps which Mr. Hore furnishes are a valuable addition to the cartography of the lake, which is now for the first time delineated with any pretence to accuracy as a whole. The map of the southern part of the lake, Livingstone's Lake Liemba, is on the scale of five geographical miles to the inch. Mr. Markham's paper on the *Jeannette* expedition and Commodore Jansen's notes on recent Dutch Arctic voyages, and Mr. Leigh Smith's probable position we have already referred to at some length, and in connection therewith need only add that a map is now given of Wrangel Island from Lieut. Berry's survey. The geographical notes bring us some interesting news of African exploration, chiefly on the east side of the continent, and hold out the hope of a future paper on the little-known interior of Mozambique by a new traveller.

THE first seven sheets of the large map of Eastern Equatorial Africa, with the preparation of which Mr. Ravenstein was entrusted in 1878 by the Council of the Geographical Society, are at last ready for issue by Mr. Stanford.

DR. HARMAND, who has for some time been an assistant secretary of the French Geographical Society, and has lately been appointed Consul for France at Bangkok, is shortly to avail himself of the opportunity thus offered for making natural history and ethnographical collections in the Indo-Chinese peninsula.

WE have received parts 27–29 of the new edition of Stieler's Hand Atlas, containing the following maps:—A railway and steamer map of Germany and neighbouring countries; Austria-Hungary; India and Inner Asia, northern sheet; a meteorological chart of the world; Iran and Turan; general map of South America; sheet 4 of the six-sheet map of South America; North-East Africa and America; South Africa and Madagascar. Other three parts, containing eight maps, will conclude the new issue of this Standard Atlas, which will have ninety-five maps in all.

THE *Deutsche Geographische Blätter* (Heft 4 Band 10) of the Bremen Society contains the narrative of the brothers Krause, sent by the Society to explore the Behring Straits region, mainly for commercial purposes. Capt. Koldeway contributes a paper on the position of the Arctic ice during the past summer, which was peculiar in some respects; Capt. Koldeway shows that it was dependent on meteorological conditions with which we are imperfectly acquainted, but for a knowledge of which the Arctic observing stations ought to do much. There is also a useful summary of the Arctic work of the year, in which it is claimed for Capt. Dallmann that he was the first to land on Wrangel Land in 1866. In a note on p. 448 of the "Voyage of the *Vega*," vol. i., Baron Nordenskjöld, however, thinks it strange that Dallmann should only now have mentioned this voyage.

SINCE 1873, Herr Dietrich Reimer of Berlin has published at intervals important contributions to the literature of African exploration, under the title of "Beiträge zur Entdeckungsgeschichte Afrika's." The first issue was a series of small maps showing the progress of a general knowledge of Africa from antiquity down to the nineteenth century. The second contains a paper on the part taken by Germany in African exploration, and a map, with text, showing what the various nationalities have done for African exploration during the nineteenth century. The third issue is a volume containing the journal of Dr. Paul Pogge during his exploration of the Lunda States, in the southern basin of the Congo in 1875–6. The fourth volume gives a narrative of Herr Otto H. Schütt's exploration on the Lower Quanza in 1877–9. These are all of considerable value, especially the two last issues, which contain the results of much detailed work by competent scientific observers. We trust Herr Reimer will be encouraged to continue his enterprise.

THE Vienna Geographical Society celebrated the twenty-fifth anniversary of its foundation on December 22 last. The Society numbers 74 honorary and 644 ordinary Members; its library consists of nearly 11,000 works.

THE geographical weekly *Das Ausland* has changed hands. Up to December 31 last its editor was the well-known geographer, Fr. von Hellwald; his place is now taken by Prof. Friedr. Ratzel of Munich. The paper will in future confine its contents solely to geographical and ethnographical subjects.

ACTION OF FREE MOLECULES ON RADIANT HEAT, AND ITS CONVERSION THEREBY INTO SOUND [1]

THE lecture opens with a brief reference to the researches of Leslie, Rumford, and Melloni. The labours of Tyndall and Magnus, as far as they bear upon the present subject, are then succinctly sketched, their points of difference being

[1] Abstract of the Bakerian Lecture, by J. Tyndall, F.R.S., given at the Royal Society, November 24, 1881.

signalised and briefly discussed. This preliminary sketch is wound up by a reference to a recently-published paper by Lecher and Pernter, who, while supporting the lecturer in the matter of gases, dissent from him in the matter of vapours. These investigators are especially emphatic in affirming the neutrality of aqueous vapour to radiant heat. Following Magnus, they refer Tyndall's results to what Magnus calls "vapour-hesion," that is to say, to the condensation of the vapours on the surfaces of the plates of rock-salt used to close the experimental tube, and on the interior surface of the tube itself.

In November, 1880, the lecturer's investigations in this field were resumed. Former experiments were repeated and verified with divers sources of heat, and with various experimental tubes—some polished within, and others coated inside with lampblack. The results obtained with the one class of tubes are substantially the same as those obtained with the other.

But even a coating of lampblack may be supposed to reflect a certain amount of heat, hence the desirability of an arrangement whereby internal reflection should be entirely abolished. This was accomplished in the following manner:—A spiral of platinum wire, rendered incandescent by a voltaic current of measured strength, was chosen as source of heat. An experimental tube 38 inches long and 6 inches in diameter had two circular apertures at its ends, closed by transparent plates of rock-salt, 3 inches in diameter. The tube was furnished with three cocks—one connected with a large Bianchi's air-pump; another with a purifying apparatus; while through the third vapours and gases could be admitted. Prior to entering the tube the calorific rays were sent through a very perfect rock-salt lens, by means of which an image of the spiral was formed on the most distant plate of rock-salt. To obtain the image with clearness, the spiral was first rendered highly luminous, and afterwards reduced, by the introduction of resistance, to the required temperature. In this way a calorific beam was sent along the axis of the experimental tube without at all impinging upon its interior surface. No reflection came into play; no absorption by hypothetical liquid films, coating the internal surface, could occur; and yet experiments made with this arrangement entirely confirmed the preceding ones, wherein by far the greater quantity of heat which reached the pile had undergone reflection.

When the source of heat was changed to a carefully-worked cylinder of lime, a portion of which was rendered incandescent by an ignited stream of coal-gas and oxygen, the results were confirmatory of those obtained with the spiral. The order of absorption in both cases was the same, the only difference being that the fractional part of the total radiation absorbed in the case of the lime-light was less than that absorbed in the case of the spiral.

To condense the radiation from the lime-light, concave mirrors were sometimes employed, and sometimes rock-salt lenses. The results in both cases were identical.

An experimental tube of the dimensions here given was employed by the lecturer to check his results more than ten years ago. Its interior surface was rough and tarnished, and when warmed dynamically by the entrance of a gas its power as a radiator enabled it to disturb, to some slight extent, the purity of the results. To obviate this, the experimental tube recently employed was provided with an internal silver surface, deposited electrolytically and highly polished. By this arrangement the radiation of the tube itself, as well as its absorption, was rendered quite insensible.

The rock-salt plates used to close the experimental tube, and on which liquid films are alleged to be deposited, remain to be examined. In this case also an *experimentum crucis* is possible. If the observed absorptions be due to such liquid films, then the separation of the salts more widely from each other, the space between them being copiously supplied with vapour, ought to produce no effect; but if the absorption, as alleged by the lecturer, be the act of the vapour molecules, then the deepening of the absorbing stratum ought to produce an augmented effect. For many gases and some vapours this problem was solved as far back as 1863. By means of an apparatus then described, polished plates of rock-salt could be brought into contact with each other, and then gradually separated, until the gaseous stratum between them was some inches in depth. With sulphuric ether vapour, the distance between the plates being one-twentieth of an inch, an absorption of 2 per cent. was observed. With a thinner stratum, or a weaker vapour, even this small absorption vanished, while in passing from one-twentieth of an inch to two inches the absorption rose from 2 per cent. to 35 per cent. of the total radiation. Such experiments, recently verified, entirely dispose of the hypothesis that liquid films were the cause of the observed absorption.

The "vapour-hesion hypothesis" involves the assumption that liquids exert on radiant heat an absorbent power which is denied to their vapours. It assumes, in other words, that the seat of absorption is the molecule considered as a whole, and not the constituent atoms of the molecule. For were the absorption intra-molecular, the passage from the liquid to the vaporous condition, which leaves the molecules intact, could not abolish the absorption. So far back as 1864 the lecturer had proved that when vapours, in quantities proportional to the densities of their liquids, were examined in the experimental tube, the order of their absorptions was precisely that of the liquids from which they were derived. This result has been recently tested and verified in the most ample manner by means of the apparatus in which internal reflection never comes into play. It furnishes, therefore, the strongest presumptive evidence that the seat of absorption in liquids and in vapours is the same.

As a problem of molecular physics it was, however, in the highest degree desirable to compare together *equal* quantities, instead of proportional quantities, of liquids and vapours. Highly volatile liquids alone lend themselves to this experiment, for only from such liquids can vapours be obtained sufficient, when caused to assume the liquid form, to produce layers of practicable thickness. Two cases, however, have been very fully worked out, the substances employed being the hydride of amyl and sulphuric ether. Careful and exact experiments, many times repeated, lead to the result that when the number of molecules traversed by the calorific rays in the vapour is the same as that traversed in the liquid, the absorptions are identical. In the silvered experimental tube, which, as stated, is 38 inches long, hydride of amyl vapour, at a mercury pressure of 6·6 inches, is equivalent to a liquid layer 1 millim. in thickness, while a vapour column of sulphuric ether, of the same length, and 7·2 inches pressure, would also produce a liquid layer 1 millim. thick. The experiment has been made with the utmost care, both with the lime-light and the incandescent platinum, with the result that it is impossible to say that there is any difference between the vapour absorption and the liquid absorption. In the face of such facts the "vapour-hesion" hypothesis, as an explanation of the results published by the lecturer, cannot be sustained.

On November 29, 1880, he had the pleasure of witnessing, in the laboratory of the Royal Institution, the experiments of Mr. Graham Bell, wherein a concentrated luminous beam, rendered intermittent by a rotating perforated disk, was caused to impinge upon various solid substances, and to produce musical sounds. Mr. Bell's previous experiments upon selenium naturally led him to conclude that the effect was produced by the luminous rays of the spectrum. The contemplation of these experiments produced in the lecturer the conviction that the results were due to the intermittent absorption of radiant heat. He was experimenting on vapours at this time. Substituting in idea gaseous for solid matter, he clearly pictured the sudden expansion of an absorbent gas or vapour at every stroke of the calorific beam, and its contraction when the beam was intercepted. Pulses far stronger than those obtainable from solid matter would probably be thus produced, which, when rapid enough, would generate musical sounds. The intensity of the sound would, of course, be determined by the absorptive power of the gas or vapour.

This idea was tested on the spot. Placing sulphuric ether in a test-tube, and connecting the tube with the ear, the intermittent beam was caused to fall upon the vapour above the liquid. A feeble musical sound was distinctly heard. Formic ether was tried in the same way, and with the same result. Bisulphide of carbon was then tried, but the vapour of this liquid proved incompetent to generate a musical sound. These results, which were in perfect accordance with those previously enunciated by the lecturer, were first made public during a discussion at the Society of Telegraph Engineers on December 8, 1880 (*Journal of Telegraph Engineers*, vol. ix. p. 382).

It was obvious, however, that the arrangement of Mr. Bell—a truly beautiful one—was not suited to bring out the maximum effect. He had employed a series of lenses to concentrate his beam, and these, however pure, would, in the case of transparent gases, absorb a large portion of the rays most influential in producing the sound. The lecturer, therefore, resorted to lenses of rock-salt and to concave mirrors silvered in front. He employed various sources of heat, including that of the electric lamp. The lime-light he found very convenient. With the lime-light and concave mirror, sounds of surprising intensity were produced by all the highly absorbent gases and vapours. Among gases chloride of methyl was loudest. Conveyed directly to the ear by a tube of india-rubber, the sound of this gas seemed as loud as the peal of an organ. Abandoning the ear-tube, and choosing a suitable recipient for the gas, the sounds were heard at a distance of 20 feet from their origin. As regards intensity, the order of the sounds, in gases, corresponds exactly with the order of their absorptions of radiant heat.

Among vapours sulphuric ether stands highest, this result being in part due to the great volatility of the liquid. But the intensity of the sound is by no means wholly dependent on volatility. The specific action of the molecules on radiant heat is as clearly shown in these experiments as in those previously conducted with the experimental tube and thermopile. Upwards of eighty vapours have been tested in regard to their sound-producing power.

With regard to aqueous vapour, whose action upon radiant heat even the latest publications on this subject describe as *nil*, it was especially interesting to be able to question the vapour itself as to its absorbent power, and to receive from it an answer which did not admit of doubt. A number of bulbs about an inch in diameter were placed under the receiver of an air-pump, with a vessel containing sulphuric acid beside them. When thoroughly dry they were exposed to an intermittent beam. The well-dried air within the bulbs proved silent, while the slightest admixture of humid air sufficed to endow it with sounding power. Placing a little water in a thin glass bulb, and heating it nearly to its boiling point, the sounds produced by the developed vapour are exceedingly loud. The bulbs employed in these experiments are usually about a cubic inch in volume. They may, however, be reduced to one-fiftieth or even one one-hundredth of a cubic inch. When a minute drop of water is vaporised within such little bulbs, on their exposure to the intermittent beam loud musical sounds are produced.

It is to be borne in mind that the heat employed in these experiments, coming as it did from a highly luminous source, was absorbed in a far smaller degree than would be the heat from bodies under the temperature of incandescence.

To render the correlation of sound-producing power and adiathermancy complete, all the gases and vapours which had been exposed to the intermittent beam were examined as to the augmentation of their elastic force through the absorption of radiant heat. A glass cylinder, 4 inches long and 3 inches in diameter, had its ends closed with transparent plates of rock-salt. Connected with this cylinder was a narrow U-tube, containing a coloured liquid which stood at the same level in the two arms of the U. The cylinder could be exhausted at pleasure or filled with a gas or vapour. When filled, the sudden removal of a double-silvered screen permitted the beam from the lime-light to pass through it, the augmentation of elastic force being immediately declared by the depression of the liquid in one of the arms of the U-tube and its elevation in the other. The difference of level in the two arms gave, in terms of water-pressure, a measure of the heat absorbed. With the stronger vapours it would be easy with this instrument to produce an augmentation of elastic force corresponding to a water-pressure of a thousand millimetres. As might be expected the intensity of the sounds corresponded with the energy of the absorption, varying from "exceedingly strong," "very strong," "strong," "moderate," "weak," to "inaudible." In this connection reference was made to the interesting experiments of Prof. Röntgen, an independent and successful worker in this field.

In conclusion, the lecture draws attention to the bearing of its results upon the phenomena of meteorology. The views of Magnus regarding the part played by mist or haze, are referred to and attention is directed to various observations by Wells which are in opposition to these views. The observations of Wilson, Six, Leslie, Denham, Hooker, Livingstone, Mitchell, Strachey, and others are referred to and connected with the action of aqueous vapour upon solar and terrestrial radiation. Many years ago the lecturer sought to imitate the action of aqueous vapour on the solar rays by sending a beam from the electric light through a layer of water, and afterwards examining its spectrum. The curve representing the distribution of heat resembled that obtained from the spectrum of the sun, the invisible calorific radiation being reduced by the water from nearly eight times to about twice the visible. Could we get above the screen of atmospheric vapour, a large amount of the ultra-red rays would assuredly be restored to the solar spectrum. This conclusion has been recently established on the grandest scale by Prof. Langley, who on September 10 wrote to the lecturer from an elevation of 12,000 feet on Mount Whitney, "where the air is perhaps drier than at any other equal altitude ever used for scientific investigation." An extract from Prof. Langley's letter will fitly close this summary :—"You may," he says, "be interested in knowing that the result indicates a great difference in the *distribution* of the solar energy here from that to which we are accustomed in regions of ordinary humidity, and that while the evidence of the effect of water-vapour on the more refrangible rays is feeble, there is, on the other hand, a systematic effect due to its absence, which shows, by contrast, its power on the red and ultra-red in a striking light. These experiments also indicate an enormous extension of the ultra-red rays beyond the point to which they have been followed below, and being made on a scale different from that of the laboratory—on one indeed as grand as nature can furnish—and by means wholly independent of those usually applied to the research, must, I think, when published, put an end to any doubt as to the accuracy of the statements so long since made by you, as to the absorbent power of water-vapour over the greater part of the spectrum, and as to its predominant importance in modifying to us the solar energy."

SOCIETIES AND ACADEMIES

LONDON

Royal Society, December 8.—"On the Electrolytic Diffusion of Liquids," by G. Gore, LL.D., F.R.S. In this communication the author has described an apparatus, and an attempt made with it, to ascertain more definitely than he was able in a previous research (on "the Influence of Voltaic Currents on the Diffusion of Liquids," *Proc.* Roy. Soc., No. 213, 1881) whether, when an electric current is passed vertically through the boundary surface of mutual contact of two electrolytes lying upon each other in a narrow vertical glass tube, the mass of either of the liquids expands or moves as a whole in the line of the current, and also to obtain additional data to assist in explaining the phenomena observed in the previous research.

The results obtained with a solution of mercuric nitrate (sp. gr. 1·30) below, and a solution of cupric nitrate (sp. gr. 1·22) above, showed, first, and most conclusively, that the upper liquid diffused downwards continuously through the meniscus in the glass tube (the meniscus remaining motionless) during the passage of an upward electric current; and second, that either no manifest expansion occurred in the liquid next the cathode in the upper solution, and that equal volumes of liquid diffused in two opposite directions through the meniscus; or that any expansion of the upper liquid was compensated for by downward diffusion of an equal bulk of that liquid. Another possibility was that the united volumes of metallic-electro deposited copper, and of the acid element from which it had been separated by electrolysis, were greater than before such separation, and that this was exactly compensated by the volume of liquid diffused downwards through the meniscus.

Zoological Society, December 13.—Prof. W. H. Flower, F.R.S., president, in the chair.—Mr. Sclater exhibited and made remarks on two skins of a Rail from Macquarie Island, south of New Zealand, which had been sent to him by Sir George Grey, K.C.B.—Mr. H. Seebohm exhibited and made remarks on specimens of the Rusty Grakle (*Scolecophagus ferrugineus*) and Pallas's Great Grey Shrike (*Lanius major*), which had been shot near Cardiff, and were new to the British avi-fauna.—A communication was read from Mr. Clements R. Markham, F.R.S., containing an account of his researches into the former whale-fishery of the Basque Provinces of Spain.—Messrs. J. J. Lister and J. J. Fletcher read a paper on the condition of the median portion of the vaginal apparatus in the Macropodidæ, in which they arrived at the following conclusions :—(1) In the Macropodidæ the median vaginal canal is closed in early life. (2) In the genera *Macropus*, *Halmaturus*, and *Petrogale* (and perhaps also *Dorcopsis* and *Dendrologus*) an opening is formed, leading directly from the median vaginal canal into the urogenital sinus, which opening most probably gives passage to the young. This opening may be formed early in life, as is usual in the genus *Halmaturus*, or not till young are about to be produced, as in *Macropus rufus*. (3) The evidence with regard to *Macropus major* is conflicting; in one case the median canal has been found open after parturition, and in two others closed. (4) In *Hypsiprymnus gaimardi* (and probably also *H. murinus*) the median canal remains closed, and the young passes down the lateral vaginal canals, which present a different structure from that found in the other examples of Macropodidæ.—A communication was read from the Rev. Canon Tristram, containing the description of a new Fruit-Pigeon of the genus *Carpophaga*, from the Louisiade Archipelago, which he proposed to name *Carpophaga salvadorii*.

Geological Society, December 7.—Mr. R. Etheridge, F.R.S., president, in the chair.—William Amherst Tyssen Amherst, M.P., Robert Edward Cresswell, W. R. Eaton Hodgkinson, Simon D. Macdonald, Rev. Edward Cook Pritchard, Rev. Alexander Simpson, B.Sc., Prof. William Waagen, Ph.D., Frederick John Webb, and Charles Henry Wilson, were elected Fellows of the Society.—Mr. W. Topley made a statement respecting the International Geological Congress at Bologna.—Prof. Judd, at the request of Prof. John Milne, of the Imperial Engineering College of Tokio, Japan, called the attention of the Members of the Society to the important work now being carried on by the Seismological Society of Japan. Geologists could become Members of the Seismological Society of Japan (which stands greatly in need of help) by an annual payment of 1*l*., which will entitle them to receive the whole of the publications of the Society. Prof. Judd was prepared to receive the names of Members on behalf of Prof. Milne.—The following communications were read:—The zones of the Blackdown beds and their correlation with those at Haldon, with a list of the fossils, by the Rev. W. Downes, B.A., F.G.S.—On some new or little-known Jurassic Crinoids, by P. Herbert Carpenter, M.A. Communicated by Prof. P. Martin Duncan, M.B. Lond., F.R.S., F.G.S.—Notes on the Polyzoa of the Wenlock shales, Wenlock limestone and shales, over the Wenlock limestone. From material supplied by G. Maw, F.L.S., F.G.S. By G. R. Vine. Communicated by Dr. H. C. Sorby, F.R.S., V.P.G.S.

Anthropological Institute, December 13, 1881.—Mr. Hyde Clarke, vice-president, in the chair.—The election of Mrs. C. Hancock was announced.—The discussion on the Rev. R. H. Codrington's paper on the affinity of the Melanesian, Malay, and Polynesian languages was continued by Mr. A. H. Keane and Mr. Hyde Clarke.—Mr. M. J. Walhouse read a paper on some vestiges of girl-sacrifices, jar-burial, and contracted interments in India and the East. The great megalithic forms of interment, consisting of Kistvaens, or sepulchral underground chambers, formed of four huge slabs, covered with an immense capstone, and surrounded by a circle of standing stones, abound in nearly all the provinces of the Madras Presidency; but beside these there is another description of burial peculiar to the region of the western coast from Malabar to Cape Comorin. This consists of huge mortuary jars or urns, pear shaped, usually about five feet high by four feet in girth round the shoulders, and tapering to a point at bottom. They are of coarse, thick, red ware, wide-mouthed, generally with a rude incised cross-pattern round their neck. These great urns are buried upright in the ground, not in any cist or chamber, and a large flat stone or slab is laid over them, but no circle of stones ever placed around. They are filled with earth, and contain at the bottom a quantity of bones broken small, some pieces of iron, and occasionally a small urn also filled with bits of bone; or sometimes with clean sand, red or white, which must have been brought from a distance.—Mr. G. Bertin read a paper on the origin and primitive home of the Semites, which was followed by a discussion.

Entomological Society, December 7.—Mr. H. T. Stainton, President, F.R.S., in the chair.—Mr. A. J. Scollick was elected a Member.—Exhibitions: A variety of *Ennomos tiliaria*, Borkh., by Mr. W. E. Boyd.—Bred specimens of *Scenopinus fenestralis*, Latr., *Phora rufipes*, Meig., and *Oscinis pusilla*, Latr., by Mr. C. O. Waterhouse.—A larva of an undetermined species of ant-lion, from Zante, by Mr. F. P. Pascoe. A Curculionideous larva, found feeding in the bulbs of lilies, probably from Japan, by Mr. R. McLachlan.—A specimen of *Harpalus cupreus*, Dej., from the Isle of Wight, by Mr. A. S. Olliff.—A supposed new species of *Telephorus*, from West Wickham, by Mr. H. B. Pim.—Communications: a box of locust egg-cases, with specimens of the Bombyliid larva found feeding on the eggs, transmitted by Sir Robert Biddulph from Cyprus, was exhibited by the Secretary, who read a communication received therewith from the Colonial Office, and the report of the Committee appointed by the Society to investigate the subject.—Sir S. S. Saunders read some remarks received from M. E. André, relative to a species of *Scleroderma*.—Mr. C. O. Waterhouse read remarks on the types of *Cynips psenes* and *C. sycomori*, in the Linnean collection.—Mr. W. L. Distant read descriptions of new species belonging to the Homopterous family *Cicadidæ*; and Mr. A. G. Butler communicated a list of heterocerous *Lepidoptera* collected in Chili by Mr. T. Edwards; Part i., Sphinges and Bombyces.

VIENNA

Imperial Academy of Sciences, December 9, 1881.—V Burg in the chair.—The following papers were read:—Ed. Neusser, a contribution to the knowledge of the colouring-matters of urine.—Bohuslav Branner (Manchester), contribution to the knowledge of cerium metals.—N. v. Lorenz, on the action of metallic lead on an aqueous solution of nitrate of lead.—Willibald Vinier, a sealed packet without inscription.—G. Tschermak, on a previously unobserved case of hemhedry of fesseral system.—E. Weiss and T. Palisa, computation of the elements and ephemeris of the comets probably discovered by Mr. Wendell of Harvard College at Cambridge (Mass.).—W. Tinter, on the error made on putting the cross-wires into the plane of image.

December 15, 1881.—L. T. Fitzinger in the chair.—The following papers were read.—L. Boltzmann, on the theory of the viscosity of gases (part 3).—Some experiments made on the impact of cylinders, by the same.—Fr. Brauer, on the Diptera of the Imperial Museum at Vienna.—A. v. Heider, on the genus *Cladocera*, Ehrenberg.—T. Gaunersdorfer, contributions to a knowledge of the nature of the *heart-wood*.—O. Tumlirz, on the flow of an incompressible liquid through pipes of circular section and of any one shape and situation.—On the rotatory movement of a homogeneous liquid around an axis by influence of friction, by the same.—Bela Haller, on the anatomy of the nervous system of the *Muricida*.—T. V. Rohon, researches on *Amphioxus lanceolatus*.—F. Lorenz, on the skeletons of *Stringops habroptilus* and *Nestor notabilis*.—L. v. Barth and M. Kretschy, on the *Pirotoxin* question.—Sig. Freud, on the structure of nerve-cells of the crayfish.—T. Liznar, on the results of magnetic measurements made in Moravia and Silesia.

PARIS

Academy of Sciences, December 12, 1881.—M. Daubrée in the chair.—The following papers were read:—Surveys and itineraries executed in Tunis, by M. Verrier.—Experiments on the rapidity of absorption of virus at the surface of wounds, by M. Davaine. Small portions of the skin of rabbits were cut out with scissors, and fresh virulent anthracic blood was spread on the wound. After one hour or more, the wound was deeply cauterised. Two-thirds of the animals were preserved (a result quite different from those of Renault and M. Colin, who inoculated animals after making a small sub-epidermic incision, and found cauterisation unavailing. An explanation is offered).—On groups of binary forms having the same Jacobian, by M. Stephanos.—Researches with a view to discover organisms parasitic on phylloxera, by M. Gayon. He found microscopic organisms in a small percentage of phylloxeras examined, and tried to cultivate them. Chicken-broth neutralised with potash, and having a phylloxera (first scorched in flame), or some liquid from its body, put into it, soon swarmed with agile rods (bacteria or vibrions), but the author is not sure that the alterative germs were always from the insects (the development being constant). A curious green crystal-yielding product of those microbes, is noted. M. Gayon, is pursuing his studies.—On equations of the form $\Sigma \int_a^b e^{-zx} F(z)dx = 0$, by M. Laguerre.—On a series of Abel, by M. Halphen.—Remarks on the introduction of continuous functions not having a derivative, into the elements of mechanics, by MM. Appell and Jannand.—On a class of functions analogous to Θ functions, by Mr. Elliott.—On international polar expeditions, by M. Mascart. The object is to study, not the formation and course of cyclones, but terrestrial magnetism and allied phenomena; and in this respect the importance of polar stations is indubitable.—On the methods of comparison of induction coefficients, by M. Brillouin.—On the specific heats of gases at high temperatures, by MM. Mallard and Le Chatellier. They find the mean specific heat of carbonic acid, at constant volume, between 1800° and 0° (referred to the equivalent 44), to be represented by 12·6. It increases continuously up to 2000°, but the rate of increase diminishes with removal from 0°. The formula gives a maximum of 13·7 at 2160°. The specific heats of hydrogen, nitrogen, oxygen, and carbonic oxide, which are equal at 0°, are still so at temperatures exceeding 2000°. The mean specific heat of aqueous vapour, referred to the equivalent 18, is about 11·5 at 1600°.—On the solubility of sulphate of baryta and strontium in concentrated sulphuric acid, by MM. Narenne and Pauleau.—Processes of direct coppering of cast-iron, iron, and steel, by M. Weil. Three are described. The injurious and dear cyanides are replaced by organic acids, or by glycerine.—Pocket-battery with articulated elements, by M. Pulvermacher.—On the decomposition of water by electric effluves in presence of nitrogen, by MM. Deherain and Maquenne. The effluve of high tension causes direct combination of the nitrogen with the elements of the water, producing nitrite of ammonia. This effluve was also proved capable (like that of weak tension) of causing fixation of nitrogen in organic matters.—On the decomposition of metallic formiates in presence of water; production of some crystalline mineral species, by M. Riban.—On the influence of the choroid on acuteness of vision, by M. Fano. He describes observations of the vision of persons having choroidian atrophy.—On tetronerythrine in the animal kingdom, and its physiological *rôle*, by M. de Merejkowski.—On the origin of spermatozoids in hydrozoa, by M. de Varenne.—Note on some points still obscure in the organisation and development of Echinorhynchi, by M. Mégnin. The presence of a bifurcating intestine brings these Helminths towards Trematodes, and removes them from Nematoids.—On the characters presented by speech in deaf-mutes who have learned to articulate sounds, by Prof. Bell.—Observations on the last eruption of Mauna-Loa, from November, 1880, to August, 1881, by Mr. Green. He sends and discusses a series of photographs of the lava current, which is the most remarkable that has occurred within fifty years.

December 26, 1881.—M. Wurtz in the chair.—M. Favre presented a fourth and last batch of M. Chasles' scientific MSS. (the total numbering 113).—On some applications of the theory of elliptic functions, by M. Hermite.—Note on the mode of action of soluble ferments, by M. Wurtz. Pepsine and papaine being fixed, in the insoluble state, on certain albuminoid matters, so modify these that they can be hydrated at 40° by action of pure water, forming true peptones.—Classification of fractures of different orders (lithoclases), presented by the earth's crust, by M. Daubrée. Lithoclases are divisible into—I. Leptoclases: small fractures in two directions or one, and either synclases (*interior* mechanical action) or piesoclases (*exterior*); II. Diaclases: fractures often extending, with nearly plane form, more than 100 m. in horizontal or vertical direction. III. Paraclases: like diaclases, but often exceeding 1000 m. in horizontal direction, and presenting great outthrow of indefinite depth. Examples are given in a synoptical table.—Is the ramification in plants everywhere and always acropetal? by M. Trécul. He is led to a negative.—Reply to M. Daubrée's observations in the *séance* of December 19, by M. Blanchard. M. Blanchard had not questioned the existence of an interior sea in the tertiary epoch, about the end of which he had supposed it to disappear, through elevation. Mere isthmuses would have been insufficient for the dissemination which occurred.—Observations on the state of the Mediterranean at the close of the tertiary epoch, by M. Hébert. He gives evidence of an emersion, more or less, at the end of the miocene, and at the end of the pliocene In pliocene time (he thinks) the bottom had not the great inequalities observed now, these being due to dislocations in the quaternary epoch. On the successive differences of observations, by M. Bréger.—M. Malligand indicated the service rendered by his ebullioscope (for determination of alcohol in wines), which the French Syndical Chambers adopted in 1878.—Elements and ephemerides of the comet *g* 1881 (Swift), by M. Bigourdan.—On the successive differentials of functions of several independent variables, by M. Darboux.—On some examples of reduction of Abelian integrals to elliptic integrals, by M. Picard.—Note on naval tactics calculated by Lieutenants Des Portes and Aubert, under direction of Capt. Trève, by M. Trève.—On the works of the Swiss Seismological Commission, and on earthquakes recently experienced in Savoie, by M. Soret. A peculiar feature of some earthquakes, originating south-east of the Lake of Geneva, is that they had a strong effect on the north side of the lake, but were hardly felt on the south side, though this was nearer the place of origin.—On the function which expresses the gaseous state, and on the function λ, such that $\frac{dQ}{\lambda}$ is an exact differential, by M. Gouilly.—Contractions and dilatations produced by electric tensions in hemihedral crystals with inclined faces, by MM. Jacques and Pierre Curie. Between two bronze plates were secured two systems, the lower (to measure variations of pressure) formed of three large thin quartz plates separated by metallic plates, which were connected with an electrometer; the higher, of three large hemihedral crystals, separated by two copper rundles, on one of which were applied two bases positive by pressure, on the other two negative bases The two exterior bases communicated with earth; the two copper rundles with a Holtz machine. The dilatation of the upper system compressed the lower, and the electrometer was affected. The phenomenon was of the same order of magnitude as theory indicated.—On the decomposition of some metallic acetates in presence of water; production of crystalline mineral species, by M. Riban.—Influence of heat and proportions of glycerine on the decomposition of oxalic acid, by Mr. Lorin. The etherification of formic and oxalic acids is, in this class of experiments, a secondary accident.—On essence of angelica, by M. Naudin.—Method of purifying arsenious coppers, by M. Garnier.—Experimental researches proving that various causes, but especially lesions of the brain, may produce, after death, a general or local contraction, by M. Brown-Séquard.—On the mechanism of motor-troubles produced by excitations or lesions of the circumvolutions of the brain, by M. Conty. The circumvolutions do not seem to have any direct relation to the muscles; it is the spinal cord that plays the predominant *rôle* of centre of reaction and transformation.—On the excretion of uric acid in birds, by M. Cazeneuve. Experimenting with sparrow-hawks, he proved that the stimulation or diminution of combustion does not alter the ratio of the principles excreted. The totality of elements increases or diminishes with the quantity of food ingested; which depends on the stimulant or depressive conditions of the medium.—On the *Gastornis Edwardsii* and the *Remiornis Heberti* of the Lower Eocene of the environs of Rheims, by M. Lemoine.—Do the inferior Crustaceans distinguish colours? by M. de Merejowsky. They distinguish quantity, but not quality, of light.—Prolongation of the vegetative activity of chlorophyllian cells under the influence of a parasite, by M. Cornu. He mentions several cases of analogy to the state of lichens (which have vigorous life, though now understood to consist of an alga and a parasitic champignon).—On Sphenozamites, by M. Renault.—On the supposed organisms of meteorites, by M. Vogt. He controverts this theory of M. Hahn, and argues that the structures are inorganic.

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