THURSDAY, AUGUST 8, 1878

THE JOURNAL OF PHYSIOLOGY

Journal of Physiology. Edited, with the co-operation in England of Prof. A. Gamgee, F.R.S., of Manchester, Prof. W. Rutherford, F.R.S., of Edinburgh, Prof. J. Burdon-Sanderson, F.R.S., of London; and in America of Prof. H. P. Bowditch, of Boston, Prof. H. M. Martin, of Baltimore, and Prof. H. C. Wood, of Philadelphia, by Michael Foster, M.D., F.R.S. (London: Macmillan and Co.)

THERE is perhaps no science which is making more rapid advances than that of physiology, and which is at the same time so interesting to general readers, as well as to those engaged in its special prosecution. A knowledge of the processes of life has such a close relation to individual health and happiness that it ought to be more or less taught to every child at school, and all thinking men must note its advances with interest. So swift is the progress of physiological science, that it has necessitated for this journal a mode of publication, now becoming common in Germany, but of which this is perhaps the first example in this country. Instead of appearing at regular intervals, the *Journal of Physiology* is published in numbers, which are issued at periods varying from two to three months, according to the supply of material sent in to the editors. From four to six numbers will form a volume of about 500 pages. The advantage of this mode of publication is that it prevents a discovery made by one man from being forestalled by another whose observations, although really made later in point of time, might sometimes obtain priority under the ordinary method of publication.

The title-page of the *Journal* shows that it is to some extent an international work, three American co-operating with three English professors, under the able editorship of Dr. Michael Foster. The first numbers contain contributions from the Continent of Europe as well as from Great Britain and America, one of the most interesting articles in them being contributed by a German, Prof. Kühne, of Heidelberg. The range of subjects is very wide, and includes papers on almost every function of the body—innervation, motion, circulation, respiration, and secretion. Some time ago an account was given in NATURE of Kühne's interesting discoveries regarding visual purple, that pigment in the eye which is so susceptible to the action of light. In his present paper he takes up the other pigments of the retina, which are either not affected at all, or only to a slight extent, by exposure to light. He has succeeded in discovering and isolating from a bird's retina no less than three distinct pigments of great stability, and he gives in one paper the mode of preparation, properties, and spectroscopic appearances of these substances. In the same paper he simply mentions the black pigment of the retina, which he regards as exceedingly stable, and little altered by light; but while the number of the *Journal* in which his paper is contained was still passing through the press he made the discovery that this pigment does not resist the action of light so perfectly as he at first supposed, and is slowly altered by exposure. This leads him to remark that "if one considers the extremely widespread occurrence in the animal kingdom of the black pigment of the eye and other similarly stable pigments, it is scarcely possible to repress the idea that these, in addition to visual purple, also represent visual excitants, or so-called visual substances, and are intended to be decomposed by light during life, and to yield those substances which stimulate chemically the terminal apparatus of the visual organ." He also calls attention to the remarkable circumstance that the pigments of a bird's retina he has discovered are so mixed with oil globules that the colours in the cones of the retina represent exactly half the spectral colours, viz., from red to yellowish green, so that with their complementary colours they yield all the colours of the spectrum. He also observed that the three pigments are most readily decomposed by blue light, less by green, and not at all by red. Comment is unnecessary on the importance of this paper in reference to vision.

In a preliminary note Mr. Gaskell contributes some interesting observations on the vaso-motor nerves of striated muscles. He had previously found that irritation of the motor nerve of a muscle dilated its vessels, and increased the flow of blood through it, at the same time that contraction was produced so that fresh supplies of nutriment and oxygen were supplied to the muscle by the blood at the same moment that it was stimulated to work. He has now shown that the same phenomena may be produced reflexly by irritating a sensory nerve, and that the dilatation of the vessels will occur, and the blood will flow more freely through the muscle even when it is prevented from moving by paralysing the motor nerves with curare. On then irritating a sensory nerve, the current of blood is increased as usual in the paralysed muscle, which would have contracted under ordinary circumstances, and thus proof is afforded that the vaso-dilating nerves are distinct from the motor nerves of the muscle.

Mr. Priestley gives a full account of the literature regarding the pulsations of the lymph-hearts in the frog, and he details a number of experiments which demonstrate several new facts, as well as confirm the observations of other physiologists.

In a joint paper, Dr. Gamgee and Mr. Priestley criticise Tarchanoff's statement that each vagus nerve can set in action the whole inhibitory apparatus contained in the heart, and that when this apparatus, whose function is to lessen or stop the cardiac beats, has been exhausted by irritation of one vagus no stimulation of the other can stop the cardiac pulsations. Their own experiments show that even when one vagus has been exhausted, irritation of the other will still stop the heart, and even when both are exhausted the inhibitory apparatus is still active, so that the pulsations of the heart may even then be arrested by galvanism applied to the venous sinus. They therefore conclude that the inhibitory apparatus in the heart is much less easily exhausted by stimulation than the vagi, and that it may still retain its power over the heart although both vagi are so exhausted that they will no longer convey to it a stimulus applied to them.

The question as to whether the apex of the frog's heart contains within itself ganglia which will keep up its rhythmical motion has lately been the subject of lively debate, but Dr. Bowditch brings forward a number of

experiments which seem to point strongly towards a negative answer.

An interesting paper on the respiration of the frog is contributed by Prof. Martin, whose observations strongly suggest a close relationship between the nervous centre which regulates respiration and that which regulates general reflex action, even if the two should not be identical. He discusses the question whether there be two independent, though closely related, nervous centres, one for inspiration and the other for expiration, or whether, as supposed by Budge, there is a single centre from which the muscles of inspiration and those of expiration may receive their innervation according to circumstances. Dr. Martin shows that this latter hypothesis does not hold good for the frog, and that in it there are really two distinct centres, one for inspiration, and one for expiration, each having its own stimulus, and generating its own nervous impulse, which can travel in them only to its own set of muscles quite independently of the resistance opposed to discharge from the other centre.

Those who are interested in the electro-motive properties of muscle will find in this journal an admirable report on this subject by Prof. Burdon Sanderson, in which he gives an account of Hermann's recent work in this department of animal electricity, along with such information both regarding modes of investigation and experimental results as greatly facilitate comprehension of the subject.

A most laborious and fatiguing series of experiments has been made by Mr. North on the effects of starvation with and without severe labour, and on the elimination of urea from the body. These experiments were made upon himself, and, in addition to the personal discomfort produced by a complete abstinence from food, he voluntarily underwent severe exercise upon the treadmill, for the purpose of ascertaining exactly the effect of labour upon the excretion of urea. Flint had found that in the case of Weston, the pedestrian, the excretion of urea was considerably increased during a long walk, and Mr. North's observations go to show that severe exercise does increase the elimination of urea, but the increase is very small, both when the person is fed upon ordinary diet, and when nitrogenous food is entirely withheld. The quantity of urea passed, however, depends largely on the condition of the body at the time, varying according to the greater or smaller reserve of nitrogenous material contained in it, and he thinks that Weston, before entering upon his walk, had accumulated a large reserve, from which the urea he excreted was derived.

The paralysis produced by potash salts when injected into the circulation, is usually ascribed to a special action upon the muscles and heart. Dr. Ringer and Mr. Murrell, however, from a number of experiments on the subject, have come to the conclusion that potash has no special affinity for muscle, but is a protoplasmic poison, having an equal affinity for all protoplasm, and destroying the tissues in the order of their vital endowments.

Mr. Langley has made a number of observations upon the salivary glands, and finds that Nussbaum's supposition that the disappearance of the black colouration produced by osmic acid from the sub-maxillary (?) gland after treatment with glycerine is not due to the removal of ferment from the gland, but to some other cause, and that furthermore an amylolytic ferment does not exist at all in the sub-maxillary gland of the rabbit. He finds that there is a marked difference between the cat and the dog in regard to the salivary secretion, the sympathetic secreting nerves having a different connection with the gland cells in the two animals, a difference which favours the paralysing action of atropia in the cat.

The secretion of sweat is now known to be, like that of saliva, directly under the control of the nervous system, and to be excited by secreting nerves, independently of alterations in the vessels which supply secreting glands. Dr. Ott and Mr. Field show that the nerve centres in connection with the sweat glands can be stimulated by the poison muscarine, and that a greater amount of carbonic acid than usual in the circulating blood will also excite functional activity, a fact which would tend to explain the greater tendency to sweat which people observe when they are shut up in a close room, a tendency which appears to be greater than can be readily accounted for by the warmth of the room alone.

These brief observations will give some idea of the variety of physiological subjects discussed in the *Journal of Physiology*, and we heartily congratulate the able editor and his co-operators on the importance and interest of the results set before us in the numbers which have already appeared. We have no doubt that in such competent hands this journal will continue to maintain its high character, and, while absolutely indispensable to all who desire to follow the progress of physiology, it will, we think, do much to diffuse a knowledge of that science amongst general readers.

A UNIVERSAL GEOGRAPHY

Stanford's Compendium of Geography and Travel, based on Hellwald's "Die Erde und ihre Völker." Africa: Edited and extended by Keith Johnston. *Central and South America:* Edited and extended by H. W. Bates. With Ethnological Appendices by A. H. Keane, B.A. Maps and Illustrations. (London: Stanford, 1878.)

HELLWALD'S "Die Erde und ihre Völker" is well known in Germany, and has achieved a great popularity. We doubt, however, if a simple translation of Hellwald's work would have been either fair or wise; for though it is written more brilliantly than German works usually are, and although Hellwald himself is a competent geographer, it has several drawbacks which we should have regarded as serious defects had they been permitted to stand in this English edition. For one thing, Hellwald is a violent Anglophobist, and he takes every opportunity of depreciating English travellers or ignoring them altogether. We therefore think it wise in the publisher of the English edition to take the German work simply as a basis on which to found an English work that shall fairly represent the present state of geographical knowledge. The method adopted by the publisher appears to us well adapted to attain the end in view. He has succeeded in obtaining the services of geographers having a special knowledge of the various divisions of the earth of which the several sections of the work treat. These editors, taking the translation of Hellwald as their raw material, go over it, correcting and extending as far as they deem necessary in order to

produce a work which comes up to their standard. Thus Mr. Keith Johnston has dealt with Africa, and Mr. Bates with Central and South America; of the future volumes, Europe will be edited by Prof. Ramsay, North America by Dr. Hayden, the chief of the U. S. Geological Survey, Asia by Col. Yule, and Australasia by Mr. A. R. Wallace. It must be admitted that no more competent men could be found for the parts allotted to them, and judging from the two volumes before us, the "Compendium of Geography and Travel" ought to take its place as a standard authority on geographical knowledge and geographical exploration.

The volume on Africa by Mr. Keith Johnston, who himself will shortly lead an expedition to that much-explored continent, contains a complete account of our knowledge of the "dark continent," up to the date of publication, including the recent discoveries of Mr. Stanley. After a general introduction, each of the principal regions of the continent, from the region of the Atlas southwards, is treated separately, in all its aspects —physical, geological, topographical, ethnological, and biological. It is evident that Mr. Johnston has added largely to the German original; indeed, his volume is two or three times the size of the section of Hellwald's work devoted to Africa. The result is a work which gives a full and satisfactory summary of our present knowledge of perhaps the most interesting continent of the globe. It would, however, be a mistake to imagine that the work is a dry geographical treatise; it reads more like a well-written narrative of travel, and besides its value to all interested in geography as a standard work of reference, it will be found genuinely interesting reading. Mr. Johnston's Notes on the distribution of rain in Africa, illustrated by a series of fourteen rain-charts, are of distinct scientific value. Mr. Keane's Appendix on the African Races is evidently the result of long and conscientious research; and while he possibly makes too much of language *per se* as a test of race, he is evidently master of his subject, and has gathered together in a clear and well-arranged form a mass of information of great ethnological value.

To many, perhaps, the second volume, on Central and South America, edited and to a considerable extent re-cast by Mr. Bates, will contain more of novelty than the first, treating, as it does, of a region less familiar to the public than Africa. Under the title of Central America the second volume includes not only the smaller states of the isthmus—Guatemala, Honduras, San Salvador, Nicaragua, Costa Rica, and British Honduras—but also Mexico proper, the whole forming a region probably upheaved by volcanic agency, and which seems to taper away gradually from north to south. The area of this large district of country exceeds more than five times that of Spain, and would seem to be sufficiently distinct both in a geographical and geological point of view from those broad continental expanses known as North and South America. The highlands of this district form a series of wonderful lofty table-lands, intersected by detached hilly portions and flanked by commanding volcanic peaks. In some places these table-lands rise in terraces one over the other. In others these will be suddenly interrupted by deep intervening valleys of very various forms, sometimes mere chinks, at other times fissures of variable breadth and upwards of a thousand feet in depth between whose steep rocky walls flow little streamlets. The great mountain-chains culminate in such giant volcanic peaks as Popocatepetl, which is nearly 18,000 feet in height.

In addition to the chapters describing the physical and natural features of this area, and a brief account of its former wondrous greatness, there are chapters on the present inhabitants, and copious information is given as to each of the States. Especially would we note the chapters relating to the population and government of Mexico.

The second division of Mr. Bates's volume is devoted to the West Indian Islands. This large group of islands lying east of Central and north of South America, includes Cuba, Jamaica, Hayti, and the Lesser Antilles. The condensation of this part is carried too far. These islands awaken many memories of the past, not, indeed, of a prehistoric past, like those that cling round Mexico, but as it were of a modern past, with which some of our own island glory is connected, and it would have been well had the editor not only edited, but extended, from the English point of view, Hellwald's notices of Jamaica, Cuba, and Hayti. In an appendix it is true there is a most useful tabulated survey of the principal islands in this group, which gives details of their population, a list of their chief towns, and a short account of the products and industries of each, but what we would have liked would have been to have had all this incorporated in the text, with a short account of the past greatness if any of each of the larger islands.

The third division treats of South America, a well-defined continent, over some portions of which our editor has often wandered, a continent, the greatest in the world for some of its natural wonders, a continent conspicuous for its mighty mountain ranges, for the peculiar way in which these run, which fact in combination with their great height and their vast woody slopes, accounts for their giving birth to so many gushing streamlets which, in their turn uniting, form so many mighty rivers, by which the future greatness of this part of the world will be achieved. The carefully edited chapters of this section read—though not exaggerated in tone—like so many pages from some tale of fairyland. Passes over mountains upon the snow—just on the very line of eternal whiteness with bright flowers and brighter humming-birds, views from these lofty eminences that no words can describe, views of nature in its vastness and its greatness that seem to pain the human soul because it has to confess its inability to take them wholly in. Then the vast steppes or llanos, then those rivers, such as the Amazon and her tributaries, and lastly the volcanoes. Amid all this nature the great towns and the varied peoples of South America are, however, not overlooked, and there are some good woodcuts illustrating the chief features of both scattered through this portion of the volume.

The chapters also on the natural products and resources of the various tribes and people are most interesting, and the statistics seem to prove that the leaven of civilisation is at last beginning to work in the huge human mass.

The chapter on the ethnography and philology of the American continent, by Mr. Keane, covers 100 pages, and seems all but exhaustive; it is accompanied by several maps, and, as in the case of Africa, by a long list in

alphabetical order of all the known American tribes and their languages. Each volume has a good useful index, a most important item in a work of this nature.

The abundant equipment of maps adds greatly to the value of the volumes, as the numerous illustrations do to their interest.

OUR BOOK SHELF

Geometry in Modern Life, being the Substance of Two Lectures on Useful Geometry, given before the Literary Society at Eton. By J. Scott Russell, F.R.S. (Eton: Williams and Son, 1878.)

IN a recent number (NATURE, vol. xviii. p. 263) we took occasion to suggest that the usefulness of a school scientific society might still further be increased by calling in the assistance of scientific men to deliver lectures which should be open not merely to the members, but also to a wider circle. The literary Society at Eton has, we believe, adopted this plan on very many occasions; recently it will be remembered that Mr. Gladstone addressed the society on Homer. Mr. Russell's lecture is a full one, and on the lines which it follows, a useful one. "Geometry is a pure science, gives logical training, is a discipline of thought, is an instrument of human culture, and has high educational value. But geometry is equally the development of a method pervading nature; its mastery gives man a power to govern matter. The training which enables him to comprehend the mechanism of the universe, enables him also to make creations of his own in harmony with those greater designs of which his own are but a small portion. These two uses of geometric education the one purely gymnastic, the other practical and technic, may be so combined that each shall aid and not impede the other. The order, number, and measure which pervade the universe can be easily brought within the scope of elementary education, and so form the fit preparation for scientific observation and experiment in later life, by means of which the standard of application of abstract truths to matter and events in human life are determined and made familiar. But the one learning cannot be too soon begun, nor the other too long continued, and each is a material aid to the other." This extract shows the author's views, which he has worked out in some detail. Starting from the Greek geometry, he passes on to useful geometry: its applications to land-measuring, trigonometry, navigation. He touches also on numbers, goes on to symmetry, harmony, melody, then to light, shape, and shadow. He closes with a chapter on matter, force, and motion. To sum up, the whole furnishes a quantity of illustration from an eminent practical man, which is likely to be profitable to teachers in search of such illustration—to allure the "what's the use of it?" boys who form a part of every mathematical master's geometrical classes.

Die Geologie der Gegenwart. Dargestellt und beleuchtet von Bernhard von Cotta. Fünfte umgearbeitete Auflage. (Leipzic: J. J. Weber, 1878.)

THE appearance of a fifth edition of von Cotta's well-known work is a sufficient proof of its popularity—a popularity which, in spite of some unfortunate drawbacks to its usefulness, we cannot but regard as being well deserved. Since the first appearance of the volume in 1866 it has been steadily growing in bulk, and in the present edition the author has brought his work up to date by noticing the principal contributions which have recently been made to geological science. Among such additions we may point to his notices of the method of study of rocks by the means of the microscope, of the new classification and nomenclature of the stratified rocks suggested by Carl Mayer, of the results of the *Challenger* expedition, of the latest speculations on the causes of volcanic activity and the nature of meteorites, and of Croll's theory of the recurrence of glacial periods. The coloured frontispiece now added to the work, we can scarcely regard as an improvement, seeing that it tends to perpetuate those views of the restriction of certain classes of volcanic products to distinct geological periods, which, though so frequently insisted upon by German petrographers, do not appear to be sustained by extended observation in the field.

Ocean and Her Rulers. By Alfred Elwes. New and Revised Edition. (London: Griffith and Farran, 1878.)

Under the Red Ensign. By Thomas Gray. (London: Simpkin, Marshall, and Co., 1878).

THESE are two good books, each in its way. The former is a narrative of the nations which have from the earliest ages had dominion over the sea, comprising a brief history of navigation down to the present time. It is evidently intended for boys and is likely to interest the more thoughtful of them and send them to works which will give a more detailed account of the peoples whose exploits by sea are told, and lead them to take an interest in geographical discovery. The reading is rather miscellaneous and unconnected, and the information sometimes undigested, but as a whole the book is useful and interesting.

Mr. Gray's booklet is one that will prove thoroughly useful to parents intending to send their boys to sea, as well as to the boys themselves. Mr. Gray knows well what he writes about, and the information and advice he gives as to the choice of a sea-life as a calling, how to get a boy launched into it, what kind of ship to choose, how the boy should conduct himself, what books he should read, and a multitude of other points are admirable. We are glad to see that among the books he recommends a large proportion are standard scientific works.

Memoir of the late Alfred Smee, F.R.S., by his Daughter. With a Selection from his Miscellaneous Writings. (London: George Bell and Sons, 1878.)

MR. SMEE was in many respects a remarkable man, and this readable memoir by his daughter will, we doubt not, be acceptable to those who knew him personally or through his works. An Appendix contains about forty papers, letters, pamphlets, &c.; these occupy quite two-thirds of the volume.

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.*]

An Intra-Mercurial Planet

WITH reference to the important announcement, by telegram, of the discovery by Mr. Watson of an intra-Mercurial planet during the late eclipse of the sun, it may be worth remarking that the position of θ Cancri agrees very well with that given in the telegram published in NATURE, and that there may be a possibility that the object observed is in reality this star. The position of the suspected planet recorded by Mr. Watson is R.A. 8h. 26m., and N.P.D. 72°; the apparent place of the star, computed from the mean place given in the new Nine-Year Catalogue for 1872, January 1, is, for July 29, R.A. 8h. 24m. 40s., and N.P.D. 71° 29′ 40″. The magnitude of this star is, however, smaller than that given by Mr. Watson, that in the British Association Catalogue being 5½, and that in Argelander's

Uranometria Nova 6. This discrepancy may very easily occur in the hurry of such a sensational observation, as on these occasions the time at the disposal of the observer is so limited.

Royal Observatory, Greenwich, G. B. AIRY
August 3

Floating Magnets

I HAVE no intention of discussing the beautiful experiments of Prof. A. M. Meyer on floating magnets; but as a privately-expressed opinion of mine has appeared in NATURE, vol. xviii. p. 260, I feel bound to defend it. The mutual repulsion of the vertical floating magnets varies nearly inversely as the fourth power of the distance at great distances, and nearly inversely as the square at small distances. The horizontal attraction of the magnet, held vertically over the water, varies nearly inversely as the fourth power at very great distances. At a certain moderate distance it reaches a maximum, and close to the centre it varies directly as the distance. It is easy to see that variations of the magnetisation of the lengths of the magnets, and of the distance of the large magnet from the surface of the water, may render configurations stable which would, under different conditions, be forms of unstable equilibrium. Prof. Meyer thinks that the configuration . . can never be stable. It is easy to see that it is a form of equilibrium, and in fact that any given size of hexagon will be brought into equilibrium by placing the large magnet at a suitable distance. It may, therefore, be in equilibrium when the floating magnets are on the circle of maximum attraction of the fixed magnet. But, in this case, the equilibrium is stable; for work would be expended in altering in any way the position of any one of the floating magnets. If this one is carried away from the others they repel it less, and it will be brought back; if it is carried nearer to the others they repel it more, and again it will be brought back.

The nature of equilibrium where there are several degrees of freedom may be illustrated by considering a tract of country upon which water can run. The hollows are positions of stable equilibrium; the summits and passes (saddles) are positions of unstable equilibrium. Then, if any one speaks of the former as more or less stable (as Prof. Meyer does of stable configurations), he may be understood as having reference to the curvature of the hollow, or to its level, or to some vague and mixed characters. It is very easy to understand why the form . ⋮ . should be difficult to produce or maintain. It is because the floating magnets are in this case at much greater distances from the centre than when they assume the form ⋮ Hence, the potential energy of the former configuration is much greater than that of the latter. The reverse is the case with ⋮ and ⋮, and still more so with . . and ⋮ ⋮, and so with greater numbers of magnets.

C. S. PIERCE

Mons. A. Cavaillé-Coll on Musical Pitch, the French Diapason Normal, Scheibler's Tuning-Forks, &c.

IN the course of my researches on musical pitch, with the view of discovering the source of the discrepancy between Appunn's and Lissajous's measurement of the French diapason normal, I have had the good fortune to enter into correspondence with M. Aristide Cavaillé-Coll, the celebrated Parisian organ-builder, and in his long and obliging answers to my inquiries he has communicated some facts which I have thought it important, with his permission, to lay before the readers of NATURE, as far as possible in his own language.

Scheibler, and the Persistency of the Pitch of Tuning-forks.—M. Cavaillé-Coll had the advantage of personally knowing Heinrich Scheibler, silk manufacturer, of Crefeld, near Düsseldorf, who died November 20, 1837. Scheibler's experiments on tuning, with which I had long been acquainted, are the most important hitherto made; but I had feared that his wonderfully accurate tuning-fork tonometer was irrecoverably lost. I find that M. Cavaillé-Coll is fortunate enough to possess one, and Herr Amels, of Crefeld, another, that is, a series of fifty-six forks, proceeding by degrees of four beats in a second, from A 220 to A 440 double vibrations in a second, which last was adopted by the Stuttgart Conference in 1836 as the best normal pitch. This was chosen by Scheibler as his standard, because it was the mean of the Viennese grand pianos in his day. Of him M. Cavaillé-Coll says:—

"M. Scheibler n'était pas un savant, mais, en s'appuyant sur les expériences faites par Sauveur en 1701 pour la détermination d'un son fixe, il était arrivé par ses patientes recherches à créer, en 1834, un tonomètre différentiel de la plus rigoureuse exactitude et qui n'avait pas été fait avant lui."

Of the exactness with which Scheibler worked M. Cavaillé-Coll gives the following remarkable proof, which is at the same time a proof that tuning-forks will preserve their pitch for at least twenty-eight years; so that there is no reason to suppose that, when properly protected, they will not form a lasting record. This was a point on which I dwelt much in my letter to M. Cavaillé-Coll, because it has been often thought that they might vary considerably. See Zantedeschi (*Sitzb.* Vienna Acad. vol. xxv., year 1857, p. 172), whose conclusions I believe to be erroneously based. M. Cavaillé-Coll says, in his first letter (January 24, 1878):—

"En 1862, j'ai eu l'avantage d'assister aux expériences faites par M. Léon Foucault pour la détermination expérimentale de la vitesse de la lumière. Ce savant expérimentateur, que la mort a enlevé à la science en 1868, se servait, pour mouvoir son miroir tournant, d'un petit tambour mis en mouvement par une soufflerie et un régulateur de pression que je lui avais établis; laquelle turbine devait faire 400 tours à la seconde. Or avec cette vitesse, la turbine faisait entendre un son d'axe dont le nombre de vibrations correspondait au nombre de tours." In a subsequent letter (February 8, 1878) M. Cavaillé-Coll adds:—"M. Léon Foucault, bien qu'il fit construire ses instruments par les premiers constructeurs, était toujours obligé de les vérifier et de les rectifier lui-même pour arriver à la régularité de marche qu'il avait en vue d'obtenir."

"Pour mesurer la vitesse de la turbine, M. Léon Foucault avait imaginé un moyen nouveau que je vais essayer de décrire. D'abord une pendule de précision, construite par l'habile constructeur Froment, mettait en évidence une roue dentée de 400 dents, laquelle faisait un tour entier par seconde. Ensuite, la turbine était disposée de manière à réfléchir un rayon lumineux du miroir tournant sur les dents de la roue. Or la coincidence des rayons lumineux avec le passage des dents de la roue de la pendule permettait de reconnaître, à l'immobilité apparente des dents de cette roue, que la vitesse de la turbine était alors exactement de 400 tours par seconde." This description is necessary to understand the extreme delicacy of the test of Scheibler's work, which follows. "Un jour que j'assistais à une de ses observations, M. Léon Foucault me dit: 'Si nous avions un diapason exactement accordé de 400 vib. par seconde il devrait se trouver d'accord avec le son d'axe de la turbine? Sans rien dire à M. L. Foucault, je cherchai dans mon tonomètre de Scheibler un diapason de 400 vib., et l'ayant comparé avec le son d'axe de la turbine, je le trouvai si exact que je fus émerveillé de constater que par des moyens différents et à plus d'un quart de siècle de distance ces deux savants expérimentateurs avaient atteint avec la même perfection la détermination d'un son fixe donnant exactement 400 vib. par seconde. Cette circonstance est venue confirmer dans mon opinion que le tonomètre de H. Scheibler pouvait être regardé comme un instrument de la plus haute précision." M. Cavaillé-Coll concludes:—"Dans mon opinion le diapason conserve le même ton à la même température. Il n'y a que l'altération du métal lui-même qui puisse faire changer le ton; mais si l'on prend les soins nécessaires pour préserver les diapasons des influences climatériques, comme le faisait H. Scheibler, on peut être à peu près certain qu'ils conservent le même ton."

Improvements in the Siren, Bellows of Precision, Double-Action Counter.—M. Cavaillé-Coll was also personally acquainted with M. le Baron Cagniard de Latour, and was "initié à ses travaux." He calls him "un des plus savants acousticiens français du siècle présent," and says he is "sans contredit le véritable inventeur de la syrène;" adding, "la date de la création de ce merveilleux instrument, qui se trouve aujourd'hui dans tous les cabinets de physique d'Europe, remonte à l'année 1819;" and he complains that Helmholtz should have mentioned Seebeck's first, even on the score of simplicity of construction, as it was invented so long afterwards.

The difficulty of using the siren for the exact determination of pitch is ordinarily very great, so that observations made by it without proper precautions are, as a general rule, defective. The causes of error (besides imperfect workmanship) are—1. The difficulty of estimating with precision at what time the continually rising pitch of the siren note reaches the height of the continuous tone with which it is compared, precise equality of pitch (as in the example just given) being always extremely difficult to attain, and also to verify, except under the most favourable circumstances, and with the siren the circumstances are most unfavourable; 2. The difficulty of obtaining a blast under constant pressure to make the tone of the siren continuous; and 3. The difficulty of comparing the counter of the rotations of the siren's disk with the seconds counter. Now M. Cavaillé-Coll, as an experienced, ingenious, and scientific organ-builder, turned his attention in the first place to the second difficulty, which when overcome would obviate the first. It is clear that if the tone of the siren could be indefinitely sustained at the same precise pitch, it could be completely compared with another tone either by unison or by beats. In 1863 (*Comptes Rendus*, vol. lvi. pp.309-443) M. Cavaillé-Coll invented a "soufflerie de précision" for giving a constant blast, applicable not only to the siren but to many other scientific instruments. The complete bellows, such as he furnished for the physical laboratory of the Sorbonne, is expensive (about 80*l.*), but he has arranged "un petit modèle de soufflerie de précision pour des expériences d'acoustique, et que j'estime à 500 fr.," 20*l.* (not including the siren), inclosed in an oak case about 27½ inches long, 17¾ inches wide, and 32½ inches high, and therefore of most convenient dimensions for an experiment. "Cette soufflerie," he says in his letter of February 8, 1878, in answer to my inquiries, for the small model is not described in the *Comptes Rendus*, "est mise en jeu par une pédale en fer à la portée de l'opérateur. Au-dessus de ce bâti est un grand régulateur de pression communiquant avec un sommier de 13 notes sur lequel on peut monter toute espèce de tuyaux; de chaque côté du grand régulateur et communiquant avec lui, j'ai disposé deux petits régulateurs angulaires à poids curseurs, avec leurs sommiers sur lesquels on peut monter soit la syrène, soit deux tuyaux pour l'étude des battements. Sur le sommier du grand régulateur de 13 notes j'ai placé une série harmonique de tuyaux à bouche du ton de 8 pieds à partir du 3ème (*Ut* de 2 pieds), et composé de 13 tuyaux d'étain exactement accordés, donnant les sons 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 et 16. Bien que les trois premiers tuyaux de la basse manquent, cette série des sons harmoniques naturels permet néanmoins de faire de bonnes expériences sur le *timbre*, et sur les *sons résultants*." I have given the description of this instrument at length, because it is evidently precisely what is wanted for acoustical experiments. The ordinary laboratory blowing apparatus I have found quite useless for experiments on pitch and beats. By means of these constant action bellows it is possible to maintain any tone on the siren for many minutes, and hence the two first difficulties are overcome. The third difficulty (of counting), not to mention insufficient accuracy of workmanship in the siren, still remained.

"En général," remarks M. Cavaillé-Coll in his letter of February 8, "l'exécution de ces appareils [les syrènes de commerce] laisse beaucoup à désirer. Quand j'ai voulu faire des observations exactes, j'ai dû faire retoucher l'appareil avec beaucoup de soin par un de mes employés; mais après avoir obtenu la régularité du mouvement de la syrène, j'ai rencontré une nouvelle difficulté pour marquer exactement la durée de l'observation au moyen d'une pendule à secondes. C'est alors que j'eus l'idée de compléter la syrène par un compteur à pointage, que me permet d'embrayer du même coup le compteur de la syrène et le compteur à secondes, de manière à bien préciser le point de départ et le point d'arrivée de l'observation. Je construisis à cet effet un petit appareil en bois que je conserve dans mon cabinet comme souvenir historique de mes essais, et qui fonctionnait fort régulièrement. Plus tard j'ai composé le dessin d'un appareil plus élégant, pouvant se fixer sur l'armature de la syrène, et j'en ai confié l'exécution à l'opticien qui avait établi ma syréne, espérant que cela pourrait lui donner l'idée d'en construire de semblables pour le commerce; mais ce petit travail fut mal construit, et ce n'est que longtemps après que j'ai pu faire exécuter sous mes yeux, dans mes ateliers, l'instrument que j'ai montré, et qui est encore unique en son genre."

By means of this complete regeneration of the siren, M. Cavaillé-Coll says, in his memoir in the *Comptes Rendus*, that he has been able to "faire des expériences qui ont duré plus de dix minutes, avec une telle exactitude, qu'en répétant plusieurs expériences les résultats n'ont jamais varié que de quelques vibrations sur 50,000 environ." In his letter he says:—"J'ai fait à cette époque (1858-9) avec mon appareil, plusieurs observations dont la moyenne concordait avec les nombres constatés au tonomètre de Scheibler."

Pitch of the French Diapason Normal, and how Lissajous determined it.—As regards its pitch, M. Cavaillé-Coll has carefully compared the French diapason normal with Scheibler's 440 double or 880 single vibrations, the accuracy of which, after the striking proof already given of Scheibler's exactness, admits of no question. He says, on January 24:—"J'ai trouvé alors, que notre diapason normal de 870 vib. simples, donnait exactement 871·75 vib. par seconde, d'où il résulte que notre diapason, au lieu de 435 vib. doubles, donnent 435·875 vib., soit près d'une vibration sonore en plus que le chiffre de 435 vib. assigné par le rapport de la commission."

This is a most important piece of information. Copies of the French normal are easily procured, but they almost all vary by some vibrations in ten seconds, even when costing 20 to 35 francs. I have given means of making forks of 440, 256, 512 vibrations, according to Scheibler, and hence also of the exact pitch of the French normal, to Messrs. Valentine and Carr, 76, Milton Street, Sheffield, successors to, and long workers with, Mr. Greaves, from whom physicists can be pretty sure of getting any pitch they like, within a few tenths of a vibration, for 3*s.* a fork, small size, but sounding 20 to 30 seconds. I mention the names of these workers because people do not generally know where to go for such work, and it is not safe to give orders second-hand through the music-sellers. For larger forks and greater accuracy, and of course much greater cost, perhaps Mr. Ladd, of Beak Street, would be the best person to consult, but he uses Koenig's pitch. Messrs. Valentine and Carr can also make large forks if required. Time must also be given. To make a fork with perfect accuracy is often two or three weeks' work, for after filing, the pitch rises, and the fork has to rest three days at least before it can be tried again. This was Scheibler's experience, fully confirmed by my own.

Now, my observations on Appunn's instrument, just finished, but not reduced, show that his numbers are in excess about one per cent., a little more or less. His tonometer, when in perfect condition, gave the pitch of Broadwood's copy of the French normal, presented by the French Commission in 1859, as 439 exactly. As Koenig's forks showed perfect intervals when measured by this tonometer, we may take it as almost, if not quite, exactly correct that the acceleration of the beats in that instrument is uniform throughout. This would show that Appunn's numbers should be reduced in the proportion of 435·875 to 439, in order to obtain Scheibler's pitch, which is probably as accurate as we can hope any measurement to go. But I have since found that Broadwood's copy was not quite accurate, and that the best approximate rule is to throw out 1 in 123 vibrations. Thus the fork of the Liceo Musicale of Bologna, sent officially to the Society of Arts in 1869, and measured "graphically" at Bologna as 443·89, but measured by me with Appunn's tonometer as 447·2, would be 443·6 by Scheibler's pitch, and this agrees with actual measurement by Scheibler's 440. Again, by Appunn's tonometer, Koenig's Ut_3 was 258·4, which, corrected as above, gives 256·3. Now the measurements of Koenig's Ut_3, by Prof. Alfred Mayer and Prof. McLeod, with their own special instruments, give the pitch nearly as 256·3, and this agrees with actual measurement by one of Scheibler's own forks given me by M. Cavaillé-Coll.

For some time I had vainly endeavoured to learn the method employed by M. Lissajous to determine the pitch of the diapason normal, which I regarded as of great importance in the history of practical music. I am indebted to M. Cavaillé-Coll for the following information (on February 8):—

"M. Lissajous s'est servi de la syrène de M. Cagniard de Latour, mise en jeu par ma soufflerie de précision, munie d'un régulateur de pression, pour déterminer le ton du diapason normal. Quant au compteur à secondes dont j'ai armé ma syrène, je ne pense pas que M. Lissajous en ait eu connaissance lors de la détermination du diapason normal, et c'est peut-être à cela qu'est dûe la petite erreur que j'ai constatée par mes expériences à la syrène et par comparaison avec le tonomètre de Scheibler." "Je n'ai pas assisté," he had written, on January 24; "aux expériences de M. Lissajous pour la détermination du ton normal, vu qu'à cette époque nous n'étions pas d'accord sur

l'abaissement du quart de ton qui a été fixé par la commission. Je voulais, avec quelque raison, je crois, fixer le ton du diapason à 888 vib. qui avait pour base l'*ut* de 32 pieds égal à 33 vib. par seconde, le *la* géometrique = à 880, et le *la* tempéré 888, ainsi que je l'ai expliqué dans la petite brochure, 'De la Détermination du Ton Normal ou du Diapason pour l'Accord des Instruments de Musique,'" published originally in *L'Ami de la Religion*, February 6, 1859, before the normal La was fixed. At the close of this paper M. Cavaillé-Coll says, in favour of 888 v. s., besides his present remarks, "Ce nombre, qui se trouve de 8 vibrations plus élévé que le *la* normal du congrès de Stuttgard et de 8 vibrations plus bas que le diapason de l'Opéra de Paris [en 1857] aurait, suivant nous, le mérité, s'il était adopté, de concilier les exigences de la science physique et les besoins de l'art musical." The peculiarity that C 264 gives a just A 440 $= \frac{5}{3} \times 264$, and a tempered A 444, has been productive of some confusion. The committee called together by the Society of Arts in 1859 recommended the Stuttgart pitch A 440, which they considered would give C 528, whereas on equal temperament it would give C 523¾. But they made C 528 their standard, which would give the tempered A 444, and the Society of Arts commissioned the late Mr. J. H. Griesbach to make them such a fork, for which he employed the instrument now in room Q of the South Kensington Museum, and to this he endeavoured to make an equally tempered A. His results in place of C 528, A 444, were, when reduced from Appunn's to Scheibler's standard, C 535 and A 446, which do not even agree with each other, for his C requires an A 450, and his A requires a C 530, both being rather sharper than was intended. In the organ of the cathedral of St. Denis M. Cavaillé-Coll measured the pitch as A 444·25, by means of the siren, but before the application of his bellows of precision. The Bolognese fork, already mentioned as being nearly A 444, was also measured at Bologna by the siren, but the result is not stated in the report preserved by the Society of Arts.

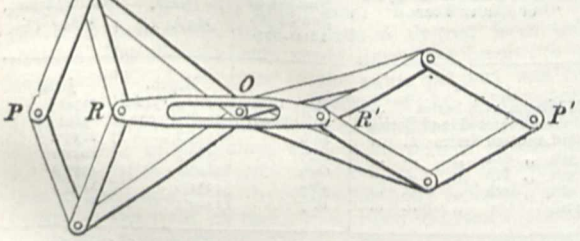
As regards the introduction of equal temperament into France, M. Cavaillé-Coll informs me that up to 1834 their house tuned on the old mean-tone principle, but that subsequently to 1834 he has consistently laboured to carry out the equal temperament. He thinks, however, that equal temperament was used for pianos before that date. I may mention that the change was made at Broadwood's, in London, between 1841 and 1846. That at the first Great Exhibition of 1851 in London, only one organ (by Schulze) used equal temperament, and that at least three organs had not adopted it a year ago (St. George's, Windsor, Turvey Abbey, and Norwich Cathedral).

Kensington, W., July 13 ALEXANDER J. ELLIS

Peaucellier Cell

THE following application of the Peaucellier Cell may possibly interest some of your readers. The object of this arrangement is to make two points—one on each side of a lens—move in such a way as always to remain at conjugate foci.

In the accompanying wood-cut P, R, and P′, R′, are the poles of two cells, alike in all respects, which have a common origin



at O; and the poles R and R′ are connected together by a bar with a slot in it, through which the pin which forms the pivot at O passes. Then if P, R, P′, R′, are constrained to keep in a straight line, P and P′ can approach or recede from O, only in such a way that, if there is a lens of proper focal length at O, P and P′ will always be conjugate foci.

This is easily proved thus:—

Suppose P O $= p$, P′ O $= r'$,
R O $= r$, R′ O $= p'$,

and the bar R R′ $= l$.

From the property of the cell,

$$r = \frac{k}{p} \quad r' = \frac{k}{p'}, \text{ where } k \text{ is a constant,}$$

$$l = r + r' = k\left(\frac{1}{p} + \frac{1}{p'}\right)$$

$$\frac{1}{p} + \frac{1}{p'} = \frac{l}{k}.$$

Hence, if $\frac{k}{l}$ is the focal length of the lens, P and P′ are conjugate foci.

Mr. Francis Galton wanted to use the above arrangement, but found he could not get sufficient range unless the cells were made of unwieldy size. HORACE DARWIN

The Microphone

IN reproducing the experiments first made by Prof. Hughes with the microphone, I interposed in the circuit a galvanometer, and first found with the battery used (made with three small glass cones, as used by Prof. Hughes), when the microphone was not in the circuit, the current was sufficiently strong to deflect the needle to 40°. Now interposing the microphone, made of mercurised carbon peas in a small glass tube, it acted well as a transmitter only when the pressure on the carbon peas was so adjusted that the needle of the galvanometer stood about 15°.

When the pressure was very slight and the resistance to the current so great that the needle swung only to 5° or 8°, then the "continuous distant waterfall roar" of the telephone was plainly audible. The slightest sound of the voice in the room would produce the painful *pat*, *pat*, indicating an intermittent current and not a continuous one of varying intensity.

This "distant waterfall roar" emitted by the telephone, not unlike the "murmur of the sea-shell," was in all respects similar to the sound familiar to those who have attempted to use a telephone whose line was greatly affected by the induced currents of a number of proximate telegraph lines in active use. When the pressure of the carbon peas was so slight and consequent resistance great, the vibrations of the air in the room, when most quiet, so increased and diminished the resistance to the electric current as to cause the incessant tremor of the tympanic plate of the telephone, and thus rendered audible the constant murmur.

Among many other methods I tried a torsion pendulum, made by suspending, with a small cotton cord, a double cone of mercurised carbon an inch long, between two pieces of carbon less than an inch apart, to which the connecting wires were attached. The pressure was regulated by the torsion of the cord. In this simple manner any required delicacy was easily attainable.

Vanderbilt University, Nashville, Tenn., July 1 WM. LEROY BROUN

OF the many ingenious forms the microphone has taken—and I believe I am acquainted with most of them—none is, I think, more efficacious than the one I offer for your inspection. The jarring sound in the principal instruments in use, which, by vibration, may emanate from passing vehicles, &c., is entirely obviated, and the sound of a piece of fine silken thread, or the now well-known tramp of a fly, is heard with double the distinctness of any microphone I have listened to.

It consists simply of a cup and ball of carbon, the cup being fastened to a small piece of board, and one of the insulated wires attached to it in the usual manner, while the other is carried through the bottom of the cup sufficiently far to touch the ball without disturbing it in its socket.

From this little instrument I have obtained the most satisfactory results, and have heard distinctly that which I had to strain my hearing to catch before. Unless my "idea" is already anticipated, might I ask you to make it known to your numerous readers? GERALD B. FRANCIS

23, Bessboro' Gardens, S.W., July 24

A Simpler Form of the Phoneidoscope

MOST of your readers will be familiar with Messrs. Tisley and Spiller's beautiful instrument, known as the phoneidoscope. In using it, however, I have found certain defects, which my improvement on it is intended to obviate.

These are :—

1. That it is sometimes difficult to adjust the angle of the film so as to get the best light on it.

2. It is impossible to vary the distance of the film from the mouth so as to use both loud and faint sounds.

3. There is no means of adjusting the tension of the film.

My phoneidoscope, which is free from these defects, and which I have found to work exceedingly well, simply consists of the hand and some soap-suds. The forefinger and thumb being bent so as to form a circle, a soap film is drawn across them with the other hand. By turning the wrist, the angle which the film makes with the direction of the light can be accurately adjusted.

A motion of the elbow alters the distance from the film to the mouth, and by slightly separating or bringing together the finger and thumb, the tension of the film can be exactly regulated so as to give any degree of sensitiveness that may be desired.

The extra delicacy obtained by this adjustment much more than counterbalances the absence of the tube and mouthpiece.

Pixholme, July 30 J. E. H. GORDON

Spectrum of the Electric (Jablochkoff) Light

I WOULD suggest that when your readers visit Paris they should take their pocket spectroscopes. They will find a very interesting spectrum in the electric lamps now being used for lighting some of the principal public places in the city. One might have expected to have found from the brilliant spark inclosed in a white opaline globe a continuous spectrum such as is afforded by the voltaic arc. But the contrary is the case. The Jablochkoff candle now in use in Paris, even when viewed by one of Browning's small pocket instruments, presents a very complicated and highly interesting spectrum. I had no chart with me for comparison, nor did I, as I intended subsequently, make even a rough record of the spectrum; but speaking from memory, I may say that several lines in the blue and green were very marked and distinct, and, in fact, the whole spectrum was traversed by bright and dark lines. I thought, probably, some of these dark lines might be due to absorption by the white opaline glass globe, but I have tested several specimens of this white glass, and I find it does not alter in any way (except by generally reducing its brilliancy) a continuous spectrum, nor does it change the character of the solar spectrum. We must, then, turn to the light itself and to the atmosphere surrounding it for the cause of these phenomena. I believe that in a chemical sense there is no difference between the ordinary electric arc between the carbon points and the arc of the Jablochkoff candle, except that between the carbon points of the latter is a rod of kaolin, which has, I think, a calcium base. This kaolin is intensely heated by the current, and is volatised at the same rate as the carbon rods by the alternative current which this form of candle requires. The light, therefore, is a combination of the electric and the lime light, the current taking the place of the oxy-hydrogen elements. The surrounding atmosphere will be the same in both cases, but the products of combustion will obviously be different, and partly so from the composition of the kaolin. Still, I confess that I cannot suggest the cause of this complicated spectrum, and I hope that some observers who have more accurate means and more experience will give us the *rationale* of the phenomena.

I may say that there is not at present any Jablochkoff candles to be seen in use in this country, but in the course of two or three weeks they will be introduced into a large establishment, where excellent means of observation will be afforded.

Royston House, Tottenham, July 27 E. WALKER

P.S.—Since forwarding the above I have observed the Loutin light now on view at the Gaiety Theatre. The spectrum is somewhat similar to that of the Jablochkoff light, but much less distinct. This is probably owing to the circumstance that at the Gaiety the arc is inclosed in a small opaline globe, which is itself encased in an ordinary ground glass lanthorn (the proper lamps came to grief in transit), this diffusive ground glass causing, by overlapping, the indistinctness. Still there are absorption bands and some remarkable bright lines, which, with my small pocket instrument, I will not attempt to define. Nor, as it is a matter for careful observation, will I speculate further than to suggest—seeing that the Loutin light is from the carbon points only—that the white opaline glass may exercise a selective power over the spectrum given by this high state of incandescence which it does not in ordinary cases, and may give us also, to an extent, the actual wave due to a particular element rather than its obscuration. If so the Loutin light should differ somewhat from the Jablochkoff light, being deficient of the kaolin. E. W.

The Meteor Showers of July

THE prominent shower of *Aquarids* mentioned in my letter in NATURE, vol. xviii. p. 356, had become extremely feeble on July 31 and August 1, for of 136 shooting stars seen on those nights only three or four were conformable to that radiant point which, from a careful re-examination of all the paths recorded from it, is situated exactly at 341°—13°, near δ Aquarii (from fifty-four meteors).

Between July 26 and August 2 403 shooting stars were recorded here, of which no less than sixty-three (including one perfectly stationary) belonged to a very sharply-defined radiant near χ Persei, at 32° + 53°. Fourty-four of these were noted on the three nights, July 30-31 and August 1, when the shower appeared to attain its full intensity. The meteors were very swift with short paths (of about 7°), and almost invariably left streaks of 3° or 4°. They were shorter and less bright than the August *Perseids* at 43° + 58°, and in strong contrast to the long, slow meteors of *Aquarids* seen on the few preceding nights. This very rich stream at 32° + 53° has escaped previous detection, for, being near the date and position of the August *Perseids*, there can be no doubt that its meteors have in past years been attributed to that well-known shower, and given it an undue extension of period. The two radiants are, however, quite distinct, and it is now easy to explain the statements of some observers that there are many *Perseids* visible during the latter part of July. I believe that but few of the old *Perseids* can be seen before August 6 or 7. My own observations this year show that only seven or eight were seen before August 2, though I watched that region in which the radiant lies very carefully, and noted 400 meteors amongst the constellations there!

Thus at the end of July we may expect two special meteor showers: one of *Aquarids*, at 341°—13°, the other of *Perseids*, 32° + 53°. The former comes to a maximum two or three nights earlier than the latter, which may be called the "*Perseids* II.," in order to distinguish them from the old *Perseids* of Heis.

Ashleydown, Bristol, August 3 W. F. DENNING

The Rainfall of Brazil and the Sun-Spots

AN examination of the scanty records of rainfall obtainable in Brazil proves that the relation between rainfall and sun-spots, which has been pointed out in India by Dr. Hunter and others, holds good for the inter-tropical portion of Brazil.

The only stations from which I have been able to obtain records for a series of years are the city of Fortaleza (better known in Europe as Ceará), in latitude 3° 42′ S., and Rio de Janeiro, in latitude 23′ S. The rainfall of these two stations is shown in series in the following table :—

Series of Years in the Cycle of Eleven Years.	Average relative Annual Number of Sun-Spots, 1811-1875.	Mean Annual Rainfall of Ceará, 1849-1877.	Mean Annual Rainfall of Rio de Janeiro, 1851-1877.
		March.	June.
Minimum 11th Series ...	16·3	1429·3	1134
Group 1st & 2nd Series	10·8 mean.	1298·6 mean.	986 1032·6
3rd and 4th Series	48·6	1493·8	1039·2
5th ,, 6th ,, ...	88·3	1587·7	1011·2
7th ,, 8th ,, ...	65·3	1608·1	1355·3
9th ,, 10th ,, ...	38·5	1252·6	1139·3
11th ,, ...	16·3	1429·3	1134

The northern provinces of Brazil outside of the Amazon valley, and notably that of Ceará, are subject to severe and prolonged droughts, of which that of 1877 is one of the most terrible on record. The annals of Ceará make mention of thirty years of drought since 1711, many of which, however, were only partial or slight, and many of which occurred in groups of consecutive years, there being one group of five dry years, another of four, and four groups of two years each. Twelve notable floods are also recorded since 1776. The droughts and floods are distributed as follows, among the groups of the years of the sun-spot cycle, proposed by Dr. Hunter :—

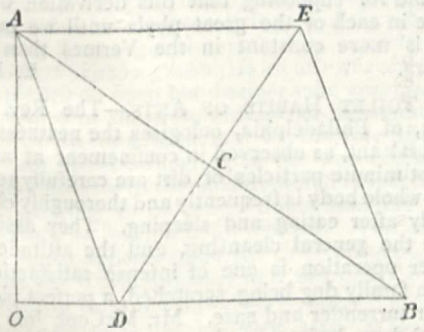
	Droughts.	Floods.
Minimum Group (11th, 1st, and 2nd Series)	13	2
Intermediate Group (3rd, 4th, 9th, and 10th Series) ...	10	4
Maximum Group (5th, 6th, 7th, and 8th Series) ...	7	6

Of the seventeen cycles of eleven years, between 1711 and 1877, only three have no record of one or more dry years. The great droughts were those of 1722, 1778, 1792, 1825, 1845, and 1877, of which four occurred in the minimum group, one commenced in that group, but culminated in the intermediate group, and one was confined to the latter group.

Rio de Janeiro, June 12 ORVILLE A. DERBY

The Cell of the Bee

THE following simple construction shows in one figure all the elements of a cell of a honey-comb. On two rectangular axes take OA and OB equal to the side and diagonal of a square. Join AB and bisect it in C. Draw CD normal to AB. Join AD, and complete the rhombus whose sides are AD, DB. Then if OA be a side of the hexagon, ADBE is one of the three equal planes forming the trihedral angle which closes the cell. The three short diagonals DE meet in the vertex of the cell, and are



normal to each other. The three long diagonals AB form an equilateral triangle. OD is the height of the vertex above the hexagonal face of the prism. AED is the angle which the axis of the prism makes with each of the diagonals DE. ADO is the angle which the axis of the prism makes with each of the edges of the trihedral angle. The diagonals DE and AB are in the ratio of the side and diagonal of a square. Such a cell contains a maximum volume with a minimum surface.

Bardsea EDWARD GEOGHEGAN

OUR ASTRONOMICAL COLUMN

THE REPORTED OBSERVATION OF "VULCAN."—In the telegram received from Mr. Lockyer relating to the solar eclipse which appeared in NATURE last week (p. 353), and which, like many other similar messages, had suffered in course of transmission, mention was made of Prof. Watson's observation of an object of 4½ magnitude in R.A. 8h. 26m., and declination 18° 0′ north, which was neither a known planet nor a star. θ Cancri, a star of the fifth magnitude, is less than a degree from this position, but the observer would doubtless be aware of its presence. A telegram to the same purport was received by M. Mouchez, the director of the Observatory at Paris. By the formula deduced by Leverrier from the observations of suspicious objects in transit across the sun's disc, if the indeterminate k be put = 0, the elongation in longitude of his hypothetical body from the sun's centre at the time of totality at Prof. Watson's station would be 5°·9 eastward, and if $k = -1$, 9°·5 westward, neither of which, it will be seen, accords with the position given in the telegram. The fourth-magnitude star, δ Cancri, must have been within the limits of the coronal surroundings of the sun, and was only just beyond them during the total eclipse of July 28, 1851, when no observer, to our knowledge, remarked the star. In the instructions for observing the eclipse issued from the United States Naval Observatory, Washington, and prepared by Prof. Harkness at the instance of Admiral Rodgers, the superintendent, it is remarked: "As the truth of Leverrier's discovery of an apparently unexplained motion of the perihelion of Mercury is now established beyond all doubt, it is important to renew the search for an intra-Mercurial planet or planets." And to facilitate the work of such astronomers as might institute a search with considerable telescopic power, a chart was appended to the instructions showing every star so large as the seventh magnitude in that portion of the heavens occupied by the sun at the time. This chart extends from 7h. 32m. to 9h. 40m. in right ascension, and from 11° to 26° in declination. θ Cancri, the only star which appears near the position indicated for Prof. Watson's object, is marked on the chart as a sixth magnitude, which is the estimate of the *Uranometria* and *Durchmusterung*, but the star has been occasionally rated a fifth magnitude as in the first Radcliffe Catalogue, wherein particular attention was paid to the brightness of the stars. This is only a half-magnitude below Prof. Watson's estimate, but it remains to be seen from further intelligence whether there was any possibility of the star having been the object really noted; if it were separately remarked, or if the observed position does not admit of such change as would be necessary for identification, then it may truly be said that the American astronomer will have rendered the occasion of this eclipse a memorable one in the history of the science. Leverrier's confidence in the existence of an unexplained motion in the perihelion of Mercury and the necessity of accounting for it, by admitting the presence of matter in some form within the orbit of the planet, continued undiminished up to the time of his decease. One of his last communications to the writer of these lines was upon this subject.

THE LUNAR ECLIPSE ON AUGUST 12.—The eclipse of the moon on August 12 is the only one that will be wholly visible in this country until the year 1884; first contact with the earth's dark shadow at 10h. 42m., the middle of the eclipse at 12h. 8m., magnitude 0·59, and last contact at 13h. 34m. On October 4, 1884, there will be a total eclipse of the moon, the middle near 10 P.M., and the passage through the shadow nearly central.

THE AUGUST METEORS.—The earth will arrive at the descending node of the orbit of the comet 1862 III., in the track of which the meteors of the August period are found to move, soon after noon on Saturday next; the comet itself has now receded from the sun to a distance nearly equal to the mean distance of Neptune, to return to these parts of the system probably between 1980 and and 1985. Moonlight interferes this year with observation of the smaller meteors August 9-11, during a part of the night.

TEMPEL'S COMET.—The following places of this comet are deduced from M. Schulhof's elements, with the time of perihelion passage, corrected by the early observations at Strasburg by Prof. Winnecke:—

12h. G.M.T.	Right Ascension.	North Polar Distance.	Log. Distance from Earth.	Intensity of Light.
	h. m. s.	° ′		
August 23	... 16 20 30	... 109 3	... 9·9018	... 0·86
,, 25	... — 25 55	... 109 52		
,, 27	... — 31 28	... 110 40	... 9·9079	... 0·84
,, 29	... — 37 12	... 111 27		
,, 31	... — 43 6	... 112 13	... 9·9144	... 0·82
September 2	... — 49 10	... 112 58		
,, 4	... 16 55 24	... 113 42	... 9·9213	... 0·80
,, 6	... 17 1 48	... 114 24		
,, 8	... — 8 22	... 115 5	... 9·9286	... 0·77
,, 10	... — 15 5	... 115 44		
,, 12	... — 21 58	... 116 22	... 9·9365	... 0·74
,, 14	... — 29 0	... 116 58		
,, 16	... 17 36 11	... 117 33	... 9·9448	... 0·71

On September 10 the comet passes very near to the orbit of Mars, but the planet is far distant. The dimen-

sions and eccentricity of the orbit of the comet are now :—

Perihelion distance ...	1·3393	Semi-axis major ...	2·9956
Aphelion ,, ...	4·6518	,, minor ...	2·4961
Eccentricity ...	0·55289		

The interval between the perihelion passages in 1873 and 1878 is 1899·78 days.

BIOLOGICAL NOTES

THE PRIMARY GERM-LAYERS AND THE ORIGIN OF THE MALE AND FEMALE REPRODUCTIVE ELEMENTS.—Prof. Edouard Van Beneden, of Liége, three years ago observed that in the marine hydroid polyp Hydractinia the cells forming the testis and giving rise to spermatozoa, were derived from an ingrowth of the outer of the two primary cell-layers which form the foundation of all higher animal bodies, whilst the ova, he found, were simply cells of the inner primitive layer. This complementary function of the ectoderm and endoderm in Hydractinia led him to frame the hypothesis that throughout the animal kingdom the outer cell-layer is male in function, and the inner cell-layer female. On reviewing the facts known as to the derivation of the sexual cell-elements in various groups of animals, he was able to show a considerable amount of evidence in favour of the view that the testis is always ectodermal and the ovary always endodermal. Though accurate observations in this matter are excessively difficult, and definite knowledge as to the facts, in nearly all cases, is still wanting, yet Prof. Van Beneden's hypothesis was plausible and worthy of full consideration. It has been adopted by Gegenbaur in the last edition of his "Grundriss." The hydroid polyps consisting, as they do for the most part, of the two primary cell-layers in a very slightly differentiated condition, present the most ready field for the further testing of Van Beneden's hypothesis. The observations of Kleinenberg on Hydra were opposed to it. According to these *both* the sperm-cells and the egg-cells of Hydra develop from the ectoderm. Mr. J. Ciamician, of Vienna, has made a special study of this question in certain genera of hydroids (*Zeitsch. wiss. Zoologie*, 1878, part 4), and has published careful drawings in support of his statements. In *Tubularia mesembryanthemum*, assuming the accuracy of Mr. Ciamician's drawings, both female and male reproductive cells develop from a hollow in-growth of the ectoderm (the gonophors of the two sexes being distinct), which at first depresses the endoderm, but is afterwards itself flattened out by the up-growth of the endodermal layer of the spadix. In *Eudendrium ramosum* the ova develop from cells of the ectoderm, and the sperm-cells from cells of the endoderm, precisely the reverse of the relations detected by Van Beneden in Hydractinia. It seems hardly possible to interpret Mr. Ciamician's drawings of Eudendrium in any other sense than that which he himself adopts; the cell-layers at all stages are as clear in this species as they possibly can be. In the female gonophors of Hydractinia, Van Beneden saw an in-pushing of ectoderm at the apex developed in the same place as the in-pushing at the apex of the male gonophor, from which the sperm-cells developed. Van Beneden interpreted the rudimentary in-pushing in the female gonophor as a survival of a primitive hermaphrodite condition of the gonophors. Ciamician considers, on the contrary, that this ectodermal in-pushing is only the commencement of the formation of a medusa (in fact, the space between umbrella-margin and manubrium), which, instead of being completed, subsides into the condition of a medusoid gonophor. Hence, in place of a constant law of ectoderm being male and endoderm being female, we have in the three genera Tubularia, Hydractinia, and Eudendrium, the following variations respectively :—1, ectoderm male and female; 2, ectoderm male, endoderm female; 3, ectoderm female, endoderm male. The only possible generalisation from these facts is that of Ciamician, viz., that primitively the sexual functions are not assigned exclusively to cells of either layer: ectoderm may produce both male and female elements, and so may endoderm. With increased development and specialisation of structure, the production of reproductive elements would become limited to particular tracts of cells, and these would be necessarily *either* exclusively endoderm-cells or exclusively ectoderm-cells, but might be either one or the other indifferently even in closely-allied genera; and might be the same or complementary for the ovary and testis respectively. Nevertheless it must be admitted that though such indefiniteness in the relation of the sexual glands to the primitive cell-layers might be expected in Cœlentera where the differentiation of the two layers is at its commencement (both layers, for instance, developing nematocysts), yet in the higher groups of the animal kingdom we should be justified in looking for absolute constancy in the derivation of ovary and testis respectively from one or other (the same or diverse) of the two cell-layers—and we have not ground for supposing that this derivation would be the same in each of the great phyla until we can show that it is more constant in the Vermes than in the Cœlentera. E. R. L.

THE TOILET HABITS OF ANTS.—The Rev. H. C. McCook, of Philadelphia, eulogises the neatness of the agricultural ant, as observed in confinement at any rate. The most minute particles of dirt are carefully removed, and the whole body is frequently and thoroughly cleansed, especially after eating and sleeping. They assist each other in the general cleansing, and the attitude of the ant under operation is one of intense satisfaction, like that of a family dog being scratched, a perfect picture of muscular surrender and ease. Mr. McCook has seen an ant kneel down before another, and thrust forward the head under the face of the other, and lie motionless, expressing quite plainly the desire to be cleansed; the other ant understood this, and went to work. Sometimes this is combined with acrobatic feats, in which these ants excel, jumping about and clinging to blades of grass in a remarkable fashion. Sometimes the cleansing ant hangs downward from the grass, and to her the ant operated upon clings, reaching over and up with great agility to submit to her friend's offices. Evidently moisture from the mouth is used for washing. Mr. McCook has observed most minutely the whole of these processes, which are recorded in the Philadelphia Academy's *Proceedings* for this year. He suggests that with ants as with the human kind an artificial condition induces greater attention to personal appearance.

THE MODE OF RECOGNITION AMONG ANTS.—The combats and communications of ants are among the most interesting and mysterious phenomena. The Rev. H. C. McCook has given an account to the Academy of Natural Sciences at Philadelphia of some experiments he has made to determine what is the mode of recognition among ants. He has studied the pavement ants (*Tetramorium cæspitum*), which he has observed engaged in continued combat for over a fortnight, the warriors being only the workers or neuters. There is no distinguishable difference between the ants of the fighting parties, yet they recognise each other infallibly as friend or foe. They challenge all comers with their antennæ; if they are friends, they pass on; if foes, they straightway interlock and "fall to." Sometimes many ants are congregated against one, which is being torn limb from limb. Mr. McCook surmised that recognition was based upon a certain odour emitted by the respective factions. He found that if they were enveloped in an odour of eau-de-Cologne, while not at all deprived of activity, all became harmonious; those who were previously engaged in

battle unclasped one another, and they went on for several days amicably feeding, burrowing, and building. The same experiment was tried on the carpenter ants, which behead their enemies; their hostile proceedings were not stopped by eau-de-Cologne.

THE SNARE OF THE BASILICA SPIDER.—Science is under obligations to Mr. McCook of Philadelphia, for his study of the marvellous constructions of the Basilica spider (genus *Epeira*), near the Colorado River, Texas. It was first found about two feet from the ground upon a bush. The general form is pyramidal, the upper part of it a mass of straight lines knotted and looped, and crossing in all directions. Within this is suspended an open silk dome, of a vast number of radii crossed by regular concentrics. The dome was suspended from the upper erection so as to be perfectly steadied and kept in form. Beneath the dome was a light sheet of irregular cobweb. The spider itself is very beautifully coloured. This form appears to be a capital specimen of transition between the orb-weavers and the line-weavers. It has the characteristics of the line-weavers, namely, right lines and sheet-web in exact detail, and dome-shaped web in outline; it also has the geometric web of the orb-weavers, or radiating lines regularly crossed by concentrics. An allied species (*Epeira globosa*) is an orb-weaver, adding to the simple orb an open but distinct tube reaching almost to the centre of the web, with a free ray running along the floor of the tube, kept taut by the fore feet of the spider. An insect struggling in the web communicates the motion directly to the spider, which rushes along the covered gangway to its prey. Sometimes the gangway is imperfect, or even wholly omitted. The orb in the basilica spider appears to be the chief means of capture, the dome the dwelling-place, and the upper pyramid a suspension for this, and a protection against enemies.

SEXUAL CONDITIONS IN THE RED MAPLE.—It is commonly stated that maples bear hermaphrodite, male, and female flowers, but Mr. Thomas Meehan, of Philadelphia, asserts that the red maple is, according to his observations, really dicœcious, having only flowers of one sex on the same tree. But the male and female flowers are similar in outward appearance at first opening, except that the small pistil is not developed in the male flowers. The female flowers have anthers of full size, and are supposed to be of both sexes, but the fact is that the anthers do not develop after the flower has opened, and shed no pollen. This is a very remarkable survival from a condition when the flowers were perfect. It is not uncommon to find trees, originally female, sending forth male branches, but Mr. Meehan has not found male trees produce female branches. The male flowers were found fragrant, the female not so.

GEOGRAPHICAL NOTES

UNDER the title of "Naturalists in the North West," a Sydney paper has recently published some interesting articles, the last of which relates to Mr. Miclucho-Maclay's account of the manners and customs of what he calls the Papuans of the Maclay coast. Their food consists mainly of vegetable products, but they have also some animal food, though it is somewhat scarce. Many of their domestic implements are of a very primitive nature; a flat splint of kangaroo bone forms a knife, of which a large kind is made from a smooth shell; axes are made sometimes of agate, and a few large ones, 3 inches wide, are kept as public property in each village. The dress of these natives is the *mal*, a piece of cloth prepared like the tapas of the Polynesians, from the bark of trees. The men all carry the *jambi* and the *gun*, to supply the want of pockets, the former being a bag suspended from the neck, and containing tobacco, &c., and the latter one woven of different coloured threads, and ornamented with shells. The *gun* is slung over the left shoulder, and contains the box of lime, betel-nut, knives, bamboo boxes of red and black dyes, &c. The natives also wear bracelets of bark or grass above the elbows, into which the *dougan* is thrust, and implements or weapons are also placed in the bangles on their legs. Wild boar's tusks are highly prized as manly ornaments to be worn on the chest, and ear-rings of tortoise-shell, bamboo, stones, or flowers, are all considered the proper adornment of the men. The women do not decorate themselves to the same extent, but they have cords from the upper part of one ear passing over the forehead to the other, and also bunches of dogs' teeth hanging from the lobes of the ears; they carry two bags, in one of which they place provisions and in the other their young infants or some pet pigs or puppies. Their huts and villages are situated in groups round clearings in the forest, and the plantations are usually at some distance. They have three sorts of houses—for the single people, the families, and a common house, principally used by the bachelors. These habitations do not resemble the pile-dwellings of the Western Papuans, and are only slightly raised above the ground. In each cluster of huts is a gong, like a boat raised on trestles, which, when struck in the right place, emits so great a volume of sound that it can be heard at a distance of six miles. It may be mentioned that these people have no means of obtaining fire, and frequently have to go to the hill tribes, who are acquainted with a cumbersome mode of friction by which they obtain a light.

GREAT exertions are being made by the Marquis de Croizier, and others, to ensure the success of the coming International Congress of Commercial Geography, which will be opened at Paris on September 23, under the presidency of M. Meurand, of the French Foreign Office. Numerous foreign societies have been invited to send representatives to the Congress, and we believe that the Royal Geographical Society will be represented by some members of their Council. The programme of the Congress is an extensive one, the numerous subjects proposed for discussion being arranged under the following five heads: Explorations et Voies Commerciales; Produits Naturels et Manufacturés; Emigration et Colonisation; Enseignement; and Questions Générales. A detailed programme and a *résumé* of the proceedings of the Congress will be published each day and forwarded to all the members. The meeting will be brought to a close on September 28.

AT a recent meeting of delegates of the German African Society at Berlin, it was resolved to grant the sum of 10,000 marks (500*l.*) to the International Association for the Exploration of Africa, and also to support Dr. Buchner, who is about to start for a tour through the districts lying south of the Congo River. The reports recently received from Herr Schütte, the engineer of the society, who is now at the Congo, continue to be favourable, and are accompanied by excellent maps of the districts he visits.

DR. OTTO FINSCH, the Director of the Natural History Museum of Bremen, will start for a scientific expedition to Australia at the end of this year; he is sent out by the Royal Academy of Sciences of Berlin, who will defray his expenses from their Humboldt fund.

THE ELASMOTHERIUM

AMONG the extinct animals of the diluvial age, few have left such scanty remains as the elasmotherium. At the beginning of the present century Fischer von Weldheim, when examining the palæontological collections of the University of Moscow, came across the half of the under-jawbone of an unknown animal, to which he assigned a place between the rhinoceros and elephant. The name elasmotherium was given to the new species,

on account of the peculiar appearance of the teeth, which seemed to consist of plates of enamel longitudinally folded. Later scattered teeth of this animal were found in Hungary, in Sicily, and in various Russian provinces. A few years since a complete under-jawbone was discovered at Petrowski; a fragment of the back part of a skull in the Museum of the Jardin des Plantes, at Paris, which was discovered on the banks of the Rhine in the last century, has likewise lately been identified as

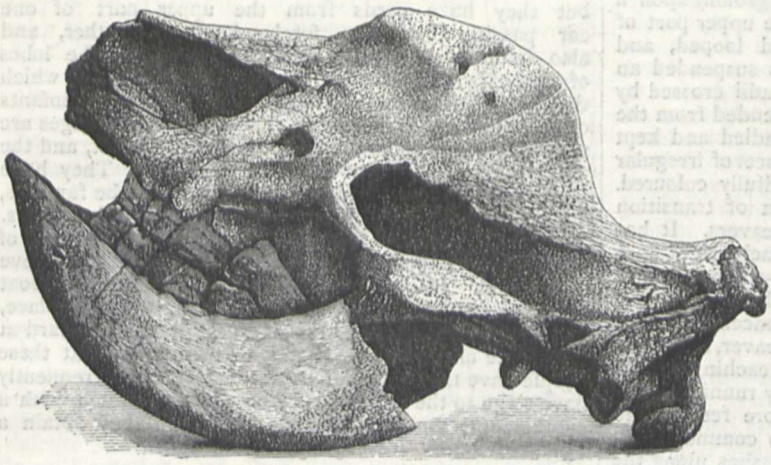


FIG. 1.—Side view of the skull of the Elasmotherium

belonging to the elasmotherium. These remains were altogether too limited, to offer the zoologist any satisfactory clue to the general character of this animal. While the form and size of the jaw showed a strong resemblance to that of the rhinoceros, a close relationship was forbidden by the peculiar characteristics of the teeth.

Interesting as were the questions arising with regard to the nature and habits of this extinct resident of Europe, they have hitherto remained unanswered, until a fortunate discovery at the beginning of the present year, placed the zoologist in possession of a well-preserved skull of the elasmotherium. This object, certainly the most valuable of late palæontological discoveries, was found attached to the net of some fishermen in the river Volga, not far from its mouth, a district which has furnished many valuable remains of the extinct fauna of Russia. The St. Petersburg Academy of Sciences has become the fortunate recipient of the newly-found treasure, and to one of its members, Dr. Alexander Brandt, the scientific world owes the first complete summary of the deductions drawn from the study of this skull, as well as its detailed description. Besides his communication on the subject to the Academy, he has published a longer article in the Russian periodical *Niwa*, and translated it likewise into German.

The skull (Fig. 1) itself has the following dimensions. Length 33 inches, height, including the under-jaw, 21½ inches, breadth 16½ inches. Its most striking feature is an enormous bony protuberance on the brow. This is hemispherical in shape, possessing a circumference of over 3 feet, and projecting forward about 5 inches, and is hollow, forming a portion of the frontal cavity. Unusual developments of this cavity are noticeable in the skull of the ordinary cow, and more especially in those of the elephant and rhinoceros. As in the case of the latter animal, the protuberance of the skull of the elasmotherium presents a rough, uneven surface, traversed by deep furrows once occupied by blood vessels. The whole analogy with the rhinoceros points with the greatest certainty to the previous existence of a horn, which, to judge from the size of the blood-vessels once encircling the base, must have possessed enormous dimensions, and easily exceeded the length of the skull itself. The presence of a similar, rough protuberance of much smaller dimensions lower down towards the nostrils, would incline to the supposition that a second smaller horn was likewise present on the elasmotherium.

The front view of the skull bears a general resemblance to that of a horse or a ruminating animal. The rear portion of the skull, however, shows the relationship with the rhinoceros, and this relationship, at least, to the extinct rhinoceros, is still more strongly evidenced by the bony partition dividing the nasal cavity, a most peculiar and characteristic anatomical formation; for with the exception of these two animals, all other mammals known to us possess simply a cartilaginous division in this cavity. The structure of the teeth (Fig. 2) presents, on the contrary, no points of similarity with that of the rhinoceros. They are composed of winding folds of plates of enamel, extending the whole length of the tooth, and presenting, on the upper surface, an odd foliated appearance.

To judge from the skull in question the elasmotherium was most closely allied to the rhinoceros family, standing between it and the horse. Its proportions surpassed, however, those of any of its congeners, thus far known, existing or extinct. The proportions of the skull would point to a length of body ranging between 14 and 16 feet. With regard to the form of the body and limbs, nothing definite can be said. The nose was much narrower than that of the rhinoceros, while the eyes were larger, and the powers of vision of the elasmotherium, therefore, probably greater than those of the rhinoceros. Analogy with the contemporary rhinoceros and mammoth of

FIG. 2.—Grinding surface of tooth (natural size).

Siberia would warrant the supposition of the presence of a shaggy coat of hair.

The absolute, as well as the comparative size of the cranial cavity would assign to the elasmotherium a low degree of intelligence. Dr. Brandt pictures it as an

enormous animal, of great strength, but clumsy, awkward, and slow in its movements. It wallowed in the mud, lazily chewed its food of grass and tender twigs, and stretched itself to rest among the reeds or grass on the river's edge. From this apathetic condition it would be roused only by the attack of a rival, of a mammoth, of a rhinoceros, or of some one of the great carnivorous animals of that distant epoch. It would then rush enraged on its adversary, and endeavour to lay it low with its formidable horn.

The discoveries of remains of the elasmotherium show that it once wandered over the greater portion of Europe, from the Ural to the Rhine, and as far south as Sicily. It is also highly probable that later palæontological discoveries will show its existence in Asia, in company with the other large mammals, whose remains have been so well preserved in Siberia.

It was also in all probability contemporary with the men of the stone age, its remains occurring in the same deposits, in which the anthropologist finds the flints, collections of bones, and other evidences of prehistoric man. From their weapons the elasmotherium had probably little to fear.

In connection with this interesting discovery Dr. Brandt recounts a tradition of a tribe of Tartars in South Siberia, which describes the death of an enormous black ox. It possessed, however, but a single horn, and that of such size that it could be transported on sledges only. Possibly a reference to the elasmotherium.

UNDERGROUND MONSTERS

IN a former number (vol. xvii. p. 325) we gave some account of a curious underground monster, the Minhocao, supposed to exist in Brazil. Dr. Spencer Baird, of the Smithsonian Institution, sends us an interesting document, which shows that the belief in such a monster is not confined to Brazil, but is shared in by the people of Nicaragua. In the *Gaceta de Nicaragua* for March 10, 1866, is a long letter signed "Paulino Montenegro," containing a circumstantial account of an object possessing very much the same attributes as the Minhocao. The letter is dated Jinotega, Nicaragua, February 21, 1866. The writer states that he went to Concordia on private business, when he heard on the 17th of a serpent having taken up its abode at a place called La Cuchilla, within the jurisdiction of the village. Along with some friends, M. Montenegro set out on the 18th to examine into the foundation of the report. A tradition concerning such a monster has existed from "time immemorial." After having travelled on that day about two leagues (1 league = 2·6 English miles) north-east from the village, they reached the spot where the inhabitants of the neighbourhood had traced signs and tracks, which, M. Montenegro states, positively prove the existence of such an animal.

The most detailed accounts stated that here, some five years before, a sort of platform of about fifty varas diameter had been formed at the foot of a large rock cropping out from a hillside. One of the neighbours had established there an orchard, though no one had been able to account for this new formation. Three years before, however, people began to observe that this little piece of level ground was gradually deepening, and that in the month of November the base of the rock adjoining it became exposed and worn from some agency, notwithstanding that there was not sufficient water to cause the phenomenon. At the same time mighty trees (*robles*[1]) were observed to become uprooted and to fall in great disorder, while immense rocks were moved and shifted their foundations so much, that in the following month of December, during one night, the road from Chichiguas and Cuchilla to San Rafael del Norte was destroyed by a multitude of cracks and clefts, which had suddenly opened. At that time the ground was observed to be undermined, falling in at intervals. These occurrences were observed some three days before M. Montenegro and his friends visited the place, which they saw all to be in accordance with the statements. Immediately on examining the locality for themselves they came to the conclusion that there were signs not of one but of two animals, probably of the shape of huge fishes.

In commencing their work these animals seemed to pursue a kind of an upheaving movement. As the bottom of their hiding-place was loose, shifting ground, the surface of this was seen to give way, while trees were shaken out and came down crashing. The noise of this seemed to scare the animals away. One of them—believed to have been the male on account of its larger size and greater strength—took to the left in descending, but always in a parallel direction with and along the slope of another hill, which here terminated. As it broke through the banks of a ravine, which measured about twenty varas in width and nine feet in depth at its greatest opening, he passed with his head underground. The thrown-up soil showed the tracks of the head, which left its marks both in the soil and on the roots of the trees, which were broken, the broken pieces being four inches thick. The main part of the body, which certainly must have passed here uncovered, left its traces at the bottom of the ravine. Passing out from this the animal entered upon ground more level and friable, which it went through at a depth of five quarters (1·25 varas), forming a furrow and leaving behind a ridge more than one vara high. Following the ravine for a distance of about sixty varas it encountered two deep ditches, when it turned and traced its way back, and, approaching the aforesaid ravine, took to the bed of a pond and disappeared perpendicularly.

The other animal, which left behind a smaller track, and therefore was believed to have been the female, went at once to the right, to the outlet of the pond of water before referred to, leaving behind it everywhere the same marks as the other. When it reached the two deep ditches it turned back also, and undoubtedly encountered its companion afterwards.

The whole ground had become irregularly disturbed and broken up, and the power of these animals is shown by their being able not only to throw up huge masses of soil but even to move rocks weighing more than thirty quintals.

The animals seem to be covered with a skin clad with scales or plates, the markings of which, imprinted on the soft clay or loam, bear much resemblance to those of the garrobo[1] in the mud. It appears that the shape of these animals must be like that of the guapote.[2] The length of the body is at least twelve varas, the height three, and its thickness 1·5 varas.

A tradition about such an animal as this has been kept up unaltered, without contradiction, for more than a hundred years. It is described in general as a large snake, and called "sierpe," on account of its extraordinary size, and living in chaquites.[3] One is said to have been once killed by lightning the moment it had left its hiding-place in the river "Sebaco viejo."

TWO AUSTRALIAN GEOLOGISTS

AUSTRALIA has recently lost two of its most eminent geologists, the Rev. W. B. Clarke and Mr. Richard Daintree. The death of Mr. Clarke we noted some weeks

[1] "Roble," in Spanish, means an oak. The same name is found through various parts of Spanish America, applied to trees belonging to very different botanical families, having no natural affinities among each other, and also none to the "Cupuliferæ." On the River Atrato, in New Granada, South America, a huge tree, a species of *Tecoma*, is called "roble." The name "roble," no doubt, is given to these different forms merely on account of some external resemblance to an original Spanish species of oak.

[1] [2] "Garrobo" and "guapote" are names of which the exact application cannot be ascertained.

[3] "Chaquites" seems to be an Indo-Hispanic expression and a provincialism; probably pools or ponds is meant in the present case.

ago, and now by the kindness of a correspondent we are able to give a few details as to his career.

The Rev. W. B. Clarke was born on June 2, 1798, at East Bergholt, in Suffolk. In October, 1817, he went to Cambridge and entered into residence at Jesus College. In January, 1821, he took his B.A. degree, and in July, 1824, he was made M.A. and a member of the Senate. From May, 1821, until November, 1824, he officiated as curate of Ramsholt, Nedging, Whatfield, Chellesworth, and Brantham; after this he became curate for a time in his native parish. The rector seems to have had a proper appreciation of his talents, for he not only allowed but enjoined him to travel during a portion of each year, a privilege of which Mr. Clarke availed himself in order to pursue and complete the geological and mineralogical studies that he had commenced at the University under the teaching of Prof. Sedgwick and Dr. Clarke, the celebrated traveller in the Holy Land. During this period he made some fifteen distinct journeys of exploration either on the Continent or in different parts of his native land, enlarging his experience and acquiring fresh stores of information. In 1823 he was presented by Lord de Manley to a small vicarage in the county of Dorset, with a written promise of the succession to a desirable rectory in Gloucestershire. Having, however, rheumatic affection, and seeing no immediate prospect of succeeding to the Gloucestershire living, he determined to take a voyage to Australia, and arrived in Sydney in the year 1839. He appears to have found in Australia a fitting field, both for his labours as a clergyman and for the prosecution of his favourite studies in geology and mineralogy, and he at once applied himself to both. He had been considerably influenced in deciding to make Australia his home by correspondence he had had with the late Sir Thomas Mitchell, formerly Surveyor-General of the colony, and with the late Bishop Broughton, who had been his fellow-undergraduate at Cambridge. The first charge to which he was appointed was that of King's School, Parramatta, a position which he continued to fill until the beginning of the year 1841, after which he retired from the school, and attended only to his clerical duties. In 1844 he took charge of the parish of Willoughby, North Shore, with which he remained connected till 1870.

Mr. Clarke filled many positions of honour and distinction in connection with his own communion, and with learned and scientific bodies in various parts of the world. He was Fellow of St. Paul's College, vice-president of the Royal Society of New South Wales, trustee of the Australian Museum, trustee of the Public Free Library, Fellow of the Geological Society of England since the year 1826, member of the Geological Society of France, member of the Royal Geological Institute of Austria, member of the Royal Geological Society of London, &c., &c. In the department of science to which he had more particularly devoted his attention, he was regarded as an authority by all geologists. Perhaps his largest and best-known work is that entitled "The Southern Gold-fields," which contains an exhaustive description of the auriferous deposits throughout Australia. This work was written in consequence of Mr. Clarke having been commissioned by the Government to visit and report upon the principal gold-producing localities in the colony. A number of his papers were at different times read before the Royal Society of New South Wales, and are preserved among its records. They are almost entirely confined to subjects relating to geology, mineralogy, and meteorology.

Some two or three years ago Mr. Clarke was elected a member of the Royal Society of England—an honour which has been so rarely conferred upon colonial *savans* that Mr. Clarke valued it perhaps more than all the other distinctions he had won, especially as the honour was conferred upon him by the unanimous and spontaneous action of the Society. Mr. Clarke died on June 16.

The announcement of the death of Mr. R. Daintree, C.M.G., F.G.S., will be read with deep regret alike in this country and the Australian Colonies, more especially Victoria and Queensland. Next perhaps to that of Mr. Clarke, his name has been more intimately associated with geological science at the Antipodes than that of any other observer, more particularly in connection with the former province.

On his first arrival in Victoria Mr. Daintree became connected with Mr. A. R. C. Selwyn, F.R.S. (now Director of the Geological Survey of Canada), in the geological survey of that colony, and did good work in the exploration of the Bass River, the survey of the Cape Patterson Coal-field, and other difficult explorations. He was also engaged in the survey of a large tract of country to the south-west of Melbourne, around the now flourishing town of Geelong, comprising the Barrabool Hills, the Anakil, and other minor ranges, and to the north the districts of Ballan and Bacchus Marsh. An accomplished photographer, his knowledge of this science was turned to good account in the preparation of a large number of photographs illustrative of the general geology of Victoria and Queensland, and more especially of the physical structure of the gold fields, and the methods in operation for the mining and extraction of gold. The formation and mode of occurrence of the precious metal attracted a good deal of his attention, more especially with regard to its presence in rocks associated with dioritic dykes in Queensland.

Mr. Daintree's connection with the Geological Survey of Victoria commenced in 1854, and, with the exception of a short interruption in 1857-8, continued down to 1864. In that year he left Victoria for North Queensland, and settled there as a "squatter," continuing at the same time to interest himself in matters geological. In 1869 the Queensland government appointed him government geologist for the northern half of the colony—a choice amply justified by the remarkably good work he performed whilst acting in that capacity. Queensland owes to Richard Daintree no ordinary debt of gratitude for the important part he took in the development of her mineral resources, the discovery of several important gold fields having followed quickly upon his prognostications.

Daintree's geological map of Queensland will give some idea of the vast tracts of country traversed and reported on during the course of his residence in that province, and on which the geological boundaries of the various formations were laid down with great care and precision. Whilst on this subject we would call attention more particularly to the definite delineation of the boundaries of the great secondary formation of north-eastern Australia about which little, comparatively speaking, was known up to that time, except the occurrence of typical fossils at a few isolated localities. The great tertiary series, aptly designated by Daintree the "Desert Sandstone," was shown to have extended over the greater part of Australia at one time.

In 1871 Mr. Daintree was appointed Special Commissioner for Queensland to the International Exhibition of 1872, and organised the admirably-arranged Queensland annexe, which was, in that and succeeding exhibitions, so universally admired. An experienced and determined bushman, he had, during his Australian career, paid too little attention to the preservation of his health, and in all probability laid the seeds of the complaint which afterwards terminated fatally. Soon after his appointment in March, 1872, as Agent-General for the Queensland Colony in London, his health began to give way, and his condition caused much anxiety to his numerous friends. Notwithstanding his removal to a warmer climate during our winters, signs of pulmonary disease

rapidly manifested themselves. He died last month, at the early age of forty-seven years. By his death there has passed from amongst us a true, most unselfish, and large-hearted man, a true friend, and a most agreeable companion. He was an accomplished geologist, a close and accurate zoological observer, a thoroughly practical chemist, and a photographer of no mean order. It will be long ere the vacancy in Australian science will be filled.

THE BRITISH ASSOCIATION

TWENTY-ONE years have passed since the British Association met in Dublin. It was then under the presidency of Dr. Lloyd, the venerable, but still hale, Provost of Trinity College. On Wednesday next, as our readers are aware, the forty-eighth annual gathering of this congress of science once more meets in the metropolis of Ireland, the President-Elect again being an eminent mathematical physicist, Dr. Spottiswoode.

Notwithstanding the fact that Dublin is now as easy of access from London as Edinburgh, and as near in point of time, yet the average Englishman knows far more of Paris or Switzerland than he does of the sister-isle. We trust the forthcoming meeting in Dublin will help to remove much of the prejudice with which Ireland is regarded, prejudice which proceeds from ignorance. For instance, not long ago an eminent scientific Englishman having been asked to lecture in Dublin, seriously inquired whether it would be advisable to be armed with a revolver, exhibiting a fear less reasonable than that of the man who, on a visit to Christiania, took precautions against being attacked by bears. Dublin no longer deserves the second adjective in the epithet of "dear dirty Dublin," in fact, its well kept streets, its splendid buildings and squares, the activity of its commercial and intellectual life, delight and surprise the stranger. In point of situation it is, perhaps (at least next to Edinburgh, our Scotch friends will think), the most beautiful capital in the world, backed by the Dublin and Wicklow Mountains, flanked on one side by the Hill of Howth, and on the other by Bray Head, the Bay of Dublin, with its clear blue water, is even comparable in beauty to that of Naples, if corresponding atmospheric conditions be granted.

Unusual facilities have been offered by the railway and steam-boat companies for the conveyance of visitors to Dublin. To some of our readers it may be convenient if we summarise the ways of reaching Dublin from London. The quickest route is of course by the Irish day or night mail from Euston Square: for example, leaving London at 8.25 P.M., one is landed in Dublin before seven the next morning. The splendid and perfect arrangements of the mail steamers from Holyhead to Kingstown are too well known for us to describe them. Recently the London and North Western Company have built two magnificent steamers, which run during the day from Holyhead to Dublin, and *vice versâ*. The fare is less than by the mail, and the boats are quite as large and sumptuous as the mail-boats, though not quite so fast. To those who intend travelling second class (there is no third by the mail) we should recommend their selecting the North Western boats from Holyhead to North Wall, Dublin; second class passengers being allowed to use the first class saloon without extra charge. The night boat, which meets the 5 P.M. train from Euston, is not quite so fine as the day boat, but the visitor has the advantage of entering the Bay of Dublin by daylight, reaching North Wall about 7 A.M. At the present season of the year no alarm need be felt on the score of sea-sickness by those who travel in the mail-boats from Holyhead to Kingstown. The boats are so large and steady that even with a considerable wind little motion is felt; and the passage is very short, about four and a half hours being the average. Another route is *viâ* Liverpool to Dublin, these are good boats. Lastly, to those who prefer a long sea-trip and can spare the time, nothing is more pleasant than going from London to Dublin direct by steamer. So much for transit. As regards accommodation in Dublin, the Executive Committee have provided a very complete list of lodgings; and the hotels, we understand, have not raised their usual tariffs.

The arrangements of the meeting we have already announced. The sections will meet in Trinity College, the addresses will be delivered in the Exhibition Palace, and lectures will be given by Mr. Romanes and Prof. Dewar an August 16 and 19. On August 15 a *soirée* will be given by the Royal Dublin Society to the Association. This promises to be a very brilliant affair. The Department of Science and Art has allowed a liberal selection of objects from the South Kensington Museum and the Science Collection to be lent for the occasion. Electrotype reproductions of many of the most interesting relics exhibited in the Loan Collection of Scientific Apparatus will be shown at this *soirée*, together with other curiosities from South Kensington. Dr. Spottiswoode has also kindly lent one of his new leviathan condensers which, used in conjunction with an enormous induction coil lent by Mr. Horatio Yeates, will be sure to attract much attention during the evening, and further, the Stereoscopic Company have promised to exhibit the phonograph at this *soirée*. A *conversazione* will also be given by the Royal Irish Academy, when its unrivalled museum of Irish archæology and antiquities will be seen to advantage and with interest by the members of the Association.

No neighbourhood lends itself so easily to beautiful excursions as that around Dublin, and the excursion programme this year is most varied and complete. Here is the list for Saturday, August 17 :—

High Park and Artane Reformatories, to be entertained at the Artane Reformatory; St. Doulough's Church, Malahide Castle, and antiquities of Swords, to be entertained by the Right Hon. Lord Talbot de Malahide; Bray Head, Kilruddery Demesne, Hollybrook, Charleville, the Dargle and the Scalp, to be entertained by the Right Hon the Earl of Meath; Maynooth R. C. College, Carton, Lord Annaly's and Phœnix Park, to be entertained by his Grace the Duke of Leinster; Howth and Ireland's Eye (walking excursion), to be entertained to afternoon tea by residents of Howth; Lucan and Leixlip, Valley of the Liffey, Woodlands and Phœnix Park, déjeuner will be provided by committee at Lucan; Irish Lights Board, Dublin Bay—steamer *Alexandra*, to be entertained on board the steamer by Irish Lights Board; London and North Western Railway—steamer *Rose*, to be entertained on board the steamer by Committee; Glencree Reformatory, Killakee Demesne, Waterfall, Dargle and Enniskerry, to be entertained at Glencree Reformatory by the Managers.

For Thursday, August 22 this is the list :—

Glendalough and Seven Churches, to be entertained at Newrath Bridge; Vartry Waterworks, déjeuner at Vartry Lodge; Vale of Avoca, déjeuner at Glenart Castle, given by the Earl of Carysfort, and at Skelton Abbey, by the Earl of Wicklow; Boyne, déjeuner at Drogheda; Cashel, déjeuner at Limerick Junction; Parsonstown, déjeuner at Birr Castle, given by the Right Hon. the Earl of Rosse; Powerscourt, déjeuner at Powerscourt Castle given by Viscount Powerscourt; Curragh Camp, déjeuner at Stand House, Curragh; Kilkenny, déjeuner at Kilkenny Castle, by the Most Noble the Marquis of Ormonde; and on Friday, August 23, an excursion is arranged to Belfast, luncheon being provided at Glanmore, Lisburne, by Messrs. Richardson and Sons, with dinner at Belfast.

Dublin is famous for its hospitalities, and, amid other festivities, the following have been arranged :—On the morning of Monday, the 19th, members will be enter-

tained at breakfast in the Zoological Gardens by the Royal Zoological Society, in the afternoon at a dinner by the College of Physicians, and in the evening at a *conversazione* by the Royal College of Surgeons. Their Graces the Duke and Duchess of Marlborough will also hold a reception in the Viceregal Lodge and entertain a number of distinguished visitors at dinner.

Several eminent visitors have already announced their intention of being present at the meeting, among others Messrs. Cornu, Chevalier, Brown-Sequard, Emile de Laveleye, Perier, Feil, Bertrand, Ranvier, Maas, Zirkèl, Vogel, Salensky, Kanitz, Wittmael, Stricker, Cope, Sylvester, Draper, Sterry Hunt, H. M. Stanley, and Capt. Burnaby.

Through the unceasing labours of Dr. Ball the Royal Astronomer for Ireland, Dr. Norwood, and their co-secretaries, Dr. Sigerson and Mr. Goff, the meeting promises to be an unusually good one.

NOTES

MR. CHARLES DARWIN has been elected Corresponding Member of the Paris Academy of Sciences in the section of Zoology by 26 votes against 14. This success is all the more notable that Mr. Darwin obtained only 5 votes in a scrutiny which took place quite recently. Prof. Asa Gray has been elected a corresponding member in the Section of Botany in succession to the late Dr. Braun of Berlin.

AT the meeting of the French Association, of which M. E. Fremy will be president, M. Janssen will give a lecture on a question of physical astronomy, Prof. V. Trélat one on the Hospital, and Prof. Marey another on graphic researches relative to animated motors. Among the sectional papers promised are the following:—In the Mathematical Sciences, Signor V. Cerruti, of Rome, on the infinitely small movements of a solid body. In Physics and Chemistry, Prof. Crova on the solar heat; M. Ducretet on the liquefaction of gases; M. Janssen on new data obtained by photography on the constitution of the sun, and on the constitution of photographic spectra of short exposure; M. Montigny on the scintillation of the stars; M. Woeikoff on climatological researches. In Natural Science, Dr. Alix on myology of mammals; Dr. Baillon on the development of the ovular teguments; Dr. Blandet on geological periods before the secular variations; Prof. Chauveaux on the rate of propagation of excitations in the vaso-motor nerves; Prof. A. Gaudry on the evolution of primitive mammals; M. A. F. Nogues on method in geology, and on the climatology of geological times; Dr. Topinard on the notion of race in anthropology. Altogether there are about 250 papers already down to be read.

WE notice that the Bavarian Academy of Sciences at Munich at its last session elected to membership the famous French chemist Prof. Adolphe Wurtz, of Paris. Prof. Wurtz is at present engaged in a careful study of the more modern chemical laboratories of the German universities, preliminary to the completion of the plans for the new laboratory in connection with the École de Médecine at Paris. This structure will face on the new Boulevard de St. Germain, and its erection will require about five years. When completed it is expected that it will rank among the model laboratories of the world.

THE Berlin Academy of Sciences has elected to its membership the astronomer, Prof. Aubers, and the archæologist, Prof. Conze.

SOME improved forms of microphone and telephone are described in the August number of *Scribner's Monthly*. One form of telephone, as devised by Mr. Phelps, gives surprisingly good results. It contains two diaphragms, and in shape somewhat resembles a double crown. Twelve permanent magnets bent into a circular form are used in place of the single magnet employed in other magneto-telephones. Six of these on each side of the instrument have their like poles joined to one of the cores which carry the helices, and radiate from it in as many different directions. The opposite poles are joined to the periphery of the diaphragm on the corresponding side of the instrument, while the helices are so connected that the currents generated in them when the diaphragms are made to vibrate mutually strengthen each other and thus contribute to the effectiveness of the apparatus. Some idea of the performance of these improved instruments will be conveyed by mentioning the results obtained at a recent exhibtion of them in the Sunday-school room of Dr. Wells's church, Brooklyn. Mr. Edison's carbon transmitter was used for sending, and Mr. Phelp's crown telephone for receiving. The sound was also reinforced at the receiving end by the use of a large paper cone, whose smaller extremity was held to the mouthpiece of the instrument. The circuit extended from the residence of Dr. Wells, near the church, to the lecture-room. Speech from the telephone was distinctly heard in all parts of the room by an audience of about three hundred persons, while the singing of a vocal quartette, solo singing, and guitar playing, were transmitted with surprising clearness and loudness. It should be observed, moreover, that the performance in this case was very different from the so-called musical telephones by means of which only the pitch and rhythm of the notes are distinguished, the tone always resembling that of a penny trumpet. In this instance the quality of the tone, which is the real life of music, was exactly reproduced; this is one of the characteristics of the magneto-telephone—everything is faithfully reproduced. Dr. Wells addressed the audience from his parlours through the telephone, and not only was he clearly understood, but his voice was also instantly recognised.

THE observatory of the University of Jena, which occupies a romantic site in the garden where Schiller wrote his "Wallenstein," has been for three years unoccupied since the death of Prof. Schrön in 1875. By a recent appointment Prof. Abbe has been assigned to the chair of astronomy, and will commence active duties in the observatory.

THE seventeenth annual meeting of the Devonshire Association for the Advancement of Science, Literature, and Art, was held on July 30 and 31, and August 1, at Paignton. Mr. W. Froude, F.R.S., was the president-elect, but in consequence of the lamented death of his wife that gentleman was unable to discharge the duties of the office, and at the last moment Sir Samuel Baker, F.R.G.S., was chosen to fill the vacant place, and delivered an address upon the chief points of progress in the past half century. The list of papers was a very full one, thirty-four in all, including the reports of the various committees through whose action much of the work of the Association is now systematised. Thus there are committees at work upon the subjects of Devonshire meteorology, folk lore, celebrities, verbal provincialisms, Dartmoor, the Devon domesday, and for the collection of scientific memoranda of a miscellaneous character; and to these two others were added at Paignton, one to collect and to record facts relating to Devonshire barrows, and the other to perform a similar duty with regard to ancient and still existing manorial customs. Scientific papers predominated, and among these geological papers occupied the foremost place. Mr. Pengelly, F.R.S., contributed a fourth instalment of his collections of the literature of Kent's Cavern prior to the investigations of the British Association; a fifth set of "Notes on recent Notices of the Geology and Palæontology of Devon;" and papers on "The Geology of the North-Eastern Coasts of Paignton;" "Cetacean Remains found in Torbay;" and a second instalment of "Notes on Slips (*i.e.*, blunders of various writers) connected with Devon-

shire." Mr. W. A. E. Ussher, F.G.S. (Geological Survey), read papers on "The Geology of Paignton," and "The Mouth of the River Exe;" Mr. R. N. Worth, F.G.S., "On the Origin of the Ossiferous Deposits at Oreston;" Mr. A.R. Hunt, F.G.S., "Notes on Torbay," the Rev. W. Downes "On the Fossils of the Culm Measures about Holcombe Regis," while Mr. E. Parfitt contributed another important instalment to his fauna of Devon —a list of the *Lepidoptera*. There were several other papers of a more general character. Some of the papers gave rise to lively discussions, and incidental to one by Mr. Ussher, Mr. Champernowne, F.G.S., entered upon a brief exposition of his views of the Devonian question. The whole of the papers read will appear in the *Transactions*. The membership of the Society continues highly satisfactory, approaching 400.

AFTER a lapse of some twenty years the Oreston quarries have yielded another ossiferous fissure, the contents of which were removed under the direction of Mr. R. N. Worth, F.G.S., and will be deposited in the museum of the Plymouth Institution. The quantity of remains is not large, and they are almost wholly of *Bos* and *Cervus*, but the find is valuable inasmuch as it adds to the Oreston cave fauna the Aurochs (*Bison priscus*) and Great Irish Elk (*Megaceros*), and thus reduces the points of difference between the Kent's Hole fauna and that of Oreston. The relics of the Aurochs include a very fine horn core in an excellent state of preservation.

IN its last session the Municipal Council of Paris voted a sufficient sum to defray the expenses of a laboratory for the detection of adulterations in articles of food, a want the necessity of which has long been felt. At the same session 6,000 francs was appropriated for the purchase of tickets to the Exhibition, to be placed at the service of the teachers of the city.

THE Royal Archæological Institute commenced its annual meeting this year at Northampton on Tuesday last week. Lord Talbot de Malahide, president of the Society, presided, and congratulatory addresses were read from the municipality, the local clergy, and Architectural Society. Lord Malahide then vacated the chair in favour of the Ven. Lord Alwyne Compton, president of the Northampton meeting, who delivered an address. The week was devoted to visits to places of archæological and historical interest and to sectional meetings.

THE British Medical Association commenced its forty-sixth annual meeting at Bath on Tuesday, when it was calculated that upwards of 1,000 members were present. The proceedings commenced in the morning with Divine Service at the Abbey. During the afternoon some business meetings were held, and in the evening Dr. Falconer, of Bath, the president for the year, delivered his opening address.

M. LEVERRIER established at the Paris Observatory a daily journal which published not only the warnings of the meteorological service, but also all the astronomical news of general interest. The separation principle having prevailed, the *Bulletin International* is now entirely devoted to meteorological purposes, and the Observatory has no means at its disposal for conveying to the public the observations it receives, except by the channel of daily papers. It was only by chance that information as to Watson's discovery of an intra-Mercurial planet was obtained by the papers from Admiral Mouchez. The Admiral is preparing to establish at the Observatory a course of lectures on astronomical observations during the winter months. During summer the pupils will be admitted to practise with instruments belonging to the establishment. The pavilion in the Paris Observatory in which has been placed the transit instrument given by M. Bischofsheim, will be called Bischofsheim Pavilion. Admiral Mouchez has decided that the public shall be admitted twice a month to the Paris Observatory instead of once as usual. Letters requesting admission are to be directed to the Secretary of the Observatory.

ON Sunday next a monument will be inaugurated at Chamounix to Jacques Balmat, who was the first to ascend Mont Blanc. The *fête* is due to the co-operation of the Geological Society of France and the French Alpine Club. The programme is a very brilliant one, comprising an ascent of Buet and various rejoicings at Chamounix.

THE Helvetic Society of Natural Sciences meets at Berne on August 12, 13, and 14.

THE monuments to Alexander and Wilhelm von Humboldt, the former by Prof. Begas, the other by Herr Otto, will soon be erected one on each side of the entrance gate to the Berlin University. Both monuments are in marble and the figures are represented in a sitting position.

SENOR RAIMONDY, one of the first scientific authorities of Peru, has just published a new work on the minerals of Peru which is specially intended for the use of those who wish to examine more closely the rich and valuable collection of Peruvian minerals sent to the Paris Exhibition.

WE recently referred to Dr. Siemens' idea that the Falls of Niagara might be utilised to supply industrial wants. This idea seems likely to be realised, as we learn that a company has been formed in America to make use of the Falls to transmit to Buffalo, twenty-two miles distant, a constant supply of compressed air, which it is expected will be used as a substitute for steam in the principal establishments at Buffalo.

AN earthquake is reported from Jenbach (Tyrol); it occurred on July 19, at 10.32 A.M., and lasted for ten seconds.

M. ELISÉE RECLUS, the eminent geographer, who had been sentenced to transportation for the part taken in the communistic troubles, but had his sentence mitigated to exile, has, by a recent decree of the President of the French Republic, been authorised to return to Paris.

THE great Trocadéro lift is in full operation. The number of persons that can be elevated at once is fifty. In a single day 1,200 persons have used it. The time required for ascending is about four minutes for an altitude of fifty-three metres. The velocity is rather great at first, but gradually diminishes, and is very slow at the end. The distance run is about $\frac{1}{10}$th of the elevation reached by the captive balloon.

THE ascent of the Giffard captive balloon was stopped on July 31, owing to the wind-pressure suddenly increasing to eighteen pounds per square yard. No attempt was made during the two following days, but the wind having diminished it ascended again on August 3, at two o'clock. The air was so humid that the balloon seen from the earth appeared almost lost in clouds. Various interesting observations have been made.

WE have received a specimen sheet of a catalogue of books and papers on Electricity and Magnetism, compiled by the late Sir Francis Ronalds, F.R.S., which will shortly be published by the Society of Telegraph Engineers. This catalogue, which contains more than 12,000 entries, and will probably extend to over 600 pages, is believed to include every important work and almost every paper which has been published upon the subject of Electricity and Magnetism up to the date of its author's death in 1873. It also forms a valuable catalogue of scientific works generally. Sir Francis Ronalds devoted the greater part of his lifetime to its compilation and in the formation of the valuable library now in the possession of this society. It is proposed, should the number of subscribers be sufficient to cover the extra cost for printing, &c., to issue a separate librarian's edition,

printed on one side of the paper only, for the use of librarians. The price to subscribers of each copy in this form will be 20*s*., delivered post free in the United Kingdom, and plus the extra postage for abroad. The price of the catalogue in the ordinary form will be 16*s*. The importance of this enterprise, not only to science but to bibliography generally, need not be insisted on. Those interested should communicate with the Librarian of the Society, 4, Broad Sanctuary, Westminster, S.W.

A LARGE coal-field, we learn from the Sheffield *Daily Telegraph*, has just been opened out near Hemsworth, about seven miles from Barnsley. The thick or Barnsley seam of coal has been reached on the estate of Mr. Allott, at a depth of 635 yards from the surface. This proves that a well-known and valuable bed exists in what may be termed the largest unworked coalfield in the West Riding. The shaft is the deepest in South Yorkshire, and the field in which the seam is worked commences at its southern extremity close to the town of Nottingham, and extending through Derbyshire, proceeding along the margin of the limestone to Barnsley and the east of it and the Ashworth Rock. The great coal-field, which includes parts of Derbyshire, Yorkshire, and Notts, is the largest in England, and only 150 square miles less in area than that of South Wales, the extreme length being sixty-six miles. The southern boundary is new red sandstone, and the strata rise and cross out westward near Bradford and Leeds, and then turning to the east, disappear under the magnesium limestone. The thickness of the bed near Hemsworth is about eight feet, which may be considered as about the average in South Yorkshire, while at Shireoaks Colliery, near Worksop, it is little more than three feet. The new colliery will be able to raise, when fully opened out, more than 1,000 tons daily, so that there will be an addition to the coal-producing power of South Yorkshire of 400,000 tons a year.

THE possibility of keeping a manatee in a healthy state in an aquarium is fully proved by the good condition of that at Westminster. It arrived on June 20, and has increased in size and done well. The only other specimen brought alive to England lived at the Zoological Gardens from August 6 to September 7 only, in 1875. At Westminster the animal is in a glass tank above the level of the ground, and accessible on both sides, so that its movements, position in floating, &c., can be well seen.

THE *Times*' notice of Bank Holiday amusements speaks of the Nubian Camp at the Alexandra Palace as an educational entertainment. In this we quite agree, and hope that every success may attend such instructive exhibitions as this.

RESPECTING the tornado, by which Canton was visited on April 11, the Rev. John Chalmers writes to the London Missionary Society that after careful inquiry and personal observation, he concludes that the whirlwind did not extend much further than three miles, the average width of its path being about three hundred yards. But on the next two days there were several distinct whirlwinds of a similar character in the neighbourhood. Over the space above indicated the tornado seems to have equalled in force and destructive effect anything of the kind heard of in the West Indies.

IN our "Meteorological Notes," vol. xviii. p. 287, the name of Mr. Eliot, who is officiating for Mr. H. F. Blanford in India, during the absence of the latter, should have been quoted instead of that of Mr. Blanford, as the authority for the forecast of the monsoon referred to.

AN astronomical correspondent suggests that in Mr. Lockyer's Eclipse telegram last week the words "Corona probably photographed in Siam. Fluorescent eye-piece worked well," should read "Corona probably photographed; it seemed fluorescent. Eye-piece worked well." With respect to the place of "Vulcan" as observed by Watson, R.A. 8° 26′ should be R.A. 8h. 26m.

THE additions to the Zoological Society's Gardens during the past week include a Slow Loris (*Nycticebus tardigradus*) from Borneo, three Chinese Cranes (*Grus longirostris*) from China, presented by Mr. Theodore Hance; a Mexican Deer (*Cervus mexicanus*) from Mexico, presented by Mr. A. Scrutton; a Common Fox (*Canis vulpes*), European, presented by Mr. Athelston Riley; three Great Bustards (*Otis tarda*) from Spain, presented by Lord Lilford, F.Z.S.; a Tiger Bittern (*Tigrisoma brasilianea*) from South America, presented by Mr. Hammond Hawbyne; a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, presented by Mrs. A. A. Hole; a Passerine Owl (*Glaucidium passerinum*), a Bacha Eagle (*Spilornis bacha*) from Borneo, presented by Mr. J. S. Jameson; two Beisa Antelopes (*Oryx beisa*) from North-East Africa, a Brown Coati (*Nasua nasica*) from America, deposited; an Ocelot (*Felis pardalis*), a Black Vulture (*Cathartes atratus*) from America; two Chilian Sea Eagles (*Geranoaëtus melanoleucus*), a Brazilian Caracara (*Polyborus brasiliensis*) from South America, two Rufous Tinamous (*Rhynchotus rufescens*) from Brazil, nine Spotted Tinamous (*Nothura maculosa*) from Buenos Ayres, a Razor-Billed Curassow (*Mitua tuberosa*) from Guiana, purchased; an Axis Deer (*Cervus axis*), born in the Gardens.

THE PHONOGRAPH AND VOWEL-SOUNDS[1]

II.

IN our last communication we confined our attention to the letter *ō*. We will now turn to the letter *ū* (corresponding to *oo* in "food"). Fig. 2 shows a series of curves obtained for

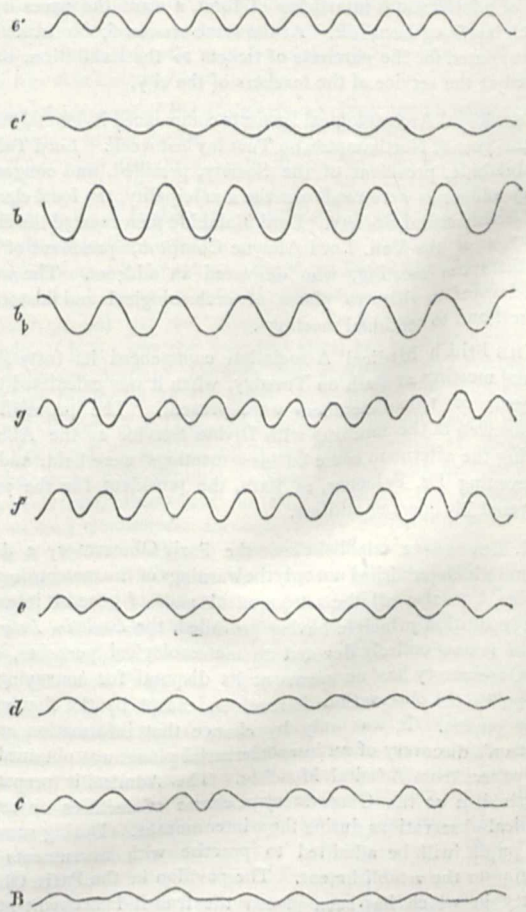


FIG. 2.—*Wave-forms of ū Sung by the same Voice at Various Pitches*

ū by the mechanical process already described. They are all

[1] Continued from p. 343.

sung by one voice: that numbered 5 in our previous communication.

Table V. gives the amplitudes of the first six harmonic partial tones for this series; and Table VI. gives the same constituents of another series of *ū*'s, sung by the voice formerly numbered 1.

Comparatively few curves have been transcribed for the sound *ū*, because the groups of constituents in this letter are much simpler than those in *ō*. Moreover, although the curves for only two voices have been analysed, we have by numerous examples satisfied ourselves that the selected examples represent with sufficient accuracy results produced by several other voices.

In examining Fig. 2 it must be borne in mind that the phonograph was turned in all cases at approximately the same speed, as accurately as this could be done by aid of a metronome. The length of the period in the curve corresponds, therefore, to the duration of the vibration which the voice produced on each note. On the upper path of the scale the wave-forms are almost exactly simple harmonic curves, but from *g* down to *d* the period is composed of two halves each closely resembling

TABLE V.—*Harmonic Constituents of ū Sung at Various Pitches by Voice No.* 5.

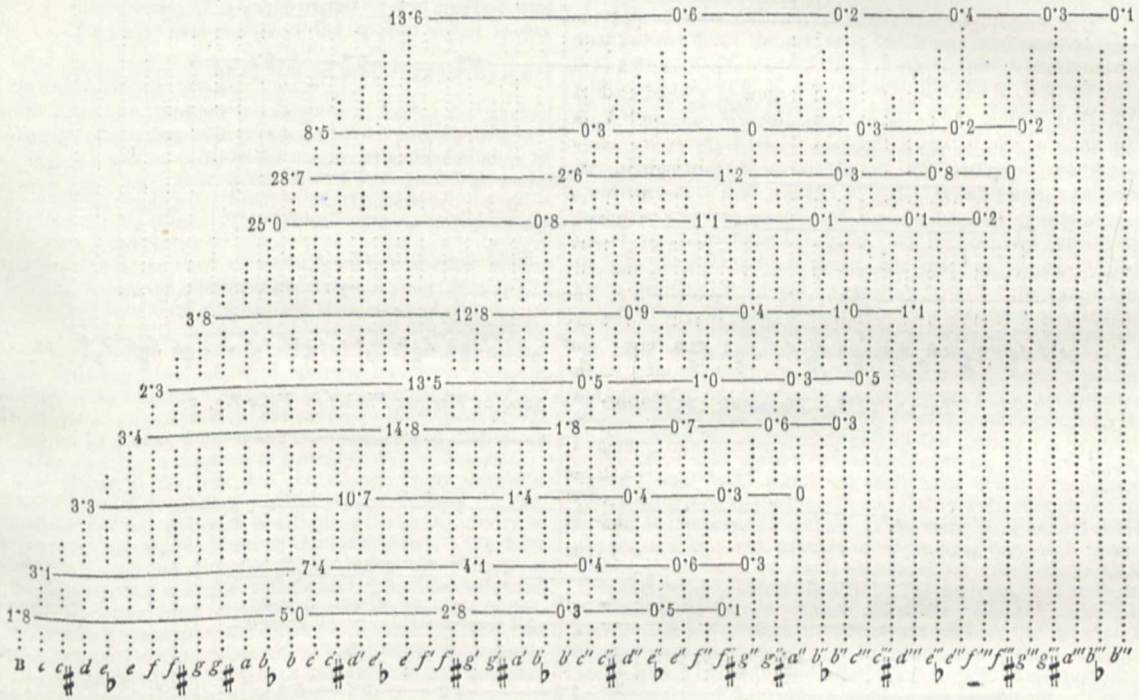
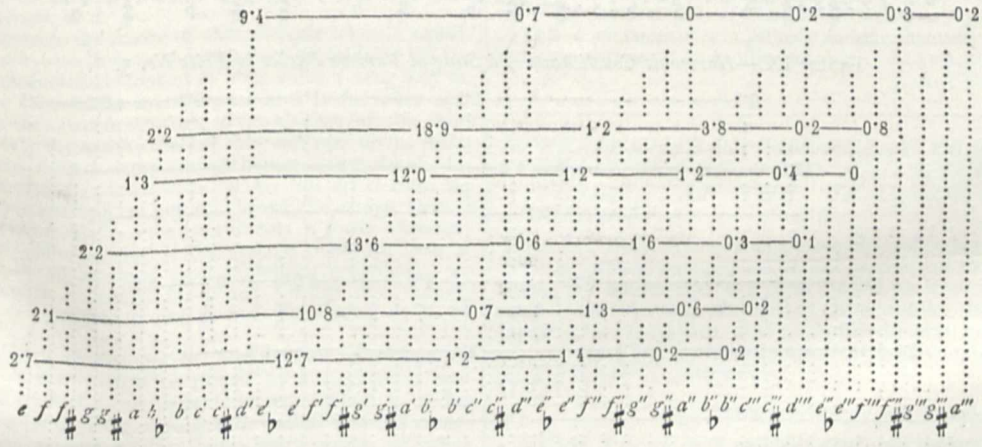


TABLE VI.—*Harmonic Constituents of ū Sung at Various Pitches by Voice No.* 1.



a simple harmonic curve, so that the form on *e*, for example, is not readily distinguished by eye from that on *e'*, an octave higher. Below *d* the curve breaks up into a somewhat irregular triplet.

We will call the curves for the notes above *b♭* *simple ū* curves, and those from *g* downwards *duplex ū* curves. The analysis of the duplex curves shows that they consist of a very weak prime tone with an immensely strong second partial. The figures and tables might easily be extended above *e'*, but it is unnecessary to continue them, for the higher notes all give the same close approximation to the simple harmonic wave. We cannot say that we have obtained a good *ū* below *d* from any voice. The marks on the tinfoil were always feeble, and the sound as repeated by the phonograph was little more than an inarticulate groan. It will be observed that the note *a* is wanting in the tables and in the figure. It has been omitted because we had difficulty in getting a good *ū* back from the phonograph when the vowel was sung on this note. We have no doubt a good *ū* can be pronounced at this pitch, but we observed a constant tendency towards the *ō* character both in the curves and in the sound; that is to say, there was a tendency to give the two lowest partials instead of a simple prime, or a strong second and very weak prime. Moreover, the curves would vary in character

during the utterance, which was seldom, if ever, the case at other pitches, indeed, the constancy of the wave-forms produced by the voice over hundreds of periods has usually been very striking.

In order to maintain the *ū* quality throughout a series of *ū*'s, the change from the single to the duplex form had to be quite abrupt. To test the *ū* at this critical point *slurs* were executed by voice 5 both up and down; that is, attempts were made to

TABLE VII.—*Harmonic Constituents of ō Artificially Produced at Various Pitches.*

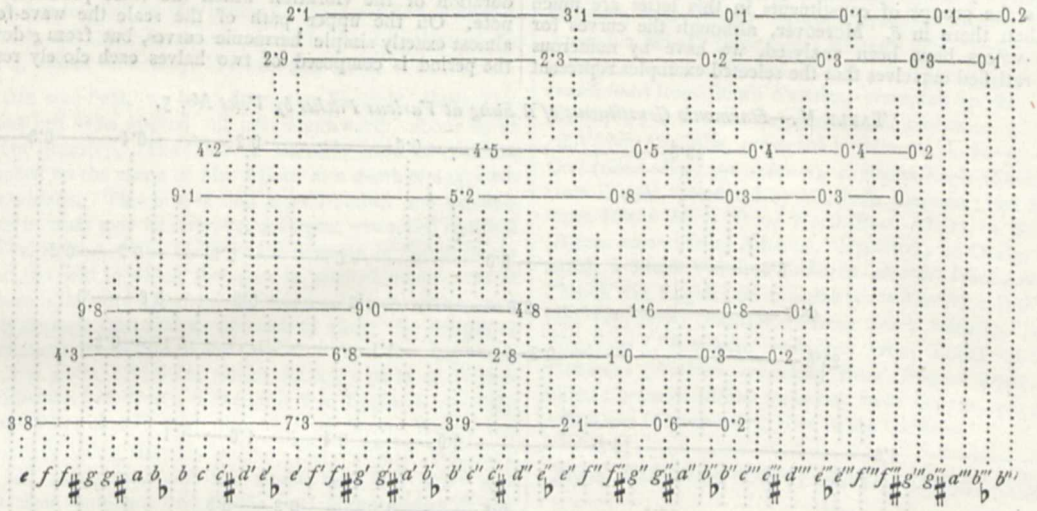


TABLE VIII.—*Harmonic Constituents of a° Sung at Various Pitches by Voice No.* 5.

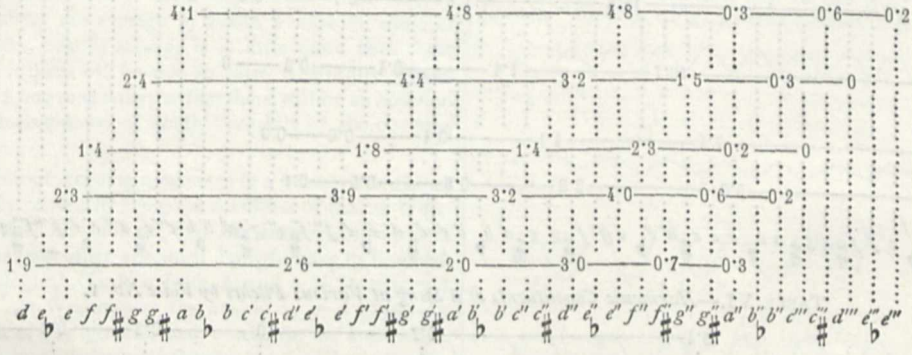
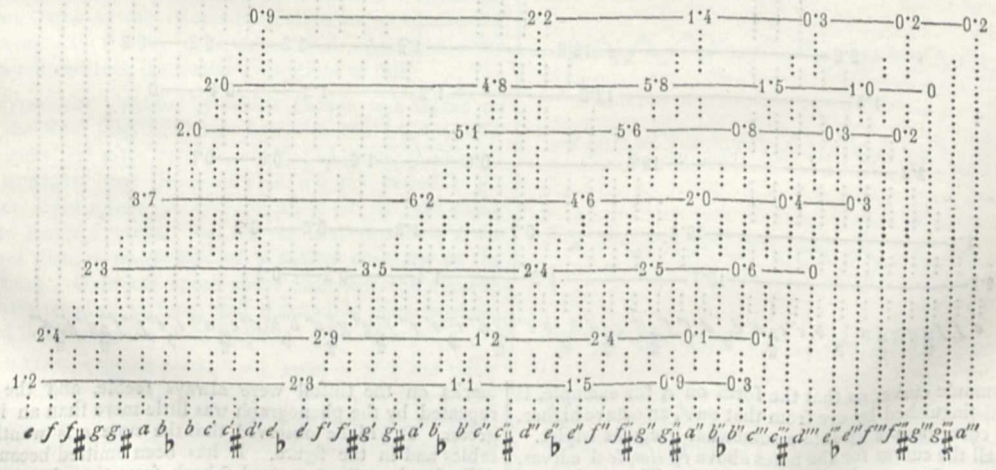


TABLE IX.—*Harmonic Constituents of ā Sung at Various Pitches by Voice No.* 5.



continue to say *ū*, and at the same time gradually raise and lower the pitch past *a*. At this pitch one of two things invariably happened. Either the curves became so like those for *ō* that they could not be distinguished from *ō* at the same pitch either by eye or ear, or they sunk to such an insignificant size as to indicate an interval of almost total silence.

One voice (No. 7) carried the simple harmonic form of *ū* down as low as *f*. This voice had a very limited range, and could not produce the duplex form at all. Moreover, the sound of the simple *ū*, while being spoken on *f* or *g*, was less vocal and more like a whistle than the duplex *ū* given by other voices.

One and the same voice, when singing on *a* or *b*♭, would sometimes give the simple and sometimes the duplex form.

The following general propositions are, we think, established by these experiments:—

1. The generic character of *ū* from *d* upwards is given by the prominence of a single partial tone. Above *b*♭ this partial is the prime. Below *a* with certain voices it is the octave of the prime.

2. The amplitude of the second partial is sometimes as much as nine times greater than that of the prime, but the sound will be recognised as *ū* when the second partial is only three or four times the size of the prime, provided the pitch of the prime is below *a*.

3. Below *d* the experiments do not warrant positive conclusions. The prominence of a single partial is less marked, and at the same time the vowel quality of the spoken sound is very poor.

4. The average pitch of the reinforced tones is generally lower than the average pitch of the group for *ō*.

5. We have not detected any single note having the marked characteristics for *ū* that were possessed by the note *b*♭′ for *ō*.

6. There is a critical pitch in the neighbourhood of *a* or *b*♭, at which a sudden change takes place in the wave-forms given by certain voices in singing *ū*. Further experiments are desirable in this sound at this pitch. The critical pitch is not perfectly constant for a single voice.

As some doubt may not unnaturally be felt whether or not the singular change of character observed in *ū* at or near the note *a* may not have been due to some peculiarity of the instrument, we may repeat that, being fully aware of this danger, we tried the experiment repeatedly with changed mouth-pieces, changed vibrating discs, changed springs, and with different thicknesses of tin-foil, but invariably with the result that certain voices passed at this pitch from the simple to the duplex *ū*. It must not be forgotten, too, that one voice, using the same instrument, carried the simple *ū* as low as *f*.

7. This points to the fact that the change from simple to duplex *ū* is not made on account of the requirements of the ear, but on account of the difficulty in adjusting the mouth-cavity so as to continue the simple form on the lower notes. We have seen that, not only do different voices make the change at different pitches, but a single voice gives sometimes one and sometimes the other form at pitches near its critical point. We thus see that the simple and duplex forms overlap, and that in this case sounds of the same pitch, which differ by a whole octave in the pitch of their single prominent tone, are accepted by the ear as generically the same vowel.

The prominent tone in *ū* is found to lie in the region from *a* upwards, but we have not found any one sharply-defined pitch to be characteristic of *ū*.

With reference to the theory of characteristic tones in vowel-sounds we draw attention to the very great prominence of the tone *b*♭′′ (the characteristic tone of *ō*) when voice 1 sang *ū* or *b*♭. What may be termed the average pitch in *ū* is for notes near *d* and *e* lower than that in *ō*, owing to the absence of the third partial; but it is noteworthy that, as the voice runs up the scale, the constituents of *ū* are on an average higher than those of *ō* for *g*, and in the case of voice 1 even for *b*♭; this arises from the comparative smallness of the prime. When the simple form is reached the average pitch of the constituents is lower than that for *ō*. If, instead of looking at the average pitch, we look at the pitch of the highest and most prominent constituent, we find that this pitch is identical for *ū* and *ō* when these vowels are sung on *g* by voices 1 and 5, and when sung on *b*♭ by voice 1.

Further light is thrown on the whole theory of vowels by experiments on the vowel *ō* as uttered by a mechanical contrivance made by Prof. Crum Brown and lent by him to us for investigation by help of the phonograph. It consisted of a bag-pipe reed fitted to a tube leading into a gutta-percha resonance chamber which had such a form and such openings (tentatively arrived at) as caused it to speak a very good *ō* when the reed was blown. No one listening to this sound could doubt that the letter *ō* was being distinctly spoken. We held this apparatus to the phonograph, and the record obtained from it gave back a remarkably good *ō*, better indeed than the original, as the jarring noise of the reed was lost. When the pitch of the reed was changed, the same vowel continued to be given. The pitches in our experiments with this resonance bottle ranged from *e* to *e*′. We had thus a constant cavity producing unmistakably the same vowel throughout an octave.

Table VII. gives the constituents of each *ō* thus artificially produced. They agree with the *ō*'s pronounced by the voice in being composed of a prime and its octave for notes above *b*, also in having the first three partials on *e* and *f*♯. On *g* the third is stronger than in the human voice. No specially strong reinforcement appears to exist in this artificial *ō* for *b*♭′, or any tone near it, but there is a wide range of reinforcement extending on both sides of this pitch. It may be stated that this artificial *ō* was what might be called a bright *ō* whose pitch of general or of maximum resonance might be expected to be somewhat higher than that of the *ō*'s given by the human voice.

We draw attention to the fact that even supposing the prime not to have been reinforced at all, this irregular gutta-percha cavity must have reinforced tones, more or less strongly, through a range of at least fifteen semitones, namely, from *e*′ to *g*″. This fact follows from the analyses, but it was confirmed by another and independent experiment. A short tube was inserted into the bottle in place of the reed and the end of the tube applied to the ear so that the cavity acted as a resonator to sounds from outside. The keys of a piano were then struck in succession and the listener noticed by the bumming noise in the bottle what tones were reinforced. On working down the scale resonance was first noticed at *g*″♯. It increased, and became excessively strong on *f*″, and remained nearly equally strong on *e*″. It then diminished a little, but became very intense again on *e*″♯, then diminished again, but even on *g*′ and *f*′♯ it was much stronger than could be accounted for by the strengthening of the second partial. Below this the experiment was not suited to detect the influence of the cavity as a resonator on account of the reinforcement of upper partials in the notes struck. It sufficed, however, to prove that this irregular cavity possessed not only one, but probably several proper tones, so near to one another as to give the effect of a resonator strengthening, more or less, every tone between widely distant limits.

We have also made a few experiments on the vowel sounds "awe" and "ah," which we shall write *a*° and *ā* respectively. The phonograph spoke these sounds fairly well, though not quite so well as the sounds *ō* and *ū*. It may here be remarked that our phonograph was not capable of registering very high tones; a shrill whistle, however loud, produced no effect on the tinfoil. This fact proves, independently of the analyses, that in the case of those vowel sounds which it did speak well, the comparatively low partials were sufficient fully to characterise the vowel. The observations show that for *a*° the first three partials are prominent where *ō* has only two; and that for the same part of the scale *ā* has four consecutive partials all prominent. The fifth partial was considerably strong for *ā* when sung on *e*, where *ō* was composed of three partials and *a*° of four. Tables VIII. and IX. show the analyses made of these two vowels as sung by voice 5.

This communication is already so long that we must defer our general remarks to another number.

FLEEMING JENKIN
J. A. EWING

EXPERIMENTS ON THE RELATIVE SPECIFIC GRAVITIES OF SOLID AND MELTED MATERIALS AT THE TEMPERATURE OF FUSION

DR. MUIRHEAD communicates the following account of experiments undertaken at his request, for the purpose of testing the notion that the earth's crust, as it cooled, became relatively heavier than the molten mass within; that the crust, breaking into fragments, sank; and this process, going on time after time, by and by built up a sort of honeycombed arrangement of the earth's interior:—

"*Railway Works, Leeds*, March 30, 1878

"DEAR SIR,—I have carefully gone over the experiments *re* the melting of metals in contact with liquid metals. I was certain on this point, from more than half a century's observation, before you wrote me, and I think I stated that conclusion in a former letter. I have now only to indicate the order in which I conducted the experiments, the result of which I now communicate.

"With several different compounds of brass, at various temperatures, I melted similar compounds; skimming the metal in the crucible, I laid the solid piece carefully on the clean surface, which piece, coating itself partially by chilling the liquid metal, very soon re-absorbed a sufficient amount of heat to be fused,

and, fusing from the *bottom side*, gradually dissolved. I then placed similar blocks of metal endwise on, when, dipping beneath the surface, they bounded back to the surface, and subsequently dissolved, endway down. These results apply to various weights and sorts of compounds. I then conducted similar experiments with cast-iron, and found that the facts were still more conspicuous in the cast-iron (all of the same tendency) than in brass.

"Placing the iron on the surface of the liquid iron, a rapid chill set in, and a coating of iron, apparently about ¼" thick, attached itself to the cold iron, but very shortly re-melted, when the cold iron disappeared with it. I then dropped a small piece of cold iron (the same being dried to prevent explosion) endwise on to the surfaces of the liquid metal, when, bounding back to the surface, it melted in that position.

"The argument applies precisely to the experiments conducted in lead.

"In all cases the cold metals were relieved of any exterior ingredient by being well filed over. In every case of brass and iron the material melted was about 1" in diameter and 4" in length, each piece being round. With regard to the lead, the pieces varied in size, weight, and form, but all the experiments resulted in the same way. "JOSEPH WHITLEY"

"*Railway Works, Leeds*, April 11, 1878

"MY DEAR DR. MUIRHEAD,—Confirming my letter of yesterday, I have now to report the results of several experiments which, you will see, perfectly coincide with and demonstrate the truth I have again and again assured you of, viz., that all liquid matters that are susceptible of solidification will, when solid, float upon similar matter when in a liquid state.

"I intimated to you in my last that I feared I could not, in a small crucible, sufficiently fuse granite and whinstone, and in my experiments of yesterday, although I melted my crucible, I did not sufficiently liquefy the granite so as to float a piece upon the liquid mass. I therefore deferred further manipulations till to-day, and having secured a quantity of whinstone, I also determined to alter my course and to take advantage of a much larger focus of heat than that of a furnace 30" × 20" × 20", with a 60-lb. crucible. So I called upon Messrs. Taylor Bros. and Co., ironmasters of this town, and with their permission I proceeded as follows :—

"Being passed over by their manager to a subordinate officer—a worthy and very intelligent fellow, and, by the way, a strong believer in the doctrine that matter sinks in like matter when melted—we went to a furnace where we had three tests with whinstone, which he said disappeared, and I believe that he was justified in the two first experiments, because he was not sufficiently up in his observation as to notice a stream of gas liberated from a bubble formed on the surface by the melting of the whinstone immediately under it. In the next furnace we went to we had a large quantity of liquid 'cinder' 'tapped out' of a furnace into a trough. I really wish you could have seen it; to me the sight was grand, the gases given off by the melting of the whinstone blazed with a sort of blending of tints of purple, yellow, and green. I never saw anything so fine in flame. The whinstone was like a thing of life, so buoyant—of course the specific gravities of the liquid and solid materials varied considerably, and hence the buoyancy of the whinstone. We then tried a large number of small pieces of cinder—same as the liquid mass before us; but my friend the officer insisted that they went to the bottom—they certainly, except in one instance, never returned to the surface, because they liquefied before they had time to rise. My whinstone being done, and seeing that the results were not so satisfactory to my friend, I remarked that I was prepared to go all day and all night rather than give up the task of convincing him that his conclusions were wrong. I therefore suggested we should take a larger furnace, and deal with larger masses. We therefore, instead of dealing with quantities of 8 oz. weight, and weights of 1 lb., took pieces of 5 and 6 lbs. weight, each of solid cinder. Had my faith not been implicit I might have been deceived, for No. 1, 2, and 3 pieces went to the bottom, and my friend said, 'Now are you satisfied?' and I replied 'No, I am not.' Imagine his astonishment when No. 1 came bounding to the surface, and floated about like a cork, when the mass of heat had dissolved the coating which it clothed itself in at entering the bath and had begun to melt the original piece, up came No. 2 and 3, and I let him float them about on the surface with an iron rabble, so as to sear, as it were, the lesson sufficiently deep into his soul that it might never be erased. There were eight or nine jolly fellows looking on, and who enjoyed the joke, when my friend took off his hat and bowing politely said, 'Well, I am exceedingly obliged for the lesson you have taught me, and I shall never forget that all solid matter floats upon like matter when melted, as ice floats upon water.' Of course I had a joke and told him he was only one of a few who believed in the doctrine, and that he was the last convert. "JOSEPH WHITLEY"

P.S.—In the name of science I take this opportunity of tendering to Messrs. Taylor Bros., of the Clarence Iron Works, Leeds, my grateful thanks for their generous acquiescence in my request, and the facilities they kindly rendered in the experiments.—J. W.

THE INFLUENCE OF LIGHT UPON BIOPLASM[1]

SOME twelve months ago we briefly recorded in NATURE the results of our observations on the effect of sunlight on bacteria, and other organisms commonly associated with putrefaction and decay. Most of the experiments were subsequently described in detail in a paper communicated to the Royal Society. The chief of our earlier conclusions may be summed up shortly as follows :—

1. Light is inimical to, and under favourable conditions may wholly prevent, the development of these organisms, its action on the common forms of bacteria being apparently more powerful and rapid than upon the mycelial fungi which are prone to appear in cultivation-fluids.

2. This action appears to attain its maximum in the waves of greatest refrangibility. It is demonstrable in yellow light, but towards the red end of the spectrum sinks to a minimum.

3. The fitness of the cultivation-fluid to act as a nidus is not impaired by the insolation.

We found, moreover, that tubes containing a cultivation fluid and plugged with cotton wool, when removed to a dark place after exposure to the sun for a sufficient period remained perfectly clear and free from organisms for months. We thought, therefore, that the "germs" in these solutions had been completely destroyed by the solar rays.

While, however, we believe that, if the insolation be sufficiently prolonged, all the germs or spores originally present may be killed, and that, as regards bacteria, the insolation, under favourable conditions, need not be of very long duration, we have reason to think that, by *cell-walled* organisms, the destructive action of light may be resisted for a considerable period, and that the first result is to reduce the spore to a state of torpidity in which it may lie dormant for many months.

The investigation of this point, however, must necessarily extend over a long time; and in the above remarks we would wish to be understood as offering a suggestion rather than a definite conclusion.

We noticed last year that sunlight had no retarding effect on the *action* of the "indirect ferments," or, at least, of the soluble ferment of yeast (*zymase* of Béchamp, *ferment inversive* of Berthelot), which we used for our experiment. More recently, however, we have tested the effect of prolonged insolation on the soluble ferment itself, and have found that, at the end of three weeks' exposure to a midsummer sun, the *zymase* had entirely lost its characteristic property of hydrating cane-sugar, while a corresponding specimen, which had been kept in the dark, still retained its energy. It would appear, therefore, that the action of light affords no means of distinction between the "organised" and the "indirect" ferments.

We have attempted to elucidate the intimate nature of this action of light upon the organisms which have formed the subject of our experiments, and we have evidence pointing strongly, as we think, to the solution of the problem. Early in 1877 we set ourselves to this task, and, in order to obtain some insight into the effect of light upon certain organic bodies, we made a number of observations upon oxalic acid.

We have elsewhere[2] shown that a solution containing 0·63 per cent. (decinormal) is entirely decomposed by a somewhat prolonged exposure to strong sunlight when air is present. We now find that in a corresponding solution, *in vacuo*, no change

[1] By Arthur Downes, M.D., and T. P. Blunt, M.A. Oxon.
[2] *Chemical News*.

whatever is produced. This points conclusively to oxidation as the cause of the phenomenon.

We may here remark that this conclusion agrees with the results of the recent observations of M. Chastaing[1] upon a number of organic bodies, which he found to be oxidised under the influence of light.

As regards our oxalic acid, we have also determined that the oxidation in this instance is probably of the hydrogen and not of the carbon of the molecule.

From analogy and from direct experiment we believe that the mode in which light injuriously affects the organisms with which our investigation deals, is neither more nor less than a gradual oxidation of their living bioplasm, similar to the oxidation of the comparatively simple molecule of oxalic acid.

There is a lingering belief in the minds of many that matter which is endowed with life can by its "vital resistance" the more endure and survive the effect of injurious influences. This belief, derived, perhaps, like many others from a misapprehension of the indirect for the direct and from a misapplication of analogies, has no support from our experiments. On the contrary, we have met with results which are best explained by the consideration that bioplasm is matter of the utmost complexity and instability of constitution, ever-changing and most instable when the vital forces are at their full. We believe, in a word, that instability of this life-stuff is a predisposing cause for the destructive action of light, while in its stabler conditions it is more resistant.

We wish to keep this note within the limits of brevity, and will only remark in conclusion that, since the organisms which have been the subject of our work may be regarded as "life-units," well fitted by their tenuity for the demonstration of the action of sunlight upon the "physical basis" of their life, we may reasonably expect, and, indeed, may see, that this action is not limited to these special cases. We have chosen, therefore, in the heading of these remarks, to indicate the wider field of their application, but we by no means wish to imply that the relations of light to bioplasm are in all cases so simple.

[1] *Ann. de Chim. et de Phys.*, 5 ser. t. xi.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

AT the Graduation Ceremonial in Medicine and Law in connection with the University of Edinburgh held on August 1 the honorary degree of LL.D. was conferred on James Risdon Bennett, M.D. Edinburgh, F.R.S., President of the Royal College of Physicians, London, Sir Joseph Fayrer, M.D. Edinburgh, K.C.S.I., F.R.S., John Richard Green, M.A. Oxon, Joseph Lister, M.B. London, F.R.S., lately Professor of Clinical Surgery in the University of Edinburgh, and now of King's College, London.

AT the annual meeting of the Council of the Royal School of Mines the prizes were awarded as follows:—The two Royal Scholarships, of 15*l*. each, for first year's students, to Mr. R. G. Scott and Mr. W. Cross; the Royal Scholarship, of 25*l*., to Mr. R. Lancaster; the Edward Forbes medal and prize of books, to Mr. P. F. Frankland; the De la Beche medal and prize of books, to Mr. F. G. Mills; the Murchison medal and prize of books, to Mr. M. Terrero; and an extra medal to Syed Ali.

MRS. CATHERINE DAUNTESEY FOXTEN has bequeathed to Owens College, Manchester, the sum of 5,000*l*. to found two scholarships, one Legal and the other Medical.

WORK has been commenced on the extensive edifices of the new Berlin Polytechnic, which is to be situated a short distance out of the city at Charlottenburg. Five years are expected to elapse before the completion of this much-needed institution.

THE city of Lille has received from the French Department of Education the sum of 50,000 francs to assist in the foundation of a medical school.

THE Imperial ukase announcing the foundation of the new Siberian University states that it shall number four faculties, the medical, the legal, the historico-philosophical, and the physico-mathematical. Orders have been issued for the prompt construction of the edifices, towards the expense of which the provincial government of Tomsk has already appropriated 250,000 roubles—about 35,000*l*.

SCIENTIFIC SERIALS

Kosmos, April.—On life in Kosmos, by Carl du Prel, discussing possibilities of life in other worlds than ours.—The kingdom Protista, first part, by E. Haeckel.—On the physiology of the new-born, by M. Preyer. Part 1: On hearing and sight.—On the nests and gardens of *Amblyornis inornata*, or, rather, theories about them, by O. Beccari.—The sway of ceremonial, by Herbert Spencer. Part 4: On presents.—The discontinuance of human sacrifices, by E. Krause.

May.—The kingdom Protista, by E. Haeckel, describing Amœba, Protococcus, Euglena, Flagellata, Volvocina, Noctiluca, Infusoria, Acineta, Rhizopods, Foraminifera, and Radiolaria; forty-one excellent woodcuts.—On the physiology of the newly-born, by M. Preyer; on smell and taste.—The animal kingdom, as regards similarity of adaptations, by W. von Reichenau.—The sway of ceremonial, by Herbert Spencer: On marks of honour.—Sexual selection in plants, by W. Focke.

June.—Contribution to experimental æsthetics, by Rudolf Redtenbacher, pursuing Fechner's researches and discussing his results, analysing the causes of pleasure as regards the shapes and textures of flat surfaces, as well as of crystals.—Ernst Haeckel continues his popular articles entitled "The Kingdom Protista." He diverges very much into theory as usual, expounding his doctrine that the true animal kingdom is defined by the formation of a gastrula in its embryonic stage. On the side of phylogeny he considers the protista ascended to true animalism by becoming parasites.—Fritz Müller describes the queens of the Meliponæ, investigated in Brazil. He finds in four species the queens, or in some cases the parthenogenetic females, extraordinarily alike, while the males and workers are very different.—Herbert Spencer's sixth paper on the sway of ceremonial deals with forms of address; these articles are extracted from the future second volume of "Sociology."

Zeitschrift für wissenschaftliche Zoologie, vol. xxx. part 4.—On the origin of the sexual products in hydroida, by J. Ciamician; two plates of tubularia and endendrium.—Further contribution on the genus analges or dermaleichens (crustacean), by G. Haller; three plates.—On the structure of *Reniera semitubulosa* (sponge), by E. Keller; two plates.—On the structure of the Malpighian vessels of insects, by E. Schindler; 74 pages, three plates.

Vol. xxx., supplement, part 2.—Anatomical and zoological observations on the amphipods and isopods, by F. Leydig; fifty pages, four plates.—On the development of the testes and the alternation of generations in the salpæ, by W. Salensky.—On a mathematical method in zoology, illustrated from the acarida, by P. Kramer.—The reproductive organs of some ectoparasitic trematodes, by Carl Vogt; four plates, thirty-seven pages.—On the movements of "flying fish" through the air, by Karl Möbius; one plate, forty pages; giving an account of all observations on the movements of these fish, the anatomical structures on which they depend, and the way in which the mechanism works.—Studies of the freshwater fauna of Switzerland, by F. A. Forel. He distinguishes the characters of the littoral, the pelagic, and the deep-sea fauna of Lake Leman; discusses the relations between the present fauna and that of recent geological periods, and the migrations of species; and concludes that the lacustrine fauna of the subalpine waters has entered by migration since the glacial period; that the littoral fauna has come from other lakes of other lands; the pelagic fauna from forms already differentiated as such before migration; and the deep fauna by modification from the littoral.—On mud-dwelling cladocera, by W. Kurz; one plate, eighteen pages.

Vol. xxx., supplement, part 3.—On the early embryonic development of *Tendra zostericola*, by W. Repiachoff, one plate.—On the comet-forms of star-fishes, with a discussion of the phylogeny of the echinodermata, by E. Haeckel, one plate.—Contributions on protozoa, by A. Schneider: on actinosphœrium; on development of miliola; on trichosphærium and chlamydomonas, one plate.—On the form and signification of organic muscle-cells, by W. Flemming. The author believes he has discovered the development of unstriped muscle-cells in *Salamandra maculata* out of connective tissue cells, one plate.—On the anatomy of the entomostracan *Limnadia hermanni*, by F. Spangenberg.—Studies on the history of the Polish Tur, by A. Wrzesniowski. In this exhaustive paper of sixty pages all the historical references are examined, and most interesting woodcuts copied from representations of two animals are given. The conclusion is that two of the Bovidæ

remained extant in Poland to comparatively recent times, viz., *Bos primigenius* and *Bison europæus*, and that the former was the last to die out, in the beginning of the seventeenth century. —On the unity of the structure of the brain in the different orders of insects, by J. H. L. Flögel, illustrated by two plates of capital photographic reproductions of microtome-sections, thirty-seven pages.—On *Archigetes sieboldi*, a sexual cestode-nurse, by R. Leuckart.—The epiphysis on the brain of plagiostomes, by E. Ehlers, illustrated by two plates from *Raia clavata* and *Acanthias vulgaris*.

Bulletin de l'Académie Royale de Belgique, No. 5, 1878.—This number contains a memoir by M. Firket, treating of geological and chemical phenomena which have altered the rocks of an important metalliferous region in the province of Liége. The first part refers to the silurian fault and the metalliferous veins of the Champ d'Oiseaux; the second to the constitution and course of beds of oligiste; and the third to epigenic transformation of oolithic oligiste into siderite, in contact with a vein of pyrites (*à propos* of metalliferous veins of the mine of Landenne).—M. Spring, having conceived some doubts as to the existence of pentathionic acid, has examined anew the so-called pentathionates of potassium and baryum, and he finds these tetrathionates instead of pentathionates.—M. van Beneden announces the discovery of some gigantic fossil reptiles (probably Iguanodon) in the coal formation of Bernissart, near Peruwelz; and there is some correspondence between Count Du Moncel and MM. Navez on the subject of the telephone.

Reale Istituto Lombardo di Scienze è Lettere, Rendiconti, vol. xi. fasc. x.—We note the following papers in this number:—Critical annotations on duodenal anchilostoma, by Prof. Sangalli.—Causes and circumstances which influence hereditary transmission in animals (continued).—Hereditary transmission in the act of fecundation; note by Prof. Lemoigne.—Cure of varicocele by means of the temporary sub-cutaneous elastic ligature, by Prof. Scarenzio.—First lines of a cardiographic study designed for clinical purposes, by S. de Giovanni.—On the electromotive force developed from saline solutions of different degrees of concentration, with metals which do not form the base, by Prof. Cantoni.—*Résumé* of meteorological observations at Milan, in the Royal Observatory of Brera in 1877, by S. Fisiani, Jun.

The Journal of the Russian Chemical and Physical Societies (vol. x. No. 6) contains the following more important papers: On the action of iodide of butyl upon isobutylene in the presence of metallic oxides, by Miss Julie Lermontoff.—On quinine and cinchonine, by A. Wischnegradsky and A. Boutlerow.—On the fatty acids which are formed by the action of alkali upon cinchonine, by M. Lubavin.—On the hexylenes resulting from tertiary hexylic alcohols, and on their condensation, by L. Tavein.—On the preparation of bromide of trimethylene, by T. Bogomollez.—On the structure of the hydrocarbon $C_{19}H_{14}$ resulting from chloride of triphenyl-carbinol, by V. Hemilian. —On the anhydride of glyceric acid, by N. Socoloff.—On the formation of albumen from one of its products of decomposition, by A. Danilewsky.—On the action of bromine upon the compound homologues with benzol in the presence of bromide of aluminium, by G. Gustavson.—On diallylpropylcarbinol, by P. and A. Saytzeff.—On the conversion of primary alcohols into ethers, by N. Menschutkin.—On the theory of the current, by P. Van der Vliet.—On the resistance of steel, by M. Picatscheff.

SOCIETIES AND ACADEMIES

PHILADELPHIA

Academy of Natural Sciences, January 29.—On the mode of recognition among ants, by Rev. H. C. McCook.—Notes on the natural history of Fort Maçon, North Carolina, by Dr. Elliot Coues and Dr. H. C. Yarrow.—Description of new invertebrate fossils from palæozoic rocks of Illinois and Indiana, by Dr. C. A. White.

February 5.—Note on *Calycanthus floridus*, by Mr. T. Meehan.

February 26.—On the alkali of the plains in Bridger Valley, Wyoming, by E. Goldsmith.—On the mechanical genesis of tooth-forms, by J. A. Ryder, an important paper on mammalian teeth.

March 26.—On the electric constitution of the solar system, by Jacob Ennis.

April 2.—On the toilet habits of ants, by Rev. H. C. McCook. —On the Basilica spider and her snare, and on the probable geographical distribution of a spider by the trade winds, by same author.—Notes on *Acer rubrum*, by Mr. T. Meehan.

April 6.—On the vegetative repetition of cerebral fissures, by Dr. A. J. Parker.

PARIS

Academy of Sciences, July 29.—M. Fizeau president, in the chair.—New communication on the subject of the notes on alcoholic fermentation found among the papers of Cl. Bernard, by M. L. Pasteur. M. Pasteur finds that the notes, as printed in the *Revue Scientifique*, are in several places incorrect; M. Pasteur intends to repeat Bernard's experiments. M. Berthelot made a few observations on M. Pasteur's communication. —On the variations of the intensity of currents transmitted across mediocre contacts, according to the pressure exercised upon them, by M. Th. Du Moncel.—Absorption by the living organism, of carbonic oxide introduced in determined proportions into the atmosphere, by M. N. Gréhant.—On the *rôle* of coal dust in the production of explosions in mines, by M. L. Simonin.—New theory of the alterations caused by the phylloxera on the roots of the European vine, by M. Millardet. —Observations of the periodic comet of Tempel, made with the equatorial of the garden of the Paris Observatory, by M. Pr. Henry.—On the covariants of binary forms, by M. C. Jordan.—Note on a theorem on relative movements, by M. Laisant.—On the non-existence of the lengthening of a conductor traversed by an electric current, independently of calorific action, by M. R. Blondlot.—New observations on the subnitrates of commercial bismuth, by M. A. Carnot.—Thermic formation of phosphoric hydrogen and of arsenious hydrogen, by M. J. Ogier.—Researches on amylic alcohol (continued); dextrogynous alcohol, by M. J. A. Le Bel.—On the identity of the inulines of various origins, by MM. Lescœur and Morelle.— On the diffusion of salicylic acid in the animal economy (presence in the cephalo-rachidian liquid), by MM. Ch. Livon and J. Bernard.—On the anatomical characters of the Aye-Aye, by M. Edm. Alix.—On the influence of leaves in the production of sugar in beet-root, by MM. B. Corenwinder and G. Contamine.—Age of the bed of Mont Dol (Ille-et-Vilaine), by M. Sirodot.

CONTENTS