THURSDAY, MAY 13, 1875

LORD HARTISMERE'S VIVISECTION BILL

THE Bill brought forward in the Upper House by Lord Hartismere for regulating the practice of Vivisection deserves special attention on account of its being the first important legislative attempt to restrict the prosecution of physiological research.

It enacts that it shall not be lawful for anyone to perform a vivisection except in a place which is registered in pursuance of the proposed Act, the registration being in such form and under the management of such persons as the Secretary of State shall appoint. The registration certificate is to be renewed once a year; it may be cancelled at any time on its being proved that any provision of the Act has been contravened, and the place registered may be visited at any time by any inspector of anatomy. Complete anæsthesia is compulsory, and curare is not to be deemed to be an anæsthetic. The Secretary of State may grant special licenses for the performance of vivisections in which anæsthetics are not employed; there shall be paid in respect of every such license a sum not exceeding ten pounds, and each license is to continue in force for six months.

In the framing of this Bill there is a serious misrepresentation of the true requirements of the case. The source of error lies in the fact that it is taken for granted that there is only a single class of physiological workers. Such, however, is not the case; there are two distinct classes, and although we agree with the tenor of the Bill as far as one class is concerned, we are certain that it would so severely affect the other that its results would be seriously detrimental to the prosecution of physiological research in this country.

Among ourselves there are several scientific men who devote part of their life to the study of the problems of the vital mechanism. Some do so from the inherent interest of the subject; others from a desire to obtain a further insight into pathology and disease generally. In the course of their investigations it is now and then absolutely essential for the completion of a line of argument, or for the acquisition of the knowledge of the collateral phenomena attending some previously recorded result, that an experiment or experiments should be performed on a living animal. Those whose mental development leads them to conduct investigations of this character are frequently peculiarly unwilling to do so in public institutions. It is their spare minutes, when they are entirely their own masters, that they employ in their favourite study. Are they to be compelled, against their natural dispositions, either to obtain an official license for the performance of these experiments on their own premises, or, as an alternative, conduct them in some previously specially licensed establishment which is under the control of others? The necessity for such a method of procedure would deter many an excellent worker from commencing investigations which he recognises to be so much impeded by *legal* restrictions. There might as well be a tax on astronomers directing their telescopes to any special planet or to the moon. The public may feel certain that students of the class to which we refer will never go beyond the limits of the innate laws of sympathy present in all civilised humanity. Such do the most valuable work in a scientific point of view; and any legislative measure which in any way affects them injuriously, either by rendering the whole research apparently too formidable at the outset, or by the introduction of unpleasant details during its prosecution, ought most strenuously to be resisted. The power of turning to a practical end the results of inductive reasoning is the basis of the British nature. Inductive research cannot be had for money; it is always a labour of love; it is not fair to put impediments in the way of it.

The class of physiologists to whom legislative restrictions with regard to vivisection do apply, is the teachers. There is no doubt that those who assert that the performance of vivisectional demonstration is unnecessary will have the sympathy of the majority. A fact may be learned from books or by practical demonstration. As far as natural science goes, the extra time which has to be expended in obtaining the results practically is generally quite made up for by the accessory details introduced, which are many of them omitted in written or verbal descriptions. Observation is a far more sound basis on which to start fresh work than the knowledge acquired from books alone. The student should therefore, where nothing counter indicates, have the opportunity of repeating, on his own account, the experiments he reads of. In the case of practical physiology, however, another consideration has to be introduced. Here the subjects of experiment are sentient beings, and the question comes to be whether the advantages of the practical verification of fully described phenomena which involve pain are counterbalanced by the injustice done in the production of the pain itself. We think not, and are therefore fully in favour of legislative restrictions on the powers of those who wish to employ living animals for the purpose of demonstration, even where anæsthetics are employed, because there is a tendency among those who are in the habit of repeating experiments to neglect those parts of them which are not absolutely necessary. But any measure which in any way impedes original work, as does the Bill before us, ought, in our opinion, to be strongly opposed.

GEIKIE'S "LIFE OF MURCHISON"*

II.

Life of Sir Roderick I. Murchison, Bart., F.R.S. etc. Based on his Journals and Letters. With Notices of his Scientific Contemporaries and a Sketch of the Rise and Growth of Palæozoic Geology in Britain. By Archibald Geikie, LL.D., F.R.S., Director of H.M. Geological Survey of Scotland, and Murchison Professor of Geology and Mineralogy in the University of Edinburgh. 2 vols. Illustrated with Portraits and Woodcuts. (London: John Murray, 1875.)

MR. MALLET, in a memoir published in the *Philosophical Transactions* (vol. 163, p. 147), which has attracted attention as much for the boldness of its tone as for anything else, has laid down the dictum that no sound progress can be made in geology unless the investigator be also mathematician, chemist, and physicist. Now, Murchison was none of these, yet he would be a

* Continued from p. 3.

bolder man than the writer of that memoir who should affirm that no sound progress was made in geology by him.

It is true enough, no doubt, as Prof. Geikie says, that "he was not gifted with the philosophic spirit which evolves broad laws and principles in science," and he therefore contributed nothing to this branch of geology. It is strange, in fact, that when he did express any opinion on debated theories—and he did so frequently with vehemence—he generally took that side which the advance of science has condemned as untenable; so that the only assistance he gave to theoretical geology was that of affording the holders of any new theory the notorious advantage of having some one to argue against. He made no speculations himself, but only discussed those of others. In fact, "he had the shrewdness to know wherein his strength lay. Hence he seldom ventured beyond the domain of fact, where his first successes were won, and in which throughout his long life he worked so hard and so well. In that domain he had few equals."

But for the observation of geological facts there is no necessity for a universal acquaintance with science, however great an advantage such an acquaintance may be; and this is proved by the successful labours of many a field geologist—by the example of Wm. Smith, so often called the Father of English Geology, who had no such advantages, and by Murchison himself, as these pages of Prof. Geikie abundantly show.

Yet there are qualities requisite for such work as Murchison's, which are rarely so abundantly possessed as by him; they are, a keen perception of the really essential features of a district, or, as Smith somewhat quaintly expressed it, "a fine eye for a country;" a power of correlating apparently dissimilar objects; and last, not least, an untiring industry and perseverance that persist in pursuing an intricate subject until it is fully mastered. These appear in all his work, and are well brought out in his "Life."

Although the name of Murchison is now indissolubly connected with Palæozoic rocks, he did not begin his geological work among them, but among those easier Secondary rocks in which the order and arrangement is so much clearer. His first work, in 1825, was a "Geological Sketch of the North-western extremity of Sussex and the adjoining parts of Hants and Surrey," which was certainly up to the average geology of the time, and gave promise of better things in the future. Indeed, when it was thus seen that he had the ability, and intended to be a worker in the science, he was elected to the secretaryship of the Geological and fellowship of the Royal Society, rather from the hope of what he would do than from what he had done—and fortunately the hope was not disappointed.

His next work was the determination of the age of the coal-beds of Brora on the east coast of Scotland, in connection with which he described those remarkable remains of Secondary rocks so marvellously preserved on both sides of Scotland, and which have lately been the subject of such admirable and beautiful memoirs by Judd and others.

The difficulties he found in understanding some of the rocks he saw on this tour induced him to seek the co-operation of Sedgwick, and thus commenced that long and happy association of two great men, which, though clouded for a time, cannot be said to have been entirely broken up. We may mention here that these volumes are enriched with portraits of some of the chief geologists that have been or are, and nothing more life-like, as far as we know the originals, could be desired.

Another of his early works, in conjunction with Sedgwick, was an account of the structure of the Eastern Alps, which raised much discussion among European geologists, who have not finally accepted the conclusions they contended for—as, for instance, as to the age of the remarkable Gosau beds which they considered to be Tertiary—though they are now generally regarded as Cretaceous.

During all this time he had, like most geologists, avoided as much as possible what he called the "interminable Grauwacké." In the summer of 1831, however, he started with his wife and "two grey nags" to make the first attempt at unravelling the complicated features of these slaty rocks. He determined to begin at the top and trace the succession downwards. In this way he made out satisfactorily that summer the limits and range of the Ludlow rocks. Subsequent summers were devoted to the same work, and arrangements of the Silurian rocks of increasing accuracy were from time to time presented to the Geological Society until his final conclusions made their appearance in the "Silurian System."

On the controversy concerning the nomenclature of the Palæozoic rocks, which led to the painful estrangement between Murchison and Sedgwick, Prof. Geikie throws every possible light, and renders the whole matter perfectly clear. We cannot but think, however, that Sedgwick had more cause for complaint than Prof. Geikie would seem to admit, for if Murchison had no intention to disparage Sedgwick's work, he really, to a great extent, ignored it in comparison with his own. The facts are these. Murchison, in working downwards, described as Lower Silurian the rocks which formed his Caradoc and Llandeilo series, but without defining any satisfactory base line. Sedgwick, in working upwards, described as lying above a series of, at that time, unfossiliferous slates, a set of rocks which he called the Bala group, or Upper Cambrian. Now, though both these geologists went in company over both districts, they failed to discover that these two series were the same—in fact, they pronounced them distinct. Hence, when it was discovered that the one series, the Upper Cambrian, rolled over an anticlinal into the other, the Lower Silurian, each geologist blamed the other for the error. But in the meantime it was ascertained that the fossils were identical, and hence, "zoologically speaking," two different names could not be employed. If, as Murchison supposed, there was a total absence of organic remains beneath these disputed rocks, much might be said in favour of associating them in name with the fossiliferous Silurian rather than with the azoic Cambrian. Yet the manner in which this was done by Murchison, so fully explained by his biographer, leaves little surprise at Sedgwick's indignation, but only that he should have been so long in discovering the drift of what was being done. For in 1842 Murchison writes him a letter, begging the whole question by calling them Lower Silurian, as if there could be no possible idea of calling

them Cambrian, and bidding Sedgwick, if he would retain the latter name, to find some fossiliferous beds *below*. This is followed by the complete dropping out of the name in his "Russia;" and when in after years a series of Lower Fossiliferous beds *were* found, Murchison still sought to include them under the title of Silurian. It is astonishing that Sedgwick should for so long have failed to perceive the drift of these changes—and when he did at length arouse himself he found half his Cambrian system gone, and not unnaturally felt that his friend had "stolen a march on him." Such appears from the data afforded by this work to be the true account of this controversy. In late years, however, chiefly owing to the labours of Mr. Hicks, much new light has been thrown on the succession of faunas in these earliest rocks, and it has been shown that by no means the greatest break in life occurs at the base of the Llandeilo rocks as described by Murchison; and it is therefore probable that the true limits of the two systems will have yet to be re-adjusted under the light of the new facts.

The "Silurian System" is a masterpiece of industry, perseverance, and comprehensiveness, and will be a classical work so long as Geology is a science; it is undoubtedly Murchison's *magnum opus*, and it led directly to those other researches by which he has also contributed so much to our knowledge. Thus it was, on being told that plants had been found in Silurian rocks in Devonshire, that he persuaded Sedgwick to accompany him there, when they found that the so-called Silurians were really of Carboniferous age—but on what did they rest? on a series of rocks with a peculiar assemblage of fossils, which gave them great difficulty at first, but which at last they recognised as a new system, the Devonian, with which they boldly classed the Old Red Sandstone, though no community of fossils had yet been proved. This last step, however, was fully justified, by Murchison's finding in Russia the fishes of the one associated with the shells of the other, and thus the Devonian system was settled on a firm basis.

The received classification, however, of the Devonian rocks was called in question by Prof. Jukes shortly before his lamented death; he assigned the greater part of them to the Lower Carboniferous system, and Prof. Geikie considers it to remain now an open question. He says: "They who have given most attention to this part of geology will probably most readily admit that, whether in the way of contest or not, the question must be reopened; that the accepted classification is far from being satisfactory, and that Jukes did a great service by boldly attacking it, and bringing to bear upon it all his long experience in the south of Ireland, which gave him an advantage possessed at the time by hardly anyone else." Whatever controversy, however, there may be on the classification of particular rocks, there can be no doubt that there is a distinct epoch of life between the Carboniferous and Silurian, and this Murchison and Sedgwick together first defined and established.

It was for the study of the Silurian system, too, that Murchison was led into Russia, and here it was that he found that large development of rocks containing a special fauna overlying the Carboniferous, to which he gave the name of Permian, and which formed the subject of several subsequent researches.

We are greatly indebted to Murchison for the introduction of good names into Geology. It was he who first proposed the use of geographical terms, so happily illustrated in "Silurian," which introduce no theory and no incongruity, such as is involved in calling rocks "transition rocks," or speaking of the Old Red Sandstone as represented by a clay. This method of nomenclature has been widely adopted and is now almost universal, and it has the further advantage of carrying with it information as to the locality where the series is typically developed.

The minor works of Murchison, in the shape of papers and addresses during the time that these "systems" were being worked out, were numerous, and, with the exception of his "Geology of Cheltenham," almost entirely confined to those Palæozoic rocks that had now become so familiar to him. But he brought forward now, not only his own researches, but those of more humble workers also, always giving them due credit. Amongst the most remarkable of these were the discovery of the curious crustaceans of a new type, now known as Eurypteridæ, in the Upper Silurian rocks of Lesmahagow, by Dr. Slimon. Another was the discovery of fossils in the ancient crystalline rocks of the Highlands, by Mr. Peach, which led ultimately to the last of the valuable series of labours that Murchison performed. In the same category as the above must be placed the publication of "Siluria," in which he embodied from time to time, not only his own original researches and additions to them, but the works of all who had laboured in that field, by which the work became at the same time less his own, and more comprehensive than the "Silurian System."

Finally, in the chapter entitled "The Foundatio Stones of Britain," Prof. Geikie gives an account Murchison's last geological work, that of making out the structure of the extreme north-west of Scotland, and discovering there the oldest rocks in Britain. Here, in 1858, he discovered three series of rocks, each overlying the one below unconformably, and it was in the upper of these three that Mr. Peach had found Lower Silurian fossils. If, then, the second be the Cambrian, the lowest must be a series still older. To this he gave the name of Fundamental Gneiss, but afterwards classed it with the Laurentian system of Sir E. Logan, which had been hitherto unrecognised in Britain. This work, however, valuable as it is, is of a different kind to that which made Murchison what he was—a master-builder in Geology.

His chief work consisted in uniting vast masses of rocks stretching over miles of country, variously characterised lithologically, and containing numerous different suites of fossils, into large comprehensive groups; in grasping the features by which many minor periods are united into single systems; in laying down the broad outlines in which the complete geological picture is to be traced. This is the work wanted at the birth of a science; it requires a peculiar power of mind, possessed in large degree by Murchison, who thus deservedly takes rank among the founders of Geology.

We leave Prof. Geikie's work with regret. Like him in writing it, we live again in reading it, with this hero of science; and no one can rise from its perusal without a deeper interest in the progress of knowledge, and especially of geology. A man of great power, thoroughly

devoted to the advancement of science, and pursuing it with energy and discretion, is an example of which we cannot have too many; and the history of Murchison shows how much valuable material may yet be lying dormant in some who have as yet shown no devotion to anything but pleasure and sport.

MARSDEN'S NUMISMATA ORIENTALIA

Marsden's Numismata Orientalia. A New Edition. Part I. "Ancient Indian Weights." By Edward Thomas, F.R.S. (London: Trubner and Co., 1874.)

THIS is the first part of a new edition of "Marsden's Numismata Orientalia," on an enlarged scale, and is the reproduction of an essay published some years ago. As it treats of the earliest information that has come down to us of the system of monetary weights in use amongst ancient Eastern nations, it is considered as an appropriate introduction to subsequent numbers, upon the coins of various Eastern countries, to be contributed by other authors.

Mr. Thomas's essay is a work of considerable interest, not only as regards the information contained in it relating to ancient Indian weights and coins, but also for its philological and ethnological information. The earliest and most important authority cited is from the Sanscrit text of the original code of Hindu law by Manu, the exact date of which is undetermined. Although portions of it are assigned by some authorities between the twelfth and thirteenth centuries B.C., yet the body of the compilation is more generally referred to a period about 400 B.C.

The Indian weights mentioned in the Code of Manu were those of Central India, south of the Himalayas, and comprised between the rivers Indus and Ganges. They were in use after the occupation of this country by the Aryans, whose invasion from the north-west is referred to a period as early as 1600 B.C. Mr. Thomas, however, claims a still earlier origin for this system of ancient Indian weights, and that they were already in use before the Vedic Aryans entered India. The old system appears to have been based on the weight of native seeds. The principal unit was the *Rati*, the seed of the wild liquorice plant. A second unit or standard of weight is stated to have been the *Másha*, a small wild bean, which is also mentioned in the Code of Manu as a food grain. The following tables of monetary weight are taken from the ancient record, and include the smaller seed-grain weights, which, in the original Sanscrit text, are made to originate and lead up to the larger weights in metal, together with the smaller sub-divisions of the seed-grain unit. Their equivalent weight in Troy grains is given by Mr. Thomas as computed from the mean of experimental weighings of the several seeds, and as confirmed from the ascertained weights of less ancient Indian coins.

TABLE I.—*Minor sub-divisions of the Unit, the* Rati.

		Troy grain.
Rati (seed of wild liquorice)		= 1·75
Yava (barley corn husked)	= ½ Rati	= 0·5833
Gaura-sarshapa (white mustard seed)	= ½ Java = 1/12 Rati	= 0·0972
Raja-sarshapa (black mustard seed)	= ½ Gaura = 1/72 Rati	= 0·0324
Likhya (small poppy seed)	= ½ Raja = 1/144 Rati	= 0·0108
Trasarenu (mote of sunbeam)	= 8 Likhya = 1/1152 Rati	= 0·00135

TABLE II.—*Multiples of the Unit, the* Rati.

		Troy grain.
Silver.		
Rati		= 1·75
Mashaka (small wild bean)	= 2 Rati	= 3·5
Dharana Purana	= 16 Mashaka = 32 Rati	= 56·0
Salamana	= 10 Dharana = 320 Rati	= 560·0
Gold.		
Masha	= 5 Rati	= 8·75
Suvarna	= 16 Masha = 80 Rati	= 140·0
Pala, or Nishka	= 4 Suvarna = 320 Rati	= 560·0
Dharana	= 10 Pala = 3200 Rati	= 5600·0
Copper.		
Karshapara	= 80 Rati	= 140·0

The fanciful introduction of the "[very small mote which may be discerned in a sunbeam passing through a lattice" throws doubt on the practical use of this table; but there appears abundant evidence of the continued use of seed-grain weights in India from a very early period.

The earliest record of Indian measures of capacity, which are only incidentally mentioned in Manu, are quoted from a Sanscrit work for which very high antiquity is claimed. It gives the measures of *ghi*, or clarified butter, in equivalent weights of the *masha* and other multiples of the *rati*.

As to Indian measures of length, though permanently based upon natural units, as the digit, span, and cubit, yet the same seed principle is applied in Manu to the small sub-divisions of the digit. Thus, taking the cubit as the unit, the sub-divisions are stated to have been as follows:—

Hosta (cubit).	
Vitasti (span)	= ½ Hosta
Angula (digit)	= 1/12 Vitasti
Yava (very small barley corn)	= ½ Angula
Yuka	= ½ Yava
Liksha (poppy seed)	= ½ Yuka
Balagra (hair's point)	= ½ Liksha
Renu	= ½ Balagra
Transvarenu (mote of sunbeam)	= ½ Renu

The *Hosta*, or cubit, was thus [equal to twenty-four digits, or six palms. Mr. Thomas does not assign any particular length to the cubit of *Manu*, but inferentially defines its length from the determined length of the Sikendari *gaz*, or yard, at the end of the fifteenth century, which is rather more than thirty imperial inches. This *gaz* is stated to have been equal to 41·5 digits, and the digit is computed as being equal to 0·72976 inches. This would make the ancient Indian cubit equal to above 17·5 inches.

Mr. Thomas considers that the system of Indian weights here described was indigenous, and he differs from Don V. Queipo, who traces the derivation of the Indian system of weights to primary Egyptian sources. He prefers the "wise reserve of Boeckh," who expresses himself in the following terms:—

"In cases where the weights of measures of different nations are found to be in a precise and definite ratio one to the other—either exactly equal, or exact multiples and parts of each other—we may fairly presume, either that the one has borrowed from each other, or that each has borrowed from some common source. When the ratio is inaccurate or simply approximative, it is to be treated as accidental and undesigned."

The more recent discovery, since the publication of Don V. Queipo's work, of the unit of ancient Egyptian weight, the *Kat* = 140 grains, equivalent in weight to the Indian copper unit, the *Karshapara*, to the gold *Suvarna*, and to one-fourth of the silver *Suvarna*, tends to confirm Don V. Queipo's hypothesis of the identity of the practical units of Egyptian and Indian weights. The Indian

cubit of 17·5 inches, divided into twenty-four digits, is also almost identical with the ancient Egyptian natural cubit of six palms and twenty-four digits. But it appears to be now impossible to determine whether these Indian units were derived from the Egyptian, or both from an earlier common source; although we may fairly assume that this natural cubit was of the same length as that used by Noah before the Deluge. Mr. Thomas's hypothesis of the lesser Indian unit of weight and of length, and of the scale of multiples and parts, is, however, probably correct, as being derived from natural and local sources.

OUR BOOK SHELF

Arboretum et Fleuriste de la Ville de Paris. Description culture et usage des Arbres, Arbrisseaux et des Plantes herbacées et frutescentes de plein air, et de serres, employées dans l'ornementation des Parcs et Jardins. Par A. Alphand. Folio, pp. 110. (Rothschild, Paris.)

ORNAMENTAL gardening, among other things that added to the attractions of the city of pleasure, was greatly fostered during the latter part of the reign of Napoleon III., and does not appear likely to languish under the Republic. The magnificent publication, "Les Promenades de Paris," by the author of the book now before us, is a costly work, known to comparatively few people in this country. We presume that the present volume is regarded as an appendix or supplement to the work named, otherwise we cannot account for the publication of what is little more than a catalogue of names in so unwieldy a form.

An enumeration of the plants grown for the embellishment of the parks and gardens of Paris, in a handy octavo form, would be welcome to almost every lover of horticulture; but the object of the compiler of the "Arboretum et Fleuriste" was doubtless such as we have indicated. It is printed on one side of the paper only, and the matter arranged in columns, giving the names, native countries, soil, use, height, form of leaves, colour of flowers, &c., of the various plants. As a horticultural catalogue the work is fairly well executed, but, like most gardening books, it contains errors that have been copied from book to book, though they were cleared up long ago. In the first part of the work the author has indulged in an attempt to introduce a reform in botanical nomenclature; why it was not carried through we are not told, probably for the reason that, however desirable reformation may be, this one would scarcely receive any support from botanists. It consists in giving all substantive specific names an adjectival form, and, a less justifiable act, of changing the terminations of good Latin names. Thus, for example, *Pinus Coulterii*, *Hartwegii*, and *Fenzlii*, become *P. Coulterea*, *Hartwegea*, &c. Objections might be urged against this course; but why should we change *Benthamiana* and kindred names into *Benthamea?* And *Pinus inopsea* for *P. inops* is quite inadmissible.

The information under the several headings is usually not inaccurate, but somewhat loose. Thus, under the genus *Magnolia*, Pennsylvania is given as the native country of *M. acuminata*, Carolina of *auriculata*, Virginia of *glauca*, and so on; whereas these trees have a much wider range of distribution. Again, under *Cratægus coccinea*, we are told that the specific name indicates scarlet flowers; but the flowers are white, and the fruit scarlet. But as it is not a botanical work, it is scarcely fair to criticise it by a botanical standard, though it is scarcely excusable to give North Africa as the native country of *Calla Æthiopica*, New Zealand of *Caladium esculentum*, &c. *Libocedrus decurrens* is referred to *Thuja gigantea*, and the true *T. gigantea* to *T. Menziesii*; but the synonomy of these plants has long been cleared up even in gardening books.

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.*]

Prof. Willis's Mechanical Models

THERE is a slight error in your account of the disposition of Prof. Willis with regard to his mechanical models in your last impression (p. 14).

Prof. Willis did not put any price upon his models; but by his will, dated May 11, 1872, directed that his "mechanical models" should be "offered to the University of Cambridge at a price to be fixed by the valuation of some competent appraiser to be nominated and chosen" by his executors.

In consequence, we have caused the models to be so valued, and fixed upon the sum named (1,200*l.*) after due consideration of the means of the University and the requirements of the estate.

A Syndicate was appointed on April 29 to consider whether the whole or a part of the collection shall be purchased. In the event of the University declining to purchase, the portion rejected will be offered for sale by public auction or private contract.

JOHN WILLIS CLARK
W. H. BESANT
Executors to the late Prof. Willis

Cambridge, May 9

Ants and Bees

IN NATURE, vol. xi. p. 306, Mr. Alfred George Renshaw refers to and criticises a paper on "Ants and Bees," lately read by Sir John Lubbock, and assumes, or seems to assume—and the language quoted justifies such assumption—that Sir John advanced the idea that bees have no means of communicating knowledge to each other.

It seems strange to me, who have been all my life familiarly acquainted with the working of bees, that anyone should doubt their power of communicating knowledge. The very idea there advanced, that "if the bees had the means of communicating knowledge, those bees would have told the others in the hive where they could obtain a good store of honey with a very little trouble, and would have brought a lot back with them," I have seen proved and illustrated hundreds of times.

Bee-hunters understand this faculty in the bee perfectly well, and turn it to a good account. Going to a field or wood at a distance from tame bees, with their box of honey, they gather up from the flowers and imprison one or more bees, and after they have become sufficiently gorged, let them out to return to their home with their easily-gotten load. Waiting patiently a longer or shorter time, according to the distance of the bee-tree, the hunter scarcely ever fails to see the bee or bees return, accompanied with other bees, which are in like manner imprisoned, till they in their turn are filled, when one or more are let out at places distant from each other, and the direction in each case in which the bee flies noted, and thus, by a kind of triangulation, the position of the bee-tree proximately ascertained.

Those who have stored honey in their houses understand very well how important it is to prevent a single bee from discovering its location. Such discovery is sure to be followed by a general onslaught from the hive unless all means of access is prevented. It is possible that our American are more intelligent than European bees, but hardly probable; and I certainly shall not ask an Englishman to admit it. Those in America who are in the habit of playing first, second, and third fiddle to Instinct will probably attribute this seeming intelligence to that principle.

It seems to me, and I think it may be so concluded on scientific principle, that there is no difference, except in degree, between the intelligence, or whatever it may be called, of man and of lower animal life. If the honey-bee, the ballooning spider, the agricultural ant, or the dog, is governed wholly by instinct, then it seems reasonable to infer that man is also governed by instinct. If all the actions of lower animal life are automatic, on what principle shall we say that man's are not automatic? If man builds his house, and, intending to furnish it and lay in a stock of provisions, ascertains from his neighbour where he can get the most at the cheapest rate, does he act on any principle different from the bees, who build their house and jointly or separately ascertain where the best stock of honey can be obtained?

In regard to selfishness, I think the bee has the advantage of

man. In my own garden, where I have had standing always from ten to fifty swarms, and over which I thought I was watching with almost a fatherly affection, I have learned how utterly selfish I was in looking forward to autumn, when, by the destruction of the industrious and unselfish bees, I could lay in for my own consumption what they had so laboriously gathered in the summer to sustain each other through the winter. I learned, from their unselfishness, to divide with them, always leaving enough to sustain the colony till the spring should again bring the flowers.

I think, too, that both Sir John Lubbock and your correspondent are mistaken as to the object of beating pans, sounding horns, and making other hideous noises in hiving bees. The object is not, as Sir John intimates, originally to drive away evil spirits, or to assert ownership, as indicated by Mr. Renshaw. It is simply, as everyone knows who ever thumped on a pan, sounded a horn, or yelled through a speaking trumpet on such an occasion, to drown the voice of the queen or guides who are to conduct the swarm to the new home which members of the community who had been sent out, as the Israelites sent forward Joshua and others, had found for them.

Mr. Renshaw's law is probably good, but does not apply in the case trying. JOSIAH EMERY

City of Williamsport, Pa., U.S.

Flowering of the Hazel

IT was with great interest that I read the communication from F. D. Wetterhan, in NATURE, vol. xi. p. 507. But I cannot help expressing quite a different opinion as to the bearing of the interesting fact that proterandrous and proterogynous individuals are to be found in the same locality. From the structure of the flowers and from insects never visiting the stigmas, I am convinced that the hazel is a strictly anemophilous plant; that the red colour of its stigmas is solely an effect of chemical processes connected with the development of the female flowers to maturity, just in the same manner as in the female flowers of the larch-tree and some other Coniferæ; and that likewise the coexistence of proterandrous and proterogynous individuals in the hazel relates solely to the influence of the wind, and not at all to the agency of insects.

Whilst in Primula, Pulmonaria, and many other entomophilous plants, so admirably treated of by Charles Darwin, two kinds of individuals, viz., long-styled and short-styled ones, have originated from the positions of the anthers and the stigmas diverging in different individuals in opposite directions—among the anemophilous plants in *Juglans regia* * and *Corylus avellana*, among the entomophilous ones in *Syringa vulgaris* † and *Veronica spicata*,‡ two kinds of individuals, namely, proterandrous and proterogynous ones, have originated from the periods of development of the anthers and stigmas diverging in different individuals in opposite directions. The effect in the two contrivances has been the same, cross-fertilisation not only between different flowers, but also between different branches, having become indispensable.

In dimorphous species, this cross-fertilisation, as is known, is effected by the visiting insects touching with the same part of their body the anthers of the long-styled and the stigmas of the short-styled form; and with some other part of their body the anthers of the short-styled and the stigmas of the long-styled form. This kind of intercrossing can apparently never be effected by the wind; whence long-styled and short-styled (dimorphous) species are never to be found among anemophilous plants. But in these the coexistence of proterandrous and proterogynous individuals produces the same effect, the pollen-grains of the proterandrous individuals, of course, being transported by the wind only to the stigmas of the proterogynous ones, and *vice versâ*.

Lippstadt, May 1 HERMANN MÜLLER

Variable (?) Star in Sextans

THE following may be of interest to the readers of your Astronomical Column:—

About 2½° *north* of, and a little *preceding* λ Hydræ (4 mag.), is a star marked 5th mag. in Harding's large *Atlas Novus Cœlestis* (1822). This is now invisible to the naked eye, and of about mag. 7. It is 19662 in Lalande's Catalogue, in which it is rated at 4½ mag. It seems difficult to understand how excellent observers like Harding and Lalande could have made a mistake of 2 magnitudes in the estimation of a star's brightness, particularly as it is closely preceded by a 7½ mag. star (Lalande, 19646). So that probably this star has faded since 1822. Its position for the beginning of the present year is in R.A. 9h. 57m. 30·46s., and N.P.D. 98° 58′ 0″·42.

Punjab, India, April 3 J. E. GORE

Equilibrium in Gases

MR. NICHOLS, in NATURE, vol. xi. p. 486, advances the opinion that in a vertical column of gas at rest the temperature does not tend, as generally believed, to become equal throughout, but that such a column is in a state of thermal equilibrium when the temperature diminishes at the rate of 1° centigrade for every 233 feet of ascent (or 1° Fahr. for every 129 feet). This is a question of thermo-dynamics, and I am not mathematician enough to offer any opinion on it from the theoretical point of view, but it seems inconsistent with well-known meteorological facts. Were it true, there would be, as Mr. Nichols points out, a constantly renewed tendency for the lower strata to flow upwards in consequence of their higher temperature and consequent relative expansion. Such a tendency is no doubt very common, but Mr. Nichols's theory would require it to be universal, and it does not appear to exist in the absence of direct solar heating. Cumulus cloud is an infallible proof of the presence of ascending columns of air, and according to the report of the Austrian Polar Expedition in NATURE, vol. xi. p. 415, cumulus is never seen in the Arctic winter; and I have somewhere read the same respecting the Siberian winter. The true cause of the accumulation of heat in the lower atmospheric strata, to which upward currents and the formation of cumulus is due, is, I have no doubt, that usually assigned—namely, that the atmosphere is more pervious to the heat of the sun than to heat radiated back from the earth; so that, as I think Tyndall expresses it, the sun's heat is caught as in a trap. JOSEPH JOHN MURPHY

Old Forge, Dunmurry, Co. Antrim,
April 30

Curious Phenomenon of Light

ROWING on Loch Lomond recently, above Luss, there were seen to the north-west, at an apparent distance of about 100 yards, two bright lines of prismatic light, 60° apart and on the level of the water. Their length seemed to equal the breadth of a rainbow. Their violet ends were towards each other, and were joined by a line of dull white light, to the middle of which the sun and the spectator were at right angles. Standing in the boat, the colour and brilliancy were lost, and only a diffuse white light was visible. The time was 10 A.M. The sun was hot, the sky cloudless, the air hazy and still, and the loch a mirror. This apparition fled before our approach for some minutes, till dispelled by a slight breeze, which rippled the water.

Luss WM. M'LAURIN

Destruction of Flowers by Birds

I ENCLOSE some flowers of the common blackthorn, that I suppose to have been snipped off by birds. The bushes were growing in the outskirts of a wood, in a very sequestered situation (near Dunstable). The upper branches appeared to have chiefly suffered. The grass below was quite conspicuously starred with the fallen blossoms. I can hardly think that human intervention had anything to do with it. R. A. PRYOR

Hatfield, May 5

[In the accompanying specimens the limb of the calyx (carrying the stamens and petals) had been neatly cut away from the tube.]

OUR ASTRONOMICAL COLUMN

ORBITS OF BINARY STARS.—Dr. Doberck, of Colonel Cooper's Observatory, Markree, Co. Sligo, has published the results of a new investigation of the elements of the revolving double star σ Coronæ Borealis, in which measures to the end of 1872 are included. The period of revolution is increased to 843 years, which is longer than any yet assigned to this star. Dr. Doberck's comparison of his orbit with the measures of the late Rev. W. R. Dawes affords another proof of the remarkable excellence of that astronomer's observations, particularly in the last

* Delpino, "Ulteriori osservazioni," Parte II. fasc. ii. p. 337.
† H. Müller, "Befruchtung," &c., p. 339.
‡ Ibid. p. 285.

fifteen years of the period over which they extend, when he had the command of comparatively large telescopes; and a similar remark applies to the measures of Baron Dembowski, who during upwards of twenty years has produced work of the greatest value in this department of astronomy. Dr. Doberck also gives us a provisional orbit for τ Ophiuchi, which Sir William Herschel in 1783 considered the closest of all his double stars; and after appearing single to Struve with the Dorpat refractor in 1825, was oblong in 1827, and is now an easy object. The period assigned is 185 years, with a peri-astron passage, 1820·63; the semi-axis, 1″·11.

THE STAR LALANDE 19662 (SEXTANS).—Mr. J. E. Gore, of Umballa, Punjab, in a letter printed in another column, directs attention to the probable variability of this star. It was observed by Lalande, 1798, April 10, "Histoire Céleste," p. 330, where its magnitude is entered 4½, as in the reduced catalogue published by the British Association (which, by the way, as well as the other two catalogues prepared at the instance of that body, is unfortunately becoming scarce). It appears in Heis's Atlas as a 6·7; but after searching through the modern catalogues where it was likely to be included, we have only discovered a single meridian observation by Lamont in his Zone 314, on 1845, April 5, when it is called 7·8. It does not occur in Argelander's "Uranometria," nor was it observed by D'Agelet, Bessel, or Santini.—Another of Lalande's stars, No. 23726 in Corvus, is in all probability variable. He estimated it 7½, 1795, May 10, and Bessel in May 1824 called it 8; Heis, however, saw it as a *fifth* magnitude. What is the actual degree of brightness? The star's position for the commencement of the present year is in R.A. 12h. 37m. 2s., and N.P.D. 103° 10′·3.

THE STAR 61 GEMINORUM.—The Rev. T. W. Webb has remarked the probable variability of a small companion of this star, distant about 1′, and not far from the circle of declination to the south (estimated angles from 160° to 190°), and appears inclined to identify it with Smyth's companion of the 9th magnitude, for which he gave, 1835·85, position 110°·0, distance 60″. Smyth's estimates of magnitude down to 9 may be generally relied upon, though for smaller stars he is often wide of the mark, according to our present standard. It is very possible that he may have caught one of the minor planets close to 61 Geminorum; his angle, though it has only his lowest weight, differs considerably from recent estimations for the faint star. Our principal object in referring to the Rev. T. W. Webb's remarks is, however, to suggest that 61 Geminorum may be itself variable; D'Agelet considered it 6 in October 1784. Piazzi observed it ten times on the meridian, and estimated it 7·8; it is 7 in Lalande, 6·7 in Taylor's volume for 1834-35, 6 in the "Uranometria" and Heis's Catalogue, 6·5 in "Durchmusterung," and 6·3 in the Radcliffe Observations, 1870. The deep yellow colour noticed by Smyth, and now stated to have disappeared, may perhaps be considered by some readers as an indication in the same direction.

COMETARY ASTRONOMY.—The *Astron. Nach.*, No. 2,034, contains a fine series of observations of the faint comet discovered by Coggia, 1874, August 19, taken at the newly-erected observatory of Col. Tomline, Orwell Park, Ipswich: it extends to the middle of November, and will no doubt be of material service in the final determination of the orbit. (The position of the Orwell Park Observatory is in long. 4m. 55·8s. E., and lat. 52° 0′ 33″). Vienna observations of the same comet appear in No. 2,035 of the above-named periodical, but extend only to October 19: they are accompanied by positions of Winnecke's Comet (1874, April 11) to June 17, and of the comet detected by Borrelly (July 25) to October 19.—In No. 2,036, Dr. Sandberg has given elements of the elliptic comet of Tempel, 1873, II., which will be preferable to any hitherto published. It will be remembered that this comet, near the preceding aphelion passage, experienced very heavy perturbations from the action of Jupiter, having approached that planet in January 1870 within 0·35 of the earth's mean distance from the sun. In the instantaneous ellipse at perihelion, 1867, May 23, the period of revolution was 2,080 days: at the last passage by the same point of the orbit, the perturbations had increased the period to 2,179 days. Other elements for 1873 are: semi-axis major, 3·2889; semi-axis minor, 2·9169; perihelion distance, 1·7695; the period in years is 5·965, so that we may expect to see the comet in the spring of 1879 under similarly favourable conditions for observation to those of 1867 and 1873.—In No. 2,037 we have definitive orbits (parabolic) for Comet 1870, IV., which was observed for only seven days, and of Comet 1871, II., both by Herr Schulhof, of the Observatory at Vienna. As the manner in which the elements are expressed may not be readily understood by the uninitiated in such calculations, we transcribe the orbits in the form that has so far been adopted in our catalogues. The perihelion passage is expressed in Greenwich time, and the longitudes are from mean equinox at commencement of the year.

	Comet 1870, IV.	Comet 1871, II.
Perihelion passage ...	Dec., 19·87609	July, 27·01925
Long. of perihelion ...	4° 8′ 56″	115° 35′ 44″
,, ascending node	94 44 43	211 54 40
Inclination	32 43 35	78 0 36
Log. perihelion distance	9·590242	0·031763
Motion ...	Retrograde.	Retrograde.

*LECTURES AT THE ZOOLOGICAL GARDENS**

III.

May 6.—Mr. Garrod on the Deer Tribe.

THE Deer may be defined as those Ruminant Artiodactylate animals in which deciduous horns are developed, and the young are spotted. Some, namely the Musk Deer (*Moschus*) and the Water Deer (*Hydropotes*), never have antlers; in both these the young, however, are spotted, as they are not in any of the hollow-horned Ruminants.

The degree of development of the antlers is closely related to the size of the species. In the small Pudu Deer and the Muntjacs they are simple or but slightly branched; whilst their branching is very considerable in the large Reindeer and Wapiti. The typical antler seems to consist of a main stem or beam, with a small basal, anteriorly directed tyne, the brow antler. The apex of the beam bifurcates, one branch being directed forwards, and a little external to the brow antler; the other starts from the inner side of the posterior surface. In one well-marked group, the *Elaphine*, the anterior of these upper branches is inconsiderable and does not branch, the posterior enlarging and branching in most—becoming palmated in the Fallow Deer. The larger species of this elaphine section, including the Wapiti, Maral and Red Deer, possess a second brow antler; whereas in the smaller species this is not found (*e.g.* the Fallow, Formosan, Mantchurian, and Japanese Deer). In the Mesopotamian Deer, recently discovered by Sir Victor Brooke, which is intimately related to the Fallow, the palmation is found in the basal portion of the antler, including the brow antler, together with extra small tubercles very frequently found in that region.

In the group of Deer called *Rusine* the bifurcation is more equal, and when there is a further branching, the anterior as well as the posterior branch participates in the division. The brow antler is simple. This type of antler is found in its most uncomplicated condition in the Sambur of India, and the closely allied species *Rusa equinus*, *swinhoii*, &c. of the Malay region and

* Continued from p. 9.

Formosa, as well as in the smaller Axis, Prince Alfred's and Hog Deer. In the Siamese Deer, named by Mr. Blyth after Mr. Schomburgh, the brow antler is long, whilst each of the two branches of the short beam again divides in a very regular manner, the ultimate tynes being of nearly equal length. In Duvaucel's Deer, from India, the beam is longer than in the last-named species, and the branching is very similar, except that the posterior bifurcation is less developed than the anterior. This reduction is carried to an extreme in Eld's Deer, from Eastern India, where the anterior division of the antler is very large and curved forward, whilst the posterior is represented by a minute tyne. The gradation between these three forms was demonstrated by Mr. Blyth. In the Reindeer the general conformation of the beam very closely resembles that of Eld's Deer, but with this rusine peculiarity, the strangely palmated brow antler is double, as only elsewhere occurs in the elaphine type. In the American Roes a similar conformation obtains, the brow antler being small in the Virginian Deer and almost absent in the Mule Deer, which latter species in the branching of the beam very closely agrees with both Duvaucel's and Schomburgh's Deer.

The South American Guazupucu (*Blastocerus paludosus*), which differs considerably from the Mazame, a species generally supposed to belong to the same genus, has the anterior bifurcated tyne. This may be the modified brow antler, as may be the similar branch in the Chinese Elaphure discovered by the Père A. David, both these species having a simple, or comparatively simple, posterior beam, and no gland on the outer side of the metatarsus.

The interpretation of the affinities of the Roebuck by means of its horns is not easy. In that species there are three small tynes, the anterior being situated higher up than is usually the case with brow antlers, and the two posterior much like those of the Hog Deer. In the last-named species, however, the brow antler is not low, and it is not difficult to imagine it being carried a little further up. On this assumption the Roebuck is the only European representative of the rusine type.

The simple nature of the antlers in the Brockets of South America and the peculiar Muntjacs of the Indian region, in which the horns are attached on the top of elongated pedestals, makes it impossible to decide, from them alone, the forms to which they are nearest allied.

As far as the hornless Musk and Water Deer are concerned, Sir V. Brooke has shown in how many points they differ from one another; whilst Prof. Flower, at a recent meeting of the Society, has demonstrated to a certainty that the former of them is not at all related to the Chevrotains, which they so closely resemble in size and general contour, and with which they have generally been associated.

The horns of the Elk do not agree with any of the above-described forms. The fan-shaped palmation into which they spread is based on a radiating framework, and no specialised brow antler is to be seen.

With reference to the geographical distribution of the Deer, none are to be found in the Australian or Ethiopian region, the Barbary Deer being the only member of the group found in Africa at all, and that north of the Sahara. The Elk is found both in North America and Northern Europe, as is the Reindeer. The larger Elaphines are represented in North America by the Wapiti, and by several closely-allied species distributed throughout the Palæarctic region as defined by Mr. Sclater to include Europe, North-west Africa, and Asia with the exception of India and the Chinese Empire. The smaller Elaphines abound in Japan, China, and Formosa. The true Rusas are most numerous in India and the Indo-Malay Archipelago, the most recently discovered species, named by Mr. Sclater *Rusa alfredi*, having been obtained by the Duke of Edinburgh from the Philippines, whilst *R. Swinhoii* is from Formosa.

Mr. Swinhoe's new Water Deer abounds at and near Shanghai, whilst the equally peculiar Elaphure probably has its home in South-west Mantchuria, though it exists in large numbers in a semi-domesticated state in the Imperial Park at Pekin, together with commoner species. The Musk Deer comes from India and the country north of it, and the Muntjacs are found in India and China, as well as the intermediate regions. The Cervidæ are also represented in North America by the Virginian, Mexican, and Mule Deer; the Guazus, Guemuls, and Brockets replacing them in the southern continent.

(*To be continued.*)

THE IRON AND STEEL INSTITUTE

THIS Association may now be fairly considered as having become an established institution in the country, and is to be congratulated on the success it has achieved in its attempt to introduce something like scientific method into the important industries with which it is connected. It is undoubtedly doing excellent work, and if it adheres steadily to its purpose, and goes on as it has begun, it will help greatly in enabling our iron and steel manufactures to keep pace with the rapid progress which is being made on the Continent and in America.

As we have already intimated, the Institute held its annual general meeting in London on Wednesday, Thursday, and Friday, the 5th, 6th, and 7th inst. The Report which was read was very encouraging; the number of members is now 832, and the financial statement is highly satisfactory.

The Bessemer Medal for 1875 has been awarded to Dr. Siemens, F.R.S., in recognition of the valuable services he has rendered to the iron and steel trades by his important inventions and investigations. Besides a number of foreign gentlemen, Dr. Percy, of the School of Mines, was elected an honorary member. The next provincial meeting is to be held in Manchester early in September.

Mr. Lowthian Bell, after a short address, resigned the chair, to which Mr. William Menelaus was elected. The address of Mr. Menelaus was mainly concerned with recent improvements in the manufacture of steel. Mr. Menelaus has evidently correct notions as to the method by which the industries with which he is connected are to be made the most of. "As an iron maker," he said, "my mission has been to bring into profitable use the valuable inventions of Bessemer, Siemens, and others, and to apply the scientific research of men like Mr. Bell to the improvement of old and new processes."

On the evening of Wednesday Mr. Warrington W. Smyth delivered a valuable lecture on "The Ores of Iron considered in their Geological Relations." Mr. Smyth directed attention to the oxides as met with by themselves, or combined with water or carbonic acid, and which formed the great bulk of the material employed in iron making. First in order of the ores thus limited was magnetite. This mineral, with 72·41 per cent. when pure, was the fine rich ore which had been worked with great success for centuries in several of the Scandinavian mines. In Italy fine examples of magnetite were also found, as well as in several widely-separated places in North America. Magnetite only occurred in a few localities in Great Britain, amongst which the vicinity of Penryn, in Cornwall, and Hey Tor, near Bovey, in Devon, were mentioned. The next species noticed by the lecturer was hæmatite. This ore, so little recognised thirty years ago, was now too well known to require to be enlarged on. He next described the curious ores named bauxite and wöchenite, in which alumina takes the place of the sesquioxide of iron, turgite, göthide, limonite, chalybite, the last-named often mixed with other ores on

a large scale. The most important deposit of this last-named ore was contained in the range of veins occupying a length of some thirty miles in Somerset and North Devon, from the Raleigh's Cross westward to near Ilfracombe. Proceeding next to show the relationship between the oxides, the lecturer exhibited a specimen of ore having the appearance of chalybite or spathic ore, being covered with the large rhombohedral crystals characteristic of that species, but which the presence of the brown streak and of water and the percentage of iron proved to have been turned into brown ore. A fragment from the lodes of the Deerpark in Exmoor, next shown, had also lost its carbonic acid, had acquired oxygen and water, and actually become a different substance. It had been argued that the change commenced with the formation of the more hydrated species, and passed through successive stages to those with the least amount of water; but on that point evidence was as yet defective. The brown ores were undoubtedly (for the process might be watched in the workings) formed by another series of changes from pyrites through the sulphate of iron. The crystals of brown ore, in the form of pyrites, were among the best known pseudomorphs, and there were localities which invited the inference that this action had taken place on an important scale. Mr. Smyth, in concluding, said he would not, in the present brief sketch, venture upon the vexed question of the original deposition of the great northern masses of hæmatite, although strong arguments for their having been chalybite might be adduced from the occurrence of limestone fossils turned into red ore. He brought under notice another change of condition among the oxides of iron. It was a significant fact that magnetite was characteristic of the older formations—of those bodies of rock which had during the longest period of time been exposed to the influences which bring about metamorphosis and change of substance. In the Perran lode small portions of magnetite had been formed among the brown ores near the surface. In some of the Cornish copper lodes specimens of magnetic ore had occurred which looked very much as if they had been carbonates, and amongst the beautiful red ores of Siegen small grains of magnetite appeared to testify to a partial change, while there appeared to be sufficient grounds for believing that, in many cases at least, this last change in the degree of oxidation might be produced by the ordinary action of natural causes.

One of the most interesting papers from a scientific standpoint was that read on Thursday by Sir J. G. N. Alleyne, Bart., "On the estimation of small quantities of Phosphorus in Iron and Steel by Spectrum Analysis." This paper forcibly shows the valuable practical results which may follow from lines of pure scientific research. We shall return to this paper in a future number.

Mr. Lowthian Bell then read a long account of his visit to mines and ironworks in the United States. He began by saying that in the year 1871, one half of the iron produced in England was exported to foreign countries, and one-fourth of this half was despatched to the United States, in all about 750,000 tons. In the year 1874, however, the States only took 130,000 tons, and it was stated that during the three years the producing power of that country had risen from two-and-a-half millions to four millions of tons. Mr. Bell entered into considerable details on the subject of methods of transport in the United States. The railway system has grown into dimensions far exceeding those in England, the land of its birth. At the end of 1873 the United States had 70,651 miles of road, against only 16,082 miles in England. He calculates that 46,000 acres of timber fall annually to provide fuel for the charcoal furnaces. Less than 200 acres of a four-feet seam of coal, in the county of Durham, would produce the same weight of coke as is obtained from 46,000 acres of American forest. Coal is more abundant in the United States than in any other part of the world, and all kinds are found. In some places natural gas is used for puddling, re-heating, &c. Of pit-coal itself there are 192,000 square miles, as compared with 8,000 square miles in the United Kingdom; and Mr. Bell thinks it may be doubted where there is any similar area in the world in which a larger proportion of the surface is occupied by coal-bearing strata. From the position which the beds of anthracite coal occupy, it would appear as if, after their original formation, an enormous amount of lateral compression had been experienced by the districts in which they lie. This force has raised the strata into a succession of waves, as it were, the slopes of which vary from an angle of 20 to 45 degrees, and occasionally descending to a depth of 200 to 250 fathoms or more. In some cases this compressive power has been so great as to have forced one ridge back over its neighbour, to such an extent as to convert what is the floor of the seam in one place into the roof at another, and, from a similar cause, the quantity of coal which has accumulated at the anticlinal axes of some of these coal undulations is so great as to afford a face of forty to sixty feet, or even more, in thickness. In some cases denudation has carried off not only the sandstones and shales, but a portion of the coal itself; the bared edge of the seam is found immediately under the alluvial matter of the surface. He stated that there is a vast extent of carboniferous or mountain limestone in America, frequently very near the pig-iron works. Near Baltimore the shells of oysters, which are found in great abundance at Chesapeake Bay, are used. They contain 95 per cent. of carbonate of lime, and are a very inexpensive substitute for lime itself. The United States contains abundant quantities of iron ore of all kinds except the spathose ore, which is very scarce even in Europe. The ironstone of the liassic and oolitic seams, which furnish about one-third of the pig-iron made in the United Kingdom, seems to be entirely wanting in the States. Mr. Bell described the magnetic iron ore of Lake Champlain, its peculiarities, mode of deposition, &c., its abundance, and its freedom from deleterious ingredients; he remarked that the contents of the mines are chiefly obtained by open quarry work. The ore yields something like 67 per cent. in the Iron Mountain deposit. Mr. Bell, in treating of the blast-furnaces, referred first to the establishments which have been founded for promoting scientific training and education, and he spoke very highly of the earnestness and devotion which characterises those engaged in the mining and metallurgical industries of the States.

At Friday's meeting Mr. Bell read a paper on "The Sum of Heat utilised in smelting Cleveland Ironstone."

Other papers read on Friday were: "A brief account of an Underground Fire in the Wynnstay Colliery, Ruabon, and the measures adopted to extinguish it and to re-enter the workings," by Mr. G. Thomson. The fire became so unmanageable as to necessitate the sealing up of the shafts, after which explosions of gas took place, and the shafts were resealed, and so remained for a period in all of nearly five months. Preparations were then made for re-entering the mines, and this was successfully accomplished, and, after subsequent difficulties of a varied character had been overcome, the colliery resumed operations after a cessation of about seven months, and were now in full work again. The means used to effect the object, and a detailed explanation of all the operations, together with statistics of the temperature, the pressure, and the composition of the gases in the different shafts from time to time, were given in the paper.

On "The Manufacture of Bessemer Steel in Belgium," by M. Julien Deby, C.E., Brussels, and on "The Howard Boiler," by Mr. David Joy, of Barrow-in-Furness.

Altogether the meeting has been a satisfactory one.

THE PROGRESS OF THE TELEGRAPH*

V.

WE now continue our description of Wheatstone's electrical "Jacquard."

The rapid sequence of currents passed into the line-wire by the "Transmitter" are automatically recorded at the distant station by means of an apparatus called the "Receiver," or printer, which marks upon a continuous paper ribbon, as it passes through the instrument, the "dot" and "dash" code of the Morse alphabet, corresponding to the holes in the perforated Jacquard ribbon, as rapidly as the sequence of currents can be passed into the line. Two forms of this receiving instrument may be noticed: one shown in Fig. 22, in which the "dot" and "dash" code is represented by dots upon the paper ribbon upon either side of a central line, the lower line of dots being read as "dashes" and the upper line as "dots." The paper ribbon, mechanically advanced forward through the machine in a continuous manner, is passed under a shallow dish containing ink or other marking fluid. Two fine small holes are made through the bottom of this reservoir, in a position to correspond with the dots to be printed upon the ribbon as it passes underneath the reservoir. By reason of capillary attraction, the ink is prevented from passing through these apertures. Two electro-magnets, one on either side of the ink-reservoir, actuate two needles, which are adjusted so as to be depressed by the action of the current, and, dipping into the reservoir, pass into the holes, and carry a small dot

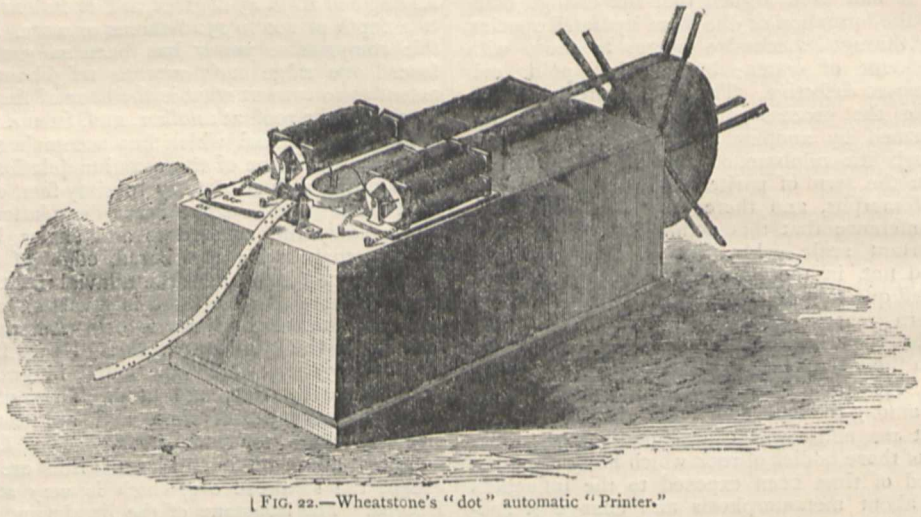

FIG. 22.—Wheatstone's "dot" automatic "Printer."

of ink through on to the paper ribbon; thus the mark is printed as a "dot" or "dash," according as the respective needle is depressed without any friction or mechanical resistance beyond that of the needle dipping into the ink held in the capillary tubes. The electro-magnet coils are so arranged that only the respective needles are acted upon by the currents as they flow from the positive or negative poles of the battery. The "dot" printing is shown at Fig. 23.

In the other form of "Printer" the Morse code is printed in "dot" and "dash" characters, the groups and sequence of groups forming the letters and words exactly corresponding with the dot and dash perforations in the Jacquard ribbon. Fig. 24 is the automatic printing upon this system from the perforated ribbon shown at Fig. 20. Capillary attraction is here again made use of, only in a different manner. A small inking disc of metal mounted upon a delicately poised axle capable of a slight angular oscillation in a lateral direction, according as it is influenced by the to-and-fro motion of a permanent mag-

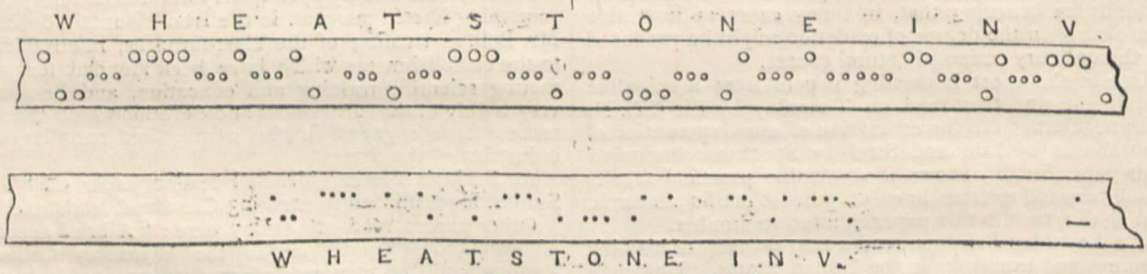

FIG. 23.—Perforated Jacquard ribbon and printing by the "dot" automatic system.

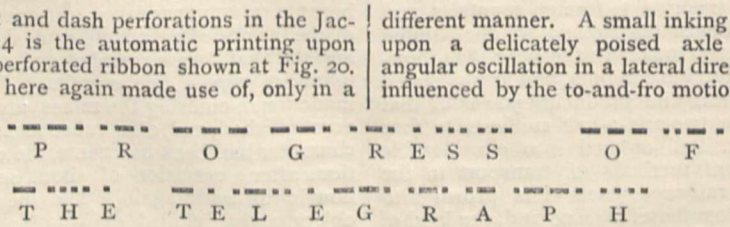

FIG. 24.—An "electric loom," or automatic telegraph printed message from the perforated paper ribbon (Fig. 20.)

netic armature when acted upon by the alternate currents passed into the line from the "Transmitter," is made to rotate rapidly by the same mechanical means that advances the paper ribbon. This little rotating inker is placed close to the surface of the paper ribbon, so that on receiving a lateral motion in one direction its edge is pressed against the paper and removed from it by an

* Continued from vol. xi. p. 512.

opposite motion, while in its neutral position it is free from contact. Thus contact with the paper will produce marks, either dot or dash, according as the inking contact is either momentary or of a sensible duration; the contrary movement producing the spacing between the printed marks. Now, as the currents from the Jacquard ribbon (Fig. 20) are passed at equal intervals and in alternate directions, the spacings between the signals will be automatically regular; the "dash" being the effect of the retention of the magnetic armature acting on the inking disc for double the time of the "dot," by reason of the grouping of the perforations to form the "dash," giving a longer duration without a reversal of the current being passed into the circuit. The arrangement for supplying ink to the little revolving inking disc is simple and effective. A metal wheel, having its edge cut into a V shape, is kept revolving in a dish of ink, and by capillary attraction this V groove is kept constantly filled with ink, and thus the periphery of the little inking disc which revolves in this groove of ink is without any rubbing friction kept constantly supplied with the proper amount of ink to continuously record the rapid motion of the armature as the currents flow from the transmitter into the wire. It is by these very simple means that Wheatstone has produced his high-speed printer, at once an accurate recorder and a telegraphic necessity in these days of special press-transmissions to the chief commercial centres of the United Kingdom.

In order to realise the great value of the automatic high-speed system upon extended lines of telegraphic transmissions, it is only necessary to compare the speed of the Morse apparatus on lines of a given length with that of the automatic electric Jacquard weaver. With an apparatus combining such celerity of transmission and recording powers, it becomes necessary to adopt a special system for the despatch and receipt of intelligence; to economise manual labour, and utilise the capacity of the wire to the greatest extent. Messages are therefore passed into the machine for transmission along the wire in groups; that is to say, on a circuit of 300 miles in length, twelve messages will be perforated upon a continuous ribbon and sent through the "transmitter" at the same time, and *vice versâ*. Employing a wire of a capacity known as No. 8 Birmingham wire gauge over this distance, four

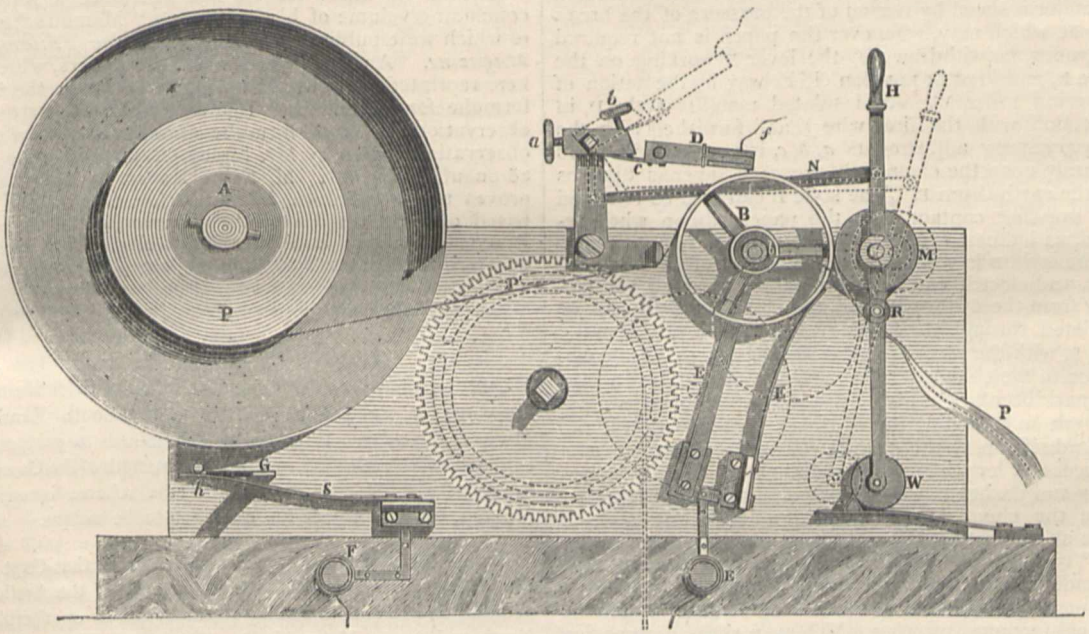

FIG. 25.—Alexander Bain's Automatic Chemical Printing Telegraph, 1846.

distinct groups consisting of twelve messages of thirty words each can be forwarded, and three similar groups received, in an hour; equivalent to eighty-four messages of thirty words each, and with the average of five letters to a word, a total of 12,600 letters, or an average of 210 letters per minute, equivalent to forty-two words per minute, with all the necessary formalities and acknowledgments in addition. Such a speed may be maintained in moderately fine weather, and requires a staff of five clerks at both the receiving and transmitting stations; namely, two for perforating the messages on to the paper ribbon, two for writing or translating, and one for the working of the apparatus in sending acknowledgments and signals for repetitions, &c. When dealing with parliamentary and newspaper despatches, a much higher speed can be obtained, first because there is no necessity for grouping the messages, and secondly because, as a rule, the transmissions are only in one direction, either as wholly received or forwarded messages, which circumstances greatly reduce the initial delay in the transmission. With a No. 4 wire gauge between Aberdeen and London, forty words may be reached, and with a No. 6 wire between Edinburgh and London fifty words, between Newcastle-upon-Tyne and London sixty words, and between Glasgow and Liverpool 120 words may be recorded. The shorter the length of the line, the greater the speed obtained. A very rapid form of a chemical automatic printing telegraph has been designed in America, based upon Alexander Bain's chemical automatic printer, 1846. This American chemical automatic machine has sent and printed, under favourable conditions, intelligence between Washington and New York, a distance of 282 miles, at a speed of 1,050 words or about 5,250 letters per minute, at which rate the apparatus required ten perforators, thirteen copyists, and two instrument-operators to keep the circuit supplied and the transmissions transcribed for general circulation. How far such a speed can be profitably employed for telegraphic purposes remains to be developed. It is quite possible to transmit intelligence beyond a profitable speed, for, irrespective of the difficulty of always commanding a sufficient amount of intelligence to keep the apparatus fully employed, the vast staff of manipulators necessary to ensure the preparation of the Jacquard ribbon, and translation of the symbolic

code into language, must always form a very important element in the commercial value of all high-speed arrangements, when the speed is beyond that of the public requirements of the circuit.

Alexander Bain's chemical printing telegraph, invented in 1846, of which this American automatic machine is only a modernised adaptation, is shown at Fig. 25. It combined methods of arranging, transmitting, and receiving electrical telegraph communications, in which mechanically-composed communications were transmitted through electric circuits, and received by chemically prepared surfaces, both apparatus being kept in motion by mechanical means, without the aid of magnets. The apparatus consisted of a frame containing a driving power by which a rotatory motion was imparted to the metal drum B, placed in connection with the earth by means of the contact springs E E. The paper strip P P, chemically prepared by being immersed in a solution of sulphuric acid and prussiate of potass to receive the sequence of currents transmitted through the wire from the "transmitter," is wound upon the drum A, and is drawn forward over the revolving earth contact B at a uniform speed by reason of the pressure of the break roller M, which may, whenever the paper is not required to advance, be withdrawn by the lever H working on the centre R, and kept in position either way by the action of the spring roller W. An insulated metallic style D, in connection with the line wire *f*, and furnished with the necessary screw adjustments *a*, *b*, *c*, is arranged to press uniformly upon the chemically-prepared paper as it passes over the earth drum B. The style D can also be removed from pressing contact with the paper ribbon when required, as indicated by the dotted outline. When therefore the style D is passing over the surface of the prepared paper, and electric currents are passed through the line wire *f* from the distant station, the electric circuit will be completed through the paper ribbon P, and the metallic drum B, with the earth E, and in the passage of the current, the iron in the chemical solution is decomposed and a dark blue mark becomes visible upon the paper corresponding in length to the duration of the current; so that if the Jacquard ribbon at the distant station is perforated into the necessary length of holes to represent the sequences of dots and dashes in the Morse code, to form letters and words, the chemical decomposition from the style D will be an accurate replica of the distant message in the "dot" and "dash" symbols. It was thus that in 1846 Alexander Bain, the clever and ingenious Edinburgh watchmaker, originated a system of electric automatic chemical Jacquard printing, which even at the present day is scarcely understood, and which in all probability is left to American skill to develop. Its extreme simplicity and wonderful chemical sensibility speak volumes in its favour, provided, as has been already observed, such extreme velocities can be profitably worked in this small planet of ours.

(*To be continued.*)

RECENT FRENCH MATHEMATICAL PUBLICATIONS

M. CHASLES is reprinting a new edition of his celebrated work, "Aperçu Historique:" the first part has been already issued. The learned geometer has made no alteration in the book, which was written many years ago and long before he had been led to assert frivolous claims in favour of Pascal, and no allusion is made to the Newton forgeries. The whole work will cost no more than 20*s*., only one-fourth of the selling price of the old edition, which has for some time been very scarce.

There has been in France a revival of interest in the subject of imaginary quantities. Thus, a translation by Laisant of Bellavitis's "Calcul des Equipollences" has been published lately. It is regarded by Bellavitis himself as a system of quaternions in one plane, and thus is somewhat analogous to the efforts made in England to popularise the great Hamilton's theories. But it is only a partial effort, as Bellavitis's results do not admit of being generalised so as to apply to solid geometry.

M. Hoüel, whose name is connected with the publication of a series of useful tables, will very likely be more successful in this respect, as he is preparing a "Theory of Quaternions."

The same mathematician has edited a reprint of a work on the "Geometrical Representation of Imaginary Quantities," originally published in 1806 by Argand. One of his objects appears to have been to defend the rights of his illustrious countryman. But they are not so disregarded in England as the author seems to suppose.

The third and concluding part of the new edition of Briot and Bouquet's "Theory of Elliptic Functions" has appeared. It is quite a new book, though professing to be a second edition of the small octavo volume which became rapidly so popular amongst mathematicians.

M. Paul de Saint Robert has published a third and concluding volume of his interesting "Memoirs," several of which were published in English in the *Philosophical Magazine*. Amongst these valuable papers, which are here reprinted, we must not neglect to notice the "New formulæ for determining the altitude from barometric observations." These formulæ embody the results of the observations taken by Mr. James Glaisher in some of his aëronautical ascents. M. Saint Robert in this way improves the well-known Laplace's formulæ, which were based only on the Ramont's observations taken in the Pyrenean ranges; and takes into account the carefully observed facts which had been neglected in England.

NOTES

THE Committee on the Loan Exhibition of Scientific Apparatus met in the Science Schools at the South Kensington Museum yesterday. It has been determined to postpone the exhibition till March 1876, and from the strength of the Committee appointed and the interest taken in the scheme by scientific societies, we may expect the collection to be unique.

IT will be of interest to geologists to know that Capt. Feilden, R.A., the naturalist of the senior ship of the Arctic Expedition, in addition to making the observations on the birds of Northern Europe, Malta, India, China, and North America, which will be found scattered through the pages of the "Zoologist" and quoted by Prof. Newton and Messrs. Sharpe and Dresser in various works, has given much attention to the palæontology of many of these countries, especially to the Miocenes of Malta and the Faroe islands, and the Mastodon beds of South Carolina. By permission of Prof. Ramsay, V.P.R.S., the Director-General of H.M. Geological Survey, Capt. Feilden has also recently been shown the method employed in carrying out geological field-work by that Survey, by one of its staff, Mr. De Rance.

THE French Academy of Sciences, at its sitting on Monday last, received the report of M. Fleuriais, the head of the Transit of Venus Expedition to Pekin. The observations were very satisfactory indeed, the four contacts having been photographed with complete success. The weather was very boisterous all the day long, but at the four important moments the observers were favoured by a total absence of clouds. They succeeded in executing a map of Pekin, in spite of the obstacles placed in their way by the natives. The dimensions are 8,000 metres by 7,000, and the length of the walls is 33 kilometres. The instruments set up by the missionaries last century are in perfect

order. The instruments sent by the Academy to China are to remain there, and perhaps a permanent observatory may be established.

PROF. JAMES DEWAR, in resigning his post of Chemist to the Highland Agricultural Society, on his appointment to the Jacksonian Chair, Cambridge, has told that Society some wholesome truths, which we hope they will take to heart. Mr. Dewar writes:—"After what has occurred, it will hardly be necessary for me to say anything about what might have been had the chemical department been rearranged in the way I naturally anticipated after the death of Dr. Anderson. You are aware I intended prosecuting investigations in vegetable physiology, had the proper means been placed at my disposal; and the desire to do so was the main reason of my leaving the University. As it seems, however, the opinion of a portion of the Society that an agricultural chemist (so-called by the uninitiated, because his business is chemical analyses and the manipulating of the farming interests) rather than a scientific chemist would be best qualified to discharge the duties of the office of chemist, I have considered it my duty to accept the Cambridge Professorship as the best means of getting out of a false position. I still trust, however, the Society will ultimately see that this office of chemist will never be properly filled except by one thoroughly trained in scientific research, and this, the making him a real agricultural chemist, will depend on the means placed at his disposal for applying his scientific knowledge to agriculture."

WE are glad to see that the University of Glasgow is doing what it can to promote experimental investigation among its students; for this purpose the following two prizes are offered:—1. In Natural Philosophy, the Cleland Gold Medal, for the best "Experimental Determination of Magnetic Moments in Absolute Measure." All students of the Natural Philosophy Class in Session 1874–75, or Session 1875–76, may be competitors. 2. The Watt Prizes of 10*l*. for the best "Numerical, Graphic, and Experimental Illustrations of Fourier's Solutions of Problems in Thermal Conduction." Cooling of a cylinder to be worked out *numerically* in one or more cases: cooling of a globe may be illustrated *experimentally* in one or more cases. All matriculated students of the University in Session 1875–76, who have finished, or who on the 1st day of May, 1876, shall finish a regular course of Languages and Philosophy, may be competitors. Two or more competitors for the prize may work together and give in a joint essay; and two prizes will be given in case of sufficient merit. The Physical Laboratory of the University will afford the requisite experimental means for candidates for the Watt and Cleland Prizes. When will Oxford and Cambridge follow such a good example?

IT is with great regret that we record the death, in his fifty-fourth year, of Admiral Sherard Osborn, C.B., F.R.S., which took place suddenly on Thursday night last. Admiral Osborn's name is well known in connection with Arctic exploration, and he was to have read a paper last Monday on the Arctic Expedition before the Royal Geographical Society. He was born April 25, 1822, entered the navy in 1837, and served in the East Indies and in China. He obtained his commission as lieutenant in 1846, and three years later was selected as a volunteer for the Arctic Expedition, under Capt. H. T. Austen, sent in search of Sir John Franklin, being appointed to command the *Pioneer*. He afterwards served with distinction during the Russian war, in China, and in Mexico. In 1864 Capt. Osborn was appointed to the command of the turret-ship *Royal Sovereign*, and was afterwards for several years managing director of the Great Indian Peninsular Railway at Bombay. Admiral Osborn naturally took a keen interest in the Arctic Expedition which is so soon to leave our shores.

THE following naturalists have been elected foreign members of the Linnean Society of London, viz.: Alexander Agassiz, H. E. Baillon, Ferdinand Cohn, M.D., A. de Quatrefages, and F. Parlatore.

DR. G. J. Allman, F.R.S., has been elected Examiner in Zoology, and Dr. M. T. Masters, F.R.S., Examiner in Botany to the University of London.

AN outline of the lectures on the Invertebrata being delivered at Edinburgh University by Prof. Huxley is being published in the *Medical Times and Gazette*; the first instalment appeared in last Saturday's number.

OUR readers are familiar with the name of the Penikese School of Zoology in the United States, and last week we gave the programme of a similar institution for the practical study of Geology. The faculty of Harvard College are, we believe, arranging for similar schools for other branches of scientific instruction, and have announced three separate courses, besides the one on Geology:—One of Chemistry, under Prof. J. P. Cook, to be held at Cambridge. The second is a course in Phenogamic Botany, to be given in the Botanical Laboratory at Cambridge, by Prof. Goodale. The Botanical Garden and Herbarium will furnish material for instruction in Structural and Systematic Botany. All necessary appliances, including dissecting and compound microscopes, will be furnished by the instructor. The third course is that of Cryptogamic Botany, under Prof. W. G. Farlow. This course will be held at some point on the seashore, possibly Provincetown or other suitable locality, and in this respect will correspond to the plan of the summer school of zoology at Penikese. Twelve lectures will be devoted to the Algæ and six to the Fungi. A laboratory will be established, and excursions will be made throughout the course by the students in company with Prof. Farlow.

FROM Baron Mueller, Government Botanist of Victoria, Australia, we have received his last report of the progress and condition of botany in that colony. From a scientific point of view, and equally in regard to the advance of applied botany, it contains many interesting particulars. The learned writer, who has done so much to promote the development of the vegetable resources of Australia, laments the withdrawal of the working votes of his department, and his removal from the directorship of the Botanic Garden, as he is thereby deprived of the means of conducting his researches. We glean the following notes from this report. The vegetation (exclusive of some of the lower cryptogams) of the whole of Australia is estimated at 11,000 species. The number of grasses is about 250 species. Numerous experiments have been made to ascertain the quality and practical working of various fibres, oils, tars, acetic acid, gums, resins, starch, potash, paper materials, dyes, &c., obtained from native and introduced plants, a complete list of which is appended to the report. In some experiments on rabbits with the tubers of *Burchardia umbellata* and *Anguillaria australis*, it was ascertained that although belonging to a doubtful family, they contain no noxious principle. In the search for jalap in the tubers of indigenous terrestrial orchids, the common *Microtis porrifolia* gave the best and highly satisfactory results. In drying, the roots of this species evolve a slight violet odour, and ten grains of the dry powder produces one ounce of good pale mucilage, free from bitterness. The tubers of *Thelymitra aristata*, although still richer in mucilage, are slightly bitter and of a brownish tinge. Very much has been effected in the distribution of the seeds of the gum trees (*Eucalyptus*), of which there are 140 species in Australia, and intesting the qualities of the numerous products of these valuable trees. In a trip to the forest regions of the Upper Yarra last year, Baron Mueller measured some trees of *Eucalyptus amygdalina*, var. *regnans*, which were approximately 400 feet in height. The magnificent grass *Festuca dives* was found in the same region growing to a height of 17 feet on the

borders of rivulets. For educational purposes in the colonial schools, 100 sets of native plants have been dried and mounted, each set containing fifty species. Since the publication of the last report about fifty new genera have been added to the flora of Australia, including many of great interest in phyto-geography. Thus the genera *Corynocarpus* and *Carmichaelia*, previously only known from New Zealand, have been discovered in Australia. A species of *Ilex* (holly) has also been found, and an elm belonging to the section *Microptelea*. About fifteen of the genera are absolutely new to science.

THE excellent collection of Madeira plants formed by the late Rev. Mr. Lowe, who, with Mrs. Lowe, was lost last year in the wreck of the *Liberia*, was deposited in the Herbarium at Kew some months since, and is, we understand, to be divided between the British Museum and the establishment named, the latter taking the *uniques*. It is fortunate that so valuable a collection has become public property, as it contains the types of the lamented gentleman's new species, and specimens of many things that are now exceedingly rare in the islands. In private hands it might have been neglected, and certainly would have been inaccessible to most botanists.

IN the appendix to the United States Coast Survey Report for 1872, now in the press, is a report by Mr. W. H. Dall on the tides, currents, and meteorology of the Eastern Aleutian region and the North-east Pacific, accompanied by explanatory diagrams. Mr. Dall's observations on the oceanic currents, which are here tabulated and discussed up to the date of the report, are of special interest as being the first series undertaken with a direct view to the solution of the problems in question, and result in the proof of the existence of a reflexed northerly arm of the great easterly North Pacific current, denominated by him the Alaska current, which had previously been surmised from isolated observations and theoretical considerations. Mr. Dall has been enabled to determine the rate and dimensions of several portions of this current, and maximum, minimum, and mean annual temperature. The existence of definite oceanic currents in the eastern half of Behring Sea is shown to be very doubtful. Some important generalisations on the relations of the Pacific and Behring Sea tides to each other are made, and the peculiarities of the compound tides of this region are graphically indicated by diagrams in a new method, original with the author, and possessing some interest for those studying these problems. The report is accompanied by numerous hydrographic memoranda and tables of meteorological, current, and tidal observations.

THE figure to the letter in last week's NATURE (p. 7), signed X, "On the rôle of feet in the struggle for existence," does not quite illustrate the author's meaning. He intended to draw the same footprint in both cases, but in the case shown in the cut on the left, each footprint should be advanced straight forward in the line of the previous one, while in the other it should be advanced obliquely, leaving a large part of the outline of the previous one clearly marked.

A MEETING was held on Monday last in the theatre of the Royal Institution, Mr. A. J. Mundella, M.P., in the chair, for the purpose of considering the best mode of extending to London the benefits of the Cambridge University Extension Scheme, at which the following gentlemen, among others, were present :—Sir J. Lubbock, Bart., M.P., Dr. L. Playfair, M.P., Dr. W. B. Carpenter, F.R.S., Dr. J. H. Gladstone, F.R.S., Sir H. Cole, C.B., Mr. S. Morley, M.P., Prof. Fawcett, M.P., Mr. T. Hughes, Q.C., Hon. G. Brodrick, Rev. W. Rogers, Mr. H. C. Sorby, F.R.S., and Mr. Jas. Stuart. After Mr. Stuart and Mr. Sorby had explained the object of the meeting, the following resolution was carried :—"That this meeting, having heard Mr. Stuart's statement, considers it desirable to introduce into London the Cambridge University Extension Scheme." A provisional committee was appointed to carry out the objects of the meeting, consisting of Mr. S. Morley, Mr. Mundella, Mr. Jas. Stuart, Rev. W. Rogers, Mr. T. Hughes, Mr. R. N. Phillips, Dr. Carpenter, Mr. W. L. Birkbeck, Mr. H. C. Sorby, and Mr. G. M. Norris.

THE regular annual meeting of the U.S. National Academy of Science took place at the Smithsonian Institution in Washington on the 20th of April, and continued three days. The attendance was about the same as usual, there being some twenty-five members present out of the seventy-five. Numerous papers of much scientific interest were brought forward. In accordance with the rules of the Academy, five new members were elected. These are : Prof. R. E. Rogers, Professor of Chemistry of the University of Pennsylvania ; Prof. Asaph Hall, one of the astronomers at the Washington Observatory ; Prof. Alpheus Hyatt, curator of the Natural History Society of Boston ; Prof. Joseph Le Conte, of the University of California ; and Mr. Lewis H. Morgan, of Rochester. All these gentlemen are eminent in their respective branches of science, and constitute a valuable addition to the membership of the Academy, which now embraces about eighty individuals, selected from the representative men of science throughout the United States. The only loss which the Academy has experienced by death during the year is, as stated by the president, that of Prof. Jeffries Wyman.

SIR CHARLES REED, as a member of the Gresham Committee, writes to the *Times*, giving the arrangements which have been made for the future conduct of the Gresham Lectures. The lectures are not in future to be delivered in the Latin tongue. The times of delivery are to be fixed, not by the lecturers, but by the Committee. The lecturers are required to deliver their own lectures, and the nomination of a substitute is allowed only in case of illness. The appointment of the lecturer is for one year, securing to the Committee an opportunity of annual revision. It will be seen that the Committee have taken a step in the right direction, and we hope that it is only the first step to a radical reform.

A scientific Society has been formed in Bedford, under the title of the Bedfordshire Natural History Society and Field Club.

IN reference to Mr. Fordham's letter in last week's NATURE, in which he states that in his part of the country the cowslip is very abundant but the primrose is not found, Mr. J. J. Murphy asks, what part of the country Mr. Fordham means? The opposite is true at Dunmurry, Co. Antrim, where there is plenty of primroses, but few if any cowslips.

WE are glad to see that at the great International Exhibition to be opened at Philadelphia next year, a Department (VII.) is to be devoted to "Apparatus and Methods for the Increase and Diffusion of Knowledge." The following are the groups into which the department is divided :—Educational apparatus and methods. Typographic aids to the preservation and dissemination of knowledge, books, periodicals, newspapers. Charts, maps, and graphic representations. Telegraphic instruments and methods. Instruments of precision, and apparatus of physical research, experiment, and illustration. Meteorological instruments and apparatus. Mechanical calculation—indicating and registering apparatus, other than meteorological. Weights, weighing, and meteorological apparatus—measures and coins. Chronometric apparatus—time-keepers of all kinds, watches, clocks, &c. Musical instruments and acoustic apparatus. Under Department X. also there are two groups which might be classed along with these :—Education : illustration of the various systems and accessories of education, from the infant school to the University, including special schools of science and art, libraries, &c. Institutions, Societies, and Organisations having for their object

the Promotion of Science: illustrations of the rise, progress, and results of the various organisations for the promotion of science; models, drawings, descriptions, and statistics.

MR. STANFORD has just published a North Polar map, superior in most respects to anything we have seen. It embraces a circle of forty degrees from the pole, thus including the whole of England. It exhibits faithfully all the circumpolar lands hitherto discovered, and in bold red letters shows the points reached by all the most important discoverers, with the date of discovery, from Sebastian Cabot down to Payer and Weyprecht; even the spot where it is hoped that H.M.S. *Discovery* will winter is indicated. By means of dark and light blue, the usual limits of the ice and open water are clearly shown, and the whole execution of the map reflects the greatest credit on Mr. Stanford's establishment.

WE have seen an ingenious scientific apparatus which entirely obviates the use of matches or tapers, and does away with the attendant danger in lighting gas. It consists of a small bichromate of potash battery, the zinc plate of which is so arranged that by the pressure of the finger it can be immersed in the exciting fluid and put the battery in action. Rising from the top of the battery is a light brass stem, like a taper-holder, but in the form of a swan's neck, terminating in a little bell, within which the two "poles" of the battery are united by a spiral of platinum wire; this wire, when the battery is put in action by the immersion of the zinc plate, becomes white hot, and will instantly ignite the gas if held over the open burner. The name which the maker, Mr. Horatio Yeates, has given to this happy contrivance is the "Galvano-Pyreon, or Voltaic Gas-lighter."

M. ELIE DE BEAUMONT left a library containing a number of valuable scientific books, which his nephew and heir has presented to the Geological Survey of France, of which his uncle was Director. The grant includes more than 2,000 volumes relating to geology, and 600 maps.

WE formerly mentioned that the widow of the late General Poncelet founded a few years ago a prize to be awarded by the Institute. It was a handsome sum of money to be given every two or three years to the author of the best essay on Mechanics. Last week Madame Poncelet sent to the Academy a large number of copies of the *Œuvres Complètes* of her husband, which were completed only last month, with the request that each successful competitor for the Poncelet Prize should be presented with a copy. But as the stock would be exhausted in the course of five or six centuries, the careful widow has created a special accumulating fund providing for a new edition in the year 2600 A.D.

THE Paris Acclimatisation Society held its anniversary meeting on the 6th of May, under the presidency of M. Drouyn de Lhuys. M. Pichot gave a long and interesting address on acclimatisation in Egypt under the Pharaohs. Many prizes were awarded for practical results obtained in the way of introducing new kinds of animals into France. One of these was given by M. Joseph Cornely, for having succeeded in the multiplication of the kangaroos left in a state of liberty.

THE additions to the Zoological Society's Gardens during the past week include a Guinea Baboon (*Cynocephalus sphinx*) from West Africa, presented by Mr. Lionel Hart; a Yellow-shouldered Amazon (*Chrysotis ochroptera*) from South America, presented by Miss M. Sutherland; a Molucca Deer (*Cervus moluccensis*), a Pampas Deer (*Cervus campestris*), born in the Gardens; two Chinese Jay-Thrushes (*Garrulax chinensis*) from China, purchased; a Patas Monkey (*Cercopithecus ruber*) from West Africa; a Hairy Tree Porcupine (*Cercolabes rupestris*), a Rock Cavy (*Cerodon rupestris*) from Brazil, deposited.

NATURAL HISTORY OF KERGUELEN'S ISLAND *

IT is difficult, owing to the inexactness of the charts, to inform you of the positions of the Astronomical Stations in whose neighbourhood I have been able to work in this island. The German station is in Betsy Cove, the American at Molloy Point, Royal Sound. The English stations also are in this Sound, the second being situated about three miles N. by W. of Swain's Haulover. The first English station is between these last two on the main land, six or seven miles N.W. of Three Island Harbour, in what will be called Observatory Bay. Two days before the Transit of Venus a party under Lieut. Goodridge, R.N., was detached from the first English station to observe the transit from a position which he selected near the base of Thumb Peak. I have not yet been able to visit Betsy Cove.

Observatory Bay is one of the minor inlets of a peninsula comprised between two narrow arms of the sea. One of these runs up from the Sound, along the western flank of the hills adjacent to Mount Crozier, several miles, and terminates at a distance of three or four hours to the north of us, and about four miles from the inlet near Vulcan Cove. The other arm, opening nine or ten miles away to the southward, proceeds in a north-easterly direction to within three or four miles of the former, and no great distance from Foundry Branch.

Besides the inlets of the sea, numerous freshwater lakes present obstacles to inland travelling. Some in this neighbourhood are two or three miles in length, but in general they are not more than a mile long. They are usually shallow, and appear to be uninhabited by fish. The bogs and streams in this vicinity are not impassable, but can be traversed with ease if ordinary care be taken.

The most salient features of the landscape are the basaltic hills, with irregular terraces of rock on their sides, and broken cliffs at their summits. In lieu of grass, their slopes are clothed with banks and boulder-like clumps of *Azorella selago*, excepting where rich damp loam affords a soil suitable for the *Acæna* and the *Pringlea*. Here and there a fern (*Lomaria*) and grass (*Festuca*) grow in the interspaces of the other plants.

The climate of Royal Sound is far warmer and drier than we were led to expect it would be. In November the weather was very pleasant; since then it has deteriorated, though the snow has not again covered the ground as it did when we first arrived. Probably the previous accounts of its meteorology were based upon observations taken in parts of the island where bad weather prevails; or it may be that the condition of the country in winter has been presumed to be constant throughout the year. In one respect we were rightly informed; for usually when there is no breeze there is a gale. A calm day is an exceptional event. Meteorological observations are being taken in Observatory Bay on board the *Volage* and by the sappers on shore.

Corresponding with the unlooked-for superiority in climate, a difference is noticeable in the vegetation of this part of the island. Some plants which occur at both extremities of the country display in Royal Sound marks of luxuriance. For instance, *Pringlea antiscorbutica*, which is elsewhere apetalous, here in sheltered places frequently develops petals; some flowers in the same inflorescence possessing one petal only, others having two, three, or four. And the petals are not always of a pale greenish colour, but occasionally are tinged with purple. Again, *Lomaria alpina*, which is mentioned in the flora as rare in the neighbourhood of Christmas Harbour, is excessively common and very finely grown here. There are also more species of flowering plants and of the higher orders of Cryptogamia here than were found by the Antarctic Expedition at the north of the island. But there are fewer species of mosses, lichens, and algæ. Their paucity, in comparison with those of the other district, is probably due to the nature of the rocks on land, and to the seclusion of the bay from the open sea. The additions to the flora are for the most part Falkland Islands species.

In speaking of the climate, it may be mentioned that the plants of Kerguelen's Island are not (as was supposed) in flower throughout the year; but probably some of them do not cease flowering until late in the winter. When we first arrived in Royal Sound the ground was covered with snow, and scarcely

* "First Report of the Naturalist attached to the Transit of Venus Expedition to Kerguelen's Island, December 1874" By the Rev. E. A. Eaton. Communicated by the President. A letter to the Secretary of the Royal Society, dated Royal Sound, Kerguelen's Island, 31st December, 1874. Read April 8.

anything had begun to come out. The *Pringlea* was far advanced in bud, barely commencing to blossom. The *Acæna* was just beginning to burst into leaf. About the first week in November *Festuca Cookii* came out, and a few days later *Azorella selago*. The young fronds of the ferns were just about to unroll. In the third week of the same month *Montia fontana* and *Acæna affinis* were in flower in a sheltered spot, and *Leptinella plumosa* was first found in blossom. *Galium antarcticum* appeared about the same date. A week later, *Ranunculus hydrophilus* and a *Festuca* (*purpurascens?*) were out, and *Lycopodium clavatum* was sprouting. By the middle of the month *Triodia* and *Lyallia kerguelensis* and also *Ranunculus crassipes* were in flower; the *Pringlea* was everywhere past flowering (excepting upon the mountains), and *Aira antarctica* began to shoot forth its panicles. Before the end of the month a *Carex* came out; but *Bulliarda* and other plants delayed still.

A few species of Mammals have been introduced into the island. Mice (evidently *Mus musculus*, L.) are common along the coast, and have been found by us in various places. The rabbits, transported by order of the Admiralty from the convict settlement in Table Bay, have been landed by H.M.S. *Volage* in Royal Sound. They share with the birds holes of the petrels, and are (it is almost superfluous to mention) propagating freely. Their favourite food is the *Acæna;* but they occasionally eat *Pringlea* leaves and gnaw away the green surface of *Azorella*. In the Crozettes, whose climate and flora are said to resemble those of this island, rabbits have become extremely abundant, and so rank and coarse that the sealers will not eat them. Goats are increasing in numbers on the leeward side of the main land.

Whales and porpoises occasionally enter the Sound. Old skulls of the latter, wanting the lower jaw, are cast up here and there on the beaches.

Up to the present time I have captured only two species of seals—a female sea leopard and two males of a Platyrhine Seal. The other kinds frequent the more open parts of the coast and islands.

Twenty-two species of birds, at the fewest, perhaps twenty-three, frequent Royal Sound, viz., a *Chionis*, a Cormorant, a Teal, a Tern, a Gull, a Skua, eleven (perhaps twelve) Petrels, two Albatrosses, and three (perhaps four) Penguins. Of these, I have procured eggs of the first six; also of six Petrels, one Albatross, and two Penguins. The *Thalassidromæ* are preparing for laying.

Fish are rather scarce in Observatory Bay. Only three species have hitherto occurred to us, two of which are common under stones at low water. The remains of a *Raia* have also been picked up on one of the islands by an officer of the *Volage*, but hardly sufficient is left to enable the species to be determined. It is allied to *R. clavata* and *R. radiata*.

The entomology of the island is very interesting. Most of the larger insects seem to be incapable of flight. I have found representatives of the orders Lepidoptera, Diptera, Coleoptera, and Colembola.

The Lepidoptera comprise a species of the *Noctuina* (as I suppose) and one of the *Tineina*. Of the first I have not yet reared the imago; the larva is a moss eater and subterranean: the adult is probably as large as an *Agrotis* of medium size. The species of *Tineina* is probably one of the *Gelechidæ*, judging from the form of the palpi. Its larva feeds on young shoots of *Festucæ*, and sometimes spins a silken cocoon for the pupa. The imago, of which the sexes are alike, has acute and very abbreviated wings, and the posterior pair extremely minute. In repose the antennæ are widely separated, and almost divaricate. When the sun shines the adult is active, and, if alarmed, jumps to a distance of two or three inches at a time. During its passage through the air the wings are vibrated.

The Diptera are represented by species of the Tipulidæ and Muscidæ. There are three of the former family. One of them is a small species of the Cecidomyidæ, which is abundant in mossy places, and presents no marked peculiarity. Another seems to be a degraded member of the Tipulidæ. The antennæ have six joints, the palpi two; the wings are ligulate and very minute. It possesses halteres, and the female has the ovipositor enclosed in an exposed sheath. Although it is unable to fly, it lives upon rocks in the sea, which are covered at high water, and there it deposits its eggs in tufts of *Enteromorpha*. The third species has full-sized wings: it was caught in the house. The indigenous Muscidæ are very sluggish in their movements, and are incapable of flight. Four species are common about here. One of them is abundant on *Pringlea*, crawling over the leaves. When it is approached it feigns to be dead, and, tucking up its legs, drops down into the axils of the leaves; or, if it happens to be upon a plane surface, one need only look at it closely, and it throws itself promptly upon its back and remains motionless until the threatened danger is over, when it gradually ventures to move its limbs and struggle to regain its footing. Its wings are represented by minute gemmules, and it possesses halteres. The ovipositor is extended, its apical joint alone being retracted. The penis is porrected beneath the abdomen, where it fits into a notch at the apex of the penultimate segment. The larva feeds on decaying vegetable matter. Another species occurs on dead birds and animals, as well as beneath stones near the highest tide-mark. It is completely destitute of even the vestiges of wings and halteres. The sexual organs are concealed. It and the preceding species are rather smooth. A third species, slightly hairy, is common among tide refuse and on the adjacent rocks, which are coated with stunted *Enteromorpha*, on which plant, *inter alia*, the larva feeds. It has very small triangular rudiments of wings, slightly emarginate near the apex of the costa, and possesses halteres. The sexual organs are not exposed. The fourth species occurs amongst grass growing along the shore, and also in Shag rookeries. Its linear and very narrow wings are almost as long as the abdomen. It can jump, but cannot fly. The sexual organs are retracted.

A *Pulex* is parasitic upon *Halidroma*, and one (possibly the same species) on *Diomedea fuliginosa*.

Coleoptera are not uncommon. The larger species seem to have their elytra soldered together. There is a small species of the Brachyelytra.

Several species of *Nirmiidæ* have been obtained.

Two *Poduræ* (one black, the other white) are plentiful.

There appear to be few species of Spiders, though individuals are numerous. Penguins and some of the other birds are infested with Ticks. The remaining Arachnida are related to *Cribates*.

The Crustacea, Annelida, Mollusca, and Echinodermata in this part of the island have probably been collected by the *Challenger* more extensively than I have been able to do; therefore I need not particularise further about them than to state that Entomostraca abound in the lakes; an earthworm is common, and a land-snail is very plentiful amongst the rocks on the hills. This last appears to appreciate comparative heat, for specimens obtained in an exposed place during the frosty weather were assembled together for warmth, under the drip of an icicle.

In Observatory Bay Cœlenterata are not numerous. One or two species of Actiniidæ on the rocks and Macrocystis roots, and an Ilyanthid in mud, are the only Actinozoa I have met with. The Hydrozoa similarly have afforded only three species—a Corynid, a Campanularian, and a *Sertularella*.

There are several Sponges.

With the exception of *Limosella aquatica*, and perhaps *Agrostis antarctica*, I have obtained all the flowering plants and ferns given in the "Flora Antarctica" as indigenous to the island. Besides these, *Ranunculus hydrophilus* and another species, a *Carex*, a *Festuca* (probably *F. purpurascens*, but I have no work containing descriptions of the flowering plants), *Polypodium vulgare*, a fern allied to *Polypodium*, and *Cystopteris fragilis* have occurred to me. There is also a plant which appears to belong to the Juncaceæ. *Lycopodium clavatum* and *L. selago* are common about here. None of the Mosses, Hepaticæ, or Lichens have been worked out as yet; but amongst them are one or two species of *Cladonia*, and some examples of *Lecanora paleacea*. Fungi are represented by *Agaricus* (*Psalliota*) *arvensis*, *Coprinus atramentarius*, and a peculiar parasite on *Azorella*, which grows out from the rosettes in the form of a clear jelly, which becomes changed into a firm yellowish substance of indefinite form. There are also some *Sphæriacei* on grass and dead stems of plants. At present few additions have been made to the marine flora. The larger Algæ in Royal Sound are usually not cast upon the shore by the waves, and I have almost been entirely dependent upon grapples thrown from the rocks for specimens of the more delicate forms. *Polysiphonia Sulivanæ* and *Rhytiphlœa Gomardii* are amongst the novelties. A large number of zoological and botanical specimens have been lost through my inability to attend to them in time without assistance. This has principally affected the number of duplicates; but in one instance it has led to the loss of a species—one of the Petrels, which was the commonest bird about here when we first arrived. Fortunately it is a well-known species.

The 1st of March is announced as the approximate date of our sailing from Kerguelen's Island. Five weeks later I hope to

arrive at the Cape and to forward to you such of the specimens collected as require only ordinary care in their transmission. The more fragile things are likely to reach you in better condition if I keep them until my return to England, than they would if they were sent with the others.

SCIENTIFIC SERIALS

Journal de Physique théorique et appliquée, Feb. 1875.—This number contains several papers reprinted from other serials, and the following original ones :—On the spectra of yttrium, erbium, didymium, and lanthanum, by Prof. R. Thalèn. On account of the difficulty to obtain the compounds of these metals in a pure state, considerable doubt has hitherto existed, whether certain lines that always appeared in the spectra of yttrium and ertium and in those of didymium and lanthanum belonged to the first or second metal in the pair ; the state of these questions in 1868 was, that there were twelve lines which always appeared when yttrium or erbium were examined, and sixteen lines in the case of didymium and lanthanum. Prof. Thalèn succeeded in obtaining sufficient quantities of compounds of each of the metals, from M. Cleve, Professor of Chemistry at the Upsala University, and these were of undoubted purity. He was thus enabled to study their spectra most accurately, and the following table shows the number of lines found in former and in the recent researches :—

Metal.	Number of lines.			
	1868.			1873.
Yttrium	70	+ 12 uncertain		106
Erbium	10			83
Didymium	6	+ 16	,,	209
Lanthanum	49			188

It was found that the twelve uncertain lines that always appeared with yttrium or erbium belong to yttrium only ; in the same way the sixteen uncertain ones in the second case belong only to the lanthanum spectrum. Prof. Thalèn gives a detailed map of the spectra in question.—Researches on the induction sparks and electro-magnets ; their application to electro-chronographs, by M. Marcel Deprez.—On analogies in the evolution of gases from their over-saturated solutions, and the decomposition of certain explosive substances, by M. D. Gernez.—On the preservation of energy in electric currents, by M. E. Bouty.—On the transformation of static into dynamic electricity, by M. E. Bichat.

Der Zoologische Garten.—In the January number, the first article is a description of the new Zoological Gardens at Frankfort, by the director, Dr. Max Schmidt, illustrated by a coloured plan. J. von Fischer gives an account of the habits of *Herpestes galera* as observed in confinement. E. Buck figures and describes an apparatus for producing currents in the water of aquaria ; it may be worked either by a miniature steam-engine or by clockwork. H. Schacht gives minute details of the breeding habits of the common swallow (*Hirundo rustica*) ; and A. B. Meyer and K. von Rosenberg both write upon the newly discovered Bird of Paradise (*Diphyllodus Gulielmi III.*, Van Muschenbroek) from Ternate.—In the February number is printed a paper read by Dr. Hermann Müller before the Provincial Society of Westphalia, on the stingless Brazilian Honey-bees of the genus *Melipona*, and the possibility of their acclimatisation in Europe. Dr. J. J. Rein remarks on the distribution of some of the mammals of Japan ; and C. Geitel writes on the feeding of small birds in winter in the neighbourhood of human habitations.

Poggendorff's Annalen der Physik und Chemie, 1875, No. 2, contain the following papers :—On the galvanic conducting capacity of melted salts, by F. Braun. The author experimented with twelve different salts, and tabulates his results ; the salts were nitrates of potash, soda and silver, carbonates of potash and soda, sulphate of soda, chlorides of potassium, sodium, strontium, zinc and lead, and iodide of potassium.—On a compilation of facts which prove a decrease of volume as a consequence of chemical action in solid bodies, by W. Müller.—On the electric conducting capacity of the chlorides of the alkalies and alkaline earths as well as of nitric acid in aqueous solutions, by F. Kohlrausch and O. Grotrian. This is the last part of the author's interesting communications, and treats of the liquids examined, of the resistances observed, of the conducting capacities in their relation to that of mercury, and of their dependence on temperature ; further, of their proportion to the percentage of concentration of liquids, of the co-efficients of temperature, and of the conducting capacity of dilute solutions.—On the theory of galvanometers, by H. Weber.—A reply to Baron Eötvös' remarks on a part of the astronomical undulation-theory by Ed. Ketteler.—Some remarks upon Helmholtz's work on Sound, "Die Lehre von den Tonempfindungen," by Emil v. Quanten ; these remarks relate principally to what Helmholtz says on vowels.—A reply to Herr C. Heumann regarding his claim of priority in observing the action of nitrate of silver upon sulphide of copper, by R. Schneider.—On the construction of lightning conductors, by Dr. W . A. Nippoldt. Some remarks by Dr. G. Baumgartner, on Prof. E. Edlund's paper on the nature of electricity.—Description of a very simple apparatus to photograph spectra, by Hermann W. Vogel ; this apparatus can even be applied to an ordinary pocket spectroscope of the smallest dimensions.—On the phenomena of interference visible on mirrors covered with dust or a fine layer of grease, by Prof. M. Sekulic.—Researches on apparent adhesion, by J. Stefan.—On the conducting capacity of the halogen compounds of lead, by E. Wiedemann.

Transactions of the Manchester Geological Society, Part viii. vol. xiii., 1874-75.—Nearly the whole of this part is occupied by an elaborate illustrated paper on "Hæmatite Deposits," by Mr. J. D. Kendall. There is a short paper by Mr. A. W. Waters on "Tertiary Coals," in reference to specimens of carbonised peat he found in Northern Italy under rather peculiar circumstances. Part ix. is occupied with the discussion on Mr. Kendall's paper on Hæmatite deposits, and with a long paper on basalt and its effects, by Mr. G. C. Greenwell, F.G.S.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, April 29.—"On a Continuous Self-Registering Thermometer," by H. Harrison Cripps. Communicated by Prof. Stokes, Sec. R.S.

The instrument is divided into two portions :—First, the thermometer, which marks the degrees ; secondly, the clockwork, which indicates the hours and minutes. The thermometer is first described. The form in which it was originally made, and which perhaps serves best for illustrating the principle, was the following :—A glass bulb, rather more than an inch in diameter, ends in a glass tube 12 inches long, having a bore of $\frac{1}{8}$ inch. This tube is coiled round the bulb in such a manner as to form a complete circle four inches in diameter, the bulb being in the centre of this circle. Fixed to opposite poles of the bulb, exactly at right angles to the encircling tube, are two needle-pointed pivots. These pivots work in minute metal depressions fixed to the sides of two parallel uprights. It will be seen from this arrangement that the bulb with its glass tube will rotate freely between the uprights, and the pivots will be the centre of a circle, the circumference of which is formed by the glass tube. The bulb is filled with spirit in such quantity that at 60° Fahrenheit the spirit will fill not only the bulb, but about 4 inches of the tube. Mercury is then passed into the tube till it comes into contact with the spirit, and in such quantity as to fill up about three inches of the remaining portion of the tube. The spirit is now heated to 120°, and as it expands forces the column of mercury in front of it till the mercury comes within $\frac{1}{4}$ inch of the end of the tube. The tube is then hermetically sealed, enclosing a small quantity of air. If the thermometer be now arranged with its needle-points between the uprights, it will be observed that, as the spirit contracts on cooling, it draws the column of mercury with it. This immediately alters the centre of gravity, and the bulb and tube begin to revolve in a direction opposite to that of the receding mercury. On again applying heat, and the mercury passing forwards, the bulb regains its original position. By this simple arrangement, the two forces, heat and gravity, acting in contrary directions, generate a beautifully steady rotatory movement. The method by which this movement is made serviceable for moving the register will now be described. A grooved wheel, two inches in diameter, is fixed to one of the central pivots, therefore revolving with the bulb. Directly above, and at a distance of seven inches from this wheel, is fixed between needle-points another wheel of exactly similar size. Around and between these two wheels passes a minute endless chain. To the chain is fixed a tiny pencil, which will be carried backwards and forwards between the wheels in a perpendicular line. This constitutes the register worked by the thermometer. The clockwork portion of the machine is so arranged that it causes a vertical cylinder, four inches diameter and five inches in length, to revolve once in twenty-four hours. Round this cylinder is fixed a piece of paper twelve inches long, five inches wide.

On the paper in the direction of its greatest length are ruled 100 lines, $\frac{1}{20}$ inch apart, each indicating 1° Fahrenheit. Across the paper, at right angles to these lines, are ruled twenty-four lines in dark ink, indicating the hours; between these three others, more lightly marked, for the quarters. The cylinder is so placed that as it revolves the surface of the paper is $\frac{1}{10}$ of an inch away from the point of the pencil register moving at right angles to its surface. A small striker is connected with the clockwork in such a manner that every five minutes (or oftener if required) it gives the pencil a gentle tap, thus striking its point against the paper. By this means all friction of the moving pencil against the paper is avoided, and the index is marked by a series of dots.

"Some particulars of the Transit of Venus across the Sun, 1874, Dec. 9, observed on the Himalaya Mountains, Mussoorie, at Mary Villa."—Note II., with appendix, by J. B. N. Hennessey, F.R.A.S.

Linnean Society, May 6.—Dr. G. J. Allman, F.R.S., president, in the chair.—The following papers were read:—On the anatomy of two parasitic forms of *Tetrarhynchidæ*, by Mr. F. H. Welch.—Notes on the Lepidoptera of the family *Zygænidæ*, with descriptions of new genera and species, by Mr. A. G. Butler, F.L.S. The main object of the paper was to rescue this section of Lepidoptera from the confusion into which it had been brought by the creation of new species and genera on insufficient grounds, by Mr. J. Walker. Some very curious instances of mimetism were mentioned between parallel series of species of hornet-moths and of Hymenoptera.—On the characteristic colouring matters of the red groups of Algæ, by Mr. H. C. Sorby, F.R.S. In this paper the author gave an account of some of the leading characters of the various remarkable blue, purple, and red substances soluble in water characteristic of red Algæ. The compound nature of the solutions obtained from the plants may be proved by the varying decomposing action of heat on the different colouring matters. He also showed that though *Oscillatoriæ* and *Rhodosporeæ* yield closely-related colouring substances, the specific differences serve to separate these two groups of Algæ quite as much as their general structure. Connecting links do indeed occur, and the further study of this question will probably yield interesting results. Specimens illustrating these facts were exhibited. A discussion followed, in which the President, Prof. Dyer, Mr. A. W. Bennett, and others took part.

Chemical Society, May 6.—Dr. Odling, F.R.S., vice-president, in the chair.—Prof. N. S. Maskelyne read a paper on Andrewsite and Chalcosiderite, the former of which is a new mineral from Cornwall named after Prof. Andrews. There were also papers entitled "An examination of methods for effecting the quantitative separation of iron, sesquioxide, alumina, and phosphoric acid," by Dr. W. Flight; and "On sodium ethylthiosulphate," by Mr. W. Ramsay.—Mr. J. Williams, in his communication "On a milligrade thermometric scale," proposes to substitute the freezing and boiling points of mercury for those of water, and to divide the scale into a thousand parts.—Mr. C. Griffin exhibited and described some new gas furnaces which are very economical and of great power.

Zoological Society, May 4.—Mr. E. W. H. Holdsworth in the chair.—Mr. Sclater exhibited and made remarks on a skin of a chick of a Cassowary (*Casuarius picticollis*), received from Dr. George Bennett, of Sydney, New South Wales. The bird had been obtained alive from the natives in Milne Bay, New Guinea, by Mr. Godfrey Goodman, Staff Surgeon, R.N., when in the *Basilisk* in 1873.—Prof. Newton exhibited and made remarks on a series of tracings of some hitherto unpublished drawings discovered in the Library of Utrecht, representing the Dodo and other extinct birds of Mauritius. Prof. Newton also exhibited and made remarks on two specimens of Ross's Arctic Gull, *Rhodostethia rossi*, one of the rarest of Arctic birds.—Mr. H. C. Sorby, F.R.S., read a paper on the colouring matter of the shells of birds-eggs as studied by the spectrum method, in which he showed that all their different tints are due to a variable mixture of seven well-marked colouring matters. Hitherto the greater part of these had not been found elsewhere. The principal red colouring-matter was connected with the hæmoglobin of blood, and the two blue colouring matters were probably related to bile pigments; but in both cases it was only a chemical and physical relationship, and the individual substances were quite distinct, and it seemed as though they were special secretions. There appeared to be no simple connection between the production of these various egg-pigments and the general organisation of the birds, unless it were in the case of the Tinamous, in the shells of the eggs of many species of which occurs an orange-red substance not met with in any other eggs, unless it were in those of some species of Cassowary.—Mr. A. H. Garrod read a note on the hyoid bone of the Elephant, as observed in two specimens of the Indian Elephant which he had lately dissected, and showed that the position of the bone *in situ* had been mis-stated by former authorities.—A second paper by Mr. Garrod contained remarks on the relationship of two pigeons, *Ianthœnas leucolœma* and *Erythrœnas pulcherrima*, which he lately had an opportunity of examining.—A communication was read from Mr. G. E. Dobson on the bats belonging to the genus *Scotophilus*, in which he gave the description of a new genus and species allied thereto. The specimen in question had been obtained in the Bellary Hills, India, by the Hon. J. Dormer, by whom it had been presented to the British Museum. It was proposed to name it *Scotozous dormeri*.—A communication was read from Lieut. W. Vincent Legge, R.A., giving particulars of the breeding of certain Grallatores and Natatores on the south-eastern coast of Ceylon, together with notes on the nestling plumages of the same.

Geological Society, April 28.—Mr. John Evans, V.P.R.S., president, in the chair.—The following communications were read:—"On *Stagonolepis Robertsoni*, and on the evolution of the Crocodilia," by Prof. T. H. Huxley, Sec. R.S. After referring to his paper read before the Society in 1858, the author stated that he had since obtained, through the Rev. Dr. Gordon of Birnie, and Mr. Grant of Lossiemouth, further materials, which served at once to confirm the opinion then expressed by him, and to complete our knowledge of *Stagonolepis*. The remains hitherto procured consist of the dermal scutes, vertebræ of the cervical, thoracic, lumbar, sacral and caudal regions, ribs, part of the skull and the teeth, the scapula, coracoid and interclavicle, the humerus, and probably the radius, the ilium, ischium and pubis, the femur, and probably the tibia, and two metacarpal or metatarsal bones. The remains procured confirm the determinations given by the author in his former paper, except that the mandible with long curved teeth therein, superstitiously referred to *Stagonolepis*, proves not to belong to that animal. From the extant evidence it appears that in outward form *Stagonolepis* resembled one of the existing Caimans of intertropical America, except that it possessed a long narrow skull, like that of a Gavial. The dermal scutes formed a dorsal and ventral armour, but the dorsal shield did not contain more than two, nor the ventral shield more than eight longitudinal series of scutes. The posterior nares were situated far forward, as in lizards, neither the palatine nor the pterygoid bones uniting to prolong the nasal passage backwards, and give rise to secondary posterior nares, as in existing crocodiles. The teeth referred to *Stagonolepis* have short, swollen, obtusely pointed crowns, like the back teeth of some existing crocodiles; they sometimes present signs of wear. The scapula resembles that of recent crocodiles; the coracoid is short and rounded like that of the Ornithoscelida and of some lizards, such as *Hatteria*. The humerus is more Lacertian than in existing crocodiles. The acetabular end of the ischium resembles that of a lizard, and the rest of the bone is shorter dorso-ventrally and longer antero-posteriorly than in living crocodiles, thus resembling that of *Belodon*. The latter reptile, from the Upper Keuper of Würtemberg, is the nearest ally of *Stagonolepis*; both are members of the same natural group, and this must be referred to the order Crocodilia, which was described as differing from other Reptilia as follows:—The transverse processes of most cervical and thoracic vertebræ are divided into more or less distinct capitular and tubercular portions, and the proximal ends of the corresponding ribs are correspondingly divided; the dorsal ends of the subvertebral caudal bones are not united; the quadrate bone is fixed to the side of the skull; the pterygoids send forward median processes which separate the palatines and reach the vomer; there is an interclavicle, but no clavicles; the ventral edge of the acetabular portion of the ilium is entire or but slightly excavated; the ischia are not much prolonged backwards, and the pubes are directed forwards and inwards; the femur has no inner trochanter, and the astragalus is not a depressed concavo-convex bone with an ascending process. There are at least two longitudinal rows of dorsal dermal scutes. The Crocodilia are divided by the author into three sub-orders:—

1. Parasuchia, with no bony plates of the pterygoid or palatine bones to prolong the nasal passages; the Eustachian pas-

sages enclosed by bone; the centra of the vertebræ amphicœlian; the coracoid short and rounded; the ala of the ilium high, and its acetabular margin entire; and the ischium short dorso-ventrally and elongated longitudinally, with its acetabular portion resembling that of a lizard. Genera: *Stagonolepis*, *Belodon*.

2. Mesosuchia, with bony plates of the palatine bones prolonging the nasal passages, and giving rise to secondary posterior nares; a middle Eustachian canal included between the basi-occipital and basisphenoid, and the lateral canals represented only by grooves; vertebral centra amphicœlian; coracoid elongated; ala of the ilium lower than in the preceding, higher than in the next sub-order, its acetabular margin nearly straight; ischium more elongated dorso-ventrally than in the preceding group, with its acetabular margin deeply notched. Genera: *Steneosaurus*, *Pelagosaurus*, *Teleosaurus*, *Teleidosaurus*, *Metriorhyncus* (*Goniopholis* ?, *Pholidosaurus* ?).

3. Eusuchia, with both pterygoid and palatine bones giving off plates which prolong the nasal passages; vertebral centra mostly procœlous; coracoid elongated; ala of the ilium very low in front, its acetabular margin deeply notched; ischium elongated dorso-ventrally, with its articular margin deeply excavated. Genera: *Thoracosaurus*, *Holops*, and recent forms.

The Mesosuchia are intermediate in character between the other two groups; the Parasuchia, where they differ from the Mesosuchia, approach the Ornithoscelida and Lacertilia, especially such as *Hatteria* and *Hyperodapedon*, with amphicœlous vertebral centra. The Eusuchia, on the other hand, are the Crocodilia which depart most widely from the Ornithoscelida and Lacertilia, and are the most Crocodilian of crocodiles. After indicating at some length the succession of modifications in the above three groups, the author remarked that if there is any solid ground for the doctrine of evolution, the Eusuchia ought to be developed from the Mesosuchia, and these from the Parasuchia, and showed that geological evidence proved that the three groups made their appearance in order of time, in accordance with this view. Thus, in the Trias there are the genera *Belodon* and *Stagonolepis* of the sub-order Parasuchia. In the Upper Lias we have *Steneosaurus* (*Mystriosaurus*) and *Pelagosaurus*, the first represented also in all Mesozoic formations up to the Kimmeridge Clay; in the Fuller's Earth *Teleosaurus* and *Teleidosaurus* occur; in the Kelloway Rock *Metriorhynchus*, also met with in the Oxford Clay and Kimmeridge Clay; in the Wealden, *Goniopholis*, *Macrorhynchus*, *Pholidosaurus*, and unnamed Teleosaurians; and in the Upper Chalk, *Hyposaurus*; all belonging to the Mesosuchia. In the Upper Chalk, again, the Eusuchia make their appearance, represented by the genera *Thoracosaurus*, *Holops*, and *Gavialis* (?). How far back the Parasuchia extend in time is not known, but they are not found in any formation subsequent to the Upper Trias. The author described a fragment of a skull of a Wealden crocodile, in which the posterior nares are smaller and situated further back than in *Metriorhynchus* or *Steneosaurus*. Of the nearest allies of the Crocodilia, the Lacertilia and Ornithoscelida, the former may be traced back from the present day to the Permian epoch, and the latter from the later Cretaceous to the Triassic epoch. The author discussed the question whether these types exhibit any evidence of a similar form of evolution to that of the Crocodilia. The cranial structure of the Permian Lacertilia is almost unknown, and the only important deviation from the type of the existing Lacertilia in the skeleton is that their vertebræ are amphicœlous, not procœlous. With this exception there is no evidence that the Lacertilian type of structure has undergone any important change from later Palæozoic times to the present day; and this change seems to have occurred earlier in the Lacertilia than in the crocodiles, as a sacral vertebra of a lizard from the Purbecks has the centrum concave in front and convex behind. With regard to the Ornithoscelida, the author noticed that the researches of American palæontologists proved the existence of those reptiles in abundance in quite the latter part of the Cretaceous epoch. He had himself indicated the existence of varied forms of Dinosauria in the Trias. He confirmed his former opinion that *Zanclodon* from the Upper Keuper of Würtemberg is a Dinosaur, and probably identical with *Teratosaurus* (von Meyer), in which case its affinity to *Megalosaurus* is exceedingly close. He corrected a statement in a former paper with regard to the ilium of the Thecodontosaurians, which he had turned the wrong way, and stated that when regarded in its proper position this ilium is much more Lacertilian than that of *Megalosaurus*. From this and other evidence of detail he inferred that the Triassic Thecodontosauria were devoid of some of the most marked peculiarities of the later Ornithoscelida, while the most ornithic of the latter belong to the second half of the Mesozoic period. The oldest crocodiles differ less than the recent ones from the Lacertilia, and the oldest Ornithoscelida also approach a less differentiated Lacertilian form, the two groups seeming to converge towards the common form of a lizard with Crocodilian vertebræ. *Cetiosaurus* is also a reptile with a vertebral system like that of the Thecodontosauria and Crocodilia, but with more Lacertilian limbs, and *Stenopelyx* may be in the same case. It may therefore be convenient hereafter to separate the Thecodontosauria, *Cetiosaurus* and perhaps *Stenopelyx* as a group, "Suchospondylia," distinct from both the Ornithoscelida and the Crocodilia (or "Sauroscelida").

"On the remains of a fossil forest in the Coal-measures at Wadsley, near Sheffield," by H. C. Sorby, F.R.S., Pres. R.M.S. In this paper the author described the occurrence of a number of stumps of *Sigillariæ* in position and with Stigmarian roots attached to them in the Coal-measure Sandstone in the grounds of the South Yorkshire Lunatic Asylum.—"On *Favistella stellata* and *Favistella calicina*, with notes on the affinities of *Favistella* and allied genera," by Mr. H. Alleyne Nicholson, F.R.S.E.

Mr. A. Tylor brought an apparatus for determining the heat evolved by the friction of ice upon ice, with a view to explain an important element in glacier motion. The apparatus, consisting of plates of ice eight inches square, placed in a wooden chuck three inches deep, was enclosed in a double sheet-iron case containing ice and salt, and kept at 32° F. One block of ice was rotated, and the other pressed against it. Four pounds of ice were reduced to water at the rate of 1¼ lb. in an hour, in consequence of the motion, that is by the heat evolved by friction of ice upon ice, the pressure being 2 lbs. on the square inch. Ice evaporates at 32°, and the same quantity of ice was reduced, when still, at about the rate of ¼ lb. in an hour at 32° F. Air at a higher temperature found its way into the case, and promoted melting. When this experiment was tried in a room at 54° F. with the same apparatus without any outer case, the friction of the ice in motion, at the above pressure, increased the production of water 3¼ times above the rate observed when the ice was still and exposed to a temperature of 54° F. The amount of heat evolved was nearly as much as in oak moving upon oak well lubricated, and the coefficient of friction was between 0·1 and 0·2. Glacier motion is impossible without a continual supply of water to lubricate the bottom. No doubt the action of denudation by glaciers produces heat to a small extent. The water obtained by melting the surface of the glacier by the sun's heat in the glacial period could not be sufficient alone. The position of deep lakes in all parts of the world in immediate connection with mountains, and never in places away from mountains, shows that lakes are integral parts of mountains; and, in fact, lakes are deepest exactly where the glaciers, once covering the mountains, were in a position to act as lake excavators. There can be no doubt that all deep lakes in the world, including those in Central Africa, below the Equator, are purely of glacial origin, and that the cold in the glacial period was nearly equally intense in the southern and northern hemispheres. The surface-ice would move much faster than the bottom ice, and the side-ice than the surface-ice, and therefore fractures would be continually occurring through all parts. The water produced by this great friction of ice upon ice would fall through the fissures to the bottom. He had pointed out that a glacier moved twice as fast when it was eight times as thick, and the influence of weight on motion must be considered a most important element. The present temperature of a thin glacier was found by Agassiz, from observation, to be one-third of a degree below freezing; but Mr. Tylor assumed that in such a lake-glacier as he had drawn, and supposed to exist in the glacial period, the temperature might be assumed to be very much below freezing, the greater cold arising from immense evaporation and other causes. He therefore concluded that the water produced by friction of ice upon ice falling to the bottom of the lake glacier through fissures would rapidly freeze, and thus expanding one tenth, would impel the glacier (shod or armed with blocks of stone and sand at the bottom) up a gradient of 1 in 20, excavating the Swiss and other lakes thirty or forty miles long, and 1,200 feet deep, in this manner. Mr. Tylor calculated that with half the work per annum of mean lake-excavation the lake of Zurich could be excavated in 15,000 years. Prof. Ramsay had pointed out, from geological evidence, that such lakes have been excavated by ice, but he did not indicate how this was mechanically possible (see *Quarterly Journal*, 1862). Mr. Tylor referred again to his experiment when the pressure was only 2 lbs. on the inch. In a large glacier

such as that described by Dr. Hooker in the Himalayan range, where the mean gradient of the surface was 40° to 50° and the actual fall was 14,000 feet in five or six miles, Dr. Hooker found great lakes attendant upon the mountains. Supposing the ice was a mile thick, the pressure would be half a ton on the inch, in the Himalayas at least, and the production of water by friction of ice upon ice enormous. Friction is dependent upon pressure and distance moved, and independent of velocity of motion.

Anthropological Institute, April 27.—Col. A. Lane-Fox, president, in the chair.—Mr. Francis Galton, F.R.S., contributed a note on the height and weight of boys aged fourteen, in town and country schools. The principal results showed the comparative heights and weights of those boys who were fourteen on their last birthday, in two groups of public schools, the one group of country schools and the other of town schools. It appeared that boys of fourteen in the country group were about 1¼ inches taller and 7 lbs. heavier than those in the town group, and that the difference of height was due in about equal degrees to retardation and to total suppression of growth; and that the distribution of heights in both cases conformed well to the results of the "Law of Error."—Rev. Joseph Mullens, D.D., read a paper on the origin and progress of the people of Madagascar. The Malagasy appeared to be a single race. No tribe is to be found secluded in any corner or in the hill districts different from the people of the plains or open provinces such as is met with in India, in Sumatra, and in Borneo; nor is any portion of the people specially degraded. The Malagasy are divided into three tribes—the Betsimisarakas, the Sacalavas, and the Hovas, the latter largely predominating in numbers and influence. With regard to the origin of the people, the author rejected the theory of Crawfurd and others, who argued for their African descent. Their language and tribal customs suggested a very different origin. There could hardly be any doubt that the Malay entered largely into the composition of the grammar and vocabulary, and continued researches into the Malay and Malagasy languages gave more and more evidence of their resemblances. The conclusion was that the Malagasy are a Malay people, following Malay customs, some of them possessing Malay eyes, hair, and features, and speaking a Malay tongue at the present time. They were an intelligent people, orderly, were well governed, and were daily improving, and the author of the paper could see the promise of a great and useful future for them.—Mr. J. J. Monteiro read a paper on the Quissama tribe of Angola, which he had written with the object of correcting some erroneous statements concerning them that had been formerly brought before the Institute.

CAMBRIDGE

Philosophical Society, March 8.—The following communications were made by Mr. W. T. Kingsley:—(1) On the cause of the "wolf" in the violoncello; (2) A description of the instruments used in sounding some of the lakes in the Snowdon district, and an account of the results obtained. Mr. Kingsley said that the "wolf" occurs somewhere about the low E or E flat, and was attributed to the finger-board having the same pitch, so that the finger-board becomes as it were a portion of the string stopped down on it and vibrates with it: if this is the true cause, the "wolf" cannot be got rid of, but may be placed at such a pitch between E and E flat as to occur on a note rarely used; also by thickening the neck of the finger-board, the extent of discursion in the vibration may be made less.—The Master of St. Catharine's College remarked that a different explanation of the phenomenon was given by M. Savart, which was to this effect. The old Italian makers constructed the violoncello of such dimensions that the mass of air included within the instrument resonates to a note making 85·33 vibrations in a second, a number which then represented the lowest F on the C string, but which now, owing to the rise of pitch since the beginning of the eighteenth century, nearly represents the note E immediately below it. Savart's theory was that notes half a tone above or below this E will cause beats between the vibrations of the string and those of the mass of included air. It seemed quite possible that the mass of air contained in the instrument should be capable of controlling the vibrations of the whole instrument, but not that the vibrations of the finger-board alone (as Mr. Kingsley suggested) could do this. For the sound, technically called the "wolf," is an actual check to the whole vibration of the violoncello, producing not merely beats, but a baying sound, destitute of the freedom of vibration which characterises other notes. But a great objection to the above explanation is this experiment. On an Italian instrument, the upper D on the fourth or lowest string is the imperfect note. But when the same note is elicited from the third string, the note is perfectly resonant. This peculiar effect seems then to depend upon the point of the finger-board which is pressed. It is also well known that the "wolf" can be modified by an alteration of the position of the sound-post. As an explanation, we may conceive that the whole framework of the violoncello vibrates like a stretched string, producing its fundamental, with a series of overtones, and that a nodal line passes through the point of the finger-board, pressure upon which produces the "wolf," and that thus, all vibrations being destroyed except those which have a node at the point of pressure, this peculiar tone is elicited.—Mr. Kingsley then gave a description of the plummet, registering apparatus, and protractors used by him in sounding several of the deep lakes in the Snowdon district last June. The plummet is a modification of the deep-sea plummet now generally used, the principal alteration being in the application of a heavy gouge to aid in bringing up specimens of the bottom. The recording apparatus is a modification of the paying-out apparatus used for laying deep-sea telegraph cables. The protractors are diagonal telescopes mounted on bars revolving on vertical axes, and having fiducial edges radiating from the centres of the axes. One protractor is placed at each extremity of the base on a horizontal table, on which is strained a sheet of drawing paper; the telescopes are first collimated with each other, and then a line is drawn by the fiducial edges on each sheet of paper; the boat with the sounding apparatus is followed by the two observers at the protractors, and when a signal is given, a line is ruled and numbered by each observer; finally, the two papers are placed so as to have the lines of collimation in coincidence and the centres at the scale distances apart; then by looking through the papers and pricking the intersections of the corresponding lines, the positions of the boat are laid down on two maps. In practice this is all done easily, and no particular skill is needed in the observers with the protractors. The results obtained showed that the bottoms of these lakes are comparatively flat, the greatest depths being reached at a short distance from the shore on the cross section, and occurring also nearer to the upper end of the lake than to the lower: the forms of the bottoms correspond in a remarkable manner with the set that would be given to glaciers descending into the hollows in which the lakes lie; and Mr. Kingsley believed them to have been formed by the action of glaciers during the extreme cold or penultimate glacier epoch; because in one case, that of Llyn Cawlyd, the lake lies almost on a watershed, where no glacier could now form, but which was a depression forming a lateral outflow from the great glacier that at one time filled the whole hollow between the Glydyns and Carnedds; during the last glacier epoch most of these hollows were again filled with ice to a great height, but these last glaciers were comparatively small. Mr. Kingsley especially dwelt upon the difficulty of disentangling the scattered moraine from the drift, and also of distinguishing between the striations belonging to the two cold epochs.

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