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THURSDAY, APRIL 15, 1875

ROYAL AGRICULTURAL SOCIETY'S JOURNAL

Journal of the Royal Agricultural Society of England. Nos. 20 and 21 Second Series.

I.

THE Royal Agricultural Society of England, the greatest Agricultural Society in the world, has on its roll 5,846 members. It was founded upwards of thirty years ago, by men to whom the agricultural classes are largely indebted. It has issued ever since a half-yearly volume of Transactions, in which most valuable papers have appeared from time to time.

We propose to review the two last numbers, 20 and 21 : the present notice is confined to No. 20. It contains sixteen papers, which treat of varied and interesting subjects. It begins with a long paper, by Prof. Wrightson, of Cirencester, "On the Agriculture of the Austro-Hungarian Empire," which affords evidence that Mr. Wrightson laboured diligently during a tour in that country, to collect facts. The most important conclusion deduced from his inquiries is that "there is little for the Englishman to learn from Hungarian farming." If consolidation of farms be ever carried to an extreme limit, "a valuable lesson may, however, be taken from that country, where it is no uncommon thing to see hundreds of thousands of acres under a central management." But it is not likely that farming will ever be practised in England on that gigantic scale.

The most readable paper in the Journal is a biographical sketch of the late Sir Harry S. M. Thompson, Bart., of Kirby Hall, Yorkshire, whose lamented death, last year, left a blank in the ranks of the Society not easily filled. This notice has been contributed by Earl Cathcart ; and it affords ample evidence that his lordship is a man of ability, a good writer, and a man of fine feelings and disposition. The late Sir Harry Thompson, Bart., better known as Mr. Thompson, was one of the most active members of the Society. Speaking from a slender personal acquaintance, we would say that he was a man of great industry and of remarkable capacity for business. He sought to probe every subject to the bottom. He had one quality, which is one of the best a public man could possess—he was true to his convictions. It is generally considered that in filling up important offices in the Society he committed grave mistakes ; but believing himself to be right, he urged his views with his usual ability, and with that strong will which enabled him to conquer many difficulties, and won. We commend to the careful perusal of the landed gentry who aspire to take a leading part in agricultural progress, Lord Cathcart's biographical notice, in which they will find the outlines of a splendid career, told with singular truthfulness and felicity.

The contributors to this Journal may be divided into two classes—amateur and professional. Lord Cathcart belongs to the former class, and so does Mr. J. Dent Dent, of Ribston Hall, Wetherby, who contributes an admirable paper under the modest title of "Agricultural Jottings from the General Report of the last Census of England and Wales." It is rather behind time, but is throughout a candid and thoughtful paper. "On the whole," concludes Mr. Dent, "the number of small holdings is more considerable than was imagined, the demands of the towns are not beyond the means of supply, and the condition of the agricultural labourer is fast rising to a more equal rank with that of the skilled artisan." According to the returns consolidation would appear to have reached the climax in England. The numbers who are described in the returns for 1851, 1861, and 1871 as farmers and graziers are as follows :—

1851	...	...	...	249,431
1861	...	...	...	249,735
1871	...	...	...	249,907

Independently of these, there is a vast number of holders of small pieces of land. The census returns do not furnish the exact figures ; but by another official inquiry, returns of live stock were obtained from 469,444 occupiers of land in England and Wales in 1871, a number which was increased to 481,412 in 1873. It may be assumed that the number of farmers and graziers accounted for in the census of 1871 devote their whole time to these pursuits ; and that agricultural labourers, tradesmen, artisans, and others, who occupy small holdings, make up the remainder of those who furnished returns of live stock. But until the fact was revealed by these statistics, the public was not prepared for the announcement made by the enumerators that in "England there are about 350,000 separate holdings, not one of which exceeds five acres in extent, and that this number is exclusive of the gardens attached to all classes of dwelling-houses, including those of labouring men."

It is strange that in the face of these facts the leading organ of public opinion has recently laboured to show that small farmers are rapidly dying out.

Professional writers appear in great force in this number of the Journal. Dr. Voelcker, F.R.S., consulting chemist to the Society, contributes two papers ; Mr. Carruthers, F.R.S., consulting botanist, contributes an original paper and a translation ; Mr. Jenkins, F.G.S., secretary to the Society, contributes a paper on the cultivation of potatoes, with special reference to the potato disease, which was pretty certain to be eagerly perused by all the members of the Society ; Prof. Simonds, Principal of the Royal Veterinary College, contributes a report on the health of farm animals ; and Prof. Brown, V.S., principal inspector of the Veterinary Department, gives us a paper "On inoculation with the virus of contagious pleuro-pneumonia of the ox."

It is no light duty to review these papers. With us it is not a voluntary task ; and this must be our apology for any criticism which may appear severe. Prof. Brown treats of a subject which has attracted a good deal of attention. Prof. Simonds, some years ago, condemned the practice of inoculation as a means of preventing pleuro-pneumonia. Prof. Gamgee has since often repeated his entire belief in it. Prof. Brown, with that caution which has characterised him, has been regarding it as an open question. He has written much on contagious diseases ; but he has rarely been able to arrive at any settled views. His present contribution is no exception. In one page we are told "science offers no evidence in favour of inoculation as a preventive of pleuro-pneumonia." Then,

may we not ask, why does a scientific man occupy time and attention in experimenting on it? The experiments recorded in this Journal were made with "the exudate from the lungs of animals which had been slaughtered on account of pleuro-pneumonia." It was assumed that the virus of the disease was present in this exudate. We should like to know on what evidence this assumption is based. We believe that the virus of the disease is given out in the breath, and is not found in any of the secretions; and that none remains, or can be generated in the system, after death. We have deduced this conclusion from our own experiments; and, according to our interpretation, the experiments upon which Prof. Brown's paper is based support the same view. Every competent authority now believes that the virus of contagious pleuro-pneumonia is communicated by a living diseased to a living healthy animal. If the virus could be communicated in any other way into the respiratory passages, there is every reason for thinking that the disease would be produced. If the virus got even into the blood, there is no known reason for thinking that it would not reach the lungs and produce the disease. When the Professor states that he failed to produce the disease with the exudate from diseased lungs, there is some ground for doubting that the exudate contained the virus, and that the title of his paper—"Observations on inoculation with the *virus* of contagious pleuro-pneumonia"—is questionable, to say the least of it.

We have next to notice Dr. Voelcker's paper entitled "Field Experiments on Pasture Land." We begin by remarking that it is more like the production of a tyro than of a man of well-earned reputation. Some eight or nine years ago Dr. Voelcker suggested to his former pupils and others a series of experiments for testing the efficacy of different manures. In the paper to which we invite attention, the result of one series of these experiments is given. Dr. Voelcker did not superintend any of these experiments. They were made in different parts of the country, by men who, we presume, possess more than average fitness for describing their own experiments. It is most desirable that experiments of this kind should be carried out on different soils and in different circumstances; and, so far, the scheme set on foot by Dr. Voelcker deserves our highest praise. It is to the execution of the scheme, and to his own report in particular, that we object. The experiments were made at four different places. We are not furnished with the analysis of the soil at any of these places. Among the manures experimented with were mineral superphosphates, Peruvian guano, crude potash salts, bone-dust, &c. It is notorious that superphosphate varies greatly in composition. It is equally well known that of late years Peruvian guano has varied greatly in quality. No man knows this better than Dr. Voelcker, and yet in the report under review he does not give the analysis of a single manure used in these experiments. Under these circumstances we submit that false conclusions are liable to be deduced from the results. This sort of work is not science, and we call upon the governing body of the Royal Agricultural Society of England to put an end to it. When we examine with care the tables and the conclusions sought to be drawn from them by Dr. Voelcker, we see additional grounds for offering this suggestion. Every farmer of experience knows that the quality of the soil varies exceedingly, not only on the same farm, but in different parts of the same field. Experimental ground should, therefore, be treated with the greatest care. In most cases it will be necessary to prepare it in a variety of ways. The writer has a piece of ground under experiment which he manipulated with the utmost care. It was dug to a uniform depth, inequalities of surface and of soil removed by levelling and mixing, and repeated crops of grain raised without any manure before any experiment was made. No such care appears to have been considered necessary in undertaking the experiments on which Dr. Voelcker reports. The tables bear out our view fully, as we shall briefly show. In each place ten plots were laid out for experiment, and two of the ten (Nos. 5 and 10) were left unmanured. In page 431 we are favoured with the result of one set of these experiments, and we take from it the following figures:—

Plot.	Manure.	Yield of grass per acre. Tons.	qrs.	lbs.
5	No manure	4	2	1
8	Crude potash salts	3	3	6
10	No manure	3	3	26

Dr. Voelcker concludes from these figures that crude potash salts diminished the produce. Now, in looking at the figures we find a greater difference between the two unmanured plots than between the one to which potash was applied and either of the others. Assuming that this difference arose from difference of soil, what guarantee have we that the crude potash salts were not applied to a soil inferior to either of the two unmanured plots?

We take another illustration of our argument from the table, page 432:—

Plot.	Manure.	Weight of grass per acre. Tons.	cwt.	lbs.
3	Fine bone-dust	4	13	0
4	Mineral superphosphates and crude potash salts	3	19	4
5	No manure	2	17	2
6	Common salt	3	18	2
8	Crude potash salts	5	4	0
10	No manure	4	0	4

Here we have the difference between the two unmanured plots greater than the difference between one of them (No. 10) and any of the manures named.

The weight of grass from common salt was more than that from one of the unmanured plots, and less than that from the other. On which are we to rely in coming to a conclusion as to the action of common salt on the land of the experimenter? And, again, are we to conclude that while bone-dust increased the produce above either of the unmanured plots, and while crude potash salts increased it still higher, a mixture composed of superphosphate and crude potash salts produced less than an unmanured plot?

COOKE'S "FUNGI"

Fungi: their Nature, Influence, and Uses. By M. C. Cooke, M.A., LL.D. Edited by the Rev. M. J. Berkeley, M.A., F.L.S.—The International Scientific Series, vol. xiv. (London: Henry S. King and Co., 1875.)

THE names both of Dr. Cooke and Mr. Berkeley appear on the title-page of this work, but in the editor's preface it is stated that the whole of the manu-

script was prepared by Dr. Cooke. There is very much that is interesting in this volume, but upon the whole the book is a disappointing one. The editor states that the work is intended for students, but we fear that the junior student will be repelled rather than attracted by the hosts of scientific names of genera and species which crowd many of the pages with italics. Then we cannot but condemn the mode of arrangement of the contents.

The mode of division of the work renders it quite impossible for the reader to obtain any connected account of the life-history of one single species. This we consider a very grave defect indeed. To trace the life-history of one form we may have to refer to the chapters on the "Structure," "Germination and Growth," "Sexual Reproduction," and "Polymorphism" before we can obtain what we want. This ought not to be, and we venture to think Dr. Cooke would have rendered his book much more useful if he had given connected life-histories of the most interesting and best known forms.

Some of the omissions have rather surprised us. For example, we do not find any account of the yeast plant, a form which most students of biology will do well to study carefully. The rather meagre index does not contain the words "Yeast," "Torula," "Hormiscium," or "Saccharomyes," although the word "yeast" occurs in the first chapter. Then there is no account of the life-history of the ergot of rye. Its life-history is perfectly well known, and most students, whether medical or not, ought to have some knowledge of it.

The book is evidently the work of a systematic rather than a morphological botanist, and this may account for some of the errors that have been made. For example, the process of conjugation and formation of zygospores in the Mucor is quite correctly described, but in what way can Dr. Cooke apply the term conjugation to the fertilisation of the oogonium by the antheridium in *Achlya* and *Peronospora* as figured on pages 169 and 171? The formation of the ascogonium of *Eurotium Aspergillus-glaucus* is only slightly indicated on p. 189, while the pollinodium is altogether omitted. The classification is that given in Cooke's "Handbook," but, for the use of the student, we do not think it equal to that given in Grisebach and Reinke's translation of Oersted's "System der Pilze," &c.

The Lichen-theory also receives a share of attention; Schwendener and his followers are condemned for the "sensational romance of lichenology," as it has been called. Truth, however, is often stranger than fiction; and if anyone would take the commonest lichen he can find and give botanists a complete account of its life-history, he would earn the gratitude not only of all algologists, fungologists, and lichenologists, but of botanists generally.

The chapters on the "Uses," "Notable Phenomena," "Influences and Effects," "Habitats," "Cultivation," "Geographical Distribution," and "Collection and Preservation," are very valuable; and if the other chapters had been run together into connected life-histories, we think the work would have been an admirable one. As it is, it cannot fail to interest and instruct, and every page bears evidence of the extensive and accurate knowledge of the author. The freedom from errors of the press in the names of the fungi shows the care with which the work has been revised and edited. The illustrations are numerous and good, but there are a few old faces among them whose absence would not have greatly grieved us.

MM. H. AND E. MILNE-EDWARDS'S NEW WORK ON MAMMALS

Recherches pour servir à l'histoire naturelle des Mammifères comprenant des considerations sur la classification de ces animaux: par M. H. Milne-Edwards: *des observations sur l'hippopotame de Siberia et des études sur la Faune de la Chine et du Tibet Oriental:* par M. Alphonse Milne-Edwards. Two vols. 4to., text and plates. (Paris: G. Masson, 1868–74.)

LAST year we called our readers' attention to the zoological researches lately made in the Tibeto-Chinese province of Moupin, by the French traveller, Armand David,* and to the particular importance of his discoveries in the class of Mammals. The work now before us gives a complete account of the many new forms the knowledge of which we owe to the energy of this excellent traveller and naturalist, besides other important contributions to the history of the same class of animals.

The work commences with an essay by the veteran zoologist, M. H. Milne-Edwards, upon the general classification of Mammals. The system here propounded, which has many good points, and embraces details already put forward by the author in previous writings, is not one that we think will meet with very general approval. Its chief feature is the elevation of the marine or pisciform Mammals (containing the two orders of Sirenians and Cetaceans) to a second sub-class equivalent in value to the normal Mammals on the one hand and to the Marsupials on the other, and the degradation of the Monotremes to a mere subdivision of the latter. Prof. Huxley's views as to the relative position of these groups, not to speak of his general arrangement of the class, appear to us to be much more easily justifiable.

The main body of the work consists of three memoirs by M. Alphonse Milne-Edwards, a worthy son of his distinguished father, illustrated by a long series of well-executed plates, which constitute the second volume. The first of these memoirs contains observations upon the hippopotamus of Liberia—a smaller form of the animal now so well known to us from the exhibition of living specimens in the Zoological Society's Gardens, and in other collections. First described in America in 1844, the smaller hippopotamus remained entirely unknown in Europe until within the last few years, when specimens were procured for the Jardin des Plantes by the exertions of Prince Napoleon when Minister of the Colonies. The figure now given by M. Milne-Edwards is the first that has been published of the entire animal, and the general skeleton is likewise now for the first time described, only the cranium having been known to the American naturalists.

M. Alphonse Milne-Edward's second essay is entitled "Études pour servir à l'histoire de la Faune Mammalogique de la Chine," and is based upon collections trans-

* NATURE, vol. x. p. 32 (May 14, 1874)

mitted from the North of China by M. de Montigny, M. Fontanier, and M. l'Abbé Armand David, especially those of the last-named traveller, who devoted several years to zoological researches in the country north of Pekin, and in the distant parts of Mongolia. The series of Mammals here treated of is of especial interest as supplementing the discoveries recently made by Russian naturalists in Central and Eastern Siberia. The forms are chiefly those characteristic of the steppe-regions of the great northern continent of the Old World, such as *Siphneus*, *Cricetus*, *Dipus*, and *Spermophilus*. A full account is also given of the deer of this district, as also of the larger and smaller cats. Amongst the latter are enumerated the Ounce (*Felis irbis*), of which examples were obtained by M. Fontanier, and two species described and figured as new, under the names *Felis microtis* and *F. tristis*. Lastly, M. Milne-Edwards records the existence in the mountains situated in the east of the province of Tché-li (as testified by M. Fontanier) of a singular species of ape of the genus *Macacus*, which he designates *M. tcheliensis*. Considering that the province of Tché-li is nearly on the same isothermal line as Paris, the discovery of this animal is not a little remarkable.

The concluding essay of the volume relates to a still more novel mammal fauna than that of Pekin. Among the Yung-Ling Mountains, in the far interior of China, lies the little-known principality of Moupin, which we have already alluded to. Here the Abbé David, after a stay of several years in Northern China, established himself for a year in one of the large valleys at an elevation of about 6,000 feet above the sea-level, and in the midst of peaks ranging up to above 15,000 feet of altitude. Of the wonderful discoveries which he here made we have already learnt something from the preliminary notices of M. Alphonse Milne-Edwards on this subject. In the present memoir, detailed accounts are given of the many strange forms of which specimens were obtained by M. David in this district. Excellent illustrations, not only of the entire animal, but also of its characteristic parts, add greatly to the value of the descriptions, and we now become acquainted for the first time with the singular appearance of *Rhinopithecus roxellanæ*, a long-haired monkey with a "tip-tilted" nose, which inhabits the mountain-forests of Moupin; with *Nectogale elegans*, a new aquatic Insectivore of the same district; with *Scaptonyx*, a new genus of the Mole family, from the confines of Setchuen; and with *Ailuropus melanoleucus*, from the inaccessible mountains of Eastern Thibet.

The last-named animal, which in external appearance presents some resemblance to a large white bear with a black band across the back, is most nearly allied to the Panda (*Ælurus*) of the Himalayas, and belongs to the same peculiar family of Carnivores. Besides these, we have an account of *Elaphodus*, a new genus of ruminants, belonging to the Deer family, but with very diminutive horns; and of many other new and interesting Mammals, which show that the fauna of this part of Thibet is in many respects akin to that of the southern slope of the Himalayas. On the whole, we think there can be no question that the present work is one of the most important contributions that has lately been made to zoological science, and reflects the greatest credit upon its accomplished authors.

OUR BOOK SHELF

An Introduction to Human Anatomy. By William Turner, M.D. (Edinburgh: Adam and Charles Black, 1875.)

PROF. TURNER having written the article "Anatomy" in the first volume, recently published, of the ninth edition of the "Encyclopædia Britannica," has, at the suggestion of the publishers, reproduced it in a separate form, the first half of which we have received as a compact volume of some 400 pages.

This part contains an account of the skeleton, joints, muscles, nervous system, and organs of special sense, together with a chapter on the minute anatomy of the different tissues of the human body. The descriptions are short and make no pretensions to extreme minuteness, as may be judged from the following reference to the atlas:—"The first (vertebra) or *atlas*, has no body or spine: its ring is very large, and on each side of the ring is a thick mass of bone, the *lateral mass*, by which it articulates with the occipital bone above and the second vertebra below." In the account of the muscles also the space devoted to each is frequently little more than that required for the mention of the name:—"The supinator and pronator muscles (of the fore-arm) are all inserted into the radius; the supinators are the supinator longus, supinator brevis, and the biceps; the pronators are the pronator teres and the pronator quadratus." The nervous system has received more attention, and the general description of the brain, together with that of its more intimate structure, is fairly full. The author's valuable observations on the cerebral convolutions, together with his investigations on the relation of these to the walls of the bony cranium and the sutures, receive their due share of notice, and are here collected together for the first time. The chapter on the organs of special sense are also well worthy of study. In the histology we cannot help thinking that almost too much credit is given to a young and promising microscopist, some of whose results are still, however, decidedly *sub judice*.

We find it difficult to decide mentally to what class of students the work before us will be of most value. To the ordinary medical student who has but a couple of years in which to fully master the subject of human anatomy, the detail will not be sufficient, and one of the text-books will be more useful. To the amateur reader there is a mass of technical terms which he will have to attempt to wade through, almost certainly without success, both on account of their number and, to him, their meaninglessness. To the special investigator of the anatomy of the nervous centres the chapter devoted to that subject will be extremely valuable, as the whole work will be to the advanced student who desires to take a rapid last glance through his subject before competing for a high examination place.

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.*]

On the "Law of Fatigue" regulating Muscular Exertion

IN NATURE, vol. xi. pp. 256 and 276, Mr. Frank E. Nipher, of the University of Iowa, has published some interesting observations bearing on the "Law of Fatigue" which regulates muscular exertion, and criticises the use which I have made of some experiments published by him, one series of which seemed to me to be highly confirmatory of the "Law of Fatigue" which I had previously established on the basis of other experiments carefully made, and quite different in principle.

The "Law of Fatigue" is thus stated by me in "Principles of Animal Mechanics," p. 442:—"Law III. When the same muscle (or group of muscles) is kept *in constant action* until fatigue sets

in, *the total work done* multiplied by the *rate of work* is constant." The words *constant action* are here to be understood in the sense in which all muscular action used by animals is constant, viz., short periods of contraction followed by short intervals of rest, as in walking, climbing, &c. And the velocities employed are understood to be, within certain limits, such as are used in all descriptions of labour.

The "Law of Fatigue" (thus stated) is based by me upon several and various classes of experiments.

Mr. Nipher's experiments (employed in my book, pp. 462–65) consisted in raising various weights at a fixed rate and at regular intervals through a fixed height, as described in page 462 of my book. The "Law of Fatigue" in this case led me to the formula—

$$n\,(w + a)^2 = A \qquad (1)$$

which is a cubical hyperbola.

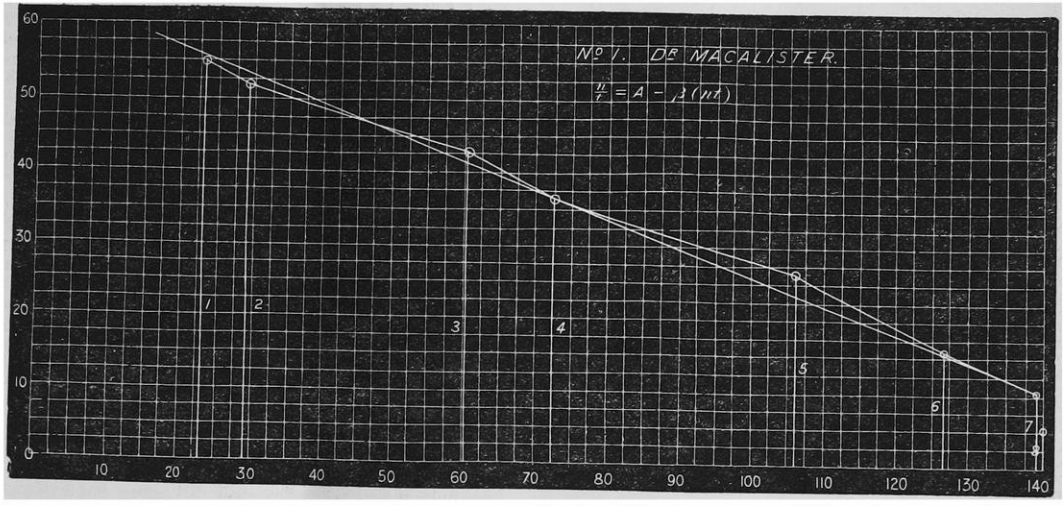
As stated in NATURE by Mr. Nipher, the comparison of this formula with observation is given in pp. 464–65, and is most complete and satisfactory. I here give it for the right arm, and refer for that of the left arm (which is equally satisfactory) to the book itself.

Mr. Nipher—Right Arm (raising weights at constant rate).

w	n (obs.)	n (calc.) from (1)	Diff.	Diff. per cent.
1 kil.	255	250	+ 5·0	+ 1·9
2	97	111	− 14·0	− 14·5
3	61	62·5	− 1·5	− 2·4
4	37·7	39·9	− 2·2	5·8
5	29·3	27·8	+ 1·5	+ 5·1
6	21·5	20·4	+ 1·1	+ 5·1
7	15·8	15·6	+ 0·2	+ 1·2
8	12·8	12·4	+ 0·4	+ 3·1

$$A = 1{,}000 *$$
$$a = 1$$

Mr. Nipher admits (NATURE, vol. xi. p. 257) that this comparison of his observations with formula (1) deduced from the "Law of Fatigue" is satisfactory, but proposes (NATURE, vol. xi. p. 276) to substitute for his observations used by me, another set of similar observations submitted to a series of reductions;



these observations are given in his Table II., and will be fully considered by me hereafter. I may here observe that the percentage error in the above table is less than that given by him in comparing Table II. with an empirical formula.

Other experiments, in which the same weight was lifted at varying rates, were made by Dr. Alexander Macalister, Mr. Gilbert Haughton, and by Mr. Nipher (*vide* "Animal Mechanics," pp. 468 to 477). Mr. Nipher now rejects his own experiments, and, as I believe, with good reason. These experiments are given in NATURE, vol. xi. p. 256, Table I., with the exception of the first line, which is taken from the experiments just given. The reason why I transferred the first experiment from the former series is this. The column for n ought to show a maximum in passing from very rapid to very slow motions; for if the motions be very rapid, respiratory distress sets in, and the work done will be less than with a slower motion; and if the motion be very slow, the useful work done will be also less, owing to the fatigue work spent in holding up the weight; from this it follows that there is a certain rate of lift at which the maximum work is done.

If we omit the first line in Mr. Nipher's experiments, Table I., we find no trace of a maximum in the column for n, which may be regarded as internal evidence of something wrong in the observations. At the time of publishing my book, I thought (and still think) that Dr. Macalister's and Mr. Gilbert Haughton's experiments were better than those of Mr. Nipher, of which, however, I made use as well as of the other experiments, as I wished to employ all the materials at my disposal in discussing the Law of Fatigue. I now fully concur with Mr. Nipher's estimate of the value of his observations, made at varying rates, which he states "were merely published as a preliminary" (NATURE, vol. xi. p. 256, *note*).

The withdrawal of Mr. Nipher's experiments at varying rate from the controversy disposes at once of the greater part of the criticisms, which are based on the difference between his experiments at varying rate and at fixed rate.

Mr. Nipher, however, not only withdraws his experiments at varying rate, but criticises Dr. Macalister's and Mr. Gilbert Haughton's experiments of the same class.

I shall first answer his criticisms on the experiments of Dr. Macalister and Mr. Gilbert Haughton, and then notice his own new experiments at fixed rate and empirical formula.

The relation between n and t in Dr. Macalister's and Mr. Gilbert Haughton's experiments is represented by a central cubic, viz.:—

$$n = \frac{A\,t}{1 + \beta t^2} \qquad (2)$$

This formula is plotted and compared with the experiments in Diagrams, pp. 472 to 474, and the agreement is evidently close. Mr. Nipher transforms equation (2) into the following:—

$$\frac{n}{t} = A - \beta\,(nt), \qquad (3)$$

and adds:—"Anyone who will take the trouble to calculate and co-ordinate the values of $\frac{n}{t}$ and nt from Prof. Haughton's ob-

If we correct these values by the method of least squares, we find $A = 1033$, $a = 1{\cdot}094$, and may reduce the sum of the squares of the percentage differences from 316·33 to 242·56, thus making the agreement between theory and observation somewhat closer.

servations, pp. 468-474, will see that these co-ordinated values form a curve instead of a straight line."

I felt much surprise at reading this statement, because if the observations agree with the central cubic (2), they must agree with any transformation of equation (2).

I now give the values of $\frac{n}{t}$ and nt and diagrams, comparing them with equation (3), an inspection of which will show that Mr. Nipher is in error in saying "that these co-ordinated values form a curve instead of a straight line." Anyone accustomed to such observations will see that they do *not* form a *curve*, but deviate *irregularly* as all observations do, above and below the "straight line," which is the true "curve" that represents them.

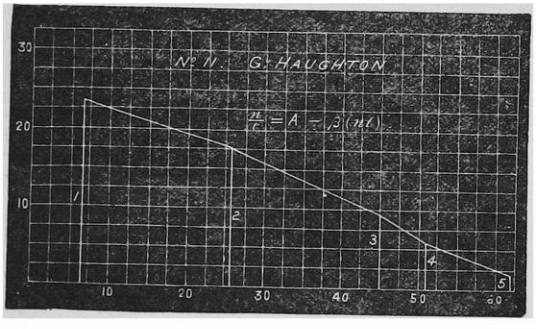
No. 1.—*Dr. Macalister's Experiments* ("*Animal Mechanics*," p. 468).

No.	nt	$\frac{n}{t}$
1	23·40	55·4
2	29·25	52·1
3	60·18	43·2
4	72·38	36·9
5	106 00	26·5
6	126·38	15·6
7	139·10	10·2
8	139·97	5·4

The accompanying diagram (No. 1) shows these values plotted, and the right line which represents them all except No. 8, which falls too much below the line.

No. 2.—*Mr. Gilbert Haughton's Experiments* (p. 474).

No.	nt	$\frac{n}{t}$
1	6·89	24·5
2	25·58	18·1
3	44·94	9·8
4	51·00	5·7
5	61·20	1·7



The accompanying diagram (No. 2) shows that these observations also may fairly be represented by a straight line.

Trinity College, Dublin, March 13 SAMUEL HAUGHTON

(*To be continued.*)

The "Wolf" in the Violoncello

As the question asked by Mr. Fryer in your issue of the 25th of March (p. 406) remains unanswered, allow me to suggest what has been brought prominently before me in some recent experiments.

The "wolf" of which he speaks occurs in all instruments of the violin family, and not only in the violoncello; indeed, it is present even in fine specimens by the great masters. It is perfectly true that it depends on the resonant case of the instrument itself, as can easily be shown in the way he suggests; a "false string" is soon detected and remedied by any player. No doubt it indicates that the consonating box has the power of reinforcing certain vibrations, but not others; and even of stifling some by interference. Curious facts on this topic have recently been brought before a foreign scientific society, which show that the acquired power of consonance depends on a molecular change in the material of which the instrument is made, that it can be increased by steady and good playing, that it is to be detected even in brass instruments like the trumpet. It has long been known that a violin deteriorates in the hands of a bad performer. But there is an obvious cause of weakness in all fiddles which seems to me to have hardly attracted sufficient attention; I mean the two "sound-holes" in the belly. These *f*-shaped apertures, which are doubtless needful to allow escape of aërial vibrations, cut the grain of the wood completely across in a most important part. Every connoisseur pays particular attention to the straightness and regularity of grain; indeed, blocks of wood well matched in this respect, from which two similar sides might be cut, have been handed down in workshops as of inestimable value. Wheatstone's well-known experiment of the Telephonic Concert proves how perfectly musical tones can be conveyed along the fibres of pine-wood to a considerable distance. These considerations led me recently to submit the point to the test of trial. What I have elsewhere termed "elliptical tension bars" are simply four longitudinal struts of light pine glued to the back of the belly, intercepting the sound-holes. They have the effect of removing the "wolf;" sometimes entirely, nearly always to a marked extent. No doubt they also act by strengthening the fabric exactly in the line in which the string pulls. The pull, which is considerable even in a state of rest, increases enormously when it is moved slightly out of its position of quiescence, for well-known mechanical reasons; and hence, besides the removal of the "wolf," there is gained by means of the bars a decided increase of power and tone.

The "elliptical" form was adopted because it is found to give considerable resistance with small amounts of material. Anything which rendered the belly of the fiddle heavy would perform the function of the "mute" as now commonly applied to the bridge, but which can be, and often is, replaced by a penny or a half-crown wedged between the strings below the said bridge. The great rigidity and low specific gravity of dry pine-wood meet the two requirements: the whole mass added does not exceed twenty or thirty grains.

Musicians are slow to adopt theoretical improvements, and dealers in violins cannot be expected to favour anything which puts a one and-ninepenny fiddle more nearly on a level with a Straduarius than it was; but I am honestly of opinion that the system is of value. I must, however, protest against its being prejudiced by the unsuccess of imitators or of previous efforts. Something of the sort has often been tried before, and it was only after long and laborious experiment that this particular attempt gave good results. By these, and in due time, I am content to let it be judged.

W. H. STONE

14, Dean's Yard

Flowering of the Hazel

THE question whether the male and female flowers of the hazel mature simultaneously on the same bush has been already discussed in your columns (NATURE, vol. i. p. 583,, vol. iii. pp. 347, 509). A repetition of the observations this spring has enabled me to confirm my previous statement that this is the case, at all events very frequently; in fact, almost invariably in all the cases that have come under my notice. As this is in direct opposition to the statements of several of your correspondents, especially one resident in Kentucky, who affirms that the hazel, though apparently monœcious, is practically dioecious, it would be interesting if we had further information as to the circumstances under which these varying conditions occur. On the present occasion the male and female flowers were found in close contiguity and both in a mature condition at the close of a remarkably protracted cold and dry season, at an unusually late period, the last week in March.

ALFRED W. BENNETT

A Flint Celt

ON Tuesday last, the 6th inst., I found on the west shore of this bay a very fine specimen of a flint celt, quite perfect. The cliff in the immediate vicinity is composed of fluviatile clays, capped with a thin bed of Bembridge limestone, in a very broken state: the vegetable soil resting on the latter is only from five to ten inches deep. Perhaps it may interest some of your readers if you do me the favour to notice this. It is rather remarkable

that the spot on which the celt was found should be within thirty yards of the site of a Roman building discovered by me in 1864.

Gurnet Bay, April 9 E. J. A'COURT SMITH

Arctic Temperatures

IN your article on the Austrian Polar Expedition (vol. xi. p. 397), it is stated that in January "the warm S. and S.W. winds always brought great masses of snow, and produced a rise in the temperature amounting to 30°–35° R. in a few hours." 32 R. = 72 F.

Such enormous fluctuations of temperature are unparalleled in any other part of the world, and it seems quite impossible that they can be due to any drift of warm air. I would suggest that they are probably caused by the wind tearing up the frozen surface of the sea, and liberating the heat of the unfrozen water below. Dr. Kane, when wintering in Smith Sound, once met with such a rise of temperature, and he says that open water was near. This explanation of the phenomenon is supported by the fact you mention in the same article, page 398, that in the summer the temperature was remarkably constant. The same cause could not act during summer, for the air is not then much colder than the unfrozen water.

There is no doubt of the power of a storm of wind to tear up a very thick sheet of ice. JOSEPH JOHN MURPHY

Old Forge, Dunmurry, Co. Antrim, March 30

AËRONAUTICS

M. GASTON TISSANDIER has just finished the analysis of carbonic acid contained in the air collected during his recent ascent (vol. xi. p. 429). He found at Paris 37 cubic centimetres per 100,000; at a height of 2,700 feet, 27; and at a level of 3,300 feet, 30. The difference of altitude between the two aërial stations being too small to justify drawing any conclusions he will shortly make another ascent with the same balloon to an altitude of 24,000 feet.

M. Godard made an ascent in the balloon *Saturn*, from Bayonne, on March 29, at half-past five, and was drifted over the Pyrenees. The trip was difficult, as the balloon was loaded with snow and hail, and all the ballast was thrown over in order to keep the balloon afloat. The cold was intense, and the wind very strong. The landing took place at Azul Mayor, a small country town east of Pampeluna, at half-past seven, the distance run being 120 kilometres. The grapnel having been broken, the aëronaut and the three passengers were severely hurt. This is the first time that any balloon has crossed the Pyrenees. The *Saturn* followed the French valley of the Nive and the Spanish valley of Baztan on the southern side. An interesting observation was made when crossing the culminating point of the pass. The Larratéce Neguya was surrounded by cirro-cumulus, which resisted the force of the wind and seemed an obstruction in the way of aëronauts, who found it necessary to throw out a certain quantity of ballast, and to reach an altitude of 6,600 feet, in order to cross that sea of motionless clouds. A strong hissing noise was heard when travelling over them; whether it was produced by the friction of the air on the peaks or on the masses of electrified vapours, can only be decided by another experiment conducted scientifically.

On April 4 two ascents were made almost simultaneously. M. Triquet ascended from the Place du Trône, Paris, and landed at Montreuil, 20 kilometers from his starting-point, forty minutes afterwards, having run in an E.S.E. direction. M. Duruof ascended from Cahors, in the Lot, and landed at Catres, in the same department, having run 22 kilometers in sixty-five minutes, but in a N.N.W. direction. Both balloons having ascended at the same moment, moved at right angles.

I have reason to believe that a number of ascents will be made simultaneously from La Villette gasworks, and the several tracks compared with each other. Some interesting facts may be elicited by these comparative trips. W. DE FONVIELLE

ARCTIC GEOLOGY*

II.

Cryolite of West Greenland Coast.—At Evigtok (*ivik*, Eng. grass), twelve miles from Arksut (Eng. leeward), in 61° 13′ lat. and 48° 9′ W. long., the mountains rise to a height of more than 2,000 feet, enclosing a sort of basin, with an area of more than a square mile, the bottom of which is covered with grass and *Salix arctica*, four feet in height, and other plants. This is much frequented in summer by the Greenlanders, who catch large numbers of capelins and cod, which frequent the coast in shoals, as well as the *Salmo arcturus*, Linn. (the *Loddé* of the Norwegians). Weights used in this fishery, taken by Danish missionaries to Copenhagen at the beginning of the century, were found to be composed of cryolite, which led to the discovery of two veins of that mineral in the gneiss at the head of the bay, which has since been worked by Mr. Tayler, F.G.S. The white cryolite bed is about eighty feet in width, dipping south with the planes of the gneiss in which it occurs. Near its higher portion there is a large quantity of galena, worked in 1854, which gave 82½ per cent. of argentiferous lead, containing forty-five ounces of silver to the ton of ore. Fifteen feet from the surface the cryolite was of a dark colour, so that it is probable that the black cryolite in the higher vein is merely less decomposed, and not bleached. The Greenlanders value the white variety most, which they call orksoksiksæt (*orsok*, blubber), from its soft greasy appearance and feel; they gradually pound tobacco leaves placed between two pieces of it, the resultant powder consisting of half of cryolite dust, which they consider superior to any European snuff.†

Large quantities of cryolite are now imported to Copenhagen, the mines being worked by Messrs. Thomsen, of that city. Mr. Qualye reports that pieces of gneiss and trap are found imbedded in the cryolite, and states that the mines are filled with snow and ice during the winter, work being carried on by fifty men from May to October; 5,000 tons are raised yearly. Cryolite, except at Miask, in Siberia, does not occur out of Greenland.

Cryolite is a fluoride of sodium and aluminium, and is composed, according to Mr. Evan T. Ellis, of—

13 per cent. of aluminium,
34 „ „ sodium,
53 „ „ fluorine.

In Denmark, it is largely used in the manufacture of soda, which is procured by mixing it with lime and applying heat, 100 tons of cryolite yielding forty-four of caustic soda. It was introduced into Philadelphia by the Pennsylvania Salt Company, who imported 8,000 tons in 1867. By mixture with silica a very beautiful glass is produced, capable of being moulded. Cryolite was used by Deville as a flux in the manufacture of aluminium, the process of extracting aluminium from it was first used by Mr. Dick in 1856, but its use has since been abandoned in favour of bauxite. The fluoride of calcium is sent to Paris to be used in glass etching.

Associated with the Greenland cryolite brought over

Continued from p. 449.

† Giesecke, *Edin. Phil. Jour.* vol. vi. 1822; J. W. Tayler, *Quar. Jour. Geol Soc.*, 1856; *Chemical News*, 1868, p. 8, &c.; *Proceedings Amer. Pharm. Soc.*, 1868 See Rink's Memoir on Greenland, published by the Royal Danish Academy of Sciences, 1853, p. 71; L. Jacobsen's "Et Aar i Grönland, 1862"; and Lieut. Bluhme, in the Danish magazine *Fra alle Lande*, vol. i.

by Mr. Tayler, M. Hagemann found, in 1868, Pachnolite and Columbite, and a mineral he termed Arksutite. Near the cryolite deposits also occur extensive veins of tinstone, covering an area 1,500 feet long by 80 feet broad, running E. and W. and N.E. and S.W., with a width of 10 inches, the tin being 1 inch to 1½, and the gangue felspar or quartz, associated with galena, spathic carbonate of iron, copper and iron pyrites, tantalite taking the place of wolfram, usually associated with tin ores.

*Mid-Greenland.**—Sigillaria and a fern, probably *Pecopteris*, were discovered by Dr. Pfaff in 1870-71, in erratic blocks, on the coast of Disco; they appear to have been derived from rocks of Carboniferous age, but as none such are now in Greenland, it is most probable, as has been suggested, that they were brought by floating ice from Melville Island.

The Greenland coast and islets are composed of gneiss from 68° 30′ to 71° N. lat., with the exception of the projecting peninsula of Noursoak, the north-eastern coast of which, in Omenak Fjord, consists of Cretaceous rocks, in which, however, no calcareous beds have as yet been discovered, and from which the only fossils obtained have been several species of plants, determined by Prof. Heer, including *Pecopteris arctica*, Hr., *P. borealis*, Brong., and eight other ferns, *Zamites arcticus*, Göpp., *Sequoia Reichenbachii*, Gein., *Pinus Peterseni*, and a Monocotyledon, *Fasciculites Grœnlandicus*, Hr.

The western coast of Noursoak consists of trap, as does also that of the island of Disco, or Kekertassuak, as far as Lievly or Godhavn, where there is a patch of syenite. The shores of the Waigat Strait, both on the Noursoak and Disco Island side, consist of Miocene beds, which also extend in Disco along the east coast to Godhavn, and are more or less associated with the trap (basalt), which consists entirely, according to Nordenskjöld, of "consolidated beds of ashes and volcanic sand," which by pressure have assumed a crystalline form.

The Cretaceous strata of the north coast of Disco are divided by Nordenskjöld into two series, the lower, or *Kome strata*, and the higher, or *Atane beds*. The former consist of a sedimentary coal-bearing formation filling up old valleys and depressions in the undulating gneiss beds, reaching a thickness of 1,000 feet, lying either horizontally or dipping 20° towards the Noursoak peninsula. It is probable that the plant remains brought home by Giesecke and Rink were from this series, beds at the base associated with the lowest thin coals being so full of leaves as to have become a felted flexible mass, resembling the vegetable parchment produced by the action of sulphuric acid on lignite. Coal is collected by the Greenlanders for their personal household use at Kome, Sarfarfik, Pattorfik, and Avkrusak. Amongst the plants from Kome are the beautiful Cycads *Zamites arcticus*, *Glossozamites Hoheneggeri*, and several plants stated by Heer to occur in the Urgonian strata of Wernsdorff.

On the gneiss of Karsok River, at 840 feet above the sea, occur sedimentary strata, basalt, and gravel, which continue to 1,150 feet up the slope, where a gravel with angular pieces of graphite occurs, near a sandstone with coal; the graphite is stated by Capt. Brockdorff, who took five tons to Europe in 1850, to form a horizontal bed eight to ten inches thick, covered with clay, sand, and sandstone. As the beds lie horizontal, and are 300 feet above the Cretaceous rocks, the graphite must be of Cretaceous or still more recent age. Graphite also occurs at Niakornet. An analysis of the Karsok graphite, by Dr. Nordström, gave carbon 95·68, hydrogen 0·22, and ash 3·60; the latter gave 50 per cent. of silica.

Graphite also occurs further north, at Uppernivik, near Sanderson's Hope, in fine-grained granite, consisting of grey quartz and felspar of a waxy lustre, with garnets one inch in diameter.

* The Danish Government divides the coast into a North and South Inspectorate, the former commencing at lat. 66°, and extending to 73° N. beyond which they do not maintain a monopoly of the trade.

The Atane strata occur on the southern side of the Noursoak peninsula, between Atanekerdluk and Atane (Nordenskjöld); the thick coal of Atane, that at 750 feet above the sea at Kome, the Ritenbenk coal-mine at Kudliset, the retinite beds of Hare Island, all probably belong to this portion of the series. Dicotyledonous leaves occur, one being near to *Magnolia alternans*, Heer, from Upper Cretaceous of Nebraska; these do not occur in the lower measures, and point to a "limit plant fauna" occurring in the Arctic Cretaceous beds, corresponding to that found in the European Gault, in which dicotyledonous plants first appear in Europe.

Two analyses have been made of the coals from Disco, but whether of Cretaceous or Miocene age I do not know; one by Prof. Fyfe,* of Aberdeen, the other by Mr. Keates, of London† :—

		Keates.	Fyfe.
Sp. gravity		1·369	1·384
Gaseous or vol. matter		44·45	50·60
Moisture		·75	—
Sulphur		·55	—
Coke	Fixed carbon	47·75	37·86
	Ash	5·50	9·54
		100·00	100·00

The lignite contains a trace of bitumen, but the coke is non-caking and useless.

Miocene Rocks.—Sir Charles Giesecke, F.R.S., describing Disco Island in 1821,‡ gives the following section of Ounartosak Mountain, near Godhavn :—

1. Basalt, columns with three to seven sides, more or less magnetic.
2. Reddish-brown ferruginous clay.
3. Amorphous basalt, with geodes of mesotite, &c.
4. Reddish-brown ferruginous clay.
5. Reddish-brown wacke, with stilbite, mesotite, &c.
6. Trap Tuff.

6*a*. Basalt Tuff, with geodes of crystallised apophyllite with mesotite or earthy zeolite.

7. Granite, with garnets.

The trap (basalt) rocks lie tolerably flat, and range S.W. to N.E., resting on gneiss. Sandstones occur at Aukpadlartok, and thence to Aumarurtiksæt, where coal seams occur, one of which is 9 feet in thickness, the section being :—1. Sandstone with pyrites; 2. Brown coal; 3. Schistose sandstone; 4. Pitch coal; 5. Argillaceous schist; 6. Brown coal; 7. Sandstone with plants.

From the granite (gneiss ?) of the islands on the south side of Disco, Giesecke records tinstone, magnetic pyrites, epidote, and diallage, and states that the Disco mesotite was found by Sir David Brewster to vary much from that of Auvergne; and he describes the occurrence of rounded boulders of primitive rocks at the tops of the highest mountains near the coast. Giesecke's collections were destroyed in the bombardment of Copenhagen, whilst he went to Greenland in the Danish service, and the collections he made in that country were captured by English cruisers and sold by auction at Leith, where they were purchased by Mr. Allan, who distributed the duplicate specimens of Greenland cryolite, sodalite, and allanite, at that time of great rarity, over Britain.

At Atanekerdluk, Nordenskjöld describes Miocene clays with vast numbers of plant impressions, at 1,000 to 1,200 feet above the sea, and newer than the Atane beds, the base of the Miocene beneath the clay being soft sandstone and sand; the strike of the strata corresponds to that of the strait, and the dip is 8—32° to E.N.E. It formerly extended across the strait, and forms sandhills 2,000 to 3,000 feet in height along the eastern shore of Disco, horizontal thin coal-bands and erect bitumenised trees occasionally occurring. No valuable coals, however, are worked in the Lower Miocene, which is separated from

* Appendix to Inglefield's "Summer Search after Sir John Franklin," p. 151.

† Phil. Trans. for 1869, p. 449.

‡ Trans. Royal Soc. Edin., 1821.

the coal-bearing Middle Miocene of Ifsorisok and Assakak by several thousand feet of basalts, but the flora is similar to that of the lower fossiliferous beds. The coals of the high fells of Skandsen and Assakak are also believed to belong to this horizon.

At the creek at Atanekerdluk the general strike of the beds is E.N.E., clay, ironstone, or siderite (Atanekerdluk-stour of Greenland Danes), with impressions of plants, being of frequent occurrence. Trap (basalt) dykes traverse the strata in regular lines running obliquely, and often stand out like obelisks, one of which is 80 feet in height. On the slopes occurred erratic blocks of grey syenite, &c.

It is probable that Greenland Miocene basalt extends, as suggested by Nordenskjöld, across the country north of the sixty-ninth degree of latitude, as Scoresby found impressions of plants in what he termed "trap" along the whole coast of East Greenland examined by him. The second German expedition has also brought back large collections, and it is possible that these deposits may extend under the sea to Iceland, Jan Mayen, and Spitzbergen, At Brännvinshamn, Skarffjäll, Kudliset, magnificent examples of columnar basalt occur comparable to Staffa and other European localities. At Godhavn, the lowest bed resting on the gneiss, is a basaltic tuff, with several species of zeolites, then columnar basalt, then tuff with zeolites, alternating with that basalt. At Atanekerdluk, near the shore, is a high mountain composed of crystalline dolerite similar to the Spitzbergen hyperite, and along the coast basaltic beds fifty to 100 feet thick, traversed by basaltic dykes, may be traced for miles.

On the east coast of Disco, sand and sandstone beds form mountains 1,500 to 2,000 feet, capped by basalt; in Waigat Straits these sink, and the basalt reaches the shore, but at a height of 1,000 feet, sand, clay, and coal occur.

These Miocene coals and plant-beds spread over an extensive area, for Sir John Richardson describes their occurrence on the banks of the Mackenzie, associated with gravels, sandstones, and potter's clay with plant remains, which he figured; while to the east, in Spitzbergen, a large number of species are in common, and many species also occur on the coast of the Baltic, in Switzerland, France, Italy, and Greece, four Greenland species including *Sequoia Couttsiæ*, so common at Bovey Tracey in Devonshire. Out of 321 species of Miocene Arctic plants now known, 167 were found in Greenland.*

East Greenland.—The second German expedition is stated to have discovered† coals of Liassic age on this coast, and a large number of Miocene plants, some of which had previously been found by Scoresby in 1822.

Both the Cretaceous and Miocene rocks of Greenland appear to have been deposited in fresh water, around which grew leafy trees, including nine species of oak, of which two were evergreen, like the Italian oak; two beeches, two planes, a walnut, hazel, sumach, buckthorn, holly, and Guelder rose, proving the climate to have been a temperate and not a tropical one.

Prof. H. E. Nordenskjöld‡ found the Greenland meteorites to be spread over an area of 200 square miles at the south-western corner of Disco Island, as Ovifak or Blue Hill, both in the region of greenstone basalt, and in that occupied by granite-gneiss; the fall he believes to have taken place in Miocene times, and he describes Widmannstætten's figures as best developed in the specimens where nickeliferous wrought is mixed with nickeliferous cast iron.

The basalt he found to be consolidated basaltic ashes, and to contain fragments of the meteorites which have been forced or fallen into cracks before the tuff was consolidated. The largest block noticed probably weighed 21,000 kilogrammes, that now in the British Museum weighing about eighty-seven.

In the British Museum is an Esquimaux knife, with a bone handle, the blade composed of small pieces of meteoric iron, presented by Sir Edward Sabine, who described it in 1819 (Quar. Jour. of Science, vol. vii. p. 79), and stated that the iron was procured by the Greenlanders from a hard dark rock in a hill in 76° 10′ lat., and 64° 75′ long.; they called the place *Sowilie*, from *sowie*, iron. Similar implements have been more recently described by Steenstrup, at the Anthropological Congress at Brussels, in 1872, and figured in *Matériaux pour l'histoire primitive de l'Homme*, 2 série, t. iv. 1873. In the third voyage of Capt. Cook, it is stated that the inhabitants of Norton Sound, Behring's Straits, call the iron they obtain from the Russians *shawie*.

M. Daubrée* describes three distinct types of the so-called meteorites from the basalt of Ovifak, discovered by Prof. Nordenskjöld: (1), a black metallic mass, which, polished, shows a network of white lamellæ (like schreiberite), and irregularly scattered grains (troilite); (2), a light grey metallic mass resembling ordinary iron; and (3), a dark green lithoid mass of silicates, with globules and grains of iron, the silica reaching in one instance 11·9 per cent. of the total weight.

	First Type.		Second Type.		Third Type.	
Iron, metallic ...	40·94	71·09	80·8	82·4	61·99	70·1
„ combined ...	30·15		1·6		8·11	
Carbon, combined	3·00	4·64	2·6	2·9	3·6	4·7
„ free ...	1·64		0·3		1·1	
Silica	0·075		0·291		...	
Water	2·86		0·7		...	

Of soluble salts he found—

	First Type.	Second Type.	Third Type.
Sulphate of lime	1·288	0·053	0·047
Chloride of calcium	0·039	0·233	0·146
Chloride of iron	0·027	0·089	0·114
	1·354	0·375	0·307

But though differing from all other known meteorites, he considers the presence of nickeliferous iron and schreiberite to prove their meteoric origin in spite of the combination of the iron with oxygen, and the abundance of carbon and the large proportion of soluble salts, considering that the preservation of the latter may be due to the feeble tension of the vapour of the northern regions.

Dr. Walter Flight, in his recent article on the History of Meteorites,† quotes Nauckhoff, who analysed ten rocks from Ovifak, and found the basalt to be a compact dark greyish green colour, of felspar (anorthite), penetrating magnetite, augite, and iron, the mass containing 49·18 per cent. of silicic acid. Tschermak describes the augite as of a light green tint, and as filling in spaces between other material, the felspar crystals as transparent, with cavities often filled with some transparent substance, and compares the Ovifak rocks to the meteorites of Juvinas, Petersburg, and Stannern; and Dr. Flight compares them to old augite and anorthite lavas of Java, Iceland, and the Eifel.

The coast of North-west Greenland, Cape York, Wolstenholme Sound, to Cape Hatherton, is described by Dr. Sutherland as composed of trap. From Cape Parry to Bardin Bay the rocks dip S.W., further north-east to the S.W. at 30°. At Whale Sound horizontal beds of sandstone occur, but on the opposite side of Smith's Sound the cliffs are high, rugged, and inaccessible. Between Cape George Russel and Dallas Bay, Dr. Kane‡ describes the red sandstones as capped by greenstones, weathering into columns, one of which, 480 feet in height, he called Tennyson's Monument, overlooking Sunny Gorge in 79°.

CHARLES E. DE RANCE

(*To be continued.*)

* The position of the plant-bearing localities are marked in Nordenskjöld's Chart, founded on Rink's, Geol. Mag., vol ix, plate vii., 1872.

† "Zweite deutsche Nordpolarfahrt," No. viii., issued by the Bremen Committee.

‡ Quar. Jour. Geol. Soc., vol. xxviii. 1872; Geol. Mag., vol. ix. p, 461, &c.

* Comptes Rendus de l'Acad. des Sc., t. lxxiv., lxxv.

† Geol. Mag., vol. ii. Dec. 2, p. 154. (London, 1875.)

‡ Arctic Expedition in 1853–55, by E. K. Kane, M.D., U.S.N. (Philadelphia, 1856.)

THE PROGRESS OF THE TELEGRAPH*

III.

WHENEVER the finger of scientific research points the way to mechanical applications, the creative powers of the human brain originate a multitude of inventions. Too often, however, like the rank growth of weeds which spring up to choke the produce of the soil, they surround as parasites the principles involved, and by misapplied talent, frustrate the simplicity and vigour of the original idea. By hundreds in all forms and shapes have telegraphic inventions crowded into the field; but ninety-nine out of every hundred patented inventions are not worth even the fees paid to Government. As with the multitude of steam-boiler patents, so with telegraph patents, a very limited number of the different patented inventions have survived to render any really practical aid to the every-day requirements of telegraphic transmissions by land or by sea on a large scale. All the earlier inventions, the five needle, double needle, and the single needle telegraph, Bain's chemical printer, the mechanical alphabetical printer, Morse transmitter, and others of a similar type, have long since been laid on the shelf as incompetent as regards submarine cable transmissions over extended lengths; and a form of apparatus, more or less derived from a skilful combination of old principles and appliances, have taken their place for practical utility. These instruments, to which the descriptions in the present instance will be confined, may be classified into two distinct groups, namely, "recording" and "non-recording" instruments; or those which mechanically record the signals on paper, and those which are read by the eye or ear, the signals afterwards being registered by hand. Before proceeding to investigate the combinations of principles employed, it is desirable to point out that these several classes of instrument have each a special department for which they are specially adapted. Thus, for submarine cable transmissions the non-recording apparatus, depending upon the correctness of the eye or the ear, must at all times be liable to error, the accuracy and precision of sight and hearing of the reader being the only voucher that the transmitter of the message has that it has been faithfully interpreted at the distant station. Mistakes under this system must therefore, of necessity, frequently arise. Instruments of the recording type are, in consequence, always to be preferred.

In all these various forms of apparatus no new principles have been discovered; they are simply successful mechanical arrangements and combinations of certain well-known electrical laws, producing new and useful results. These fundamental principles may generally be described as follows:—

When a length of insulated wire is wound round a

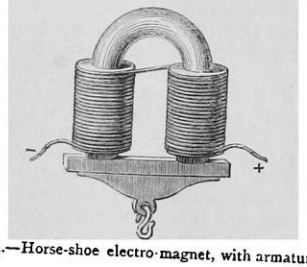


FIG. 14.—Horse-shoe electro-magnet, with armature.

piece of soft iron, and an electric current is passed through the wire helix so wound round the soft iron core (Fig. 14), the soft iron becomes a magnet and remains so, so long as the current flows through the wire; when the current ceases, the soft iron is no longer a magnet; the polarity of this magnet is reversed according to the direction in which

Continued from p. 452.

the current is sent through the coil or the direction in which the wire is wound round the soft iron core.

When a coil of wire surrounding a soft iron core is passed before the pole of a permanent-magnet, at the moment of passing it becomes a magnet by induction, and at the instant of making and breaking contact with the pole of the permanent-magnet, a wave of magneto-electricity is induced in the coil of wire surrounding the soft iron core. The current induced at the breaking is in an opposite direction and stronger than the current induced at the making contact. The more rapid and decided the make and break, the stronger the magneto-currents induced in the coil.

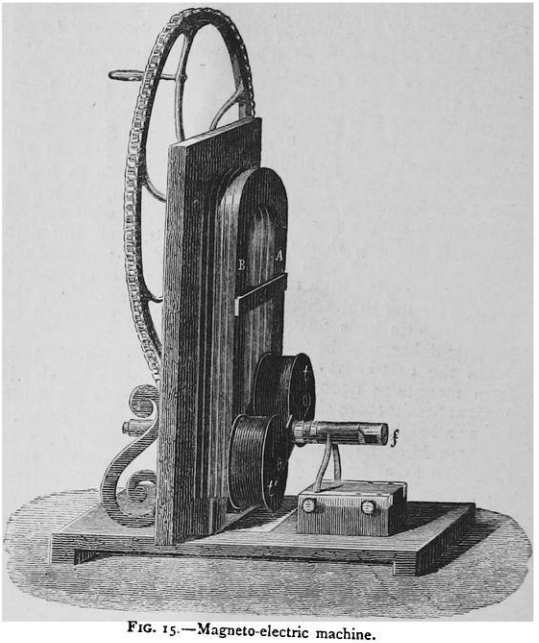


FIG. 15.—Magneto-electric machine.

A magneto-machine of this description is shown in Fig. 15. It consists of a powerful permanent magnet, A, B, composed of steel plates in the form of a horse-shoe, firmly fixed in a vertical position to a wooden frame, the two poles of the magnet being opposite to two coils of insulated wire, each furnished with a soft iron core. These two soft iron cores are connected together by an iron plate, t, t'; the coils thus arranged constitute an electro-magnet. The electro-magnet thus formed is fixed so as to revolve round an axis, f, which passes between the poles of the magnet, and is connected with an endless chain and wheel with a handle.

When the coils are put in motion, induced currents of magneto-electricity are developed in each of them, at each successive make and break of the soft iron cores with the poles of the magnet A, B. If the wires of the coils are wound in contrary directions, the induced currents developed in each coil by the approach of the two contrary poles of the magnet will be in the same direction.

When insulated wire helices are placed round the two poles of a permanent-magnet, so that a continuous circuit is formed, and an armature of soft iron is rotated before them, at the moments of the make and break of the revolving armature with the poles of the magnet, a wave of magneto-electricity is induced in the wire helices, the stronger current being that produced by the breaking contact, which is in an opposite direction to the weaker current induced in the helices at the moment of making contact.

When the poles of two permanent-magnets are opposed to each other, the similar poles will exert a *repellant*, and the dissimilar poles an *attractive* force. This principle is constant, whether the magnets are electro-magnets or permanent-magnets.

In a permanent-magnet, as is well understood, the magnetic force culminates at the two opposite extremities of the bar, and for the purposes of telegraphy may be considered as equivalent to the force emanating from the two poles of a voltaic series, but more lasting; there is no battery to be renewed, the excitation of the current is mechanical, and not chemical.

When a piece of soft iron is placed close to the poles of a permanent-magnet (Fig. 15), it will become a magnet by induction, and the polarity of the ends will be dissimilar in their nature to those of the permanent-magnet.

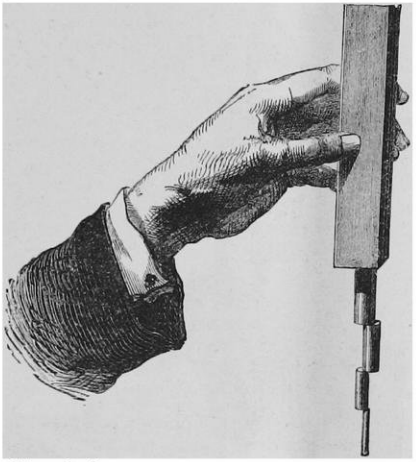


FIG. 16.—Magnetisation of pieces of soft iron by the influence of magnetism (induction).

When the pole of a permanent-magnet is placed within a hollow coil or helix of insulated wire freely suspended so as to oscillate on an axis, and a current of electricity is passed through the helix, it will be oscillated or rotated towards the right or left over the poles of the magnet according to the direction of the current.

In a similar way, when a permanent magnetic bar is freely suspended within a hollow coil or helix of wire, the magnetic bar will oscillate to the right or left, according to the direction in which the current flows through the helix.

These are the principal fundamental laws which, combined together in various mechanical details, constitute every form of telegraphic apparatus known; and it is upon the accurate balance of the resistances, and delicacy of the mechanical parts, that the excellence of the instrument for practical purposes depends. It will now be pointed out how these well-known principles have been combined to produce the beautiful machines at present employed upon submarine circuits of extended length, and by which, with feeble currents, signals are automatically recorded at the distant station.

Commencing with *non-recording* instruments, the mirror galvanometer is at once the most useful and important in its general applications to submarine telegraphy. The electrical combinations of principles which constitute this instrument existed almost in the same arrangement in the earliest days of telegraphic research. At that early period the apparatus in its elementary conditions was almost identical with the modern instrument, the bar-magnet freely suspended in the centre of a hollow coil of insulated wire, and the focal distance at which to observe the angular motion of the suspended needle to the right or left. In this crude arrangement there existed the germ of the instrument now in use, the accurate balance of resistances, and delicate adjustments of the mechanical parts, producing the difference between an historical invention and an every-day practical mechanical application. The construction of the reflecting galvanometer is exceedingly simple, the delicacy of the instrument being the result of the lightness of the moving parts.

Two hollow coils of fine wire (Fig. 17), united to form a continuous circuit, are placed one above the other, and the coils are so constructed as to admit of a very delicate axis being inserted through them free to rotate and capable of accurate adjustment, so that the centre of rotation may be in a line with the centre of the inner ring of the coils. A minute silvered mirror reflector is attached to the axis concentric with the hollow centre of the upper coil. Two extremely light bar-magnets, about three-eighths of an inch in length, are attached to the axis in the centre of each coil, one of the magnets being therefore at the back of the mirror. The polarity of these bar-magnets is reversed, producing an astatic combination. The whole arrangement of axis, mirror, and bar-magnets is suspended by a cocoon fibre, adjustments being obtained to ensure freedom of rotation by a micrometer screw and levelling screws. The mirror is brought into the field and its motion otherwise controlled by means of a permanent-magnet sliding upon the rod, the elevation or depression of which acting by induction upon the suspended bar-magnets gives more or less sensitiveness to the motion of the mirror when a current of electricity traverses the coils. It must be obvious that the eye is quite incapable of detecting with accuracy the minute angular motions of the mirror, and that some means must be employed to magnify and increase this angular motion of the magnetic bar. For this purpose a beam of light is employed which, falling on the mirror, is reflected back again upon a long horizontal scale placed some six feet off. The angle of incidence of the beam of light being equal to the angle of reflection, the oscillation of the mirror thus magnified to the eye, to right or left, is read off from a zero on the scale. The beam of light is passed through an adjusting slit immediately beneath the scale, and the mirror is brought to the zero of the scale by the magnetic adjustment before mentioned. Thus the slightest angular motion of the mirror, inappreciable to the eye, is, according to the focal length of the ray of light, increased to such an extent as to indicate the presence of the most feeble currents with an almost inappreciable movement of the mirror.

The scientific world is indebted to Prof. Sir William Thomson for this exceedingly beautiful adaptation and combination of existing laws, parts, and principles; the skilful balance of which has resulted in an apparatus now almost exclusively used for the testing of the electric condition of submarine cables. It is obvious that with this reflecting galvanometer no automatic register of the signals received can be obtained; recourse is therefore had to a Morse key, by means of which the recipient of the signal at once records the deflection of the light spot on the scale to the right or left in the symbolic Morse code of the dot and dash. The mirror galvanometer, in fact, occupies relatively the same position in electrical mechanics as the violin does in musical acoustics. In the violin, by sliding the finger up the string and thus shortening the length of the vibrating string, the musical pitch or tone produced from the string, as the bow is drawn across it, continues to ascend in the musical scale without break; each note of the entire diatonic scale capable of being produced on that string, sliding or melting into the next, the pitch of the note being the index or record of the length of the string and numerical value of its vibrations.

In a similar manner the great peculiarity of the mirror or reflecting galvanometer is, that it continuously

indicates and measures with great exactitude the various increases in the power or strength of the received electric current, the motion of the spot of light following every variation of the current, thus affording record to the eye of the value of the current under circumstances and conditions in which ordinary instruments indicating the mere presence or absence of a given strength of current would be valueless.

In the *Syphon Recorder* about to be brought under notice, the same remarkable feature of presenting the ever-varying value of the received current at the end of the cable, or the strength of the current, is preserved, while at the same time a permanent automatic record is registered for reference.

The difficulty to be overcome in the construction of such a recording instrument has been chiefly that due to the mechanical problem of obtaining marks from a very light body in rapid motion without impeding or interfering with that motion. The combination of parts and principles employed in the syphon recorder will be found to be more or less previously well known; the merit of Sir William Thomson's beautiful instrument consists in that

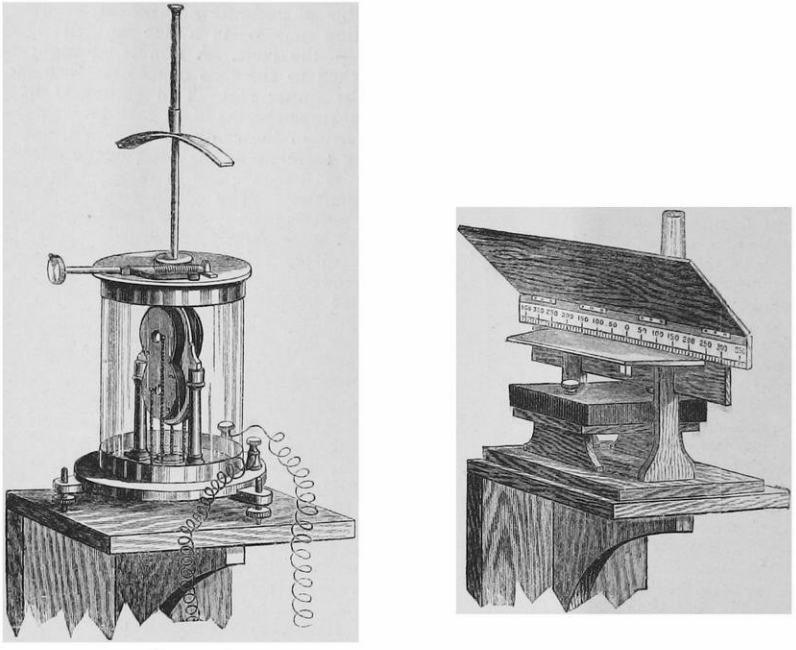


FIG. 17.—Sir William Thomson's "mirror" or reflecting galvanometer.

he has combined well-known forms and principles together in such an arrangement and combination of parts as to produce new and useful results. It is combinations such as those now to be described that constitute the value of scientific research in relation to mechanical applications.

It should be remembered that it is not possible to patent a principle, but only the application of a principle. If this axiom were more frequently remembered, the severe strictures upon patents in general that have already been made in these articles would have been rendered unnecessary. The "syphon recording" instrument fitly illustrates in what a good and valuable patent consists. With old and well-known parts and principles such as permanent-magnets, electro-magnets, coils, armatures, syphons, capillary attraction, and hydrostatic pressure and such like material, novel and practical results have been produced.

(*To be continued.*)

OUR ASTRONOMICAL COLUMN

THE SOLAR ECLIPSE OF 1900, MAY 28.—We refer to this eclipse with the view of correcting an error in Hallaschka's "Elementa Eclipsium," where it is stated to be *annular*. It is really the last *total* eclipse visible in Europe during the present century. The following elements may be expected to be pretty near the true ones :—

Conjunction in R.A. May 28, at 2h. 56m. 22s. G.M.T.

R.A.	64°	56′	49″	
Moon's hourly motion in R.A.		37	17	
Sun's ,, ,,		2	32	
Moon's declination	21	50	17	N.
Sun's ,,	21	27	15	N.
Moon's hourly motion in Decl.		1′	39″	N.
Sun's ,, ,,		0	24	N.
Moon's horizontal parallax	58	27		
Sun's ,, ,,	0	9		
Moon's true semidiameter	15	56		
Sun's ,,	15	47		

The sidereal time at Greenwich mean-noon, is 4h. 22m. 16s·8, and the equation of time 2m. 59s. additive to mean time.

The central eclipse enters Europe near Ovar, on the coast of Portugal, and passes off Spain a little south of Alicante. In longitude 0h. 34m. 0s. W. and latitude 40° 49′ N. on the Portuguese coast, totality commences at 3h. 27m. local mean time, and continues 1m. 30s., the sun at an altitude of about 43° At Alicante it commences at 4h. 10m. 11s.

local time, and the duration is about 1m. 18s. The central eclipse begins in longitude 116°·6 W., latitude 18° N.; it takes place with the sun on the meridian in 44°·8 W. and 44°·9 N., and passes off the earth in 31°·8 E. and 25°·4 N. At Greenwich the magnitude of this eclipse will be less than 0·7.

WINNECKE'S COMET.—In NATURE, vol. xi. p. 349, it was stated that the identity of this comet with that found by Pons at Marseilles, 1808, February 6, A.M., suspected by Prof. Oppölzer, is open to doubt. There is contradiction in the only two accounts of this comet which we possess. In the first one, which will be found in Zach's *Monat. Corresp.* xviii., it is described as "very small;" the discovery was not made known to the astronomical public, partly because no regular observations were procured, and the strong moonlight prevented its being seen after the morning of Feb. 9. Schumacher having inquired of Pons whether amongst his papers some more definite account of this comet were to be found, received from him, through Inghirami, a communication which was printed (apparently long after its receipt) in *Astron. Nach.* vii., c. 113. Pons says the comet was one of those of which it was not possible to calculate the elements, because there were only procured some very doubtful positions by reference to nebulæ in the vicinity. He adds: "Elle était très-faible et difficile à voir. Sa nébulosité était ronde; elle s'étendait à peu près un dégré et on y soupçonnait par intervalle un très-faible noyau en deux parties. Son mouvement était assez rapid vers le sud." He then gives a sketch showing the configuration of the comet and two nebulæ, in a telescope with a field of nearly 3°. The nebulæ he describes as "sur le ventre d'Ophiuchus un peu au dessous de l'Equateur;" and Oppölzer identifies them with Nos. 10 and 12 of Messier's Catalogue. Hence we have an approximate place of the comet for Feb. 9 (at 5 A.M. at Marseilles), and Pons tells us it was moving pretty rapidly towards the south. If we now adopt Clausen's elements of Winnecke's Comet for 1819 (obtained by connecting the observations of that year with those of 1858, by calculation of the perturbations), and assume the date of perihelion passage in 1808 with Oppölzer on April 12·0, we have the following geocentric places :—

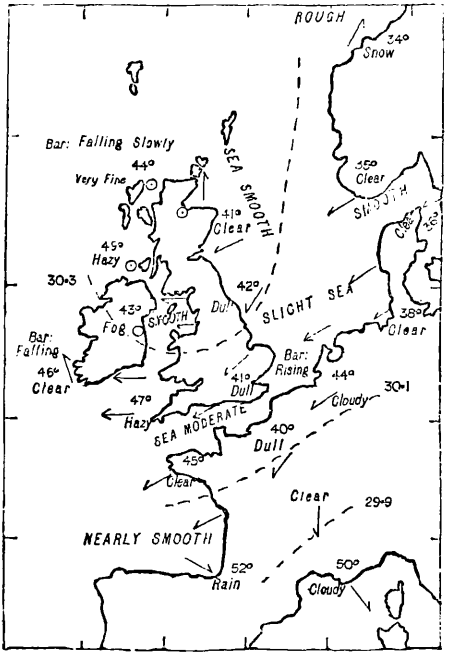
	D. H.		R.A.	N.P.D.	Distance from Earth.
			° ′	° ′	
1808 Feb.	5.16	Marseilles	237 56	97 0	1·044
	6.17	,,	239 10	97 10	1·031
	8·17	,,	241 39	97 31	1·007

These positions do not indicate what could be termed a pretty rapid motion towards the south, and at a distance exceeding the mean distance of the earth from the sun it is very unlikely that a comet would present an apparent diameter approaching one degree. So far as can be judged from Pons's communication to Schumacher, we may rather infer that the object he observed was very near to the earth. Clausen's elements of Winnecke's Comet in 1819 show that it was then moving in an ellipse with a period of 2031·8 days: two such periods reckoned backward from the date of perihelion passage in 1819 would bring us to 1808, June 2·5, instead of April 12. It does not, therefore, appear that sufficient grounds exist for supposing the comet of February 1808 to have been identical with the one which now bears Prof. Winnecke's name. We may take this opportunity of stating that according to Clausen's calculation of the perturbations, Winnecke's Comet was in perihelion on the following dates between the appearances in 1819 and 1858, passing unobserved in each year: 1825, Feb. 5·5, G.M.T.; 1830, Aug. 21·4; 1836, March 3·4; 1841, Sept. 13·9; 1847, March 29·0; and 1852, Oct. 11·7.

THE STAR B. A. C. 2695.—This sixth-magnitude star of the British Association Catalogue was missed in August last by Mr. Tebbutt, of Windsor, N.S.W., being then invisible in a telescope of 4½ inches aperture. It is No. 1871 of the Paramatta Catalogue, where the place depends upon a single complete observation, the magnitude attributed to the star being 6. It is also No. 966 of the catalogue in the fifth volume of Taylor's Madras Observations, the position depending upon two observations in each element in 1838 or 1839, but the recorded magnitude is 10. So great a difference in the estimated brightness clearly points to variability, which is confirmed by Mr. Tebbutt's recent notice. The position for the beginning of 1875 is in R.A., 7h. 57m. 30s., N.P.D. 150° 9′·7; five minutes distant from this star, on an angle of 180°, is the sixth-magnitude B.A.C. 2694, which Mr. Tebbutt found "decidedly red." It may be remarked that the *fifth* volume of Taylor's Madras Observations, to which reference is made above, is by far the most valuable of his series to the astronomer in the southern hemisphere; but it is not, we believe, now easily procured.

THE "TIMES" WEATHER CHART

MANY of our readers will have noticed the unusual appearance of illustrations in the *Times* in the shape of the small charts which have been appended to the Daily Weather Reports since the 1st inst. This measure has been the long-postponed carrying out of the line of action indicated by the Meteorological Committee in their Report for last year, and the chart in its present form differs but little from that printed as a specimen in that Report. We subjoin the chart for the 13th inst. published in yesterday's *Times*.



The dotted lines indicate the gradations of barometrical pressure, the figures at the end showing the height, with the words "Rising," "Falling," &c., as required. The temperature at the principal stations is marked by figures, the state of the sea and sky by words. The direction and force of the wind are shown by arrows, barbed and feathered according to its force. ⊙ denotes calm.

The method of preparation of the chart seems simple enough at present, but it has been the fruit of much thought, as the problem of producing, in the space of an hour, a stereotype fit for use in a Walter machine has not been solved without many and troublesome experiments.

In the first place, a material had to be provided which would admit of being engraved rapidly without burr or chipping, and would, without further preparation, serve as a mould for type metal. Secondly, drill pantagraphs had to be adapted to engrave the lines, and to be furnished with a gauge so as to vary their depth at pleasure.

The actual process is as follows:—The outline of the land is kept standing, and the composition is run in a mould bearing this outline on one face. The block, which is now an outline chart of the British Islands, is then placed under the pantagraph drill, which reduces the original drawing, furnished from the Meteorological Office, to one-fourth. The barograms and wind-arrows are put on direct from the drawing, the figures and words by means of templates, in order to ensure uniformity in the type.

The instant the block is engraved it is ready to be stereotyped, and then it is a simple matter to adapt it in the usual manner to the cylinder of the machine.

The initiative in this new method of weather illustration is due to Mr. Francis Galton, and the practical details have been carried out by Messrs. Shanks and Johnson, of the Patent Type Founding Company.

It is hardly necessary to allude to the value of such charts as these as a means of leading the public to gain some idea of the laws which govern our weather changes. As soon as they appear in our afternoon papers, we may hope for a more intelligent comprehension of the difficulties which beset any attempt to foretell the weather of these islands for the space of even twenty-four hours.

We may safely say that with these charts we have not seen the end of weather illustration, which was set on foot more than four years ago by Sir W. Mitchell in the *Shipping Gazette*, and has been continued daily; but whatever improvements may hereafter be introduced in the process, it must be remembered that the credit of breaking the egg is due to the gentleman we have named.

THE ECLIPSE EXPEDITION

THE local arrangements for the Eclipse parties, to which we referred last week, have, we now know, been altered in the cases both of the Bay of Bengal and Siam parties.

With regard to the former, letters received from Galle, written shortly before the sailing of the *Enterprise* (which had arrived at that port from Calcutta with Capt. Waterhouse, Profs. Tacchini and Pedler, and three photographic assistants on board), state that it had been determined to give up Mergui, first because the accommodation there was doubtful, and secondly, because, in the opinion of those best informed, a cloudless sky at Camorta was almost a certainty. Hence there will be two strong parties on Camorta itself as widely separated as possible; and here, it will be remembered, the totality is longer than at any other station, being no less than 4m. 27s. at Kaikul.

The Indian Government had been careful to prepare huts for observatories on this island before even the *Enterprise* had left Calcutta; and as certain parts of it are known to be malarious, all the observers will sleep on board the steamer.

With regard to the Siam party, a Reuter's telegram, dated Singapore, April 8, shows that this party, instead of going direct to Chulai Point, has gone to Bangkok; and it would appear from the telegram that the observatories were being erected at some spot nearer Bangkok than the proposed station.

NOTES

IT is with the greatest satisfaction we record that on Tuesday Mr. James Dewar, Demonstrator of Chemistry in the University of Edinburgh, was elected to the Cambridge Jacksonian Professorship; all the other candidates having withdrawn. As our readers know, Mr. Dewar has already done excellent work, and is so widely known as a gifted investigator as well as a first-rate teacher, that his presence at Cambridge will be a great gain, not only to that University, but to English Science.

THE *Alert* and *Discovery*, the two ships destined for the Arctic Expedition, are to be commissioned to-day. In addition to the naturalists specially appointed, Captain Markham and several of the lieutenants and sub-lieutenants have been undergoing special instruction in the instruments they will have to use—astronomical instruments, pendulums, magnetometers, and spectroscopes.

AT Monday's sitting of the French Academy of Sciences, a letter was read from M. Puiseux, giving a *résumé* of his calculation for the solar parallax, founded on the recent Transit observations. M. Puiseux has made a comparison between the St. Paul Transit observations by Mouchez, and those of Pekin by Fleuriais. The exact amount of the parallax is 8·879″. Both observers had 6-inch refractors. The comparison of the results obtained by Fleuriais and another observer at St. Paul with a 4-inch refractor gives 8·84″. M. Puiseux, in computing the sources of error, states in his letter that the error cannot be more than $\frac{1}{100}$ of a second, by supposing the error to be two or three seconds of time for the moment of transit. M. Puiseux spoke briefly in support of the opinion expressed in his letter.

THE following from the *Kölnische Zeitung* of March 25, in reference to the recently invented "hardened glass," will be interesting:—According to the reports of Pliny, Petronius, and Dion Cassius, a man is said to have invented the making of flexible and malleable glass in the time of the Emperor Tiberius. The happy inventor—some call him a glass-maker, others an architect—brought to the Emperor a vase made from the new glass, with the hope of a rich reward. The Emperor, fearing that the new material might cause a decrease in the value of gold and silver, threw the vase to the ground in a passion. The vase, however, did not break, but was only bent like metal, and the inventor at once repaired the damage done with a little hammer; whereupon the Emperor had the poor fellow killed on the spot, so that he should not tell his dangerous secret to anyone. For years people have lost themselves in conjectures of what material this malleable glass might have been; some thought it was aluminium, others that it was melted chloride of silver; none, however, were certain. From various quarters the invention is now announced of a new glass which resists blows and the action of fire. Last autumn a company was formed at Bourg, in France, with a capital of 1,200,000 francs, for the working of an invention in this line, made by a M. de la Bastie. The German Glass-makers' Union communicated with this company with a view to purchase the invention, but this remained without further consequences, as the demands of the company were exorbitant. In the meantime it had been found that the elasticity was given to the glass by dipping the same, while it is heated to a half liquid state, into a hermetically closed bath of oil or fat, substances therefore which melt far below the boiling-point of water. In Silesia, where repeated experiments have tested the qualities of the De la Bastie glass, another new glass was invented a few days ago, by Herren Lubisch and Riederer, in Count Solm's glass-works, Andreashütte, at Klitschdorf, near Bunzlau. This glass, which the inventors call "metal glass," is so hard, that when a pane lies on the ground and a leaden ball of forty grammes weight falls upon it from an elevation of twelve feet, it receives not the slightest impression; nor is it in the least affected when dipped whilst red-hot into cold water. Window panes, lamp cylinders, and other articles of domestic use made from this metal glass, can therefore almost be denoted as unbreakable.

MR. H. C. SORBY, F.R.S., has sent us the following:—"In the early part of this year I was much interested in reading in the *Naturforscher* an account of a paper communicated to the Academia del nuovi Lincei, in Rome, by Count Castracane, on the discovery of Diatomaceæ in the ashes of English coals. Thinking it desirable that the attention of the members of the Royal Microscopical Society should be directed to this fact, I wrote to Count Castracane, requesting him to send to me some specimens. I have now received two mounted objects of the ashes of coal shipped from Liverpool, which will be exhibited at the *soirée* on Wednesday, April 21st. I trust that this will be the means of leading some of the Fellows to devote themselves to this kind of inquiry, since they will be able to see that the specimens contain not only several well-preserved species of Diatomaceæ, but also other curious bodies somewhat like, yet differing from, the Xanthidea found in flints."

M. WALLON, who is the Perpetual Secretary of the Academy of Inscriptions, as well as Minister for Public Instruction, resumed his academical functions last Thursday. He had to read over a number of letters written to him, the Perpetual Secretary, by himself, the Minister; and his colleagues were struck with the serious way in which he performed his duties as secretary. One of them, M. de Saulcy, having asked the Academy to send two learned men on a mission to some place, said to M. Wallon: "If M. le Secretary is good enough only to speak a few words to M. le Minister, I am perfectly certain the Minister will find no objection to my proposition."

M. PAUL PERNY, a former pro-Vicar Apostolic in China, has proposed to found a Europeo-Chinese Academy in the heart of China, to be composed of missionaries, for the purpose of discovering, translating, and circulating in Europe, Chinese works of every kind bearing on the sciences, arts, and industry. M. Perny states that the Emperor Kien-Lung, who lived upwards of a century ago, drew out the plan of a general encyclopædia of human knowledge, which has not a parallel in the world. The publication of this encyclopædia is still going on. Nearly 100,000 volumes have appeared; there remain 60,000 volumes to be published in order to complete the scheme of the Emperor. The Chinese have encyclopædias of more than 300 volumes on agriculture, horticulture, pisciculture, &c.

THERE is an increasing demand for land in Ceylon for the purpose of growing tea, cinnamon, cinchona, vanilla, and other useful plants for economical purposes, as well as for the spread of the coffee plantations. A disease in the coffee plant has lately been discovered which threatens scarcity of this product unless speedily checked. It is called "leaf disease," and, as its name implies, is principally apparent in the dearth of foliage, though the produce of the berries is also considerably reduced. It is believed by competent authorities to be mainly caused by exhaustion; and is, in this respect, similar to the disease among the lemon groves of Europe, to which we alluded a week or two ago. The Government of Ceylon have taken up the subject with a view to its thorough investigation.

THE Acclimatisation Gardens in the Bois de Boulogne, Paris, have received a rare collection of artificially coloured plants from China. The plants are exhibited in the great glass house of the gardens, and excite universal admiration. Among the collection is a dwarf-tree of half a metre in height, the trunk of which is as thick as a finger, and the root of which hardly fills the hollow of a man's hand; the specimen is about 100 years old, and is a species of oak. This, however, is not a natural phenomenon, but the result of Chinese horticulture, which finds its highest problem in the reduction of the natural size of plants.

WE draw the attention of friends of geography to the *Hydrographische Mittheilungen* (Berlin, E. S. Mittler), which form the supplement to the publications of the Imperial German Admiralty *Nachrichten für den Seefahrer*; they have been published since 1873, and are most excellent in every way. The part for 1874, for instance, contains a detailed description of the Kerguelen Islands, a climatological picture of the Azores and Madeira, a treatise by Neumayer on the geographical problems in the Arctic regions, and a number of other interesting articles.

HEFT iv. of Petermann's *Mittheilungen* contains a letter from Dr. Oskar Lenz, dated Adolinalonga, on the Ogowe, which falls into Nazareth Bay, near Cape Lopez, just under the equator, giving a brief account of some short excursions he made last autumn in the district on the lower course of that river. The scenery, natives, fauna, and flora are characteristically Central African, and Dr. Lenz has been able to make considerable collections, including a large number of gorilla skulls. He seems to have been much hindered by sickness.

DR. GUSTAV LEIPOLDT, in a recently published work on the "Mean Height of Europe," after an elaborate calculation founded on a broad basis of measurement, concludes that it is 296·838 metres, 92 metres higher than the calculation of A. von Humboldt, who indeed made out the average altitude of all the land on the earth to be about 308 metres. The mean height of Switzerland, Leipoldt makes to be 1299·91 metres, while that of the Netherlands is only 9·61 metres. That of Great Britain is 217·70. Further interesting details will be found in the April number of Petermann's *Mittheilungen*.

THE same journal contains a map of Kerguelen Island, reduced from the English Admiralty Chart to a scale of 1—500,000. For comparison a map of Malta on the same scale is printed on the sheet, and gives one a very fair idea of the size of the southern island, which must be something like fifteen or twenty times the size of Malta. Accompanying the map are some remarks on the history and condition of the island.

IN the same number of Petermann's journal, Baron N. Schilling, of St. Petersburg, discusses the fertile subject of the theory of ocean currents.

AT the meeting of the Diplomatic Conference on the Metrical System, at Paris, on April 12, it was agreed to organise an International Bureau of Weights and Measures, the cost of maintaining which would be divided between the States represented at the Conference.

THE discovery of a boiling lake in the Island of Dominica is announced. It is stated to be situated in the forest-covered mountain behind the town of Roseau, 2,500 feet above the sea, and to be two miles in circumference. The margin of the lake consists of beds of sulphur, and its overflow finds exit by a waterfall of great height.

AT Monday's meeting of the Geographical Society, a paper by Mr. John Forrest was read, on his journey across the centre of Western Australia, referred to in NATURE, vol. xi. p. 93. Mr. Forrest is expected to arrive in England in the beginning of next month.

THE death is announced of the Rev. Charles New, the African missionary, who has made several additions to our knowledge of South Africa, and who is known specially for his ascent of the mountain Kilimanjaro. At the meeting of the Geographical Society on Monday, a paper by Mr. New was read, "On the Overland Route from the Pangani to Mombassa." Mr. New died from dysentery soon after this journey.

THE following lectures in Natural Sciences will be given at Trinity, St. John's, Christ's, and Sidney Sussex Colleges, Cambridge, during Lent Term, 1875.—On Electricity and Magnetism (continued), by Mr. Trotter, Trinity College, commencing April

15. On Electricity and Magnetism (continued), and on Heat, by Mr. Trotter, Trinity College, commencing April 14. On Chemistry (continuation of the course begun in the Lent Term), by Mr. Main, St. John's College, commencing April 13. Instruction in Practical Chemistry will also be given. On Palæontology (the Mollusca), by Mr. Bonney, St. John's College, commencing April 15. On Geology, by Mr. Bonney, St. John's College, commencing April 14. There will be excursions every Saturday, beginning April 17. Elementary Geology, commencing April 15. On Botany, by Mr. Hicks, Sidney College, beginning April 17. The Lectures this Term will be on Vegetable Physiology, and on Cryptogams. On Elementary Biology: a Practical Course at the Physiological Laboratory by the Trinity Prælector in Physiology (Dr. M. Foster), beginning April 15. On Animal Histology, by Mr. Martin, Christ's College.

AT St. John's College, Cambridge, J. E. Marr, from Lancaster Grammar School, has been elected to an Exhibition for Natural Science, of 50*l.* per annum, tenable for three years. C. Slater, from Clifton College, has also been elected to one of 33*l.* 6*s.* 8*d.*, tenable for the same time.

A CORRESPONDENT informs us of an interesting discovery in the Rhætic beds at Westbury-on-Severn. A party of students from Gloucester, in examining the Cardium shales, found a few specimens of a starfish, which Dr. Wright of Cheltenham, to whom specimens were forwarded, has pronounced to be his *Ophiolepis Damesii*, first found in the Rhætic beds at Hildesheim, and described by Dr. Wright in the *Zeitschrift der Deutschen geologischen Gesellschaft*, Jahrgang 1874. The specimens do not quite correspond with the plate (xxix.) of the Transactions alluded to, though the plate scarcely answers Dr. Wright's description.

AMONG the various kinds of fish which might with advantage be introduced into this country from America, perhaps none offer such good results as the Shad (*Alosa sapidissima* and *A. pseudo-harengus*). These American Shad are very much superior to any European species; and one of their chief merits is in the enormous shoals in which they enter the rivers. Some idea of this may be gathered from the fact that 5,000,000 pounds of the Shad and the closely allied "Alewife" were inspected as food for the market of Washington alone during the months of May, June, and July, 1874. No greater boon could be conferred upon Great Britain than the transfer of these two species of fish into its waters. An attempt has been made to transport this fish into Germany, but failed, owing to the length of time involved in the voyage. Very little difficulty is anticipated in such an experiment in regard to this country; the young fish could, in the opinion of American fish culturists, be easily brought over.

IN connection with the recent meeting of the French learned societies, Mr. G. J. Symons writes from Paris as follows:—"M. Michel threw out a suggestion which appears to me likely to, or at any rate possibly may, be the means of averting the principal source of danger in crossing the Atlantic. I refer, of course, to icebergs in foggy weather and the total wrecks which occur from running on to them. It is well known that the proximity of icebergs is indicated by a diminution in the temperature of the sea. M. Michel's proposal is very simple: it is merely that Transatlantic steamers should carry a submerged electric thermometer, which might easily be arranged to ring a bell in any part of the vessel on the occurrence of whatever change of temperature might be decided upon."

A RECENT letter in the *Times* states that a cross halo was seen on the night of the 14th March. On the same night at sunset a halo was observed by M. de Fonvielle, and described by him in his daily meteorological article in the Paris *Temps*. It was a circular halo, no trace of the cross being seen. It does not appear that the phenomena were produced by the same cloud, as the clouds were drifting southwards. But halos were very frequent about that time. On the 12th a solar halo was seen by M. de Fonvielle, and noted in NATURE, vol. xi. p. 395. The same cirrus may present, when seen from different altitudes, different appearances; this is proved by the variations of aspect observed by M. Tissandier in his last ascent.

AT the *conversazione* of the Quekett Club to be held at University College to-morrow night, Mr. J. F. Tafe will exhibit some specimens of the Colorado Potato Beetle.

THE large refractor (fourteen inches) of the Paris Observatory, which was damaged during the Communal disturbances, is now being restored. The roof, which had been perforated by hundreds of balls, will be put in working order. This refractor will be exclusively devoted to celestial photography.

THE publishers of the "Instructions for the Observation of Phenological Phenomena," referred to in a recent number (p. 408), are Williams and Strahan, Lawrence Lane, Cheapside. We believe that forms for recording observations may be obtained by application to the Secretary of the Meteorological Society.

The Colonies is the title of a fortnightly journal published by Silver and Co., which gives the cream of the news from the colonial possessions of Great Britain. Each issue contains one or more papers of a scientific nature on subjects connected with the colonies. The subjects are well selected, and the information is generally accurate and valuable. The number for April 3 contains two interesting papers; one on the races of man inhabiting New Guinea; and the other on the Lac insect and its commercial products (illustrated).

THE *Natal Colonist* for Feb. 26 contains an interesting paper on "The Bee-tailor and the Crane or Windlass Spider: Instinct or Reason?" The *Natal Colonist* deserves to be commended for the interest it has always shown in scientific matters; it has ever been ready to open its columns to contributions on subjects of scientific interest. In a note prefixed to the paper the editor states that he wishes to enlist the "sympathies and the aid of those readers who are observers and students in the various branches of Natural History," so as to follow up the paper referred to with a succession of similar records of observations. We hope the invitation will meet with a response from many quarters. To quote the words of the preliminary note, "We feel assured that there are many throughout the colony whose observations of the habits of animals, of the characteristic products of their own localities, whether animal or vegetable, and the like, would be of great interest to others, and possibly very materially conduce to the advancement of science, and we should be glad indeed to make our journal the vehicle of communicating such records to the public." The Town Council of Durban, we are glad to see, contemplate setting apart a portion of the new buildings for the purposes of a museum.

THE additions to the Zoological Society's Gardens during the past week include a Green Monkey (*Cercopithecus callitrichus*) from West Africa, presented by Mrs. Lange; a Vervet Monkey (*Cercopithecus lalandii*) from West Africa, presented by Miss Emily Sissison; a Golden Eagle (*Aquila chrysaëtus*) from Spain, presented by Mr. J. Arthur Wright; two Leadbeaters Cockatoos (*Cacatua leadbeateri*) from Australia, presented by Mr. G. L. Prendergast; two Shoveller Ducks (*Spatula clypeata*), European; a Blue-faced Green Amazon (*Chrysotis bouqueti*) from St. Lucia, West Indies, purchased; an Ocelot (*Felis pardalis*) from South America; a Porto Rico Pigeon (*Columba corensis*) from St Vincent, purchased.

ACCIDENTAL EXPLOSIONS *

II.

THERE is no doubt whatever that a very considerable proportion of the accidents which occur to persons using petroleum lamps are really traceable to the erroneous belief, which is still so very prevalent, in the *explosive* character of these liquids. The fact that they and their vapours are simply inflammable, and that the latter requires to be mixed with a large volume of air before their ignition can be accompanied by explosive effects, is so slowly realised, that in public prints petroleum is still often spoken of as an explosive substance. The popular belief in the explosiveness of these simply inflammable liquids contrasts strangely with the fact that many explosions have been brought about by the careless employment of candles or other naked flames in premises where the volatile varieties have been stored, or where the operation of transferring the liquid from one vessel to another for purposes of sale is carried on, the result being the ignition of the explosive mixture *produced* by the volatilisation of the spirit and its diffusion through the air. This fact does indeed tend to discourage the hope that the proportion of accidental explosions of *gunpowder* which are apparently due to ignorance may become very greatly diminished by keeping its explosive properties before the minds of those using it.

The lecturer then referred to the legislative restrictions in connection with the transfer, storage, and sale of petroleum and petroleum oils. The danger arising more especially from the transport and storage of *imperfectly* refined oils under designations which apply to the properly refined and therefore safe petroleum- or coal-oils, which do not demand special precautions for their safe storage and use, and are consequently not subject to any restrictive or precautionary regulations, renders the application of the existing legal regulations to the inspection of petroleum-*oils* imported into England of special importance. Referring to the so-called *flashing-test* described in the Act of Parliament, Prof. Abel thinks it undoubtedly desirable, in the framing of any future Act, that this test should be carefully reconsidered, as well as the question whether some narrow limit below 100° F. may not reasonably, and without incurring any increased risk, be fixed within which the flashing point of an oil (*i.e.* the temperature at which it evolves vapour) may range.†

The liability of oil or spirit to leak from casks or barrels even of the best construction, consequent upon the rough usage to which these are unavoidably subjected when transferred from store to ship or carriage, and the reverse, need scarcely be pointed out. But even in the absence of leakage from the openings of the barrels, or from any accidental point of escape, evaporation or diffusion of the volatile petroleum will occur through the wood itself of which they are constructed, especially in the warm holds of ships or in stores exposed to the sun, even though the precautionary measure is frequently adopted of rinsing the barrel out before use with a solution of glue. It is evident that the object of imparting an impervious coating to the interior of the barrel can thus be only very imperfectly attained, and that, even if it were, the alternations of temperature to which the barrels must be exposed must in course of time open up places for escape by leakage or evaporation.

The dangers resulting from the escape of petroleum spirit or its vapour from receptacles in which it is kept, in confined spaces, where little or no ventilation exists, has been but too frequently exemplified by explosions more or less violent, followed by fires in localities where it is stored or handled, or in the holds of vessels in which it is transported. Accidents of such kinds have been due either to carelessness in transferring petroleum from one vessel to another, in a shop or store in which a light has been burning at the time, or to a light being carried into or a match struck in a store where vapour has been escaping until it has formed an explosive mixture with the air. The lecturer had a vivid recollection of an accident of this kind which he witnessed at the Royal College of Chemistry in 1847. Mr. C. B. Mansfield, who was then engaged in his important researches on the composition of coal-tar naphtha, which led a few years afterwards to his sad untimely death, was engaged at one extremity of a low room (38 feet long, about 30 feet wide, and 10 feet high) in converrting one of the most important of these products—benzol—(which boils at 176° F.) into nitrobenzol in a capacious retort, which suddenly cracked, and, yielding to the pressure of its contents, allowed the warm liquid hydro-carbon to flow over the operating table. There was a gas-flame burning at the other extremity of the laboratory, and no other source of fire. Within a very few minutes after the fracture of the vessel a sheet of flame flashed from the gas-flame along the upper part of the room and communicated to the table upon which the liquid had been spilled.

Among other "accidents" referred to as arising from a similar cause, was the recent explosion of the powder-laden barge in the Regent's Canal. It was established by a sound chain of circumstantial evidence that this explosion must have been caused by the ignition, in the cabin of the barge, of an explosive mixture of air and of the vapour of petroleum, derived from the leakage of certain packages of the spirit which were packed along with the powder.

It is impossible to protect heavy packages from rough usage, in the processes of unloading ships or other vehicles of conveyance; it is therefore most important that means should be adopted of thoroughly closing the vents of receptacles of petroleum-spirit by such means as are capable of sustaining ordinary rough usage without any injury to their efficiency, and that the improvement of the nature and construction of the receptacles themselves be seriously considered with the view of reducing the liability to accidents resulting from the escape of the spirit or its vapours, and the consequent creation of danger connected with the transport and storage of these valuable illuminating materials.

The fact that combustible, and especially inflammable, solid substances, if of sufficiently low specific gravity, and reduced to a sufficiently fine state of division to allow of their becoming and remaining for a time suspended in air, may furnish mixtures with the latter which partake of explosive character, scarcely needs to be pointed out. The ignition of a particle of such a substance, surrounded by atmospheric oxygen, will, under these conditions, at once communicate to others immediately adjacent to it, and if the particles of suspended solid matter be sufficiently numerous and finely divided, the ignition will spread throughout the mixture with a rapidity approaching that of a mixture of inflammable vapour and air, the development of gaseous products and heat being sufficiently rapid and considerable to produce explosive effects, which may even be of violent character, their violence being regulated by the nature and *inflammability* of the solid substance, the proportion and state of division in which it is distributed through the air, the quantity of the mixture, and the extent of its confinement.

Explosions of an accidental nature produced in this way are believed to have occurred in connection with operations in the chemical laboratory; but it was scarcely to be expected that the first clearly authenticated cases of any importance should have arisen out of the apparently harmless operation of grinding corn.

That a mixture of very fine flour and air will ignite with a flash when light is applied to it, and produce in a very mild form the species of explosion observed on applying a light to licopodium suspended in air, is not very difficult of demonstration, but it is not easy to realise the possibility of the production of violent explosive effects by the ignition of such a mixture even upon a very large scale, though the rapidity of its ignition be accidentally favoured by the warmth of the atmosphere. Cotton mills have been known to be rapidly fired by the ignition of cotton particles suspended in the air; but, compared with flour, cotton is very combustible. Flour when absolutely dry would contain only about half its weight of carbon, and about six per cent. of hydrogen, the remainder consisting of nitrogen and mineral substances; constituents which, by absorbing heat instead of contributing to its development, must tend to reduce the rapid combustibility of the substance. Yet the possibility of very serious calamities arising out of the accidental ignition of a mixture of flour-dust and air has been but too conclusively demonstrated.

Referring to a destructive explosion in some extensive steam flour-mills in Glasgow in July 1872, the lecturer said that its origin was conclusively traced to the striking of fire by a pair of millstones, through the stopping of the "feed," or supply of grain to them, and the consequent friction of their bare surfaces against each other, the result being the ignition of the mixture of air and fine flour-dust surrounding the mill-stones.

This ignition alone would not suffice to develop any violent

* Abstract of a lecture delivered at the Royal Institution, March 12, by Prof. F. A. Abel, F.R.S. Continued from p. 439.

† As the law at present stands, an oil, the flashing-point of which is declared to be 99° by the official inspector, must be condemned; but another operator may make the flashing-point of the same oil to be slightly above 100°. Practically, an oil with a flashing-point of 97° or 98° would be quite as safe as one which answers to the test at 100°, in the hands of the same operator

explosive effects; such ignitions, though occasionally observed in small mills, being caused either by the striking of fire by the stones, or by the incautious application of a light near the millstones, or the meal-spout attached thereto, have not in these instances been attended by any serious results. But in an extensive mill, where many pairs of stones may be at work at one time, each pair has a conduit attached to it, which leads to a common receptacle called an exhaust-box; into this the mixture of air and very fine flour-dust which surrounds the millstones is drawn by means of an exhaust-fan, sometimes aided by a system of air-blowers. The fine flour is allowed to deposit partially in this chamber or exhaust-box, and the air then passes into a second chamber called a stive room, where a further quantity of dust is deposited. It follows that when the mill is at work these chambers and the channels or spouts connecting them with the atmosphere immediately surrounding each millstone, are all filled with an inflammable mixture of the finest flour-dust and air, and that consequently the application of a light to any one of those channels, or the striking of fire by any one of the millstones, by igniting some portion of the inflammable mixture, will result in the exceedingly rapid spread of flame throughout the confined spaces which are charged with it, and will thus develop an explosion. The violence of such explosions depends much upon details of construction of the exhaust-boxes and stive rooms, and upon the dimensions of the channels of communication; it must obviously be regulated by the volume of inflammable mixture through which fire rapidly spreads and upon the extent of its confinement.

The subject of flour-mill explosions, though it has attracted little if any attention in this country previous to the Tradeston explosion, is discussed in continental treatises on flour-mills, and the results of Professors Rankine and Macadam's inquiries have demonstrated that accidents of this kind are actually of ordinary occurrence in mills, especially since the introduction of the exhaust arrangements. Those gentlemen point out that it appears scarcely possible to guard against such accidents altogether, although the frequency of their occurrence may probably be much reduced by adopting efficient precautions to prevent, as far as possible, a stoppage of the "feed" to the millstone, or the accidental introduction of nails between them together with the grain, and by prohibiting the employment of naked lights in the vicinity of the mills and the dust passages. In order to reduce as far as possible the damage and risk of sacrifice of life resulting from such explosions, it is important that all receptacles into which the dust-laden air is drawn from the mills should be fixed outside the buildings, and constructed so as to offer as little resistance as possible to the sudden expansion resulting from the ignition of the inflammable mixture. The conduits leading from the mills to the exhaust chambers should, moreover, be of small dimensions, and there should be no other communication between the interior of the building and the dust receptacles, which must not be opened while the mill is at work. By adopting precautions of this kind the mill-owner may succeed, at any rate, in reducing the mischief resulting from an accidental ignition of flour-dust at the millstones to such limits that the mill itself and the lives of those engaged in it will not be endangered.

The production of explosions by mixtures of air with marsh gas, coal gas, petroleum vapours, or a finely divided inflammable solid such as flour, has been shown to be due to the application of sufficient heat to some portion of the mixture to cause the atmospheric oxygen to combine with the combustible constituents of the gas, vapour or solid, the results being the development of chemical action, the formation of gaseous products, and their expansion by the heat developed. It need scarcely be said that the same explanation applies to the producton of explosions by that class of so-called explosive agents which is prepared by intimately mixing combustible or inflammable solids with a solid oxidising agent (*i.e.*, an oxygen compound which readily yields up a part or the whole of that gas under the influence of heat, and with the co-operation of chemical force, to carbon, hydrogen, or other readily oxidisable elements). Distinct from these explosive mixtures as regards their nature, but quite analogous to them in their behaviour and the effects they produce when subjected to heat or other disturbing influences, are explosive *compounds*. The majority of these contain carbon, hydrogen, and oxygen as the most important components; they are more or less susceptible of sudden or extremely rapid transformation into gases or vapours, attended by development of great heat, in consequence either of their resolution into their elementary constituents, or generally of the rearrangement of these into comparatively simple forms of combination. Some of these explosive compounds are of such unstable character that they are liable to undergo change from very slight inciting causes, such as the existence in them of minute quantities of foreign substances of active chemical character; or they may even be prone to absolutely spontaneous charge. In such substances decomposition may be in the first instance established only to a very minute extent, but this decomposition, by the products to which it gives rise, and by the attendant development of heat, however small, may speedily promote further and more rapid change in the mass of the substance, so that eventually decomposition of violent nature may be established, and the principal portion of the compound may suddenly undergo the same transformation into gases or vapours, attended by the same development of heat, as though any one of the agencies (*i.e.*, fire, friction, or percussion) ordinarily employed to determine the explosion of these bodies had been applied. Cases of so-called spontaneous explosion thus brought about are more familiar to scientific and manufacturing chemists than to the general public, but accidental explosions of very alarming, and, in a few instances, of very calamitous character, are on record which, though not actually of spontaneous nature, in the strict application of the term, have been brought about without any apparent application of external inciting agencies, and have hence, from a practical point of view, not been incorrectly classed as spontaneous explosions.

(*To be continued.*)

SOCIETIES AND ACADEMIES

LONDON

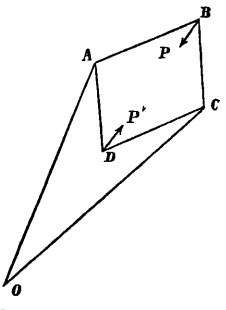
Mathematical Society, April 8.—Prof. H. J. S. Smith, F.R.S., president, in the chair.—Mr. G. H. Darwin gave an account of two applications of Peaucellier's cells, first, to "the mechanical description of equipotential lines"; and secondly, to "a mechanical method of making a force which varies inversely as the square of the distance from a fixed point." In this latter case, let o be the fixed pivot of a cell, and suppose the cell to be in equilibrium under the action of two faces, P and P', acting at D and B. Then by the principle of virtual velocities—

$$P'.\delta.oD + P.\delta.oB = o. \quad \text{Now, } oD.oB = oA^2 - AD^2$$

$$\therefore \frac{\delta.oD}{oD} = -\frac{\delta.oB}{oB} \therefore P'.oD = P.oB$$

whence $$P = \frac{P'(oA^2 - AD^2)}{oB^2}$$

If then P' is a constant force acting away from o, P is an attractive force varying as oB^{-2}. Mr. Darwin stated that the idea was the joint production of his brother Horace and himself, and that he entertained the hope that it would be possible to construct a toy to give an ocular proof of elliptic motion. A rough model was exhibited. Sir W. Thomson, F.R.S., expressed his pleasure at having heard the communication, as he had himself failed in trying to get a mechanical means of making such a force.—Sir W. Thomson then made two communications to the Society: one on the integration of the equations for the motions of a system acted on by forces expressed by linear functions of the displacements and velocities; the other on the vibrations of a stretched string of gyrostats (dynamical theory of Faraday's magnetic rotation of the plane of polarisation).—Prof. Cayley, F.R.S., made a few remarks on some integrals connected with the theory of attractions.—Mr. Tucker, hon. sec., then read a portion of a paper by Prof. Wolstenholme. The problem discussed in this paper is thus enunciated:—A tube of fine uniform bore is bent into the form of a regular polygon of n sides, and filled with equal volumes of n different fluids which do not mix; it is then closed, and held in any position in a vertical plane. The sides of the polygon formed by joining the common surfaces of the different fluids will always have constant directions; but if two conditions be satisfied, every position will be one of equilibrium. He applies his results to a few simple cases; thus, if $n = 3$, and the densities be in arithmetical progression, the straight line joining the ends of the fluid of



mean density will always be vertical. Again, if $n = 4$, and $\rho_1 + \rho_4 = \rho_2 + \rho_3$ ($\rho_1\rho_4\rho_3\rho_4$ being the densities of the fluids), then the diagonals of the square formed by the surfaces of the fluids will be vertical and horizontal. This instrument, Prof. Wolstenholme suggests, might possibly be used as a level and plumb-line; perhaps, also, some interesting toys might be made by other polygons.—A paper by Prof. J. Clerk-Maxwell, F.R.S., on the application of Hamilton's characteristic function to optical instruments symmetrical about an axis, and the value of the function for a spherical surface, was taken as read.

Geological Society, March 24.—Mr. John Evans, V.P.R.S., president, in the chair.—The President announced that the late Sir Charles Lyell had bequeathed to the Society the sum of 2,000*l.* for the purposes stated recently in our Notes, p. 434.—Prof. Prestwich proposed and Mr. W. W. Smyth seconded the following resolution:—"That this meeting, having heard the announcement of the bequest made to the Geological Society by the late Sir Charles Lyell, desire to record their deep sense of the loss the Society has sustained by his death, and their grateful appreciation of the liberal bequest for the advancement of geological knowledge placed at their disposal by their late distinguished Fellow."—The following communications were read:—On the occurrence of phosphates in the Cambrian Rocks, by Henry Hicks, F.G.S. In this paper the author showed from experiments that the Cambrian strata in Wales contain a far greater amount of phosphate and carbonate of lime than had hitherto been supposed. The results published by Dr. Daubeny some years ago, and which have since received the support of some eminent geologists, were proved therefore to be entirely fallacious when taken to represent the whole Cambrian series; for though some portions show only a trace of these ingredients, there are other beds both interstratified with and underlying these series, which contain them in unusually large proportions. The author, therefore, objects to look upon Dr. Daubeny's experiments as tending in any way to prove that the seas in which these deposits had accumulated contained but little animal life, and that we had here approached the borders of the lower limit of organic existence. He contended that the presence of so much phosphate of lime, and also of carbonate of lime, as was now proved by analyses made by Mr. Hudleston, F.C.S., Mr. Hughes, F.C.S., and himself, to be present in series of considerable thickness in the Longmynd group, Menevian group, and Tremadoc group, proved that animal life did exist in abundance in these early seas, and that even here it must be considered that we were far from the beginning of organic existence. The amount of phosphate of lime in some of the beds was in the proportion of nearly ten per cent., and of carbonate of lime over forty per cent. The proportion of phosphate of lime, therefore, is greater than is found in most of what have been considered the richest of recent formations. The amount of P_2O_5 was also found to increase in proportion to the richness of the deposit in organic remains. It was found that all animal and vegetable life had contained it from the very earliest time; but it was apparent that the Crustacea were the chief producers of it in the early seas; and of the Crustacea, the trilobites more particularly. It was always found where they were present, and the shell of some of the larger trilobites, as now preserved, contained as much as from forty to fifty per cent. of phosphate of lime. The analyses made by Mr. Hudleston and the author, of recent Crustacea, proved that they also contain P_2O_5 in very considerable proportions. In the second part of the paper the author showed that where intrusive dykes had passed through or between the beds containing the phosphate of lime, the beds for some distance on each side of the dykes had undergone a considerable change. Scarcely a trace of the P_2O_5 or of the lime was now to be found in them, though it was evident that before the intrusions into them had taken place, they, like the other portions of the beds, had evidently contained both ingredients in considerable proportions. It was well known that heat alone could not separate P_2O_5 from lime; therefore he found it difficult to account for this change in the character of the beds, unless it could be produced by gases or watery vapour passing into them at the time the intrusions took place. He thought it even probable that the dykes, which in some parts are found to contain a considerable amount of lime and also of P_2O_5, might have derived these, or at least some portions of these, from the beds through which they had been forced, and which must have been broken up and melted as they passed through them. There are no contemporaneous tuffs known in Wales of earlier date than the Llandeilo beds; and he thought these dykes belonged to that period, and that they were injected into the Lower Cambrian beds after from 8,000 to 10,000 feet of deposit had been superimposed. In an agricultural point of view the author considered that the presence of so much phosphate of lime in some of the series of beds must be a matter of great importance; and on examining the districts where these series occurred, he invariably found the land exceedingly rich. Mr. Hudleston gave the results of the analyses made by him at the request of Mr. Hicks. He found in a portion of dark gray flaggy rock taken from close to a fossil 1·62 in a portion of black slaty rock containing trilobites, but in contact with trap 0·11, in a portion of the shell of a trilobite 17·05, and in the trap above-mentioned 0·323 per cent. of phosphoric anhydride. A lobster-shell dried at 100° C. gave 3·26, an entire boiled lobster (undried) 0·76, and a boiled lobster without shell 0·332 per cent. of P_2O_5. If the analysis of an entire lobster be correct, he estimated that a ton of boiled lobsters would contain about 17 lbs. of phosphoric anhydride. In the analysis of a shell of a trilobite there appears to be a great excess of phosphoric acid, which Mr. Hudleston thought must be due to substitution.—Note on the structure of the phosphatic nodules from the top of the Bala Limestone in North Wales, by Mr. Hawkins Johnson, F.G.S. In this paper the author described the appearances presented by thin sections made from some of the phosphatic nodules and shales described by Mr. D. C. Davies, F.G.S., in his recent paper. In both nodule and shale he finds structure which he is inclined to identify with sponge-structure; but the mass also contains innumerable foreign bodies, chiefly fragments of the shells of Mollusca and Crustacea, with many irregularly ovate bodies that remind him of *Coscinopora*, and some that may be sponge-spicules. The author enumerated fourteen nodular formations from various localities and of various composition, in which he has detected organic structure, and to which he therefore assigns an organic origin; and he protested against the application of the term "concretionary" to such bodies.—On the maxillary bone of a new Dinosaur, *Priodontognathus Phillipsii* contained in the Woodwardian Museum of the University of Cambridge, by Mr. Harry Govier Seeley, F.L.S., Professor of Physical Geography in Bedford College, London. The bone described in this paper was indicated by the author in his "Index to the Aves, Ornithosauria, and Reptilia in the Woodwardian Museum," under the name of *Iguanodon Phillipsii*. Further examination and the detection of successional teeth resembling those of *Scelidosaurus*, and those referred by Prof. Huxley to *Acanthopholis*, induced him to regard the species as representing a new genus, most nearly related to *Hylæosaurus*. The specimen consists principally of the external and alveolar portion of the left maxillary bone, which is 4⅞ inches long, the alveolar part being 4½ inches, and the remainder made up by a posterior spur for connection with the malar. From the middle of the upper margin springs an ascending nasal process, separating the orbit from the nasal aperture. The presence of the posterior spur, or jugal process, seems to indicate an affinity to the Iguanodontidæ, notwithstanding the resemblance of the teeth to those of *Scelidosaurus*. The teeth, which are seen in their sockets, have their crowns resembling those referred to *Echinodon*, *Scelidosaurus*, and *Acanthopholis*, especially the last, differing chiefly by being relatively narrower, by having only 5–7 denticles on each side, by wanting the thickening at the base, and by terminating in a sharp point. The author described in detail the characters presented by the fossil, and indicated their bearing upon its systematic position. It was imbedded in a small slab of yellow sandstone, which also contained a specimen of *Pecten vagans*, and is probably of Great Oolite age.—Description of a new species of the genus *Hemipatagus*, Desor, from the Tertiary Rocks of Victoria, Australia, with notes on some previously described species from South Australia, by Mr. R. Etheridge, jun., F.G.S. In this paper the author described a new species of the genus *Hemipatagus*, under the name of *H. Woodsii*, and appended to this description some remarks on the characters of *Psammechinus Woodsii*, Laube, *Micraster brevistella*, Laube, and *Monostychia australis*, Laube; and also a synoptical list of the Australian Tertiary Echinodermata hitherto described.

Physical Society, April 10.—Prof. G. C. Foster, vice-president, in the chair.—Prof. H. M'Leod communicated to the Society some observations on the defects of the human eye as regards achromatism. The eye has been considered to be achromatic because it practically is so; but it is easy to offer abundant evidence of the defects of the organ in this respect. For instance, to short-sighted persons the moon appears to have a blue fringe. In using the spectroscope, the red and blue ends of the spectrum

cannot be seen with equal distinctness without adjusting the focussing glass. A black patch of paper on a blue ground appears to have a fringed edge if viewed from even a short distance, while a black patch on a red ground, when observed under similar conditions, has a perfectly distinct margin. Prof. M'Leod then explained that the overlapping of images in the eye produced the mental impression that there is no want of achromatism. It is interesting to note that Wollaston considered that the coloured bands of the spectrum were really divided by the black (Fraunhofer) lines, and his statement that the red end of the spectrum does not appear to have a boundary line, "because the eye is not competent to converge the red rays properly," shows that he had very nearly, if not quite, discovered the achromatic defects of the eye. Dr. Young ascribes to Wollaston the merit of having observed that when a luminous point is viewed through a prism the blue end appears to be wider than the red, the eye being incapable of recognising that the spectrum has the same width throughout its entire length. An excellent experiment was then exhibited to show the relative distinctness of a dark line on grounds of various colours. A string or wire was so arranged that its shadow traversed the entire length of a spectrum which was thrown on a screen by an electric lamp. When viewed from a short distance the edges of the shadow appeared to be sharp at the red end, but gradually became less distinct, until at the blue end nothing but a blurred line remained. Dr. W. H. Stone considered that the paper was specially valuable as suggesting a possible mode of investigating the relation between the defects in the eye and the personal co-efficient of error in observation.—Prof. Guthrie showed a kaleidoscope, devised by Mr. R. Cowper, in which the usual geometrical effects were produced by fragments of mica illuminated by polarised light.—Mr. Wilson, Demonstrator in the Physical Laboratory, South Kensington, exhibited a modification of Thomson's galvanometer, which might be readily constructed at a small expense. He used two discs of glass and replaced the usual brass quadrants by tinfoil; the connection between the binding screws and the quadrants was effected by fusible solder and platinum wires.—The Vice-President then alluded to the lamented death of Mr. C. Becker, of the firm of Messrs. Elliott, whose loss will be severely felt in every laboratory in this country.

Royal Microscopical Society, April 7.—H. C. Sorby, F.R.S., president, in the chair.—A paper by the Rev. W. H. Dallinger and Dr. Drysdale was taken as read; it was entitled, "Some further Researches upon the Life History of the Monads," and described the results of a number of careful observations made in continuance of the series communicated upon former occasions.—The President read a paper on some contrivances for the study of spectra and for applying the mode of spectrum analysis to the microscope. Having exhibited and explained the improved form of spectrum microscope, the adaptation of the spectroscope to the binocular arrangement, and a new form of diaphragm, the author proceeded to show the meaning of the absorption bands and the various methods of measurement and determination, pointing out the advantages of his new wave-length system over his former plan of comparison with the quartz interference scale. The effects of acid or alkaline additions to solutions were also shown by means of diagrams.

Institution of Civil Engineers, April 6.—Mr. Thos. E. Harrison, president, in the chair.—The first paper read was on the manufacture of steel, by Mr. Wm. Hackney, B.Sc.—The second paper was on Bessemer steel rails, by Mr. Josiah Timmis Smith. The object of this paper was to endeavour, briefly, to show that, with care in manipulation and in selection of materials, Bessemer steel might be produced constant in quality, and that certain inexpensive tests might be applied which would absolutely determine the quality of the material, in most if not all of its characters, so far as was required for railway and structural purposes.

PARIS

Academy of Sciences, April 5.—M. Frémy in the chair.—The following papers were read:—On a singular case of magnetisation, by M. J. Jamin.—On the theory of aspiration, with remarks on the new note of M. Peslin, by M. Faye.—On the limits of combining carbon with iron, by M. Boussingault.—On some documents relating to the history of diabetes, by M. Andral.—M. van Beneden then presented to the Academy a work on parasites in the animal kingdom.—The Academy then nominated a number of gentlemen to superintend the competition for various prizes during 1875.—On a scientific balloon ascent of long duration, by MM. Sivel, Crocé-Spinelli, A. and G. Tissandier, and Jobert. This is a detailed account, with several diagrams, of the ascent made by these gentlemen in the balloon *Le Zenith* on March 23rd last. The balloon was 18 metres in diameter, and held 3,000 cubic metres of gas; the scientific observations were made with barometers, thermometers, hygrometers, compasses, telescopes, and spectroscopes. Moreover, they had a fine electroscope, with a long copper wire of 200 metres, and an apparatus to measure the absorption of carbonic acid. The observers saw a fine lunar halo and six shooting stars, one of which with a long intensely blue trail. Four carrier pigeons were despatched, none of which returned to Paris.—A note by M. Sirodot, on the Mammoth of Mont-Dol (Ille-et-Vilaine).—On the relation between the m cyclic periods of the exponent of an algebraic curve of the m degree, by M. Max Marie.—Researches on co-variables, by M. C. Jordan.—A memoir by M. H. Durrande, on the applications of the general theories of dynamics to the motions of a body of varying form.—A note by M. Bouty, on the quantities of magnetism and the situation of the magnetic poles in thin needles.—On the physical properties of thin layers of collodion, by M. E. Gripon.—On the formation of iodic acid in flames in which iodine is volatilised, by M. G. Salet.—A note by M. R. Engel, on the substitution of hydrogen by mercury in creatine.—A note by by M. Lecoq de Boisbaudran, on the inequality of action of different isomorphous bodies on the same supersaturated solution; account of experiments made principally with potassic chrome alum and ammonia alum.—On a new process of extracting salt from soils, applied in the South of France, by M. A. Joannon. This process renders large tracts of land, which are now lying bare and unfertile, fit for purposes of agriculture.—A note by M. A. F. Marion, on the anatomy of a remarkable species of the group of Nemertida, *Drepanophorus spectabilis*.—A note by M. E. Prillieux, on tumours produced on the wood of apple-trees by the *Puceron lanigère* (a parasitic insect).—A note by M. Dezautière, on the sounds produced by the heart.—MM. Schnetzler, Pelletrau, Chase, Nodey, Chaperon, and Delfau, then made some communications with regard to Phylloxera.—M. Petrequin then addressed to the Academy several papers on the application of galvano-puncture in the treatment of aneurisms.—A memoir by M. Jacquet, on the use of the tables of Pythagoras for any number.—A note by M. Tridon, on the means of making telescopic observations and obtaining photographic proofs in the inside of an aërostatic diving-bell.—A note by M. Gruey, on the zodiacal light observed at Toulouse in February and March 1875, giving detailed tables of the observations of this interesting phenomenon.—On a method of calculating the absolute perturbations of comets, by M. Hugo Gylden.—On manganesiferous iron from carbonates, by MM. L. Troost and P. Hautefeuille.—Researches on the carbon of white cast-iron, by M. P. Schützenberger and A. Bourgeois.—On the theory of storms, a reply to M. Faye, by M. H. Peslin.—A note by M. Hildebrand Hildebrandsson, on the superior currents of the atmosphere in their relation to the isobaremetrical lines.—On a new formula for the calculation of the refractive power (or the number) of convex lenses, by M. Monoyer.—Gen. Morin then presented to the Academy a new part of the *Revue d'Artillerie*, published by order of the War Minister.

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