

THURSDAY, JANUARY 22, 1880

ON THE PHOTOGRAPHIC SPECTRA OF STARS<sup>1</sup>

THE author presented, in December, 1876, a preliminary note on the subject of this paper, together with a diagram of the spectrum of Vega compared with that of the sun.

The author refers to a paper by Dr. William Allen Miller and himself in 1864, in which they describe an early attempt to photograph the spectra of stars.

Other investigations prevented the author from resuming this line of research until 1875, when a more perfect driving clock, by Grubb, enabled him to take up this work with greater prospect of success.

The author describes the special apparatus and the methods of working which have been employed.

In consequence of the very limited amount of light received from the stars, it was of great importance not to spread out the spectrum to a greater extent than was necessary for a sufficient separation of the principal lines of the spectrum. The spectrum apparatus finally adopted consists of one prism of Iceland spar and lenses of quartz. The length of the spectrum taken with this apparatus is about half an inch, from G to O in the ultra-violet. The definition is so good that in photographs of the solar spectrum at least seven lines can be counted between H and K.

Though there is considerable loss of light in the employment of a slit, still, for the great advantage which it affords in obtaining spectra of comparison, a narrow slit one-three-hundred-and-fiftieth ( $\frac{1}{350}$ ) of an inch in width was always employed.

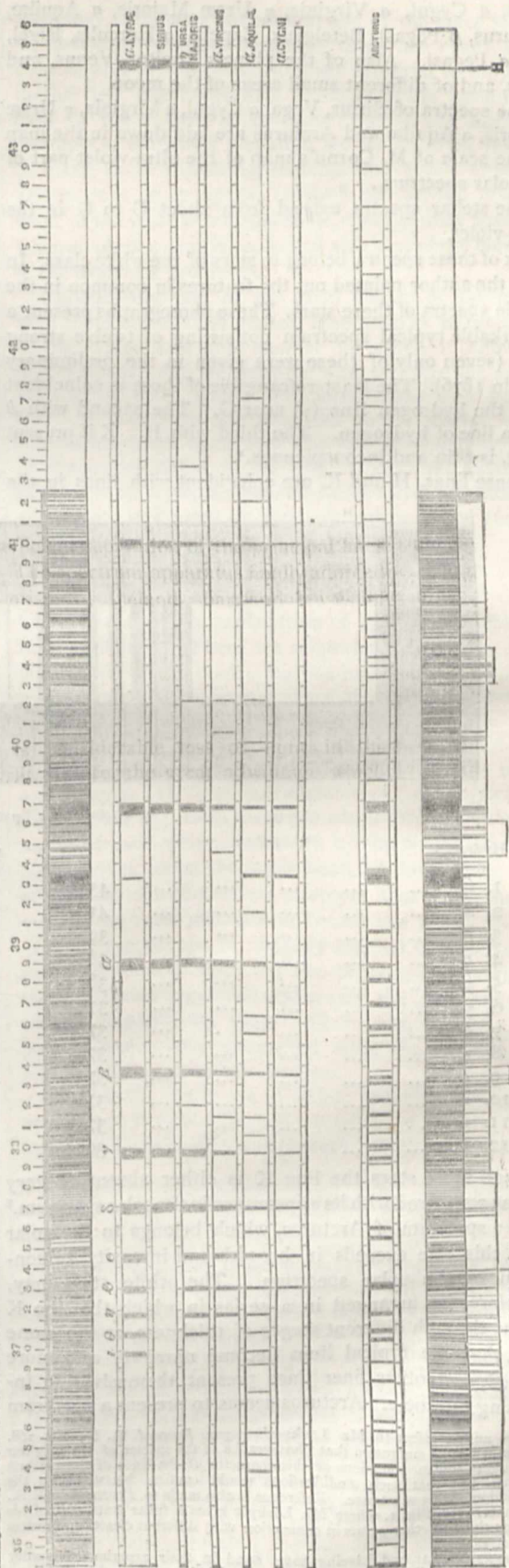
This slit is provided with two shutters. By means of these through one half of the slit a solar or other spectrum may be taken on the same plate for comparison, and for the determination of the lines in position in the spectrum. This apparatus was adapted to a Cassegrain reflector with a metallic speculum of 18 inches aperture. The small mirror was removed and the slit of the spectrum apparatus placed at the principal focus of the mirror. A simple but perfectly successful method was adopted by which the image of a star could be brought exactly upon the slit, and retained there during the whole time of exposure, sometimes for more than one hour, by a system of continuous supervision, and instant control by hand when necessary.

Various photographic methods were tried, but the great sensitiveness which may be given to gelatine plates, together with the special advantages under long exposures of dry plates led finally to the exclusive adoption of this method.

The photographs were examined and the lines measured by means of a micrometer attached to a microscope of low power. These measures were reduced to wave-lengths by the help of solar and terrestrial spectra, use being made of M. Cornu's map of the ultra-violet part of the spectrum, and of M. Mascart's determination of the wave-lengths of the lines of cadmium.

Photographs have been obtained of the stars Sirius,

<sup>1</sup> Abstract of paper by W. Huggins, D.C.L., LL.D., F.R.S., read before the Royal Society, December 18, 1879, with additions by the author.



Map of Photographic Spectra of Seven Stars.

Vega,  $\alpha$  Cygni,  $\alpha$  Virginis,  $\eta$  Ursæ Majoris,  $\alpha$  Aquilæ, Arcturus,  $\beta$  Pegasi, Betelgeux, Capella,  $\alpha$  Herculis, Rigel, and  $\alpha$  Pegasi. Also of the planets Jupiter, Venus, and Mars, and of different small areas of the moon.

The spectra of Sirius, Vega,  $\alpha$  Cygni,  $\alpha$  Virginis,  $\eta$  Ursæ Majoris,  $\alpha$  Aquilæ and Arcturus are laid down in the map on the scale of M. Cornu's map of the ultra-violet part of the solar spectrum.

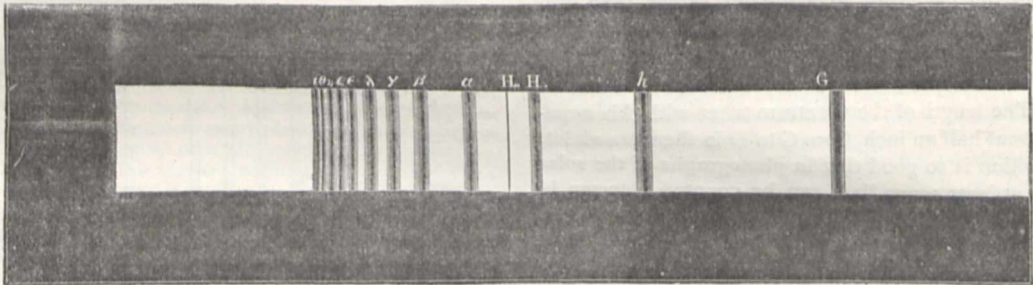
The stellar spectra extend from about G to O in the ultra-violet.

Six of these spectra belong to stars of the white class. In 1864 the author pointed out the features in common in the visible spectra of these stars. These photographs present a remarkable typical spectrum consisting of twelve strong lines (seven only of these were given in the preliminary note in 1876). The least refrangible of these is coincident with the hydrogen line ( $\gamma$ ) near G. The second with  $h$  also a line of hydrogen. The third with H. K if present at all, is thin and inconspicuous.<sup>1</sup>

These lines, H and K, are coincident with lines in the

calcium spectrum, and are usually attributed to the vapour of this substance. Now there is another pair of strong lines in the spectrum of calcium, which in M. Cornu's map have the wave-lengths 3736.5 and 3705.5. There are no strong lines in the white stars coincident with these lines. A glance at the map will show how remarkable is the arrangement in position of these twelve typical lines. They form a great group in which the distance between any two adjacent lines is less as the refrangibility increases. It is at once suggested that they are connected with each other and represent probably one substance, and two at least belong to hydrogen.

It should be stated that the continuous spectrum extends in the photographs beyond S, but no lines can be detected beyond the twelfth line at  $\lambda$  3699. For the sake of convenience of reference the author distinguishes these lines by the letters of the Greek alphabet in the order of refrangibility, beginning with the first line beyond K of the solar spectrum. The wave-lengths of these lines are as follows:—



Photographic Spectrum of a Lyrae.

Hydrogen near						
1. G	...	...	...	...	...	4340
2. $h$	...	...	...	...	...	4101
3. H	...	...	...	...	...	3968
4. $\alpha$	...	...	...	...	...	3887.5
5. $\beta$	...	...	...	...	...	3834
6. $\gamma$	...	...	...	...	...	3795
7. $\delta$	...	...	...	...	...	3767.5
8. $\epsilon$	...	...	...	...	...	3745
9. $\zeta$	...	...	...	...	...	3730
10. $\eta$	...	...	...	...	...	3717.5
11. $\theta$	...	...	...	...	...	3707.5
12. $\iota$	...	...	...	...	...	3699

In all these stars the line K is either absent or very thin as compared with its appearance in the solar spectrum.<sup>2</sup> In the spectrum of Arcturus, which belongs to the solar type, this line exceeds in breadth and intensity its condition in the solar spectrum. The white stars may, therefore, be arranged in a series in which the line K passes through different stages of thickness, at the same time that the typical lines become narrower and more defined, and other finer lines present themselves in increasing numbers. Arcturus seems to present a spectrum

<sup>1</sup> The author refers to Mr. Lockyer's paper, *Proceed. R. S.*, No. 168, 1876, in which he suggested that photographs of the spectra of the brighter stars might show modifications of this character of the lines of the calcium spectrum, and that such modifications would confirm his views on the dissociation of this substance. Reference is also made to *Proceedings R. S.*, December, 1878, Fig. 1, where Mr. Lockyer gives a fuller statement of his views on this and other points in connection with different classes of spectra of the stars.

<sup>2</sup> Messrs. Dewar and Liveing have found in their experiments similar relative changes of intensity of the lines of calcium corresponding to H and K in the emission spectrum of calcium.

on the other side of that of the sun in the order of changes from the white-star group.

The spectra of the planets were taken on the plan suggested by the author in 1864, in which the planet's spectrum is observed or photographed together with a daylight spectrum. These photographs show no sensible planetary modification of the violet and ultra-violet parts of the spectrum of the planets Venus, Mars, and Jupiter.

Numerous spectra of small areas of the lunar surface have been taken under different conditions of illumination, and during eclipses of that body. The results are wholly negative as to any absorptive action of a lunar atmosphere.

The author is preparing to attempt to obtain by photography any lines which may exist in the violet and ultra-violet spectra of the gaseous nebulae. He also points out the suitability of the photographic method of stellar spectroscopy, first inaugurated by his researches, to some other investigations, such as—differences which may present themselves in the photographic region in the case of the variable stars, the difference of relative motion of two stars in the line of sight, the sun's rotation from photographic spectra of opposite limbs, and the spectra of the different parts of a sun-spot.

In the hope of throwing light on many physical questions suggested by the stellar photographs, the author has taken for comparison a number of terrestrial spectra, especially of hydrogen and calcium, under different physical conditions. As he is still pursuing this inquiry, he reserves an account of this part of his work.

## VOCAL PHYSIOLOGY AND HYGIENE

*A Treatise on Vocal Physiology and Hygiene; with Especial Reference to the Cultivation and Preservation of the Voice.* By Gordon Holmes, L.R.C.P. (Edinburgh: Churchill, 1879.)

IT is one of the most singular facts connected with music that, notwithstanding the very wide spread of musical education, the kind of performance which is within the most general reach, namely, singing, receives the least amount of earnest culture. Almost every individual in ordinary health possesses the means of singing, which consist simply of a voice that can produce musical tones, and an ear that is capable of guiding its inflections. The latter qualification is, it is true, not so common as the former; but in all probability the cases where the human ear is absolutely wanting in the discrimination of musical pitch are extremely rare. Yet out of this great mass of mankind what a small proportion actually sing; and of those who do, what a still smaller proportion even aim at singing well!

Let us consider for a moment how the case stands in regard to that small fraction of mankind who attempt to sing in some fashion or other. The great majority of these never *learn* at all; they sing by the light of nature, using their voices in any way that will produce the notes their ears guide them to; and, no doubt, with naturally good voices and naturally good ears, music may sometimes result, which is quite tolerable, though infinitely inferior to what it might be made. But many persons do "learn to sing," and instruction of this kind forms a tolerably large professional avocation. What, then, does this imply? In most cases, unfortunately, little or nothing, so far as the true art is concerned. If a girl who finds she can sing a little asks for some lessons from an ordinary teacher, we know pretty well what will be done: there may be, just as a matter of form, a few exercises given; but the great aim will be to teach her the notes of certain songs, so as to provide her with a small repertory for social exhibition. This, however, is rather teaching *music* than singing, and the same may be said of the large number of classes for vocal performance in parts, where nothing is attempted beyond attention to the pitch of the notes used, and the time they are sung in. If we go a little further and include the cases where the teachers endeavour to give their pupils some idea of style, we about exhaust the category of vocal instruction which is common in private circles, and we need not wonder at the fact that, to educated judges, ordinary amateur singing, when it is not offensive, is at all events wretchedly poor. To learn to sing in the proper sense of the word is quite a different thing from learning songs; the voice is an instrument, the capabilities of which, in many respects, transcend those of any other known, and the cultivation of the voice, and of the singer's power over it, so as to use it to the best advantage, requires not only careful and judicious training, but long, hard, and laborious practice. It is consequently only among the professional ranks that we are accustomed to expect thoroughly good singing, and even here, whether from deficient education, imperfect powers, or defective taste, it is not often that what we expect is really found.

We might extend these remarks, in some measure to

speaking. Although the natural use of the voice suffices for common practical purposes, there are cases where considerable art and education are required to employ it to the best advantage, and yet little or no attention is paid to the matter, as is evidenced by the miserable attempts at untrained elocution we are so often doomed to listen to, in preaching, reading, and public speaking. The stage is an exception, as there the artistic management of the voice is indispensable, a fact at once perceived when amateur acting is compared with that of the members of the dramatic profession.

Undoubtedly one of the great causes of the evil in both these cases is the general ignorance as to the nature of the voice and the manner in which it admits of management; and we welcome with pleasure the appearance of a work which sets forth these and kindred topics in a way that cannot fail to be largely useful. Although written by a man who is fully conversant with all the technicalities of his subject, it is yet essentially popular in its style, and may be studied with advantage by all who are interested in the cultivation of the voice for any object whatever.

The introduction and the first chapter are devoted to an Historical Review of the Origin and Progress of Vocal Culture, and to an explanation of the general nature of musical sounds. These are somewhat lengthy, occupying one-fourth of the book; but one may fairly allow for the author's wish to render his treatment of the subject complete. In the remainder of the work he is more clearly on his own ground. Chapter II. is devoted to a description of the anatomical construction of the vocal organs, and Chapter III. to an investigation of their physiological mode of action. Both these are admirably treated of, and are illustrated, where necessary, by copious figures. The author gives, under the latter head, an interesting survey of the various theoretical attempts that were made to explain the vocal phenomena before the great invention of the laryngoscope in 1854, by Manuel Garcia, gave the power of actually observing the processes at work. By the aid of this ingenious apparatus, the explanation became comparatively easy. There are, however, some points, particularly connected with the falsetto voice, which are yet somewhat obscure.

Chapter IV. is the one to which, probably, the greatest importance is to be attached; it treats of "The Physiological Principles of Vocal Culture." The author says:—

"The cultivation of the voice amongst civilised nations has for its object the complementary development of the powers of organs which have already attained a high degree of perfection in the performance of their functions. Through the exertion of influences acting from without, and not directly controlled by the will, man proceeds instinctively and intuitively as a mere agent to the evolution of speech and language. But here, as in many other of his relations, beyond a certain point the unerring guide of nature leaves or only follows him with a perpetually widening interval, and his further advance is made voluntarily and with self-consciousness of his aim. . . . Hence we may recognise two grades in the employment of the voice—the first necessitated by the conditions of social life as a means of intercommunion, and the second undertaken with a view to the æsthetic observation of the listeners.

"The technical training of the voice lies immediately in the hands of teachers of elocution and singing. On

their taste and genius, as well as on the aptitude and natural vocal gifts of their pupils, depend in the greatest measure the success obtained and the perfection of the result. But whatever methods be adopted, the base of operations is vital organisation and action, of which the true apprehension and normal guidance must lead most directly and certainly to the desired end."

This, we take it, is the great aim, and the most useful tendency of the book, namely, in the first place to make known to those who desire to excel, either in singing or in elocution, that something more is necessary than they can obtain by the mere light of nature; and secondly, to enunciate the important truth that the art of using the voice to the best advantage can only be effectively taught by the aid of a competent knowledge of the nature and capabilities of the natural organ—matters of which great numbers of those who profess to teach have absolutely no idea at all. The value, therefore, of such information as is conveyed in this work, both to teachers and learners, can scarcely be overrated. It is not possible here to enter into details; suffice it to say that the chapter treats fully of vocal force, timbre, compass, and execution; of the modes of development; of the management of respiration; of the vibrating elements, the resonance apparatus, and the articulation; and it adds some useful data as to the treatment of that troublesome vocal defect—stammering.

The last chapter is devoted to a subject of vital interest to those who have to make public use of the voice, namely, vocal hygiene. The maintenance of the vocal powers is a matter of no less importance than their cultivation; but there is much ignorance and misunderstanding on this point, and the advice the author gives, coming as it does from one having authority, is most valuable.

WILLIAM POLE

### THE COPPER-TIN ALLOYS

*Preliminary Investigation of the Properties of the Copper-Tin Alloys.* A Report, Edited by Prof. R. H. Thurston, of a Committee on Metallic Alloys, Presented to the United States Board (Washington: Published at the Government Printing Office, 1879.)

IT is not a little remarkable that the study of the metallic alloys has been so generally neglected. Alfred Riche observes that this may in part be due to the fact that the characteristics upon which we rely in ascertaining the constitution of bodies are usually inapplicable to alloys. It is difficult for instance to determine with accuracy such physical constants as their melting points, for in many cases molecular rearrangement takes place when the alloys are heated, and, again, the properties of alloys are often greatly altered by the presence of impurities in such small quantities that it is impossible to estimate them by the balance.

Systematic efforts to clear up the obscurities with which the structure and nature of alloys are surrounded have, however, not been wanting. Thus, not to mention the well-known experiments of Hatchett, published in 1803, in 1855 Calvert and Johnson communicated to the British Association the results of a series of experiments, and in 1862 this body requested the late Dr. Matthiessen to continue his experiments on the chemical nature of alloys, the result being a report which certainly modi-

fied the views concerning them that had to that time prevailed. England then has certainly not been behind other countries in actual advance in metallurgical processes, but it is nevertheless true, as was pointed out by Abel in an address as president of the Chemical Section of the British Association in 1877, that the comparative ease with which triumphs may be won in the field of organic research has led the younger chemists to underestimate the importance of rigorous analytical work by which their science has been built up.

With regard to France the researches of Levol and of Alfred Riche will always hold a high place in scientific history; and in Germany there are many classical researches, such as those of Karsten and of Wertheim.

The volume before us affords abundant evidence that the Americans are not unmindful of the importance of metallurgical investigation. It appears that a committee, consisting of Prof. Thurston and Messrs. L. A. Beardslee and David Smith, was appointed in 1877 by the Government of the United States, to "assume the charge of a series of experiments on the characteristics of alloys," and the first result of their labours is an octavo volume, edited by Prof. Thurston, of nearly 600 pages, illustrated with photographs of fractures, and plates of curves representing the various physical constants of the alloys of copper and tin. The committee hope soon to present a similar report on the alloys of copper and zinc, and a third report on the triple alloys of copper, tin, and zinc will follow. They state that "the whole field has now been explored and the useful alloys are proved to occupy but a limited portion of its great extent, and it has now been shown that a comparatively narrow band, extending from ordnance bronze on the one side of this triangular territory to Muntz metal on the other, contains all the best of the alloys that are generally useful."

The necessary researches were conducted in the mechanical laboratory of the Stevens Institute of Technology, and the committee trust that this preliminary work will prove "to have been so satisfactorily done that its repetition may never be required, and that in future attention may be confined to matters of detail which have been shown to be of most promise." The committee did not seek to determine the character of chemically pure metal, but endeavoured to ascertain the practical value of commercial metals, melted in the way that is usual in the preparation of alloys in the foundry. The purest metals that could be obtained in commerce appear, however, to have been selected, the greatest care being taken to ascertain by a minute analysis the amounts of impurities in the metals employed and the composition of the twenty-seven alloys forming the subject of the Report.

After carefully noting the characteristics as to fracture, colour, and hardness of each alloy, their resistance to transverse stress was examined. Tests by tensile stress then follow, and the results agree, in general, very closely with those given by transverse stress. The alloys were then submitted to torsional stress in a machine devised by Prof. Thurston, and, if the autographic strain-diagrams given by the machine are compared with the curves representing resistance to transverse and tensile stress, a marked similarity will be evident. Experiments proved that the maximum resistance to compression is given by the alloy containing 69.84 per cent. of copper, and the

minimum by pure tin. A second series of alloys was then prepared, the mixtures of the constituent metals being made without reference to the chemical equivalents or the atomic weights of the metals, but a constant difference of 5 per cent. being maintained between each two alloys in the series. An attempt was made to obtain the temperature of pouring of this series by a well-known calorimetric method, but the results, of course, only profess to be approximate and relative, as the specific heats of the alloys are deduced from the mean specific heats of the constituents, and are assumed to be the same in the liquid as in the solid state. The numbers given, however, differ widely from those usually accepted, the "temperature of casting" of copper, for instance, being given as  $1,909^{\circ}$  C., while M. Violle (*Comptes Rendus*, t. lxxxix. p. 702) considers its melting point to be  $1,054^{\circ}$  C. It is probable therefore that the metals were poured at temperatures considerably above their points of fusion. The tests by transverse stress were repeated on this series of alloys and the results led the committee to conclude that they "do not seem to corroborate the theory given by some writers, that peculiar properties are possessed by alloys which are compounded of simple multiples of their atomic weights or chemical equivalents. . . . It does appear that a certain percentage composition gives a maximum strength, and another certain percentage a minimum, but neither of these compositions is represented by simple multiples of the atomic weights. Besides, there appears to be a perfectly regular law of decrease from the maximum to the minimum strength which does not seem to have any relation to the atomic proportions, but only to the percentage composition."

These conclusions are of the utmost interest and are certainly somewhat startling; it may be well to point out therefore incidentally that, since the report was published, it has been shown in this country that in the curves representing the induction-balance effect and the electrical resistance of the tin-copper alloys two critical points are occupied by alloys in which the constituent metals are combined in the very definite atomic proportions represented by the formulæ  $\text{SnCu}_3$  and  $\text{SnCu}_4$  respectively.

In summing up the results, the committee point out that the curves of resistance to tensile and torsional stress agree very closely, the curve of transverse resistance being similar, but the compression-curve is very unlike either of the others, the maximum compressive resistance being "reached by one of the brittle alloys, the tensile strength of which is not far from the minimum. It appears, therefore, that the tensile and compressive strengths of the alloys are in no way related to each other; that the torsional strength is closely proportional to the tensile strength, and that the transverse strength may depend, in some degree, upon the compressive strength as is indicated by the approach of some portions of the transverse curve to the compression curve, but is much more nearly related to the tensile strength, as is shown by the general correspondence of the curve of transverse with that of tensile strength. From the curves of transverse, tensile, and torsional strengths it is seen that the strengths of the alloys at the copper end of the series increase rapidly with the addition of tin, until about 4 per cent. of tin is reached.

The specific gravities obtained by the committee are corrected for temperature and are reduced to the standard

of water of maximum density. The results obtained by Mallet, Alfred Riche, and other experimenters are plotted side by side, but it is much to be regretted that those of the committee are only represented by a mean curve which at first sight is rather misleading.

The appendix to the volume contains several reprints of important monographs on alloys. There is also a valuable bibliography which might, however, have been more complete, and should surely have contained references to such important work as Mallet's on the density of metals in the fluid state, to some of the metallurgical researches of Eliot and Storer, and to Knox and Macgregor's on the thermo-electric properties of certain alloys.

Viewing the results as a whole there can be no question that metallurgists have reason to be grateful for the collection of facts which have been so laboriously gathered, and we trust it will not seem ungracious to express the wish that the work had been undertaken in this country.

W. CHANDLER ROBERTS

### OUR BOOK SHELF

*The Spiders of Dorset, with an Appendix containing Short Descriptions of those British Species not yet found in Dorsetshire.* By the Rev. O. Pickard-Cambridge, M.A., C.M.Z.S., &c. From the *Proceedings of the Dorset Natural History and Antiquarian Field Club*. Vol. i., pp. 1-235, with Three Plates, 8vo. (Sherborne: L. H. Ruegg, 1879.)

ALTHOUGH this book has been in our hands for several months, we have hitherto refrained from noticing it, hoping the second volume might come to hand, and thus have enabled us to give a more complete analysis. In the meantime the importance of the work deserves at least a preliminary examination.

Mr. Pickard-Cambridge's reputation as an arachnologist is a sufficient guarantee that any work written by him will be carefully executed. He states that his first idea was simply to give a list of the species found in the county in which he has so long been resident. Subsequently it was determined that the work should be monographic so far as the Dorsetshire species are concerned. It was then found that the species of the county included over two-thirds of those that occur in Britain, and it was decided to give diagnostic characters of the remainder, thus rendering the work a Handbook of British Spiders. There was urgent need for such a work. With the exception of a semi-popular outline sketch there has been nothing claiming to be monographic since the now venerable Mr. Blackwall published his magnificent Ray Society Monograph in 1860-63. This work noticed 304 species. Mr. Cambridge states that 510 are now known to him as British, and that 358 of these have been found in Dorsetshire. Considerable discrepancy exists in the nomenclature used as compared with that of Mr. Blackwall. This has mainly resulted from the well-known labours of Dr. Thorell, who, in his "Synonyms of European Spiders" (notable as a work in the English language published in Sweden), was the first to bring about tolerable uniformity in this respect. But very little inconvenience arises therefrom. Mr. Cambridge's handbook cannot supersede Mr. Blackwall's work with its magnificent coloured plates. Both must be in the hands of all students of *Araneidea*; the former elucidates and supplements the latter.

Mr. Cambridge commences with a copious "Introduction" of forty-two pages, written in a pleasing and popular style, so far as is compatible with a due explanation of the anatomy, &c., and very readable to all so far as his general remarks on the habits, means of capture, preservation, &c., are concerned. Some of his remarks

we hope to analyse more particularly hereafter, when we have the complete work before us.

Two important suggestions present themselves to us, as tending to render the book more useful. The first of these it is now impossible to apply. We think it would have been far better had the author intercalated the diagnoses of those British species not found in Dorsetshire amongst the descriptions of the others; this no doubt would have been done, but for the original indecision in the plan of the work. It is not yet too late to consider the other suggestion, viz., that a table of the family and generic characters be given at the end of the second volume. The expression at p. xxxvii. of the introduction, to the effect that "the subject of classification being practically exemplified in each of the ensuing descriptions, need not be further gone into here" is not in keeping with the popular aims of the work, and is not fair to those students who have not already acquired a considerable amount of that knowledge possessed by the author.

The three plates are excellent, and in Mr. Cambridge's usual analytical style. The work reflects great credit upon the local Society that issues it, which deserves the support and hearty thanks of all (we fear but few) who are interested in British Spiders.

*Studies on Fermentation; the Diseases of Beer, their Causes, and the Means of Preventing them.* By L. Pasteur, Member of the Institute of France. A Translation, made with the author's sanction, of "Études sur la Bière," with Notes, Index, and original Illustrations by Frank Faulkner and D. Constable Robb, B.A. Oxon. (London: Macmillan and Co., 1879.)

WE thoroughly agree with the following sentence from the English edition of Pasteur's important work: "The debt which English brewers owe to M. Pasteur can hardly be over-estimated;" but, further than this, we believe that the debt which biologists of all countries owe to him for his researches is also a very large one, for it is by a study of these low and simple forms of life that they may expect to learn something of the very beginnings of life itself.

On the appearance of the original work a very elaborate notice of it appeared in these pages (NATURE, vol. xix. p. 216); we need, therefore, now only call attention to this excellent translation, which contains many notes supplementing the facts mentioned in the original edition, several original illustrations, which cannot but be of great value in the microscopical study of the changes in the liquids with which the brewer has to deal, and an excellent index, which immensely facilitates the using of the volume.

This book may be, in the first place, one of special interest to the practical brewer, but it has a nearly equal interest for every careful student of nature, and it is so clearly written, with all the technical expressions so well explained, that we doubt not that the ordinary reader who takes it up will not put it on the shelf again without a perusal. The chapter on the physiological theory of fermentation is one we would specially commend to the general reader, to whom it may open up a quite new field for thought.

#### LETTERS TO THE EDITOR

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

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

#### Ice-Crystals

I do not know whether any satisfactory explanation can be given of the different forms assumed by ice-crystals on the

different substances on which they may be formed. These forms are very various. During an intense frost some years ago I observed upon the handrail of a wooden bridge a perfect forest of ice-crystals very closely resembling the form of ferns, standing upright, or rather at right angles with the surface from which they sprang, with stems, midribs, and fronds, the only difference being the prominence of rectangular arrangements.

Everyone has seen the variety of forms assumed on window-panes, where the crystals do not take erect positions as they did in the case last mentioned, but lie flat upon the surface of the glass.

My object, however, now is to direct attention to another form assumed by ice-crystals which is comparatively rare, and which seems to me to indicate the action of forces of a very peculiar kind.

When frost occurs suddenly as a change from a mild atmosphere highly saturated with moisture (which is common in the climate here), a peculiar form of ice-crystal is often formed upon rotten branches lying on the ground under trees. This form is that of long silky filaments, from two to three inches long, like finely spun glass. These seem to effloresce from the rotten wood, and form plumes of the most exquisite delicacy and whiteness, often curling towards the ends, and lying over the branch from which they spring.

It is curious that this form of ice-crystal seems never to be attached to any rotten branch of which the bark is unbroken; but whenever the bark upon such branches has been split, broken, or exfoliated, then from the exposed ligneous surface in certain stages of decay, these lovely plumes of ice rise up, pushing their way from underneath the projecting bits of bark, then bending round them and curling over them.

What is it in rotten woody fibre which determines this peculiar form of the ice-crystal? The phenomenon seems to be due to some special "lines of force" connected with this special material under special conditions.

During the last two nights we have had sharp frost succeeding some very mild and very damp days. In the mornings it appeared as hoar frost upon the grass, but during the whole day, long after all hoar frost had disappeared, there were scattered, under all the old woods, shining spots of snowy whiteness, and on going up to these one found invariably that they were bits of rotten branches, with exfoliated bark, and bearing these peculiar plumes.

If any of your contributors can give any scientific explanation of this phenomenon, they would much oblige. ARGYLL  
Inverary, January 13

#### Re-Reversal of Sodium Lines

THE notice of the *Proceedings* of the National Academy of Science in NATURE, vol. xxi. p. 143, misrepresents, of course unintentionally, certain remarks of mine upon "dark" spectrum lines. I have not, and never have had, the slightest doubt that the dark lines of the solar spectrum are true absorption lines. The lines in question, which I am inclined to think may not be due to absorption, are only those produced in certain peculiar cases. If, for instance, a sodium flame be "urged," by increasing the intensity of the flame and the quantity of metallic vapour present, each of the two D-lines becomes double, as is well known, widening out and showing a dark stripe down the centre. Hitherto this dark stripe has been universally ascribed to the absorption produced by the envelope of colour-vapour surrounding the flame. But if a lime-light be placed behind the flame, then, as I have found by repeated experiment, this central dark stripe *re-reverses*, and we have the sodium lines quadruple, and dark upon a light ground. The experiment is rather delicate. The bead of fused sodium bicarbonate in the flame of a Bunsen burner is placed some two inches from the slit of a spectroscope of sufficient dispersive power to separate the sodium lines about a degree; then the incandescent lime is set four or five inches behind the flame, and so as to bring the edge of the shadow of the bead just on the slit.

Now it seems to me that this re-reversal shows that the dark stripe which appeared before the lime-light was placed behind the sodium flame, could not have been a mere absorption-line, but must have been due to a real doubling of the line, the substitution of two maxima of radiation for a single one; I am unable to see how, on the contrary supposition, the centre of the line should have less absorptive power than the two pairs of lines which show black when the lime is brought into action.

May I mention in this connection a very pretty experiment

which shows that the ordinary dark line is simply due to absorption? Put into the spectroscope, in place of the micrometer wires, an opaque diaphragm of tinfoil with two narrow slits in it at right angles to each other, thus  $\perp$ . Put the sodium flame alone in front of the collimator slit, and by a little management one of the bright lines can be brought to shine through the vertical slit in the diaphragm, while it can also be seen as a sort of star in the horizontal one below. Now bring the lime-light behind the flame; the brightness of the vertical slit will at once considerably increase, but the horizontal slit below exhibits what was before the star, as an intensely dark spot in the midst of the bright continuous streak of colour, showing very strikingly that the apparent darkness of the line when no diaphragm is used, is a mere effect of contrast.

The paper referred to in the report as a discussion of "the want of achromatism of the ordinary achromatic object-glass," was a comparison of the secondary spectrum of a glass of the usual form and of great excellence, formerly used by me at Dartmouth College, with that of the instrument now used here. The latter is of the Gauss form, and is found to be decidedly superior in its colour corrections, while it is inferior in no other respect.

C. A. YOUNG

Princeton, N.Y., January 5

Death of Captain Cook

ON reading a paper reprinted from the *Memoirs* of the Boston Society of Natural History, vol. i. part 3, entitled "Notes on the Volcanoes of the Hawaiian Islands," by William T. Brigham, A.M., I find at page 370 the following strange paragraph: "Starting from the western coast at Kealakeakua Bay—the memorable scene of Cook's punishment—the island may be described," &c.

With writers accustomed to the correct use of the English language, the word punishment infers crime. Its use here by Mr. Brigham may be only a bilious outpouring of New England puritanism, but as it stands on the face of a grave scientific paper, it is a permanent accusation against Capt. Cook, whose reputation and memory as one of our greatest navigators and geographical discoverers, deserve the reverence of every Englishman. If there be any charge against Capt. Cook's reputation or moral character, which can justify the slur gratuitously cast upon his character by Mr. Brigham, in the above passage, let it be substantiated by one of his countrymen in your pages or elsewhere, but if there be no grounds on which this grave slur is justifiable, then let it not stand unchallenged by your permitting this letter to appear in the pages of NATURE.

London, January 14

ROBERT MALLET

Electricity of the Blowpipe "Flame"

I HAVE discovered what I believe to be an important fact, viz., that the blue pyrocone produced by the blowpipe from an ordinary gas-burner is not merely magnetic, but possesses polarity, for its point attracts the north pole of a compass, and repels the south pole.

W. A. ROSS

Acton House, Acton, W., January 17

Suicide of Scorpion

I MUST crave a bit of your space to beg Dr. Hutchinson (*vide* NATURE, vol. xxi. p. 226) to look to facts when he would refute anything based upon facts, and not trust to inferences.

My experience concerning scorpion suicide points to the fact that the "central temperature" of a circle of glowing charcoal embers (*i.e.* glowing when first placed on the ground in the open air, and left to die out gradually), one foot inner diameter, was never greatly in excess of the summer heat, often above 40° C. in the shade in these parts, and no doubt greater at Peshawar. I keep no record of this, but I have just made a circle of glowing embers of the size of walnuts, one foot in diameter, on the kitchen floor, before the open window, suspending immediately a Casella standard in the centre and one inch from the ground, and a highly graduated Secretan, two inches from charcoal and one inch from the floor, both bulbs free, the result being:—

Centre.—After three minutes, 49° 50 Cent.; at five minutes it had fallen to 46°, and continued to fall gradually.

Two inches from charcoal.—The heat declined gradually from 76° C., to which it rose quickly in the beginning; general temperature of kitchen = 15° 25 Cent. So much for Dr. Hutchin-

son's glowing inference! which points to little short of stupidity on my part.

The fact is that so far from being cruelly scorched, the scorpions I have watched did not appear out of their element, except when they tried to escape; then they quickly receded before burning themselves, and it was after many such attempts that they "pierced their head with their sting and died," as I have stated.

As to your correspondent's theory that "the heat kills the scorpion," it does not follow from the experiments as I conducted them; and as for his defying any one to prove that the insect dies in consequence of the self-inflicted sting, for my part I am no entomologist, and consequently am unable to make the necessary post-mortem examination. I simply state what I saw several times with a very good pair of eyes, though not, of course, "patent double-million-magnifying gas microscopes of hextra power." I now confirm the statement, and submit that if Dr. Hutchinson's paternal solicitude for his scorpions (which feeling, mind, I respect) prevents him making such cruel (?) tests, he should be content to doubt, and not pit unsound inferences against tangible evidence, much less hurl defiance at the heads of practical men.

F. GILLMAN

Prov. Jaen, Linares, Spain, January 12

The Fertilisers of Alpine Flowers

A FEW years ago I stated my belief in this journal that lepidoptera are far more frequent visitors and fertilisers of flowers, and that from this cause by far more flowers are adapted to cross-fertilisation by lepidoptera, in the Alps than in the lowland. But it was then impossible for me to give a sufficient number of facts. Now, therefore, having continued my observations in the Alps during six summers, and being about to prepare a detailed work on "Alpine Flowers, their Fertilisation by Insects, and their Adaptations to them," I will here give a statistical statement of all visits of insects on flowers which I have observed (1) in the lowland, (2) in the Alps generally, (3) above the boundary of trees; the numbers under 1 being extracted from my work, "Die Befruchtung der Blumen durch Insekten, &c." (Leipzig, 1873).

Tabular Statement of the Visits of Insects to Flowers, observed by myself

	1. In the Lowland.		2. In the Alps generally.		3. Above the boundary of trees.	
	a. Species of insects.	b. Different visits to flowers.	a. Species of insects.	b. Different visits to flowers.	a. Species of insects.	b. Different visits to flowers.
Coleoptera ... ..	129	462	83	337	33	134
Diptera ... ..	253	1,598	348	1,856	210	930
Hymenoptera ... ..	368	2,750	183	1,382	88	519
Lepidoptera ... ..	79	365	220	2,122	148	1,190
Other insects ... ..	14	49	7	15	3	6
Total ... ..	843	5,231	841	5,712	482	2,779

Hence of 1,000 different visits to flowers (differing either by the species of flower or by the species of insect) those by—

	1. In the Lowland.	2. In the Alps generally.	3. Above the boundary of trees.
Coleoptera are ... ..	89'66	59	48'22
Diptera " ... ..	305'49	324'93	334'65
Hymenoptera " ... ..	525'71	241'95	186'76
Lepidoptera " ... ..	69'77	371'50	428'31
Other insects " ... ..	9'37	2'62	2'16
	1000'00	1000'00	1000'00

Lippstadt, January 10

HERMANN MÜLLER

"Ideal" Matter

IN NATURE, vol. xxi. p. 185, you published a letter from Herr v. Nudeln, in which he alluded to the researches of Pro-

fessors Hans and Lobwirnski respecting ideal matter of various degrees. Can you inform me whether any English publications have appeared on this subject, and if not, what foreign works would be best suited to give an insight of the results that have been arrived at to one who can devote but a limited time to such investigations?

Surely the conclusion suggested by your correspondent (viz., that the moon in its composition closely resembles caseine) is intended only as a joke; for, assuming the equation given,

$$M = C_m N_n O_p H_q$$

and even granting that the quantities *m n p q* are in such proportion as to make the right-hand member of the above equation assume the form of the chemical formula for caseine, there is surely no reason why the mass of the moon (which your correspondent has chosen to denote by C) should be interpreted as carbon, nor its direction of motion N as nitrogen, nor its velocity O as oxygen.

PERCY R. HARRISON

Sun-Spots

In the "Life of Charlemagne," written by Eginardus, one of the Emperor's household, and afterwards Abbot of St. Bavon's, in Ghent, occurs the following passage:—

"Per tres continuos viteque termino proximos annos et solis et lunæ creberrima defectio, ac in sole macula quædam atrii coloris septem dierum spatio visa."

"In three successive years nearest to his death [there were] very frequent eclipses of the sun and moon, and in the sun there were seen certain spots of a black colour, for the space of seven days."

This life, written between 814 and 843, and referred to by the writer's contemporaries, has been collated with several MSS. by the Bollandists, who give it in full in their Acta Sanctorum under January 28. It is a curious, if not a valuable, contribution to the early history of sun-spots, and suggests questions which some of your correspondents may care to consider.

HENRY BEDFORD

All Hallows College, Dublin, January 15

A Clever Spider

In a letter I have just received from my brother at Rondebosch, near Cape Town, he narrates the following, which I thought might interest some of the readers of NATURE:—

"On Friday I was much interested in watching a spider and male glow-worm. The spider was a common long-legged house spider who had a web in the corner of the room. It was an aristocratic spider, in fact. Presently a male glow-worm flew into the web, and in a few minutes the spider had wound him round and round till no Egyptian mummy was more securely housed. Just as this operation was being finished, a second glow-worm flew into the web, a long way from the first. Off goes the spider, and soon he, too, was encased in silk. Then I noticed that the spider went three times backwards and forwards between the head of glow-worm No. 2 and a main strand of his web. After this he went round cutting all the threads around the glow-worm until it hung by the head strands alone. The spider then fixed a thread to the tail end, and by it dragged the carcass in the direction of glow-worm No. 1 (presumably the larder). As soon as the rope attached to the head was taut, the spider made the rope he was pulling by fast to a strand of the web, went back, cut the head ropes, attached himself to the head, and pulled the body towards the larder, until the tail rope was taut. In this way, by alternately cutting the head and tail ropes and dragging the glow-worm bit by bit, he conveyed it to the larder, where it hung alongside mummy No. 1. Another presently flew in. After he was enwrapped in silk, the spider, whether on purpose or not I cannot say, cut the last thread by which he hung, and dropped him to the ground. Whether he thought that this morsel might get 'high' before he could eat it I cannot say. I should say that the prey was some twenty times the weight of the captor."

LL. A. MORGAN

St. Thomas's Hospital, Westminster, January 12

Erratum in Paper on Tidal Friction

AN erratum has been pointed out to me in my article in NATURE, vol. xxi. p. 235, and I should be glad to correct it.

The forty-second line of the second column of p. 236 runs:—"so that the earth will rotate faster than the moon revolves." By a slip of the pen I here wrote "faster" instead of "slower."

G. H. DARWIN

January 16

AFGHAN ETHNOLOGY

THE events now in progress on the north-western frontier of British India have for the third time in this century directed the serious attention of statesmen, historians, and ethnologists to the remarkable people who give their name, or rather one of their names, to the north-eastern division of the Iranian table-land. During the empire of the Sassanides the whole of this region, from Persia proper to the right bank of the Indus and from the Koh-i-Baba, Ghor and other western continuations of the Hindu-Kûsh to the Arabian Sea was known as Khorasan, that is, Khoristan, the Land of the Sun or the East. This term, with the gradual reduction of the Persian sway, has shrunk to the proportions of a province on the north-eastern frontier of the Shah's estates, and has been replaced further east by the ethnical expressions Afghanistan and Balochistan, the lands of the Afghans and Baloches. But these expressions, as so frequently happens, are so far misnomers and deceiving that the lands in question harbour many other peoples besides those from whom they are now named. In Balochistan, for instance, the most numerous, powerful, and influential element is not the Baloch at all, but the still unfathomed Brahûi, from which circumstance it has even been suggested that the country ought rather to be called Brahuistan. A similar suggestion could not certainly well be made with regard to Afghanistan, for here there is no other people who can for a moment compare with the Afghans in numbers or political importance. Still the subjoined rough estimate of the population according to nationalities will show that it is very far from being homogeneous:—

Afghans and Pathâns ...	Iranian stock ...	3,520,000
Tajiks ...	Iranian stock ...	1,000,000
Hindkis ...	Hindu stock ...	500,000
Hazaras and Aimaks ...	Mongolo-Tatar stock	600,000
Kataghâns ...	Türki stock ...	200,000
Badakshis ...	Galcha stock ...	100,000
Baloches ...	Iranian stock ...	100,000
Kizil-Bashes ...	Türki stock ...	75,000
Kohistanis and Siah Posh	Galcha stock ...	50,000

6,145,000<sup>1</sup>

It will be noticed that in this table are included all the races forming part of the present Afghan political system taken in its widest sense, whose northern frontier is now marked by the upper course of the Oxus. Before dealing with the Afghans proper, with whom we are chiefly concerned, a few words may be devoted to each of the minor elements, all of whom continue to keep aloof from their neighbours, seldom or never intermarrying, and mostly retaining their own national customs, dress, religion, and speech. No general amalgamation has, in fact, yet taken place of these heterogeneous ingredients, so that we cannot speak of the Afghan in the same sense as we do of, for instance, the Italian, French, or English nations. The Afghan race, though by far the most numerous, has been politically predominant only since the death of Nadir Shah (1747), and its rule has been far too chequered by intestine strife and foreign troubles to have allowed time or opportunity for the slow process of

<sup>1</sup> This figure exceeds by about a million that usually given as the total population of Afghanistan. But recent exploration has shown that many of the tribes are much more numerous than had been supposed, and as our knowledge of the country increases, it will probably be found to contain even a greater population than that here given.



absorption to have made any perceptible progress. Next to them by far the most important are—

*The Tajiks*, who, here, as elsewhere in Central Asia, represent the old civilised Iranian communities, co-extensive with the former limits of the Persian empire, but since the ascendancy of the Türki, Mughal, Afghan, and Brahui races, now forming politically the subject, socially the settled, trading, and agricultural elements in these regions. Persian, or some variety of it, is still everywhere their mother-tongue; hence, in Afghanistan they are collectively known either as Parsivân, *i.e.* Persian-speaking, or Dehgân, *i.e.* peasants or agriculturists. "The Tajiks are Iranians, a remnant of the old Persian population subdued by the Afghans, but still speaking Persian and retaining the Persian type of features" (F. von Stein, in *Petermann's Mittheilungen* for March, 1879); religion, Sunnite. Remotely allied to them are—

*The Hindkis*, of Hindu stock, who have been long settled here chiefly as traders, forming numerous communities, especially in the eastern districts, said to be mostly of the Shatri caste; religion Brahminical, speech Hindustâni.

*The Hazaras and Aimaks*, occupying the northern highlands between Bamian and Herat, the former in the east, the latter in the west, are undoubtedly of Mongolo-Tatar stock, though now speaking rude Persian dialects. They claim descent, some from the Toghiani Türks, some from the Koreish Arabs, others from the old Kibti race, but seem really to be military colonists settled here by Jinghis Khân, Manku Khân, and Timûr. The Aimaks (the term simply means horde, tribe, clan), are of the Sunni, the Hazaras of the Shiah sect, and are consequently fiercely opposed to each other. Owing to this circumstance they have often been regarded as of different races, but "there seems no reason to doubt that the Aimaks and Hazaras are the same people, though separated . . . by the different sects they have adopted" (Col. C. M. MacGregor, "Afghanistan," p. 246); type, high cheek bones, with small grey eyes, scant beard, and low stature. The Aimaks occupy the Ghôr highlands, which must have been almost uninhabited when they settled there, for we read in the *National Chronicle* that about 1190 A.D., Sultan Shêhab-ed-dîn removed all the Afghan tribes from the Ghôr to the Ghazni highlands, "in order to become the bulwarks of the seat of empire and hold in awe the infidels of Hindustan." Of the Aimaks there are four main divisions, the so-called "Char Aimak" ("Four Hordes"): Taemûris, Taemûnis, Hazara-Zeidnats, and Suris, with a total population, according to some authorities, of about 450,000, including those now settled in Khorassan. The Hazaras, numbering at least 150,000, occupy the region stretching for 250 miles west from Kâbulistan, and are divided into thirty-eight main branches with numerous subdivisions, under chiefs bearing various titles, such as Khan, Sultan, Ikhtiar, Vali, Mir, Mettar, and Turkhan, and hitherto practically independent of the Durâni Amîrs. Akin to them are—

*The Kataghans*, a main branch of the Uzbeks, forming the bulk of the population in Kunduz and Balkh, that is, the region now known as Afghan Turkestan, stretching from the northern slopes of the Hindu-Kûsh to the left bank of the Upper Oxus. They take their name from a legendary Kata, from whom they claim descent in two main streams, the Beth-bula and Cheguna, with five and eleven sub-divisions respectively, each named after one of Kata's sixteen sons. Most of the tribes occupy the country south of the Oxus, but 7,000 families are now settled north of that river, consequently in Bokhara territory; religion Sunnite, speech Türki; type, small stature, broad face, high cheek bones, sparse beard, small oblique eyes. Are now mostly settled agriculturists and traders.

*The Badakhshis*, or natives of Badakhshan, in the

extreme north-east, beyond Kunduz, and abutting on the Pamir table-land, are a pure Aryan race, intermediate between the Iranians and Hindus, and of the same stock as the highland Tajiks, whom Ch. de Ujfalvy groups under the collective name of Galchas.<sup>1</sup> Chief divisions, Darwazi, Roshâni, Shugnâni, and Wakhi, or Wakhâni; religion Sunnite, speech Aryan, with Persian and Indian affinities. The Wakhi is a distinct variety, retaining many old Sanskritic elements, hence R. Shaw thinks it may be a relic of a primitive organic Aryan language current here before the race issued from the Pamir, or divided into Vedic and Zendic. It would be interesting to compare it with the Jagnôb, which de Ujfalvy tells us is unintelligible to the other Galcha tribes of Ferghâna. A Galcha skull which has found its way to Paris, has been examined by P. Topinard, who pronounces it to be identical with those of the early Celtic Aryans. If their speech also should prove to be of an organic Aryan type, as constituted previous to the dispersion, de Ujfalvy's view might be unreservedly accepted that "Ces pays mystérieux recèlent sans doute le secret de l'origine de notre race."<sup>2</sup>

*The Baloches*, of Iranian stock, and regarded by the Afghans as their brethren, are represented in Afghanistan chiefly by a number of hill tribes in the south-east corner, and by some nomads in the south and west along the Lower Helmand. Most of them belong to the Rind section of the Baloch race, the more important being the—

Kasrânis and Bozdars, on north-west border of Dera Ghazi Khan: numerous sub-divisions, the Bozdars alone with sixty-four septs (Major Minchin).

Khosabs, south of Sanghar Pass towards Shikarpur; four divisions: Kalulani, Bakiani, Toniani, Sariani.

Laghâris, overlooking the Sakhi-Sawar Pass, Dera Ghazi frontier; four divisions: Aliani, Hadiani, Boglani, Habtiani; fifty-six sub-divisions.

Gurchânis, south of the Laghâris, about Chachar Pass.

Maris, Sham district, east, north, and north-west of Kachi; four divisions: Ghazani, Loharani, Bijarani, Mazarani; twenty-two sub-divisions. The Mazarani have separated from the rest, and are now settled west of Sebi and north of the Bolan Pass.

Bûgtis, south of the Maris; two divisions: Firozani, Zarkâni; thirteen sub-divisions.

Kayânis, Seistân, former rulers of that country; by some said not to be Baloches, but Kâkar Afghans.

Religion, Sunnite; speech, a rude, uncultivated variety of the old Persian; type, regular Caucasian features, light or brown complexion; hair often chestnut and even fair; eyes light grey and sometimes blue, especially in centre and north. Of the many forms of the national name, Baloch, Biloch, Belûch, Balûch, Bilûch, &c., Baloch is the best, coming nearest to the true pronunciation, as Pottinger assured his French translator, M. Eyriès.

*The Kizil-Bashes*, or "Red Heads," known collectively as Gholam-Khani or Gholam-i-Shah, "servants of the King," are of Türki stock, and have been settled in Herat, the Gulkoh Mountains, but chiefly in Kâbul since the time of Nadir Shah. The term was originally applied by Shah Ismail to the Nikâlu, Jawânsher, and four other trusty Türki tribes to whom he owed his successes. But since then they have become a sort of brotherhood "much akin to the Beyyadiyah or 'White Boys' of Oman, and bearing some analogy to the Mormons" (W. G. Palgrave, "Report on Province Trebizond," 1868). Those of Kâbul form three divisions: the Jawânsher, originally from Shisha, the Afshar, Nadir Shah's tribe, and the Morâd Khani, composed of all the other Türkis who have from

<sup>1</sup> "Le-Badakchân est également habité en grande partie par des Tadjiks montagnards" (*Bull. de la Soc. de Géo.*, March, 1879, p. 250). But Robt. Shaw ("High Tartary") says that physically they approach nearer to the Kashmirians and other Aryans of Northern India. This is borne out by their speech, which is more akin to the Sanskritic than to the Iranic family.

<sup>2</sup> *Loc. cit.*, p. 252.

time to time removed from Persia to Kâbul; religion, Shiah, with secret rites; speech, Persian, and amongst themselves, Túrki; are a very fine race, very fair, with an evident mixture of Iranian and Tâtar blood.

*The Kohistanis and Siah Posh* ("Highlanders" and "Black Clothes") forming the bulk of the population in Kohistan, Swat, Kafiristan, Chitral, and generally of the southern slopes of the Hindu-Kûsh down to the left bank of the Kâbul river, are of pure Aryan stock, allied to the Kashmirians, but probably more closely to the Badakhshis and Wakhis. The Kohistanis are Moslem, the Siah Posh still mostly pagans, hence called Kâfirs, or Infidels, by their neighbours, and their country Kafiristan. Their speech, of which there are ten distinct varieties (Major Tanner), is described as neo-Sanskritic, akin to Dardu and Lughmâni. But it has never been critically studied, and may possibly prove to be pre- rather than neo-Sanskritic; is in any case of great philological interest, having been isolated from the kindred tongues since the eruption of Islâm in the tenth century; type, regular features, blue and dark eyes, hair varying from light brown to black, broad open forehead, tall and well-made. But General A. Abbot ("Correspondence," edited by C. R. Low, 1879) distinguishes between a fair type with blue eyes, the aristocracy "descended of the Greeks" (?) and a very dark type, the aborigines. The Kohistanis north and north-west of Kâbul, C. R. Markham says, are mainly Tajiks (*Proc. Geo. Soc.*, February 2, 1879, p. 117); but they are more probably of the kindred Galcha stock, for those of Swat are represented as closely akin to the Siah Posh whom I take to be of this race. They form two main sections, the Torwals and Garwis. They took a large share in the recent events about Kâbul and have just been reduced by the British. The Safis, who have also lately been heard of in the same neighbourhood, are simply Siah Posh converts of the Tagao valley, Kunar district, north of Kâbul; three divisions: Wadin, Gorbaz, and Mûsawîd; speech Pashae, closely allied to Lughmâni and Kohistani of Swat.

We come now to the Afghans proper, whose original home seems to have been the Kâbul valley, whence they spread westwards to the Ghôr country, southwards to the Suleimân mountains, and more recently down the Helmand and Arghandâb valleys to Kandahar.<sup>1</sup> They call themselves Bani-Israel, "Sons of Israel," claiming descent either from Saul or from the ten tribes, for on this point they do not seem to be quite clear. But this is of the less consequence that both claims are alike inadmissible. Notwithstanding a certain Jewish expression, which they have in common with the Armenians and other races of the Iranian plateau, they are beyond all doubt an Aryan and not a Semitic race, so far as these terms can be at all used as racial rather than linguistic designations. And here it may be well to remember that both Aryan and Semite belong equally to one ethnical stock, conventionally known to anthropologists as the Caucasian or Mediterranean, and that they can often be distinguished one from the other only by the test of language. We have the same phenomenon in Europe, where but for their speech no one would ever suspect that the Basques of the western Pyrenees were other than a somewhat favourable specimen of the Aryan race. This test, however, is abundantly sufficient to sever them from that connection, and the same test must suffice to remove the Afghans from the Semitic to the Aryan group.

Their most general and apparently oldest national name is Pukhtûn or Pakhtûn, as it is pronounced by the Khaibarîs, and which has been identified with the *πακτρύες*, of whom Herodotus heard through Scylax (509 B.C.) as situated about the junction of the Kôphes (Kâbul) and

Indus. Their country they still call Pukhtûn-khwa, which is equivalent to Watan-khwa, or "Home Land"; their language is always called by them the Pukhtû, softened in the west to Pushtû, and from Pakhtâna, the plural of Pakhtûn, comes the form Pathân by which they are known throughout India. This word has been connected with the root Pukhta, a hill, so that Pukhtun would mean Highlander. But such derivations are seldom trustworthy, and it may be questioned whether any people have ever called themselves *Hill-men*, though often enough so named by their neighbours.

The alternative national name, Afghân, by which they are exclusively known in Persia and Europe, has been regarded by some as synonymous with Pukhtûn, both meaning "set free;" but by others it has been connected with Ačvakan, the Ačvaka, or "Horsemen," of the Mahâbhârata, who are supposed to be the Assakani, or Assekene, of the later Greek historians. The natives themselves draw a distinction between the two names, so that although all Afghans are Pukhtâna, not all Pukhtâna are true Afghans. The latter term is properly restricted to the descendants of a legendary Kais, one of the first apostles of Islâm (ob. 662), from whom, through his three sons, Sarabân, Batân, and Gurgûst, are supposed to spring the 277 Afghan khels (tribes) proper. Of non-Afghan khels there are reckoned 128, making 405 Pukhtâna khels altogether. Of these 105 are Sarabâni (from Sarabân), 77 from Batân, in two divisions; Batanai 25, and Matti 52, these last being known as Ghilzai; 223 from Gurgûst, also in two divisions; Gurgûstai 95, and Karalânai 128, these last being the non-Afghan or Pukhtâna khels as above. In this traditional account of the national genealogies the distinction between the true Afghan and non-Afghan tribes is already obscured, for the latter are made to descend from Gurgûst, one of the three sons of Kais, who is elsewhere represented as the ancestor of the true Afghans alone. But the confusion becomes intensified when it is added that the very word Pathân, specially applicable to the non-Afghans, and which we have seen is merely the Indian form of Pakhtâna, is explained to be a corruption of Pihtan, "rudder," a title said to have been conferred on Kais by the Prophet himself. Altogether the distinction, though still maintained and recognised by the various sections of the people, cannot at all be regarded as racial. The true Afghans occupy mainly the western, central, and north-eastern districts—Herat, Seistân, Kandahar, and the Kâbul basin, as far east as Peshâwar. The non-Afghans, or Pathâns proper, are found almost exclusively in the Sufed-Koh and Suleimân highlands, as far south as the Kaura or Vahû Pass, opposite Dera Fatah Khan. A line drawn from about the parallel of Multân, through this point, westwards to Tal through the middle of the Derajât, will very nearly form the boundary in this direction of the Pathâns on the north, and the Baloches and Brahuis on the south. This relative geographical area suggests a possible explanation of the distinction between the two great divisions of the race. From their more westerly position it is obvious that the true Afghans must have been the first to adopt Islâm, and they may have thus come to look upon their pagan brethren of the Suleimân highlands as Kâfirs, undeserving to rank as genuine Afghans, the distinction thus originated naturally surviving their subsequent conversion.

In the subjoined table an attempt is made to give, for probably the first time, a complete classification of all the main sections of both divisions, with their chief sub-branches, approximate number of khels, geographical area, and population. The difficulty of the subject, occasioned mainly by the minute tribal sub-divisions, may be concluded from the fact that a complete genealogical tree of, say, the Afridis or the Vaziris alone, would occupy about two pages of NATURE.

<sup>1</sup> Till the time of Sultan Babur, founder of the Mughal empire (beginning of sixteenth century) the Afghan language was still confined to the north-eastern and western highlands, Persian being elsewhere current, as it still is mostly in the lowlands.

TABLE OF AFGHAN AND PATHÁN TRIBES.

Main Sections.	Chief Subdivisions.	Total No. of Khels.	Geographical Position.	Population.
I. Durâni or Abdali ...	1. <i>Zirak</i> :—Popalzae, Ali-kiozae, Barakzae 2. <i>Panjpao</i> :—Murzae, Alizae, Ishakzae	135	Mainly in the tract between Herat and Kandahar, 400 miles long, 80 to 150 broad; also in Kâbulistan.	800,000
II. Khugiâni... ..	Vaziri; Khairbûn; Sherzad	32	Chiefly in the Jalalabâd district, between Surk-âb and Kâbul rivers. Seem to have been originally a branch of the Panjpao Durânis.	50,000
III. Ghilzae or Ghilji ...	1. <i>Turân</i> :—Ohtak, Sakzae, Tunzae 2. <i>Bâran</i> :—Chin, Chalo, Zabar, Ali, Sulimân	140	In the country bounded N. by the Kâbul river, E. by the Suleiman Mts., W. by the Gulkoh Mts., S. by Khalat-i-Ghilzae and Poti; 300 miles long, 100 miles broad. A branch at Khubes and Nurmanshahr, Persia.	600,000
IV. Yûsafzae ... ..	1. <i>Mandân</i> :—Usmân, Utmân 2. <i>Yûsaf</i> :—Isâ, Iliâs, Mali, Rani	130	The hills N. of Peshâwar district and in the Yûsafzae division of the Peshâwar district.	700,000
V. Mohmandzae or Mahmandzae ... ..	Tarakzae; Halim; Baizae; Khwai; Utmân	63	The hills N.W. of Peshâwar between Kâbul and Swat rivers; chief town Lalpûra.	40,000
VI. Kâkars ... ..	Jala; Musa; Kadi; Usman; Khidar; Abdula	45	Extreme S.E. corner Afghanistan proper.	200,000
VII. Khataks ... ..	Tari; Taraki; Bolak	70	S.E. part Peshâwar district, and S. and E. of Kohat; some also now amongst the Yûsafzaes.	100,000
VIII. Utman Khel ... ..	Asil; Shamo; Mandal; Ali	33	The hills N. of Peshâwar between the Mohmands and Yûsafzaes.	80,000
IX. Bangash ... ..	Miranzae; Baizae; Sâmalzae	20	Miranzae, Kohat, and Kûram valleys; said to be originally from Seistân.	100,000
X. Afrîdis ... ..	Kuki; Malikdîn; Kamar; Kamr; Zakha; Aka	180	Lower and easternmost spurs Sufed Koh Mts., W. and S. of the Peshâwar district, with Bara valley and parts of Chura and Tira valleys.	90,000
XI. Orakzae or Wurukzae	Daolat; Utman; Sipah; Ishmail; Rabia; Isa	70	The Tira highlands, N. and W. of Kohat.	30,000
XII. Shinwâris or Shanwâris ... ..	Sangu; Ali Sher; Sipâi; Babur; Lohargae	30	Parts of Khaibar Mts., E. valleys of Sufed Koh and on borders of Bajâwar. <i>Note.</i> —X., XI., and XII. are collectively known as the <i>Khaibarîs</i> .	50,000
XIII. Tirâes ... ..	Shibdواني; Seh Paf	8	In the Kot valley of the Shinwari country, but distinct from them.	7,500
XIV. Jaduns or Gaduns ...	Salâr; Matkhwa; Mansur	10	S. side Mahaban Mts. and Hazara district, Peshâwar; said to be Kâkars originally, though now with the Yûsafzaes.	5,000
XV. Tarins ... ..	<i>Spin</i> :—Shadi, Marpani, Lasrani <i>Tor</i> :—Batch, Haikal, Mali	20	N. frontier Biloch province Kachi.	20,000
XVI. Povindahs ... ..	Lohani; Nasar; Niazi; Dao-tani; Kharoti; Miani	120	From head of Gomal S. to head of Lora river along W. Suleiman range, their territory forming a triangle hemmed in between the Ghilzaes, Vaziris and Kâkars.	50,000
XVII. Vaziris or Waziris ...	1. <i>Utman</i> :—Mahmud, Ibrahim 2. <i>Ahmad</i> :—Shin, Sirki, Umur 3. <i>Mahsud</i> :—Ali, Shahman 4. Gurbaz; 5. Lali	320	Suleiman Mts. from Thal to Gomal Pass, 30°-32° N. lat. A branch now with the Khugianis (II.)	250,000
XVIII. Shirânîs ... ..	1. <i>Chua</i> :—Yahia, Bairam 2. <i>Sen</i> :—Ahmad, Yahia 3. <i>Uba</i> :—Ahmad, Manu	130	Suleiman Mts. from the Shekh Hidar Pass southwards to the Ramak.	35,000
XIX. Bâbars ... ..	Mahsud; Bahâdin; Musa; Ahmad; Mardân	15	In the Koh-i-Daman of the Dera Ishmail district, opposite the Sangâo and Dahina Passes; same stock as the Shirânîs.	20,000

TABLE OF AFGHAN AND PATHÂN TRIBES (Continued).

Main Sections.	Chief Subdivisions.	Total No. of Khels.	Geographical Position.	Population.
XX. } Turis ... ..	Gundi; Ali; Mula; Mastu; Firoz; Maru	52	Kuram valley. (See Note under XXI.)	30,000
XXI. } Jajis ... ..	Maidan; Danni; Isteah; Al- garh; Ada; Lehwanni; Ali; Ahmed; Bian, Shamu	50	Kuram valley, mostly about River Ariab and from the Shutar Gardan to the Paiwar Pass. <i>Note.</i> —XX. and XXI. are not regarded as true Pathâns, being traditionally sprung of two Mughal brothers, Tor and Jaji. Edwardes says they are Khatar Hindkis from Rawalpindi.	4,000
XXII. } Zaemûkhts ... ..	1. <i>Khwaidad</i> :—Bâbakar, Hasn 2. <i>Mahamad</i> :—Wati, Manatu, Mandan	33	In the hills between Mîranzæ and Kûram.	25,000
XXIII. } Dawaris ... ..	1. <i>Tapi</i> :—Haidar, Idak 2. <i>Mâlâi</i> :—Darpa, Amzani	6	Dawari valley, 32° 57'—33° 7' N. lat.	20,000
XXIV. } Khostwâls ... ..	Ishmail; Matûn; Mandu; Shamal	10	Upper Khost valley, adjoining Kûram and Zurmat.	12,000
XXV. } Mangals ... ..	<i>Lajhwar</i> :—Fattakeh, Agar, Andaz, Miral, Khajuri, Zab	14	On Lajhi river, Kuram valley, and parts of Zurmat; are supposed to be of Mughal descent.	25,000
XXVI. } Jadrans <sup>1</sup> ... ..	—	—	East of Zurmat, E. side of Suleiman Mts.	15,000
XXVII. } Ushtarânas ... ..	1. <i>Gagal</i> :—Shaho, Musa, Ako, Shamo 2. <i>Ahmad</i> :—Ibrahim, Kadr, Mashar	42	The hills opposite extreme S. part Dera Ishmail district. Are disowned by the Afghans, though apparently of Lohani (Povindah) stock.	8,000
XXVIII. } Esots ... ..	1. <i>Noh</i> :—Ahmad, Zado, Ja- han, Chado 2. <i>Mâlâ</i> :—Ado, Khidr, Pain- da, Khadi	15	The hills west of Dera Ishmail Khan. Are said to be of Kâkar origin, though now distinct; Troglodytes.	5,000
XXIX. } Jafars ... ..	Ramdani; Mohra; Rajâli; Rawâni	12	Between the Bûj spur of the Suleimân Mts. and the Bozdar Biloches.	5,000
		1,790		3,521,000

Of the main sections in this table, Nos. I. to XII. inclusive are recognised as true Afghans, and of these, Nos. I. and III. (Durânis and Ghilzæes) are by far the most important and influential. Since the time of Nadir Shah, the Durânis have been the ruling tribe, the Popalzæ division till 1818, the Barakzæ from that year to the present time. They were formerly called the Abdali or Avdali, a name which has been traced to the Ephthalites and Abdela of the Byzantine writers of the sixth century. But it was changed to Durâni from the title of Durri-Durân, "Pearl of the Age," assumed by the Sardar Ahmad Khan, of the Saddozæ branch of the Popalzæes, when he usurped the supreme power at Kandahar on the death of Nadir Shah in 1747. The seat of government was removed from Kandahar to Kâbul by his successor, Taimûn Shah (ob. 1793), and this dynasty became extinct in 1818, when it was succeeded by the Barokzæes in Kâbul, though various descendants of Ahmad Khan continued and still continue to assert their claims to the sovereignty in Herat.

Although mentioned in the national genealogies, the right of the Ghilzæes to be considered as Pukhtûns at all, much less genuine Afghans, has been questioned. There certainly seems to be a flaw in their escutcheon, and they themselves, who always call themselves *Ghilji*, and not

*Ghilzæe*, claim Tûrki descent. The national tradition is that they entered the country in the tenth century under a certain Sabaktakin, of the Kilich Tûrki tribe "anciently situated on the upper course of the Yaxartes"<sup>1</sup> (Syr Darya). But, however this be, they are now entirely assimilated in habits, dress, religion, and speech, to the other Afghan tribes, with the exception of a few who are still nomads.

None of the other sections call for special remark except the Povindahs, who are at once agriculturists, traders, and warriors, their armed caravans yearly fighting their way through the intervening hostile tribes down to the markets of the Panjâb and Sindh. The name is supposed to derive from the Persian Parwinda, a bale of goods, and seems to be indifferently applied to the Lohanis, Waziris, Kâkars, Ghilzæes, or any other tribe temporarily or permanently forming part of this singular "trades' union." By far the most important section are the Lohanis, the oldest and most numerous members of the association, and one of the most promising elements for the future pacific settlement and material prospects of the country.

Physically the Afghans may be described as, on the whole, a fine race. Their features, though often coarse and ugly, are regular in the European sense of the term, with the occasional Jewish cast above remarked upon.

<sup>1</sup> I have not yet succeeded in obtaining the subdivisions of this section, and will feel obliged if any reader of NATURE will kindly communicate them, together with any other omissions or rectifications that may occur to him.

<sup>2</sup> H. W. Bellew, "Afghanistan and the Aghans," 1879.

Type, long, oval face, arched nose, head mesaticephalous, that is, intermediate between the round and the long, measured horizontally, with cranial index 79;<sup>1</sup> fair complexion, thick beard, hair and eyes generally black, but light blue or grey eyes and brown hair common amongst the Rohillas,<sup>2</sup> as the Suleimán highlanders are often collectively called.

The great bulk of the people are Sunnites, which is one of the causes of their profound aversion to the Persians, who are mainly of the Shiah sect. Yet the nobles and upper classes, especially amongst the Duránis, usually converse and always correspond in Persian. The consequence is that the Pukhtu, or national language, has remained a somewhat rude idiom, seldom employed in literature, and in refined society regarded as little better than a provincial patois. Its importance philologically is considerable, for though usually grouped with the Iranian branch of the Aryan family, Dr. Ernest Trumpp (Grammar, 1873), gives it a more independent position as intermediate between the Iranic and Indic, while Prof. Haug, of Munich, now regards it as a separate member of the family. It is very harsh and spoken with considerable dialectic variety everywhere in Afghanistan proper except the Hazarajat, and also in the Pesháwar district of British India. The most marked dialects seem to be the Kandahari, Dir, Tirhai, Pesháwari, Khaibari, Tarni, Vaziri, and Ushtaráni. The Pashae and Laghmáni, sometimes included in the list, are not Pukhtu at all, or even Iranian, but distinctly Sanskritic, closely allied to the Siah Posh and Kohistáni.

A. H. KEANE

### THE METEOROLOGY OF SOUTH AUSTRALIA<sup>3</sup>

MR. CHARLES TODD sends us a well-written and eminently practical paper on the rainfall of Adelaide during 1878, illustrated with a map showing the positions of the 115 stations for the observation of the rainfall of that part of Australia and their rainfall for the year. Along with the monthly rainfall for 1878 there are printed the monthly means of forty-three of the stations at which the rainfall has been recorded for at least eight years. Since these stations extend right across the continent from Palmerston in the north to Cape Northumberland in the south, we are now, through this boldly designed system of observation, obtaining just notions of the agricultural and pastoral capabilities of the colony, in so far as these depend on that prime factor of climate, the rainfall.

The rainfall of South Australia depends, on the one hand, on the tropical rains, which extend from the north coast inland, and prevail from November to April; and on the other hand on the winter rains, which extend from the south coast northwards into the interior, and prevail for the seven months ending with October.

The tropical rains extend in a greater or less degree across the interior, as far as lat. 26 S., falling off very considerably, however, south of Daly Waters, in lat. 16° 15'. The breadth over which these rains spread southwards and their copiousness depend altogether on the strength and southerly dip of the north-west monsoon, and consequently in the years when this monsoon blows over Australia with diminished force, a large tract of territory becomes nothing but an arid waste.

A different state of things, however, prevails along the north coast and for a few hundred miles inland. There the summer rains fail not. At Palmerston, for example, the average of the past nine years gives a monthly fall

for each of the four months, from December to March, of 12·38 inches; in April, October, and November, the monthly mean is 3·68 inches; in May and September it is small, and in June, July, and August no rain falls. Here, then, is a large region, doubtless with a great future before it as regards the supply of the markets of the world with fruits and other tropical produce, such as have long been shipped from the rich plains of India and Ceylon.

The winter rains occasionally extend well up into the interior, sometimes passing the centre of the continent; but generally they thin off about 100 miles north of Spencer's Gulf, and are heavy north of this gulf only along the Flinder's range of mountains. The area of minimum rainfall of the continent extends from the Great Australian Bight to the northern extremity of the Flinder's Range, over the plains to the east of this range up to latitude 25°, and spreads either way to within perhaps a few hundred miles of the east and west coasts.

The agricultural districts of South Australia are marked off by the method of distribution of these winter rains; and roughly speaking, they lie for some distance northwards along and in the immediate vicinity of the Flinder's Range, and thence southwards along the coast to Cape Northumberland. This broadish strip of territory constitutes, then, the granary of the colony; and looking at Mr. Todd's rain returns in connection with the broad physical features of the region, it is likely always to remain so.

The close connection between the average quantity of wheat reaped per acre and the rainfall is shown in a table, giving for each year beginning with 1861 the yield per acre and the monthly rainfalls deduced from the observations of rain made over the agricultural districts during these eighteen years. In 1878 the rainfall over the agricultural districts was nearly 3 inches under the average, and the yield of wheat was only 7 bushels 9 lbs., or nearly three bushels under the average. Still more instructive would the comparison be if, instead of lumping the districts together, their average rainfall and average yield of wheat were presented in a separate form.

The *Meteorological Observations* made at Adelaide Observatory, published monthly, show also the rainfall at all the rain stations with remarks, the appearance of which cannot but be watched with the liveliest interest by the Colonists. Thus in January, 1876, it is noted that the monsoon scarcely reached the MacDonnell Ranges, south of which, and as far as the east coast, drought prevailed; and in the following month the information is given that although 10 inches of rain fell at Port Darwin, the monsoon rains were comparatively light and barely reached the centre of the continent.

The observations at the Adelaide Observatory are made, printed, and discussed with extremely satisfactory fulness for an observatory not furnished with continuously recording instruments. Of special value are the comparisons made of each month's observations with the means of these months from past observations. The sorting of the wind observations into the directions for each hour of observation, viz., 6 and 9 A.M., noon, 3, 6, and 9 P.M., give most interesting results. These show for the summer months a shifting of the wind from a south-easterly direction in the morning to a south-westerly direction in the afternoon, a result doubtless due to the situation of Adelaide with reference to the heated interior of the continent, as that heating varies during the twenty-four hours.

The weak point of this system of meteorological observation is the total absence of barometrical and thermometrical observations at all the stations except Adelaide. Such observations were made at some half dozen stations during 1861-64, but since then we miss them from the reports. It would not be possible to exaggerate the importance, not only to the colonists themselves, but to

<sup>1</sup> Barnard Davis, "Thesaurus Craniorum."

<sup>2</sup> From *roh* = the Persian *koh* = mountain, whence also Rohilcund, in Northern India.

<sup>3</sup> "Meteorological Observations made at Adelaide Observatory during 1876-77-78," under the direction of Charles Todd, C.M.G., F.R.A.S. "Rainfall of South Australia during 1878" (with map), by Charles Todd, C.M.G., F.R.A.S. Adelaide, 1879.

the whole body of meteorologists over the globe, of the establishment of such a system of weather observation across this continent; and, moreover, the establishment of an efficient system of stations with their necessary equipment of instruments and observers, could not be in better hands than his whose resolute will and organising genius girdled Australia with the telegraph.

### ALGÆ<sup>1</sup>

PROF. J. G. AGARDH has taken advantage of the leisure afforded by his retirement from the Chair of Botany which he has filled so successfully for many years at the Lund University, to compose another work on algology. This very interesting volume, which embodies the results of observations made by the Professor during a long course of years, on the Morphology of the Floridæ, has just appeared in the *Transactions of the Scientific Academy of Stockholm*. It is written in the Swedish language, and is illustrated by thirty-three coloured plates of rare and little-known algæ, and of microscopic details of many others, beautifully executed by Swedish artists. It treats the subject in an exhaustive manner, as will be seen from a specification of the contents. The work is divided into three parts, each part being copiously illustrated by reference to the plates, and to descriptions of different genera and species.

Part I. treats of the general aspect and outer part of the Floridæ—their development and growth; of the root and its different forms; of the stem, branches, and leaves.

Part II., treating of the structure of the Floridæ, describes the nature of the cell-membrane and of the cuticle; the contents of the cell under different conditions of development; the various layers or strata of which the thallus is composed; the connection between the different cells, and the manner in which this connection is effected; the various ways in which the cells are formed; their different positions, and the manner in which they are grouped and united with the several strata.

Part III. describes the reproductive organs, namely, the antheridia, the sphaerospores, and the capsular fruit and cystocarp, and concludes with remarks on the so-called "double fructification." This third part will doubtless attract the attention of algologists who may be desirous of knowing whether the views of the Professor, in regard to the fertilisation of the fruit in the manner recorded by MM. Bornet and Thuret, have undergone any change since the publication of the "Epicrisis" in 1876. It will be seen from the present work, that although Dr. Agardh has made multitudes of microscopic observations on British and exotic algæ, at all periods of growth, and especially of the species which formed the subject of Bornet and Thuret's experiments, he has not materially changed his opinion. He says that the observations hitherto recorded are too few in number to determine the question, and that, as yet, he has seen nothing confirmatory of the views of the French algologists. For his reasons and remarks we must refer the reader to the work itself. It is to be regretted that Dr. Dodel-Port's very interesting observations on the fecundation of the Floridæ by Infusoria, of which an abstract was given in *NATURE*, vol. xx. p. 463, were not published before the completion of Prof. Agardh's work.

Among the verbal descriptions and illustrations are many which are especially deserving of the attention of British algologists. Among them will be found microscopic representations of the fruit, hitherto imperfectly described and figured, of many British algæ. The cystocarpic fruit of *Callithamnion cruciatum* is now, it is believed, figured for the first time. Among the whole figures

<sup>1</sup> "Floridæernes Morphologi," af J. G. Agardh. *Kongl. Svenska Vetenskaps Akademiens Handlingar*, Bandet 15, No. 6 (1879).

"De Algis Novæ Zelandiæ marinis." In supplementum "Floræ Hookerianæ," scripsit J. G. Agardh. *Lunds Univ., Arsskrift*. Tom xiv.

of algæ is one of a species which, although found on our southern shores, is almost unknown to collectors. This species is *Nitophyllum litteratum* [Plate xxvii. Figs. 1-4], which may—but very rarely—be seen in collections under the name of *N. Hillia*. From this last-mentioned species it differs in form, being more lobed, and also in the fructification. The sphaerospores, instead of being scattered over the disc as in *N. Hillia*, are located between the numerous veins which mark the lower part of the frond. Minor differences are shown in the microscopic details. The capsular fruit of this species does not appear to be yet known. It therefore adds another instance to the long list of Floridæ which hitherto have been found with sphaerosporic fruit only.

There is some diversity of opinion as to the place in a general system of classification of certain algæ of a red or purple colour, namely, Porphyra, Bangia, and Batrachospermum. By some of the later algologists they have been placed among the Floridæ, but Prof. Agardh is of opinion that they do not belong to the red seaweeds.

There is another group of algæ, which really belongs to the Floridæ, whose position in the system still appears to be uncertain. We allude to the family, *Corallinæ*. We remember to have noticed that it is not included in the classification of the Floridæ in the *Epicrisis*. We are, therefore, the more disappointed that there is no notice of this interesting group in the present work. Dr. Agardh's observations with regard to it would be most welcome. Had the present very valuable work been written either in Latin or English, it would undoubtedly have been more serviceable; as it is, however, algologists who do not understand Swedish may learn a great deal from the carefully-executed plates. Should the work be republished, it would be desirable to add a table of contents and an index.

The "List of New Zealand Algæ" is a useful supplement to the "Flora Novæ-Zelandiæ" of Hooker and Harvey. It consists chiefly of species which have been brought home by Dr. Berggren. The names of Hooker and Harvey have been generally adopted; but all the species described have been re-examined by Prof. Agardh, and many of them re-named in consequence of such re-examination. The new species and varieties are about sixty in number. Descriptions are given of new species, and copious notes on such of the already known species as require this addition are appended. M. P. M.

### GAS AND ELECTRICITY IN PARIS

SINCE the Jablochkoff light was established for the first time in the Avenue de l'Opéra, it may be said that there has been in Paris a regular competition between gas and electricity. The "Compagnie Parisienne d'Eclairage et de Chauffage" by gas is certainly one of the largest in existence, as it possesses every gas-work in Paris, and almost every one in the vicinity. A system of subterranean pipes and valves connects all these establishments, so that gas generated in Courcelles can be sent to any part of the city and suburbs if required. All these different works were conducted as separate establishments before the fusion which took place in 1854, under the auspices of the then existing Imperial Government. Two of these establishments are worthy of note—La Vilette, as being the largest, the site of experimental and chemical work, and Vaugirard, where the retorts are warmed by the Siemens' heat-generating process.

Each of the twenty arrondissements of Paris has its special gas office. The Company also sells gas-engines, and makes great efforts to develop the use of gas as fuel for warming and cooking in private houses and shops. The price of gas is dearer in Paris than in any other capital of Europe, and the arrangements are difficult to understand without an explanation of the French municipal institutions.

The cry for more light having been raised in consequence of the experiments conducted with electricity, a new gas burner has been invented by the Compagnie Parisienne, and placed experimentally in several large public thoroughfares, principally the Rue du 4 Septembre, the Place de la République, formerly place du Château d'Eau, and a pavilion in the Halles Centrales. The burners used in the Rue du 4 Septembre are the largest, and all the new burners have been constructed on the same principle. The ordinary wing burners consume about 120 litres of gas each hour. In these improved lanterns six burners, representing an hourly consumption of 1,400 litres, have been placed at the six summits of a hexagon. In the centre is a hole for facilitating the introduction of air and better consumption. The effect is really highly satisfactory, and the luminous effect is far greater than in proportion to the gas consumed. A large number of coffee-houses, theatres, and first-class shops have adopted the burners for exterior use. It is impossible to use them within any building except markets, owing to the immense quantity of heat radiated, which would be a nuisance, at least in summer time. A number of these improved gas lamps have been placed in the Lyons railway station (passenger department), and will be, within a few days, used for competitive experiments with the Lontin electric light.

Besides the hole for admission of air, a gas-pipe is placed in the central part of the lamp. The aperture has been disposed so that a small jet is always burning, and thus for lighting the lamp it is sufficient to open the valve of the gas pipe, and the six peripheral burners are lighted at once. After midnight the jets are extinguished and the central one opened, burning with a consumption of 120 litres per hour, or like an ordinary old gas-burner. The supplementary gas consumed by the city is paid for at a very cheap rate, about 1s. 6d. per thousand cubic feet. It must be said, moreover, that the *Chambre Syndicale des Tissus* and other commercial institutions have organised an agitation to oblige the Municipal Corporation to diminish the price of the gas. The Commission of the Municipal Council is at present deliberating upon that important question. A large factory, the Say Sugar Refinery, close to the Orleans Railway Station, built a private gas-work for its own use. They consume yearly about 6,000,000 cubic feet, and will turn their own gas-makers.

In electrical lighting the division principle is represented in Paris by the celebrated Jablochhoff candle, and a diversity of opinions have been expressed on the subject. The apparatus in itself requires no description, but it is necessary to explain the results which have been obtained.

The Jablochhoff light, placed in an opal globe is considered as perfectly suited to large shops and large public thoroughfares, although the diminution of light by the interposition of the globe may be valued at 45 per cent. The price of effective light is enlarged in the same proportion. This is the reason why many persons suppose that from an economical point of view it will never do except in large open places, as the Place de la Bastille, where semi-transparent globes are used without fear of any complaints from shopmen or street passengers. But even for illuminating these large places, it is supposed by many competent persons that other electric lights would be more successful, and at all events more economical. The only place where the Jablochhoff candles can be considered as unrivalled are large establishments like the *Grands Magasins du Louvre*, the *Buttes Chaumont* and the *Ville de France*, where the effect obtained is alone considered without much regard to the expense. The illumination of the *Palais de l'Industrie* during the evening sittings of the Exhibition of Fine Arts, was a success last summer. It was not attempted a second time during the Exhibition of Sciences Applied to Industry, owing to several circumstances, having nothing

to do with the value of the system. At the Hippodrome the illumination is effected by a combination of gas lights and Jablochhoff candles, and ordinary regulators with luminous points carefully concealed. The general effect is quite satisfactory, but the expense in motive power is considerable.

Jablochhoff candles are used in the illumination of large works carried on at present on the Seine for repairing the Pont des Invalides. These works have been interrupted for the last month owing to the frosty weather, but the Jablochhoff light has worked admirably. The use of the Jablochhoff candles is progressing immensely in private establishments, although the Municipal Council will in all probability discontinue the electric lighting of the Avenue de l'Opéra, the Place de la Bastille, &c., from February 1, and keep it burning only on the Place de l'Opéra. This impending resolution is attributed to the prevalence of the gas interest.

In the first months of the Jablochhoff trial, many complaints were made against the irregularities of the light; now extinctions are almost unknown, and the red colour of the electric flame less frequent.

Extensive preparations have been made in the green room of the opera for a comparison between Jablochhoff and Werdermann candles, and will be completed in a few weeks. It is argued by Werdermann's opponents that his light is merely incandescent light, and that the loss of illuminating power is far greater than with the Jablochhoff system. M. Garnier, the architect, being intrusted with the task of reporting on the matter, it would be unbecoming to give an opinion before his verdict is published. M. Reynier has another incandescent light offering some analogy with Werdermann's, but the contact being more intimate, the loss in power is larger, and the public exhibition of it has been considered a failure. It is regarded as merely an apparatus for lecturers wishing to show their audience an electric light with few elements. The lamp is cheap, and its working quite regular.

It should not be forgotten that even naked Jablochhoff lights lose a part [of their illuminating power. A quantity of electricity, which may be valued at 30 per cent., passes through the insulating caolin or plaster.<sup>1</sup> Consequently it must not be wondered at, if some inventors tried to dispense with insulating lamina.

M. Denayrouze, the former lessee of the Jablochhoff candle, has purchased the Jamin candle, in which the electric flame is directed by the attractive power of magnetism or electricity. Private experiments have been made, and they are preparing for an exhibition in one of the suburbs of Paris. M. Jamin having to lecture at the Sorbonne on January 17 it is probable that the large hall will be illuminated by his own light on this occasion. This light company has purchased a patent for gas engines, and will try to use the gas under the furnace as fuel, dispensing with it for illumination. They are said to contemplate a public issue of shares for a large capital.

It is known that the principal difficulties in the construction of regulators, has always been the absolute fixity of the luminous point in space. It has led M. Serrin to the invention of his excellent regulator. But the use of the Jablochhoff light proved that inventors had gone too far in the way of complication, at least for street illumination, and where no dioptric or catoptric arrangement is contemplated. M. Suisse was the first to start a lamp which may be regarded as a simplification of Serrin's original, and is working very well. The carbon is placed upwards, and descends in proportion as the negative is consumed. In order to diminish that consumption the diameter of the negative carbon has been enlarged.

A number of regulators have been tried in competition

<sup>1</sup> It shows that a Jablochhoff candle placed in an opaque globe is diminished (1) 0.70 by the loss of the caolin, and (2) 0.50 by the opacity of the globe, so that it gives only 0.35 of the original illuminating power.

or will be, but Suisse's is now the only one which works regularly at the Lyons railway terminus, in conjunction with a few of Lontin's regulators and with Lontin's generator. The results of the illumination are quite satisfactory, eighteen lamps being fed at an expense of 36 kilogrammes of charcoal per hour during fifteen hours every day, and with an expense of 9 francs per hour, including three francs of royalty for the Lontin Company. When this extensive space was illuminated by gas, the expense at 19 centimes per cubic metre was 6 francs per hour, and would have been nine francs if the gas were charged 30 centimes, or the full price. The economy for the Company results from the immense augmentation of the light distributed. They were enabled to diminish by 70 per cent. the number of hands engaged in night work, and the risks from fire are reduced to nothing. Lontin's system will be tried within a few days, in competition with improved gas, on the platform of the passengers department.

At the exhibition of the Palais de l'Industrie, Lontin's machine is working regularly every day from two to the closing hour, which varied according to the hour of sunset. No accident has been recorded. Siemens's machine has been very seldom at work, owing to several circumstances which prevented the public from making a direct comparison. The engineer of M. Siemens's factory having been selected as one of the jurymen, Siemens's machine was *ipso facto* out of competition; consequently we will not risk giving any definite opinion at present, confining ourselves to known facts. We visited Siemens's light at the works established by the universal firm at Passy, and we were very much satisfied with the effect which we witnessed. The illuminating power and regularity were out of question.

All the work of the Jablochhoff candle is done with Gramme machines, which have been fitted with a current inverter.

Lontin, Suisse, and other regulators are worked with continuous currents, which is considered as more advantageous.

Three different magneto-electric generators are before the public: Gramme, Lontin, and Siemens, based on similar principles, having a strong similarity in many respects, each of them claiming priority. We cannot presume to give a definite opinion on their special value, or on the value of their respective claims. The question can only be settled by the city or the Government deciding for the illumination of some part of the city or of some large public buildings.

We can state, at all events, that the Meritens Company, has started new machines, which we witnessed working with regularity at the Continental Hotel on the occasion of a great ball; that the Alliance machine, although excellent for lighthouses, has proved too heavy, too expensive, and too cumbersome for ordinary purposes. The Lontin machine is rotated at a rate of 200 or 250 turns per minute, and its rival from 700 to 800, which is a decided advantage in its favour.

It is not our province to adjust the claims relating to the manner of exciting almost any number of currents with a single generator and an electro-magnetic divider. But all the visitors to the Palais de l'Industrie have been astonished by the regularity of the Lontin light and its facility of combining the several arcs.

The other day the Ouest Railway Company established in the terminus of La Rue Saint Lazare three rival lights: Lontin, Parisian Company's improved lights, and Jablochhoff candles.

We decline to give a definite opinion of the respective merits of the Lontin and Jablochhoff systems before the moment when the numerous measures officially taken with a new photometer and the expenses in coals, electric carbon, and oil will be made public; but we can say that gas-light seems to be one-third dearer, and one-half only in general intensity.

Some of the great expectations raised when the Jablochhoff light was first exhibited have proved groundless. The shares of the gas companies have recovered from their depression, and reached at least their former value. But it cannot be said gas has conquered electricity, as electric lighting, with all its variety of origin and regulation, is gaining ground daily. Siemens's agents are at present fitting a large factory at Meaux with their regulators and generators. The works of installation of the Senate and Chamber of Deputies would have been impossible without the help of the electric light. A new influential daily paper, *Gil Blas*, has opened on the Boulevard de l'Opéra an "Halle aux Nouvelles," with no less than eight Jablochhoff candles. There is no part of Paris where electric lighting has not been exhibited, and its appearance is no longer a novelty, which is an all-important thing for its propagation.

In the meantime there are other inventors trying to generate electricity by new means. M. Beaudet has started a bichromate battery which he calls *unpolarisable*, perhaps without any real ground, but which, at all events, keeps in tolerable regulation for many days. M. Clamond has continued to produce a real electric light out of a series of thermal elements, which was considered as a mere impossibility a few months ago. We cannot say if the scheme of lighting by electricity out of a stove which warms an establishment, or a furnace which creates steam, is a Utopia, but we witnessed during some hours a light generated by the Clamond process, and a large workshop uses no other lighting process during the present winter.

The Municipal Council of Paris should open a public competition for lighting a large place or building, and invite all inventors of regulators and magneto-electric machines to place their apparatus in the hands of a competent commission, otherwise the question of electric lighting will remain in the dark for years, as it will be impossible for private individuals to decide which is the cheapest light produced and the best regulator.

W. DE FONVIELLE

#### NOTES

WE regret to have to announce the death of Mr. George Wharton Simpson, the editor of the *Photographic News*, which took place at Catford Bridge on the 15th inst. He was well known to the large circle of amateur and professional photographers as an able chemist, a lucid writer, and a careful experimenter. As one of the very earliest followers of photography, he was fully acquainted with all the many phases through which that technical science has passed, and we believe that very rarely, if ever, did he err in a matter of photographic history or technology. There existed between the readers of his journal and himself a feeling of almost personal friendship, as no question was too trivial to be answered in his notices to correspondents, and the answer given was always of a kindly and helpful nature. To Mr. Simpson we owe, amongst other things, the perfecting of the collodio-chloride process, a process which for delicacy and permanency is up till now unrivalled. Mr. Simpson was also an occasional contributor to various daily and other journals, and some of these articles we hope may be reprinted, since they are really succinct histories of progress in the art-science with which he was so greatly bound up. He will not easily be replaced in his editorial position, since there are few, if any, who have lived through the stirring times which have made photography what it is, and have followed it with the attention which he bestowed upon it. The large gathering of literary men and photographers at Abney Park Cemetery on Tuesday last evinced the high esteem in which he was held.

It is rumoured that Dr. William Ogle, Fellow of Corpus Christi, Oxford, and Examiner in Natural Science in the



University, has been appointed to succeed Dr. Farr in the Registrar-General's Office.

SIR JOSEPH FAYRER, K.C.S.I., has been appointed Examiner for the Medical Service of the Army in Anatomy and Physiology, *vice* George Busk, F.R.C.S., who has resigned the appointment.

THE first meeting of the Society of Telegraph Engineers will take place on Wednesday, the 28th inst., when Mr. Preece, the new president, will deliver his introductory address.

M. DUMAS, who is the Chancellor of the French Academy, pronounced the speech in answer to M. Taine, the new member. Everybody was struck by the spirited delivery and eloquence of the venerable perpetual secretary of the Academy of Sciences. The house was so full that even academicians were unable to find room on their benches.

MR. CROOKES has been exhibiting his wonderful experiments on radiant matter in Paris at the *École de Médecine*, on Thursday, January 8, and on Saturday, the 11th; at the Observatory on Thursday, the 15th; and at the *Société de Physique* on Friday, the 16th. On all these occasions Mr. Crookes met with great success. M. Salle, a well-known physicist, spoke in the name of Mr. Crookes, who superintended the experiments. M. Gambetta and the Ministers of Public Works and of War were present at the Observatory, as well as the most influential members of the Institute.

THE *Times* Philadelphia Correspondent telegraphs on Sunday that the Edison electric lights in Menlo Park were still burning to the extent of about eighty lamps. Mr. Edison, finding that defective vacuums have developed in a considerable percentage of the lamps, has for several days been experimenting to improve the mechanical construction of the glass globe containing the light so as to insure a permanent vacuum. Mr. Edison's friends report that he is able to overcome the difficulty. Meanwhile, the manufacturing of additional lamps has been delayed, while no arrangements have yet been made practically to use the light in New York.

THE correspondent of the *New York Herald* has interviewed M. Dumas, M. Niaudet Breguet, Mr. Crookes, and M. Fontaine, the president of the newly established *Syndicat d'Électricité*. The object of the interviews was to obtain the opinion of these gentlemen on the Edison light, and the results have been telegraphed to America. We can state that they are not against the possibility of the success of Mr. Edison.

WE notice an important communication which was made by Prof. Kessler at the annual meeting of the St. Petersburg Society of Naturalists on January 8, on the "Law of Mutual Help," as one of the chief agents in the development and progress of organisms. Prof. Kessler, although an able follower of Darwinism, thinks that the struggle for existence would be insufficient to explain the progress in organic life, if another law, that of sociability and of mutual help did not powerfully work for the improvement of the organisms and for strengthening the species. M. Severtsoff warmly supported this view, quoting several examples which prove that the unsociable birds are in a state of decay; so, for instance, although the system of robbing is ideally organised by the hawks, nevertheless the species is in a state of decay precisely because of its want of sociability.

ON January 10 the Russian Physical and Chemical Society held at St. Petersburg its annual meeting. After the reports of the secretaries Prof. Mendeleeff gave an interesting address on the resistance of fluids; he gave an historical sketch of the subject, and, pointing out how little it has hitherto been investigated, and how important it is, he invited Russian physicists to give special attention to that part of hydrodynamics. Prof. N.

Beketoff, from Kharkoff, read a paper on the dynamics of chemical reactions, and explained the electro-dynamical theory he proposes to explain them. Prof. Lentz made a communication on electrolysis, and M. Jablochhoff exhibited his new galvanic element.

M. LE BON, in rendering an account of the progress of his observations on the comparative mean weights of male and female skulls (*Bull. of Paris Anthrop. Soc. t. v. fasc. 5*) has explained the precautions which he had taken to avoid errors arising from considerations of the differences, bodily stature, age, race, and social or civilised status. After taking all these conditions into account, he finds a difference of 172 grammes in favour of the skulls of men over those of women. He asserts that while a newly-born girl has a heavier brain than a newly born boy—an advantage which she rapidly loses—the women of inferior races are relatively superior to those of highly civilised races, in other words, woman does not advance, and consequently, the differences between her and man are constantly augmenting. If M. le Bon's assertions are to be accepted as facts, they would undoubtedly seem to point to the necessity of bringing the opportunities of intellectual culture more closely within reach of women, but the learned doctor predicts that the abomination of desolation will fall on society if women be removed from the happy ignorance of their domestic hearths. Apart from his avowed preference for women with the cerebral capacities of savages, M. le Bon's memoir will be found of great use to the student of craniology, by helping him to determine the mathematical relations of different parts of the head, and their bearing on other parts of the body. We are glad to learn that the great value of his work in elucidating various obscure questions of general anthropology, have secured for it the award of the Godard prize for 1879.

AT Vienna a "Verein für Höhlenkunde" has been formed, with the object of investigating caves. Everybody taking an interest in this subject may become a member. The subscription is only 5 florins per annum. Dr. Franz von Hauer is the president, and Prof. Ferdinand von Hochstetter the vice-president of the new Society.

THE next German Anthropological Congress will be held at Berlin early in August next, and will be accompanied by an exhibition, illustrating prehistoric times in Germany. It will be closely followed by a Geological Congress to be held in the same city.

A MONUMENT of the late eminent naturalist and horticulturist, Freiherr von Siebold, will shortly be erected in his native town of Würzburg.

THE Japan papers record the fact that an enormous piece of coral was lately dredged up near Tosa. It is stated to have five branches, the stem being 15 inches in circumference and 5 feet in length.

THE Section of the Society of Arts formed in 1874 for the discussion of subjects connected with practical chemistry and its applications to the arts and manufactures, has been this year enlarged in its scope that it may include applications of physics as well as chemistry. At the six meetings of the present year the following papers will be read. The meetings are on Thursday evenings at eight o'clock, and the dates have been selected so that they do not clash with those on which the meetings of the Chemical Society are held:—January 22, "The Teaching of Technical Physics," by John Perry, late Professor of Engineering, Japan; February 12, "Gas Furnaces and Kilns for Burning Pottery," by Herbert Guthrie, C.E.; March 11, "The Noxious Gases Bill," by Dr. S. K. Muspratt, F.C.S.; April 8, "On Recent Improvements in Benzine Colours," by F. J. Friswell, F.C.S.; April 22, "On some Recent Advances in the Science

of Photography," by Capt. Abney, F.R.S.; May 13, "On some Physical Applications of Light," by Prof. W. G. Adams, F.R.S.

THE *Thunderer* gun experiments were continued at Woolwich last Friday, the object on that day being to test what is known as the "wedging" theory—the supposition that the tilting or displacement of the wad had to do with the bursting of the original gun. The experiments on Friday tended clearly to disprove this theory.

THE Public Works Department at Yedo have just published the *Reports of Progress* for 1878 and 1879 of the Geological Survey of Japan under Mr. B. S. Lyman.

THE Indian papers state that experiments are about to be made in Cyprus to test the possibility of cultivating mango seeds, as well as the seeds of other Indian fruits and vegetables.

EARTHQUAKES are reported (1) from Weisskirchen, where on December 22 at 5 A.M. a violent shock was felt; (2) from St. Blasien, in the Black Forest, where a shock was noticed on the same day at 10 P.M.; (3) from Idria (Carniola), where a subterranean explosion took place at 8.30 P.M., combined with a violent shaking of the ground and a cannon-like report. Several shocks were felt at Churwalden (Switzerland, canton of Chur) on January 7, between 2 and 4 A.M.; the last shock was accompanied with a noise like that of thunder, so that people were awoke and dogs howled. In the Domochleg and at Savagnino only two shocks were felt, at 3h. 45m. and at 4h. 30m. The shocks had the direction from north to south.

AT Freiburg, in Breisgau, the beautiful and rare phenomenon of the *fata morgana* was observed at noon on December 16. While the sun was shining the fine pyramid of the Cathedral tower showed itself reflected above, of course with the point downwards. The reflecting stratum of air was almost at the level of the summit of the tower, thus producing a most peculiar effect.

WE are glad to see that the Epping Forest Field Club has been successfully formed, under the presidency of Mr. R. Meldola. From the tone which prevailed at the meeting of January 10, we should think the Club is likely to do good work. The original list of members is a pretty large one, and contains several well-known names.

THE continuation of frosty weather has produced unprecedented effects on the Lower Loire round Saumur. The bed of the river having an extent of about 1,000 yards, and the depth of water being very shallow, the Loire was entirely frozen and the flow of water towards the sea was almost entirely stopped. The consequence was that the level of the water was raised, and the walls protecting the low lands in danger of being submerged. It was necessary to employ dynamite to open a channel for the water. Unfortunately a part of the stream has found its way into the low lands. New ice is coming from the high lands, and the military have been ordered to work under the orders of civilian engineers.

AN ascent of Mount Hekla was made last summer by a lady, Miss Th. Petursson, daughter of the Bishop of Reykjavik, for the purpose of geological investigations. According to her observations the temperature at the bottom of the larger craters has of late risen considerably, while dense white columns of steam were rising from crevasses and holes which were hardly visible. The sulphurous odour of this steam was stronger than usual. The observations seem to indicate an approaching eruption of the volcano.

AN interesting archaeological discovery has been made near Lehmke (in the district of Oldenstadt) consisting of some 1,200

medieval metal plates, so-called *bractæ*. Most of them bear the stamp of a lion in varying positions, others that of a figure with sword and standard, and a horizontal key below. The objects in question are now in the possession of the "Kreis-hauptmann" of Oldenstadt.

THE German Postmaster-General, Herr Stephan, and Dr. Siemens, have succeeded in constituting an electro-technical society, which has for its objects the furtherance and development of the technical application of electricity, the progress of the knowledge of electricity by means of its technical appliances, and the establishment of a place of meeting for German technical electricians, whose scientific and commercial interests will, of course, be greatly benefited by such mutual intercourse.

THE additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus erythræus*) from India, presented by Mr. F. C. Grosvenor; two Bankiva Jungle Fowls (*Gallus bankiva*), two Starred Tortoises (*Testudo stellata*) from India, presented by Mr. W. Dunn, C.E., C.M.Z.S.; a Bar-tailed Godwit (*Limosa lapponica*), a Grey Plover (*Squatarola helvetica*), six Knots (*Tringa canutus*), thirteen Dunlins (*Tringa cinclus*), European, presented by Mr. F. Cresswell; three Chinchillas (*Chinchilla lanigera*) from South America, a Grey Struthidea (*Struthidea cinerea*) from Australia, a Red-throated Amazon (*Chrysotis collaria*) from Jamaica, purchased; two Fulmar Petrels (*Procellaria glacialis*), North European, deposited.

#### OUR ASTRONOMICAL COLUMN

THE ORION-TRAPEZIUM.—The following letter has been addressed to us by Prof. Holden, of the Naval Observatory, Washington:—

"In NATURE, vol. xxi, p. 117, there is a note on a seventh star in the Orion-trapezium, which is 636 of G. P. Bond's Catalogue. It is there rated as mag. 13<sup>·</sup>3. Two other stars, 612 and 618 of Bond's catalogue are as near one of the larger stars as 636 is, and if it is intended to extend the nomenclature of seventh star, eighth star, &c., to these stars (which seems inadvisable), they should be included. Their positions from  $\theta^1$  Orionis are:—

Mag.	$\Delta \alpha$ (1857 <sup>o</sup> )	$\Delta \delta$ (1857 <sup>o</sup> )
612 13 <sup>·</sup> 5	... .. - 16 <sup>·</sup> 4	... .. + 24 <sup>·</sup> 6
618 13 <sup>·</sup> 1	... .. - 10 <sup>·</sup> 4	... .. + 24 <sup>·</sup> 6

The magnitudes are too faint for Argelander's scale extended, but serve to compare with that of 636 viz. 13<sup>·</sup>3.

"As tests for large telescopes, quite a number of small stars discovered by Bond may be mentioned, whose positions are given in *Annals of the Harvard College Observatory*, vol. v. All of these really exist, as they have been repeatedly seen with the 26-inch refractor of this Observatory. They are Nos. 595 (13<sup>·</sup>9m), 601 (15<sup>·</sup>6), 608 (14<sup>·</sup>3), 621 (15<sup>·</sup>6), 625 (15<sup>·</sup>6), 631 (14<sup>·</sup>3), 666 (13<sup>·</sup>9), 677 (14<sup>·</sup>8), 676 (13<sup>·</sup>1), 642 (15<sup>·</sup>6), 675 (15<sup>·</sup>2). The faintness of these stars (which are much better seen with a low power than with a high one) speaks well for the diligence of the late George Bond, whose search in this region was very thorough. Other small stars exist in the neighbourhood as follows:—

1. Rosse, No. 56, near G.P.B. No. 581.
2. A star, s.p., G.P.B. No. 724.
3. A double-star, n.f., G.P.B. No. 685.  
(2 and 3 were discovered by Lassell.)
4. Three stars in or near the region bounded by the lines 641 to 663, 663 to 652, 652 to 641.
5. A star or mass of nebula which is not yet three years of age, has developed itself in the middle of the dark channel half way between 669 and 642. The star (?) itself is, roughly, equally distant from 669, 641, and 642.

"There are no stars within the trapezium.  
"Cooper reports a star following G.P.B. 516 a few seconds. I cannot find it.

"Any observations on these stars or on the celebrated variable 654 (frequently observed here) will be gladly received by me,

and I shall be happy to have such for insertion in a paper now nearly ready on the Huyghenian region of this nebula."

For the convenience of such observers as may not have ready access to the "Annals of the Astronomical Observatory of Harvard College, vol. v.," which contains G. P. Bond's elaborate memoir on the nebula of Orion, the following differential positions of the stars mentioned by Prof. Holden, with reference to  $\theta^1$  Orionis, are extracted:—

No.	Diff. R.A.	Diff. Decl.	No.	Diff. R.A.	Diff. Decl.
516 ...	- 276°0 ...	- 29°5	652 ...	+ 30°2 ...	+ 171°6
581 ...	- 76°1 ...	- 159°1	654 ...	+ 33°2 ...	+ 10°0
595 ...	- 46°9 ...	- 15°0	663 ...	+ 55°5 ...	+ 147°1
601 ...	- 36°0 ...	- 31°0	666 ...	+ 59°7 ...	- 195°8
608 ...	- 23°7 ...	- 18°0	669 ...	+ 63°3 ...	+ 100°0
621 ...	- 8°0 ...	- 36°0	675 ...	+ 74°5 ...	- 93°4
625 ...	- 4 ...	- 28	676 ...	+ 78°5 ...	- 27°6
631 ...	+ 3 ...	- 42	677 ...	+ 78°6 ...	- 201°4
641 ...	+ 11°9 ...	+ 111°2	685 ...	+ 97°7 ...	- 95°0
642 ...	+ 13 ...	+ 48	724 ...	+ 183°3 ...	- 176°0

It will be remarked that Prof. Holden states there are actually no stars within the trapezium. Mr. Burnham's experience with the 18½-inch refractor at Chicago is to the same effect; in the notes to his last catalogue of double stars, he writes: "Several observers have seen, or believe they have seen, other minute stars in the trapezium, most of them using comparatively small apertures. While making the measures given above, and at other times, under very favourable conditions, the interior of the trapezium and the vicinity of the principal stars were carefully examined. There was not the slightest suspicion of any additional stars. If the sixth star itself had been double, with a distance of 1''0, it could not have been overlooked. I have very little faith in the real existence of these suspected stars after the failure of this and other large refractors to show them." And he considers it is wholly improbable that they should all be variable in such manner as to render them at all times invisible during the last few years. Telescopes were not so perfect forty years since as they are now, and we might be perhaps justified in attributing to optical illusion the supposed existence of the three stars within the trapezium, recorded by De Vico in 1839, and the star, near the "fifth," detected by Struve, which Gruithuisen claimed to have discovered about the same time, and which he says Schwabe had also seen with a 6-foot Fraunhofer. But what are we to say to the observations of Dr. Huggins, as detailed in vol. xxvi. of the *Monthly Notices* of the Royal Astronomical Society? They appear to point to something more than optical illusion, and notwithstanding the negative testimony as to the actual existence of stars within the trapezium, to render it desirable that a protracted examination of this region should be instituted with telescopes of suitable capacity. One of Dr. Huggins's stars is not far from the position of a star in De Vico's diagram (see *Memoria intorno a parecchie Osservazioni . . . in Collegio Romano, l'Anno 1839*, plate I., and Gruithuisen's *Astronomisches Jahrbuch*, 1841, p. 143.

THE TOTAL SOLAR ECLIPSE OF JANUARY II.—A Reuter's telegram brings intelligence of the successful observation of the total phase in this eclipse on the Santa Lucia mountain, California, with the important addition that an intra-Mercurial planet has been again seen. In the longitude of this mountain the duration of totality upon the central line, employing the elements of the *Nautical Almanac*, would be only 38 seconds, with the sun at an altitude of 12°; if the semi-diameters adopted for eclipses in the American ephemeris are used, the duration would be even less—hardly 27 seconds. Under such circumstances it must have required very minute and skilful preparation and considerable smartness of execution to insure the results announced.

### GEOLOGICAL NOTES

THE MSS. of Sartorius von Waltershausen, descriptive of Etna, have been placed, we understand, in the hands of Prof. von Lasaulx, of Breslau, with a view to publication. They will complete the colossal pile which the veteran geologist erected to the glory of his favourite mountain.

ANOTHER distinguished and venerable vulcanologist, Dr. Abich has gone to Vienna to prepare his petrographical descriptions of the Caucasian region, in which he has been so long at work. The facilities for the most delicate analyses of rocks and

minerals at Vienna have likewise attracted thither M. Renard, of Brussels, who has been entrusted with the chemical and microscopic investigation of the abyssal deposits brought by the *Challenger* from its great ocean survey. M. Renard is at present in this country arranging with the *Challenger* Commission as to the prosecution and publication of his labours. His beautifully drawn plates which illustrate the more remarkable facts brought to light by the *Challenger* dredgings, are being exquisitely reproduced by chromolithography in Vienna.

IN a recent number of the *Bulletin* of the United States Geological and Geographical Survey of the Territories (a publication still continued for a while, though the Survey itself has ceased to exist), Dr. F. V. Hayden describes the Two Ocean Pass which has for some years been known to separate the head waters of the Yellowstone from those of the Snake River. He confirms and extends previous accounts of this interesting locality, showing that it is a flat meadow-like depression cut by erosion on the watershed. During wet weather this marshy ground becomes a lake which drains both ways, one branch finding its way into the Pacific, and the other into the Atlantic, by one of the longest routes for running water on the surface of the planet.

PROF. MARSH continues his descriptions of the fossil treasures continually arriving to increase the already ample stores at Yale College. He remarks that while the Mosasaurid reptiles are so rare in Europe that the type-specimen described by Cuvier still remains the most perfect yet discovered here, and the only one from which important characters have been made out, in North America the group attained a marvellous development, and was represented by several families with numerous genera and species, of which the relics of not less than 1,400 distinct individuals are contained in the museum at Yale.

DR. MICHEL MOURLON of Brussels has in preparation a work on the geology of Belgium. It will form an octavo volume of at least 500 pages, containing full descriptions of the different geological formations, with unpublished plates of the microscopic structure of rocks, copious lists of fossils, and an account of the industrial resources of each formation, and will be followed by a complete bibliography of the geology, palaeontology, and lithology of Belgium. The re-issue of Dumont's beautiful and most trustworthy geological map of Belgium naturally suggests the desirability of some general guide to the public in perusing the map or travelling through the country, for the admirable *prodrome* of M. Dewalque can hardly now be procured. Dr. Mourlon's position as one of the Conservateurs of the Royal Museum of Natural History, and his experience as a field geologist both before and since his connection with the Geological Survey of Belgium, give him exceptional advantages for the preparation of such a work, which will no doubt be as duly appreciated by his fellow-countrymen as it will be welcomed by students of geology abroad.

### PHYSICAL NOTES

OBSERVATIONS of phosphorescence phenomena in high vacua of the nature described by Crookes and Maskelyne have been lately made on a variety of substances by Herr Stürtz of Bonn, in company with Herr Müller (*Wied. Ann.* No. 11). The following substances gave phosphorescence (those marked with an asterisk were made red hot before being brought into the tube; in the ordinary state they showed little or no phosphorescence):—Brucite,\* magnesite,\* phosphate of magnesia, pitch-blende, wolframite, cerusite, adularia, orthoclase,\* kaolin,\* axinite,\* silicate of zinc,\* zinc-spar,\* double spar, apatite, franklinite, azure spar, fergusonite,\* apophyllite,\* dolomite, celestine,\* red spinelle, cobalt-glance, stannite, baryta, chromate of iron, lazulite, lepidolite, zinnwaldite, ankerite, greenockite, pectolite, borax, cinnabar, leucite, sanidin, and Java meteoric stone of 1869. A few luminous points were observed in crystals of arsenical iron and antimonite. Pieces of a phosphorescent substance made red hot are luminous with a different colour from that of pieces of the same not made red hot. In cerusite the phosphorescence is lost through heating. The authors give a list of substances which do not phosphoresce.

A SYSTEM of electrical storing, considered to be free from the disadvantages of other systems, is described by Professors Houston and Thomson in the *Franklin Institute Journal* for December, 1879. They use a saturated solution of zinc sulphate in a suitable vessel, having at the bottom a plate of copper, to

which is connected an insulated wire. At or near the top of the vessel, and immersed in the solution, is placed a second copper plate or one of hard carbon, or metal unchanged by contact with zinc sulphate solution and less positive than metallic zinc; this is also connected with a wire. A current from a dynamo-electric machine is sent in the direction from the lower to the upper plate, the result being deposition of metallic zinc on the upper plate and the formation of a dense solution of copper sulphate overlying the under plate. The cell, after charging, constitutes a gravity cell, and continues a source of electrical current till re-conversion of all the copper sulphate into zinc sulphate, with deposition of copper on the lower plate and removal of zinc from the upper. The cells, in charging, may be arranged in multiple arc or in series, and differently from that in discharging, according to the object. The authors believe it possible to store and recover 50 per cent, or more of the 50 or 60 per cent. which good dynamo-electric machines realise in external work of the power used in driving them. Thus 25 per cent. of the original power may be given out secondarily as electric current. Assuming that in the best steam engines 20 per cent. of the heat energy of the coal may be utilised, then about 5 per cent. of the heat energy, it is thought, may be recovered after storage as current; but even with this small percentage the economy would be much superior to the use of zinc and other materials in the ordinary battery in production of current.

In a recent paper to the Vienna Academy, by Prof. Exner, on the theory of inconstant galvanic elements, proof is offered that there is no so-called galvanic polarisation in elements, but that the phenomena referred thereto are attributable to the oxygen dissolved in water. The electromotive force of an element with only one liquid appears accordingly as a constant which is in no way affected by any polarisation of the negative pole. It is further shown that the force of a Smee element is not altered when its platinum is replaced by some other metal, provided only this do not itself give rise to chemical processes.

### GEOGRAPHICAL NOTES

DR. EMIL HOLUB will read a paper before the Royal Geographical Society next Monday evening on his journey from the Diamond Fields through South Central Africa to the upper waters of the Zambesi. Dr. Holub, we understand, has for some time been exhibiting at Prague a small museum of zoological and ethnographical curiosities collected during his various journeys in Southern Africa, which has attracted much attention, and he is coming to England to attend this meeting at the special invitation of the Council of the Geographical Society.

THE *Colonies and India* reports the return of Mr. Alexander Mitchinson after some years spent in Africa. He appears to have arrived on the Gambia in 1876, and to have journeyed with a small number of followers into various parts of Africa. Following the course of the Niger, he visited the waterfalls, and returning to the west coast, made excursions into the country in various directions. After a brief rest his travels were again resumed, and from the Gaboon country Mr. Mitchinson made his way into Angola, and from Benguela proceeded *via* Bihé to Lake Ngami, returning to the coast at Walfish Bay at the end of 1879. The notes which he made in the course of his travels, are said to contain much interesting matter.

IN the current number of the *Tour du Monde* M. Désiré Charnay, the well-known archaeological explorer of Southern Mexico, Yucatan, and Madagascar, has commenced an account of what he saw during the six months he recently spent in Australia. His observations on the aborigines, their legends, customs, and traditions will no doubt be interesting, and his story will certainly be well illustrated. M. Charnay, who returned to Europe not long since, had, previously to his visit to Australia, spent some time in the East Indian Archipelago.

DR. BENJAMIN BRADSHAW, who was met by Major Serpa Pinto, during his famous journey near the Zambesi, and who was also with the late Mr. Frank Oates when he died near the Tati settlement on his way from the Victoria Falls, arrived in Capetown a short time ago, presumably to make another trial of the ways of civilisation. Dr. Bradshaw has spent a long time in the Matabele country and other parts of the Zambesi basin, living the life of the natives and making zoological collections for his own amusement and benefit. During his wanderings he has acquired a considerable amount of information respecting the less-known parts of the Zambesi and some of its tributaries,

which, we have reason to hope, may be made public before long.

A CORRESPONDENT in the *Glasgow Herald* advocates the formation of a geographical society in that great commercial centre, the second most populous city in the kingdom. We have on several occasions pointed out the advantages of the formation of such societies in our chief ports, by means of which much useful information might be tapped that otherwise would not see the light. No better field could be found for such a society than Glasgow.

PROF. NORDENSKJÖLD and his staff evidently do not consider that their work was finished when they got outside Behring's Strait in the *Vega*. During the brief stay of the ship at Galle they made excursions into the island to examine its mineralogy and natural history. Great preparations have been made for the reception of the *Vega* at Naples. The King of Sweden desires that the professor and the captain should visit Rome, Brussels, Paris, and London, and join the vessel again at Copenhagen, to be ultimately received at Stockholm.

DR. OTTO FINSCH left Honolulu on July 30 last, "on board the barque *Hawaii*, and arrived at Dshaloot, on the island of Bonham (the principal island of the Marshall group) on August 21. He intended to investigate this island thoroughly, as it appears that this has never before been done in a scientific manner. From Bonham Dr. Finsch will proceed to the islands of the Radak group.

NEWS from Dr. Stecker, the well-known companion of Dr. Gerhard Rohlfs, stated that he was going to leave Benghazi at the beginning of the present month, in order to proceed to Bornu by way of Fezan.

A FRENCH Company intends to cut a canal through the Isthmus of Corinth. Steps have already been taken to obtain the permission of the Greek Government.

THE German residents of Sydney have founded a branch of the Berlin Central Union for Commercial Geography.

MR. IM THURN, of the Georgetown Museum, whose labours in British Guiana have been referred to in *NATURE*, arrived in England last week.

### THE SIXTH CONGRESS OF RUSSIAN NATURALISTS

THE Sixth Congress of Russian naturalists began at St. Petersburg on January 1, by a public meeting in the great hall of the University. The number of members present was very large—1,200—of whom 500 were from the provinces, and thirty-eight were ladies. Prof. Kessler was unanimously elected President, but the bad state of his health not allowing him to fulfil this function, he was made honorary president, Prof. Beketoff being elected as the active one.

At the first public meeting, Prof. Wagner gave an interesting address on the "Means of Solution of the complicated Problems of Natural Science," and after a brilliant sketch of the methods of science, he drew the attention of naturalists to the necessity of the study of physiological chemistry, and especially of the problems connected with albuminous matters.

Two proposals were then discussed:—On the scientific exploration of Bulgaria, and on the necessity of making complete botanical collections of Russian plants.

The second public meeting of the Congress, held on January 7, was opened by an address by Prof. Timiriazeff, on the physiological significance of chlorophyll in the life of plants, on the absorption by it of solar rays, and on the limits of the productivity of the soil. After this the president proposed that the several projects of scientific inquiries approved by the Congress be transmitted to a special committee, which would remain as a permanent institution after the Congress, and see to the carrying out of these projects; the proposal was unanimously accepted by the Congress, and will be accomplished, if the Ministry of Public Instruction does not oppose, as it has done hitherto, the creation of a permanent scientific association of all Russian naturalists. Prof. Mendeleef proposed the publication of a popular description of Russian colonies, being a sketch of their climate, soil, flora, fauna, and economical conditions; the proposal was approved. Prof. Dobroslavine gave an address on the relations between natural sciences and hygiene. The latter has only one point in common with medicine—general pathology—whilst any progress in the department would be impossible if it were not for

the collective work of those who labour in the wide field of natural science, all most important advances in hygiene, being made by the researches of eminent specialists in natural science. Finally, Prof. Mendeleeff made the proposal to publish a new scientific periodical.

At the last public meeting of the Congress, Professors Sokhotsky and Kovalsky made a proposal to found a Russian Astronomical Society, and Prof. Tchebysheff proposed to solicit from the Government pecuniary help to the Moscow Mathematical Society; both proposals were agreed to. M. Severtsoff gave a very interesting lecture on the orographical structure of Central Asia and on its influence upon the geographical distribution of animals. Prof. Andreieff developed the idea as to the necessity of giving instruction in natural sciences in primary schools, and M. Gerd gave an address on the impulse which could be given to the study of nature in Russia, its flora, and fauna, by the teachers of the primary schools; he demonstrated by numerous facts that this help would be very effective, as a great number of teachers would be very glad to work on that field; therefore, he proposed to draw up good programmes for these studies, as well as simple manuals of the necessary elements of science. Both proposals were met with the warmest cheers of the numerous auditory, but we fear that they will meet, as have former proposals of that kind, with strong opposition from the actual Ministry of Public Instruction. After an address by Prof. Wagner, on the sociability of animals, the Congress closed its sittings; the next Congress to be held at Odessa.

In the Section of Astronomy and Mathematics we notice the following communications:—By Prof. Davidoff, on a new method for the exploration of functions, which method enables us to deduce various theorems from one general principle; by M. Preobrajensky, on the integration of Laplace's equation by means of quaternions, the communication having given rise to very animated discussion; and by M. Tchebysheff, on parallelograms, being a brilliant exposition of their importance in mechanics, together with a discussion of several points of theoretical importance. An interesting memoir was read by Prof. Bougaeff, on subtraction in the theory of numbers, which deals with several important philosophical points of mathematical investigation. Other communications were by MM. Markoff, Joukovsky, and Vasilieff, on Bernoulli's equation.

In the Section of Physics and Meteorology we notice the following communications:—By M. Ziloff, on the magnetisation of liquids; by M. Collin, on the luminous properties of electrodes; by Prof. Oettinger, on electricity; by M. Pantionkoff, on the meteorology of Bulgaria as compared with South-Western Russia; by Dr. Woeikof, on the various causes of perturbations in the diurnal changes of temperature; and by Baron Wrangel, on changes of level in the Black Sea. This level has continuous fluctuations; it is always lower during the night, and reaches its maximum at mid-day in all sea-ports of the northern and the eastern coast; it is also at a minimum in October and a maximum in May, the difference between these two levels being 18 inches. The following communications of general interest were also made in the Section of Physics:—Dr. Woeikof exhibited a new map, showing the distribution of rainfall in all parts of the world; M. Borgmann made a communication on the influence of the inductive currents on the development of temperature during magnetisation; Prof. Lemström (Helsingfors) expounded his theory of terrestrial magnetism; Prof. Tchebysheff read a memoir on centrifugal regulators, and exhibited two of his invention; and M. Tchikoleff, on electric lighting.

In the Section of Geology and Mineralogy we notice communications by Prof. Lentz, on the level of the Amu-Darya; by Prof. Fr. Schmidt, on recent formations on the shores of the Gulf of Finland; and by M. Armatelsky, on diluvial formations in the Government of Chernigov.

In the Sections of Botany and Zoology we notice the communications by M. Tikhomiroff on the bacteria which cause disease of the bladder, and on the artificial production of these bacteria; by Prof. Ganin, on the development of fishes; and by M. Sidoroff, on the insects destroying corn in Russia.

A most interesting communication was made to the Section of Physiology by Prof. Setchenoff, on the absorption of oxygen and nitrogen by blood. Besides, we notice communications by Prof. Goloubeff, on the vibratile epithelium; by Dr. Tsuboulsky, on a new method of determining the amount of blood in animals; by M. Wedensky, on the innervation of the respiratory motions of the *Rana temporaria*; and by Prof. Tarkhanoff, on the amount of blood of man.

In the Section of Anthropology were the following communications:—By Prof. Stid (Dorpat), on the relation between the indexes of the skull and that of the head; by Dr. Lubinsky on the sight, being the result of numerous observations upon the crews of the Russian navy, which observations establish a certain connection, difficult to explain, between the power of sight and the breadth of the chest. The communication by M. Dokouchaeff, on the pre-historic man of the downs of the Oka river, deals with a subject of great interest, as he affirms that the range of downs which we see along the whole of the course of that river must afford a great amount of pre-historic remains, as is the case with the downs of Volosovo and Lvinin, both having yielded thousands of such remains. Prof. Inostrantseff discussed at length the various sub-divisions of the stone period, and M. Anoutchin gave an interesting note on the frontal suture, which seems to appear most frequently in races of a higher degree of civilisation.

An interesting feature of these Russian congresses is the existence of two special sections, those of scientific medicine and of hygiene; the latter section has assumed a great importance, thanks to the energy of several eminent hygienists, as Drs. Erisman, Dobroslavine, Vyrouboff, and others. A question being raised about the hygiene of railways, the section of hygiene had two special sittings on this subject, and a committee was appointed to draw up a programme of investigations on the dress of railway employes, the number of hours of work, the sanitary state of railway stations, and of dwellings of employes, accidents, the transport of cattle, &c. A great number of other questions, as to the disinfection of dwellings, epidemics, &c., were discussed, and we hope that the work of the section will be of great importance for this kind of investigation.

Several other important communications were made in the Physical Society, and in the St. Petersburg Society of Naturalists, which both have had their annual meetings during the Congress.

#### UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—On February 3 the question of the Natural Science Degree will again come on for discussion in congregation. Last term, it will be remembered, the proposal to grant a special natural science degree was defeated after a close division, the principal opposition to the motion coming from the scientific members of congregation. It was thought that a separate science degree, not carrying with it the privileges of the master of Arts Degree, would be regarded as an inferior degree, and tend to lower the position of science in the University. A clause is now proposed by an influential body of residents—including Prof. Odling, Dr. Mark Pattison, Rector of Lincoln, A. Vernon Harcourt, Prof. Green, Prof. Lawson, and Prof. Nettleship—to the following effect:—"Every person who shall have been admitted to the degree of Master of Natural Science, shall also be admitted to the degree of Master of Arts."

At the University Museum Prof. Clifton will continue his course on Statical Electricity and Magnetism; Dr. Odling will continue his lectures on Organic Chemistry on Mondays and Fridays at noon, instead of on Mondays and Thursdays as heretofore. The examination for the Radcliffe Travelling Fellowship will begin in the Museum on Tuesday, February 10, at 10 A.M. Candidates are requested to send in their names to Dr. Acland, at the Museum, on or before February 1.

At Christ Church Mr. Vernon Harcourt will form a class and lecture on Quantitative Analysis; Mr. Baynes will lecture on Thermodynamics and Electrodynamics.

M. ROUGET, Professor of Physiology in the Faculty of Medicine at Montpellier, is nominated Professor of General Physiology in the Museum of Natural History of Paris, in succession to the late Claude Bernard.

#### SCIENTIFIC SERIALS

*Annalen der Physik und Chemie*, No. 12, 1879.—Analogies between fluidity and galvanic conductivity, by O. Grotrian.—On the magnetisation of iron rings, by A. v. Ettingshausen.—The ball-shaped electro-dynamometer, by J. Fröhlich.—On gradual passage of the band-spectrum of nitrogen into a line-spectrum, by A. Willner.—On Stokes's law, by S. Lamansky.—On a bi-constant dispersion formula, by E. Lommel.—On the dichroitic fluorescence of magnesium-platinum-cyanide; experimental proof of

the perpendicularity of the light vibrations to the plane of polarisation, by E. Lommel.—On a small alteration of the Bunsen grease-spot photometer, by A. Toepler.—On the refraction of sound-waves, by K. W. Schellbach and E. E. Boehm.—On the specific heat of water according to Dr. Baumgartner's experiments, by L. Pfaundler.—Reply to the observation of O. E. Meyer, by L. Boltzmann.—On the application of the telephone to measurements of resistance, by F. Niemöller.—On the motion of glaciers, by K. R. Koch and F. Klocke.—On hailstones with ice-crystals, by Ed. Hagenbach.—On hailstones of uncommon size, by P. Merion. (In a paper prefixed to this number, Prof. Clausius defends himself against some aspersions, by Herr Dühring, regarding his relations to Robert Mayer, *à propos* of the mechanical theory of heat.)

THE *Sitzungsberichte der naturwissenschaftlichen Gesellschaft Isis in Dresden* (1879, January to June) contain the following papers of interest:—On the recent geographical and geological investigations of the United States of America, by Dr. Geinitz.—On the coal flora of the Lagan coal-pits, by H. Krone.—On the constitution of dichloronitrophenol, by Dr. Schmidt.—On a new form of the influence machine, by Dr. Töpler.—On the action of chloride of lime upon absolute alcohol, by Dr. Goldberg.—On a gas-stove with arrangement for oxidation, by Dr. Hempel.—On a new dye, by Dr. Schmitt.—On the isomerism of ethanes, by Dr. Goldberg.—On the tension of threads and Poggendorff's fall machine, by Dr. Amthor.—On a discovery from the later stone period made in Bohemia, by W. Osborne (with 5 plates).—On the prehistoric centres of culture in Schleswig, by Herr Michelsen.—On some objects found by Dr. Schliemann in his excavations in Greece and Asia Minor, by Dr. Fiedler.—On a discovery of urns at the Hradischt, near Stradonic (Bohemia), by W. Osborne.—On the occurrence of *Castanea vesca*, L., by Dr. Friedrich.—Various smaller botanical papers of minor interest.—On the theory of Watt's centrifugal regulator, by Dr. Ritterhaus.—On some galvanometric methods of multiplication, by Dr. Töpler.—Remarks on Wallengren's work concerning Linnaeus's species of the genus *Phryganea*, by M. Rostock.—On the Neuroptera of Saxony, by the same; a most elaborate treatise with complete list and catalogue.—On the Hemiptera fauna of Transcaucasia, by Dr. von Horvath.—Obituary notices of Dr. Eduard Lösche and H. G. Ludwig Reichenbach.

*Reale Istituto Lombardo di Scienze e Lettere*, vol. xii. fasc. xvii.—xviii.—This number contains a survey of the year's work, announcements of prizes awarded (with abstracts of memoirs), and of prize subjects, &c.

Fasc. xix.—Stratigraphic observations on the precarboniferous formation of Valtellina and Calabria, by S. Taramelli.—On the dilatation of the heart in disorders of the ventricle, by Prof. de Giovanni.

*Journal de Physique*, December, 1879.—We note here the following:—Measurement of the wave-length of obscure calorific rays, by M. Mouton.—Displacement between oxygen and the halogen elements united with metals, by M. Berthelot.—A spectroscope for studying the phenomena of fluorescence, by M. Lamansky.

*Journal of the Franklin Institute*, December, 1879.—On a new theory of the retaining wall, by Prof. Du Bois.—A system of electrical storage, by Professors Houston and Thomson.—Steam boiler explosions, by Messrs. Corbin and Goodrich.

## SOCIETIES AND ACADEMIES

### LONDON

Royal Society, January 15.—“On Chemical Repulsion,” by Edmund J. Mills, D.Sc., F.R.S.

While engaged in some researches on the propagation of chemical change, I have incidentally encountered a new order of phenomena, which the title “chemical repulsion” may serve provisionally to designate. A brief outline of the experiments is given in the following paragraphs.

Upon a glass plate, laid in a horizontal position, is poured enough solution of baric chloride to cover it completely to a considerable depth. On this solution is placed another glass plate, provided with a small central perforation; when the two plates are firmly pressed together with the hands, most of the solution is extruded, and only a very thin layer of it left between the plates. All excess of the solution having been removed from the outer surfaces of the plates as well as from the perfora-

tion, some dilute hydric sulphate is now introduced into the perforation. This reagent attacks the baric chloride, throwing down a white precipitate of sulphate; and, proceeding partly by diffusion, partly by flow, does not cease to widen in every direction its figure of advance, until the edges of the plates are attained. If the perforation is circular, the figure of advance is circular; in other words, the chemical development of a circle is a circle.

Let us now suppose the two plates to be square and equal, and let the upper one have two circular perforations, equidistant from the centre of the square, and situated upon its diagonal. Let also two circular developments of baric sulphate be caused to proceed, as before, from the two perforations simultaneously. At first nothing remarkable is observed, but in a short time, the two growing circles begin to exercise a visible retardation on each other's progress; so that the figure of advance is no longer circular, but oval. [This retardation is of course observed only between the perforations; and not outside them, where the motion is entirely free.] As the development of the figures continues, so also does the retardation at their neighbouring edges increase; the final result being (however long the experiment may be prolonged), that the other diagonal of the square is completely and permanently traced out in a line of no chemical action.

The above experiments are of fundamental importance, and they obviously admit of endless variety. Of this, a few illustrations may suffice.

If the upper plate have three perforations, situated on the points of a central equilateral triangle, there are three repulsion lines; these end at the centre of the triangle, where they form a trilobular point, and traverse its sides midway at right angles.

When the upper plate has four perforations, situated on the points of a central square, there are four repulsion lines; these end at the centre of the square, where they form a quadrilobular point, and traverse its sides midway at right angles.

A very beautiful modification of the preceding experiment consists in simultaneously developing a circle from a (fifth) central perforation. This last circle has no means of escape from the surrounding four. The result is, that it eventually forms a square figure bounded by repulsion lines, and having four symmetrically situated repulsion lines at its corners.

It is easy to demonstrate that the chemical repulsion in these experiments does not depend upon flow. Two superimposed triangular plates, for instance, in neither of which is any perforation, give three repulsion lines on immersion in dilute hydric sulphate. From each corner a line proceeds midway (if the triangle be equilateral) to the centre. In this effect diffusion is alone concerned.

In addition to hydric sulphate and baric chloride, other pairs of reagents may be used with success; and I anticipate no difficulty in obtaining results in which precipitation is not concerned. A beginning has also been made with experiments in tridimensional development.

The complete explanation of what I have termed “chemical repulsion” will probably demand a varied and considerable amount of experimental work. From some incidents of the investigation, so far as it has hitherto proceeded, I am disposed to believe that the motion in any plane chemical figure is not along the radius, but at right angles to the radius; and this supposition will, if verified, explain the repulsion. The existing results afford proof of the following propositions, viz:—(1) *Chemical action can take place at a distance*; and (2) *Two or more chemical actions, identical except in position, completely exclude one another*.

Chemical Society, January 15.—Mr. Warren De La Rue, president, in the chair.—The following papers were read:—On the effects of the growth of plants on the amount of matter removed from the soil by rain, by Dr. J. H. Prevost. Soil 3 inches deep was placed in two glazed earthenware pans 17 inches in diameter on July 21; 4 grm. of white clover seed was sown in one, the other being blank. The pans were exposed till October 4. The drainage-water was collected and analysed; that from the clover soil contained 48.1 grains of solid matter per gallon, the other 220. The author concludes that rain removes much more matter from an uncropped than from a cropped soil.—Mr. Wynter Blyth described a simple apparatus for the treatment of substances in open dishes to volatile solvents. The dish is placed inside a cast-iron pan, and covered with a glass bell-jar, with condenser attached, the joint between the bottom of the pan and the bell-jar being made tight with

mercury.—On dibromanthraquinones, by Mr. W. H. Perkin. By heating bromine with anthraquinone, a dibromanthraquinone is formed, melting at 245° C.; by boiling tetrabromanthracene with chromic acid, dissolved in a large excess of glacial acetic acid, an isomer  $\beta$  dibromanthraquinone is obtained, melting at 275° C. By the action of caustic alkalis on these bodies, alizarin is formed in both cases. The author discusses the formation of this substance. In the case of the  $\alpha$  body, two other colouring matters were formed with the alizarin, one dyeing mordants, the other not. The author is investigating these bodies. He appends a note in which he concludes on further examination that Auerbach's isopurpurin is a mixture of flavopurpurin and anthrapurpurin, and is not identical with anthrapurpurin.—Mr. Warington contributed some notes on some practical points connected with his laboratory experience. He has used with great convenience the indiarubber joint covered with mercury, which was proposed by Dr. Frankland as a substitute for the steel blocks connecting the laboratory and measuring tubes. At first the indiarubber wore out rapidly; this was prevented by tying it above the conical stopper as well as below. He recommends the coating of laboratory benches, &c., by heating the wood and then rubbing in paraffin; the wood is thus protected from the action of acids. In the determination of nitrates by Frankland's process, the author suggests the addition of a drop of dilute hydrochloric acid, to ensure a complete reaction between the mercury and the nitric acid. By means of a solution of diphenylamine in strong sulphuric acid, the author has detected by the blue coloration produced  $\frac{1}{10000}$ th of a milligram of hydrogen as nitric acid.—On the melting and boiling points of certain inorganic substances, by T. Carnelly and W. C. Williams.

Zoological Society, January 6.—Prof. Flower, F.R.S., president, in the chair.—Prof. Newton, M.A., F.R.S., V.P., exhibited, on behalf of Mr. G. B. Corbin, a specimen of *Acanthyllis* (sive) *Chaturva caudacuta*, the Needle-Tailed Swift, shot near Ringwood, in Hampshire, in July, 1879, remarking that it was the second example of this Siberian species which had been obtained in England.—Mr. John Henry Steel, F.Z.S., read a series of preliminary notes on the individual variations observed in the osteological and myological structure of the Domestic Ass (*Equus asinus*).—A communication was read from Mr. E. W. White, C.M.Z.S., containing notes on the distribution and habits of *Chlamyphorus truncatus*, from observations made by the author during a recent excursion into the western provinces of the Argentine Republic, undertaken for the purpose of obtaining a better knowledge of this animal.—Dr. John Mulvany, R.N., read a paper on a case which seemed to him to indicate the moulting of the horny beak in a Penguin of the genus *Endyptes*.—Mr. O. Thomas, F.Z.S., read the description of a new species of *Mus*, obtained from the island of Ovalau, Fiji, by Baron A. von Hügel, and proposed to be called *Mus huegeli* after its discoverer.—A communication was read from Mr. R. G. Wardlaw Ramsay, F.Z.S., containing a report on a collection of birds made by Herr Bock, a naturalist employed by the late Lord Tweeddale, in the neighbourhood of Padang. Three species were described as new and proposed to be called *Dicrurus sumatranus*, *Turdinus marmoratus*, and *Myiophonus castaneus*.—Dr. Günther, F.R.S., read a description of two new species of Antelopes, of the genus *Neotragus*, *N. kirki*, from Eastern Africa, and *N. molaris*, from Damaraland.

Geological Society, January 7.—Henry Clifton Sorby, president, in the chair.—Edward Bagnall Poulton was elected a Fellow, and Prof. A. E. Nordenskjöld, Stockholm, and Prof. F. Zirkel, Leipzig, Foreign Members of the Society.—The following communications were read:—On the Portland rocks of England, by the Rev. J. F. Blake, F.G.S. The author gave a general account of the relation of the several Portland rocks in the areas of their development to each other, and hence deduced the history of the Portland "episode." The name is used on the Continent in a wider sense than in England, and this use was shown to be unjustifiable. After giving an account of his observations on the rocks at Portland itself, and dividing the limestones into the building-stone and flinty series, the author showed that the so-called "Upper Portlandian" of Boulogne corresponds to the latter, and the upper part of the "Middle Portlandian" to the Portland sand. He then endeavoured to prove, by the proportionate thickness, the indications of change in the lithology, and the distribution of some of the fossils, that the rest of the so-called "Middle" and the "Lower Portlandian" are represented by integral portions of the Upper Kimmeridge, which are thus the "normal" form corresponding

to what the author calls the "Boulognian episode." The series in the Vale of Wardour has been made out pretty completely. The Purbeck is separated by a band of clay from the Portland, and is not amalgamated with it. The building-stones and flinty series are here seen again; and a fine freestone occurs at the base of the latter. The representatives of the Portland sand were considered to be older than those of other districts. The relations of the Purbeck to the Portland rocks at Swindon were very carefully traced; and it is shown that, while the upper beds of the latter put on here some peculiar characters, the former lie on their worn edges. The upper beds of the Portland, which have been referred to the sand, correspond to the freestone and the base of the flinty series of the Vale of Wardour; hence the Purbecks of Swindon may be coeval with the upper beds of the Portland to the south. At the base of the great quarry and elsewhere in the neighbourhood are the "Trigonia-beds," beneath which is clay, hitherto mistaken for the Kimmeridge clay; and beneath this are the true Portland sands, with an abundant fauna new to England. The limestones of Oxfordshire and Bucks were considered to represent the "Trigonia-beds" only; and, as the Purbecks here lie for the most part conformably, it was suggested that they were formed in a lake at an earlier period than those at Swindon, which are of a more fluviatile character. Hence the Portland episode, considered as marine, was at an end in the north before it was half completed in the south.—On the correlation of the drift-deposits of the north-west of England with those of the midland and eastern counties, by D. Mackintosh, F.G.S.

Anthropological Institute, Jan. 13.—John Evans, D.C.L., F.R.S., vice-president, in the chair.—Dr. Hack Tuke read a paper on "The Cagots." The author showed that the popular etymology of the word Cagot, from "Canis Gothi," is probably inaccurate, and accepted the suggestion of M. de Rochas, that Cagot is derived from the Celto-Breton word *cacod* (leprous); it is easy to see how readily this would assume the form of cacou (as it is in Brittany actually applied to these people), and so the French Cagou or Cagot. The conclusions at which the author arrived as to the origin of the Cagots were as follows:—1. The Cagots are not the descendants of the Goths; they are not a distinct race, but a despised class among the people of the country in which they live. 2. They are not more subject to goitre or to cretinism than the inhabitants of the adjacent district—in short, cagotism and cretinism are in no way allied. 3. The present representatives of the Cagots are now recognised by tradition, and not by their features, and are not distinguished by any peculiar mental or physical disorder. 4. Although nothing like leprosy, or leucoderma, has for a long time affected the Cagots, and no one on the spot regards them in this light, there is evidence to show that they were originally either lepers labouring under a particular variety of leprosy, or were affected with leucoderma, the form of the affection accounting for their being regarded as in some respects different from ordinary lepers, though shunned in the same way. 5. Many were, no doubt, falsely suspected of leprosy in consequence of some slight skin affection; others, again, in later centuries, were members of families in which the disease had died out.—The Director read two papers by Mr. Alfred Simson, on the Jivaros and the Canelos Indians. The tribe of the Jivaros is a large one, and one of the most distinguished, independent, and warlike in South America. They speak a language of their own, Jivaro, and occupy the country generally from the Upper Pastassa to the Santiago, both rivers included, down to the Pongo de Manseriche, on the Marañon. They are hospitable, and their houses are large and built of palms. They have a most perfect method of scalping, by which the victim's head is reduced to the size of a moderately large orange, maintaining tolerably well all the features: the skin is cut round the base of the neck, and the entire covering of the skull removed in one piece. This is then dried gradually by means of hot stones placed inside it, until the boneless head shrinks to the required size. They also wear their slain enemies' hair in long plaits round the waist. Great festivities take place when a child, at three or four years of age, is initiated into the art and mysteries of smoking. The Jivaros of the Pintue have the habit of vomiting nearly every morning by the aid of a feather, arguing that all food remaining in the stomach overnight is unwholesome and undigested, and should therefore be ejected. Canelos, the once attractive Spanish settlement, but now forlorn Indian village, is situated on the left bank of the Bobonaza, one of the most important, if not the largest, of the

tributaries of the Upper Pastassa, and is inhabited by a mixed tribe of Indians in whom the chief element is Jivaro, though some of the better traits of these seem to be wanting in them. Their language is Quichua. Their fighting is done entirely with the lance, which is their inseparable companion, and all the author's attempts to induce any of them to part with his weapon were fruitless.

PARIS

Academy of Sciences, January 12.—M. Edm. Becquerel in the chair.—M. Daubrée presented the second part of his Synthetic studies of experimental geology; it treats chiefly of the chemical and mechanical phenomena of meteorites (which are compared with the deeper rocks).—On meteorological observations in May at Zi-ka-wei, in China, by M. Faye. Storms go from China to Japan, following a like course to that of storms coming to Europe from the Atlantic. They are independent of the prevailing monsoon, and conversely, neither preventing the other. M. Faye finds support for the theory of gyratory movements propagated downwards.—On the kinematic geometry of deformations of bodies, elastic, plastic, or fluids, by M. De Saint Venant.—Some observations on a note of M. Wurtz (C. R., December 22, 1879), by M. Sainte-Claire Deville.—Evolution of the inflorescence in Gramineæ (first part), by M. Trécul. He considers here (1) the formation of the primary axis; (2) the order of appearance of the branches; (3) that of their growth.—Influence of the nature of carbons on the electric light, by M. Du Moncel. In 1855 he called attention to the advantages of using carbons of vegetable origin for the electric light. In 1859 he produced an electric candle with plates of charcoal in a tube.—On the discord apparent between the heights recently observed on the Seine and the previsions of the hydrometric service in the passage through Paris, by MM. Lalanne and Lemoine. M. Belgrand's empirical laws apply only to the natural state of the river, but ceased to apply in the early days of January, owing to the effects of the abnormal freezing of the Seine (which occurs several times in a century). M. Dumas and Gen. Morin made some remarks, the General pointing out that the breaking up of the ice sometimes proceeds up the river, sometimes down; in the latter and more dangerous case explosives and other means should be promptly used to open the block.—On the photographic spectra of stars, by Dr. Huggins.—State of the tunnelling operations of St. Gothard, by M. Colladon. The works have been retarded. From November 11 to January 1 (fifty-one days) the advance of the north gallery was only 34'90 m. against 173'10 m. in the forty-nine days previous. This was due to pressure of an unresistant rock met with, which crushed the strongest wood-work. The perforation will likely be complete in the end of February or beginning of March.—On treatment of phylloxerised vines, by M. Marès.—On glyco-genesis in infusoria, by M. Certes. Treated with iodised serum, they present similar effects to those whereby M. Ranvier, with this substance, proved the presence of glycogen in lymphatic cells. (The effects on several organisms found with infusoria are also indicated.) The vitality of animalcules is an important factor in glyco-genesis.—Resistance of pucerons to severe cold, by M. Lichtenstein. Phylloxera and others successfully resisted cold of 11° and 12° below zero in December.—Determination, by M. Gylden's methods, of the motion of the planet Hera (103), by M. Callandreau.—On the polygons inscribed in a conic, and circumscribed on another conic, by M. Darboux.—Solar cyclone, by M. Thollon. Observing a peculiarly dark spot on January 3, he perceived two opposite deflections of the line C, corresponding to velocities of 60 and 137 km. respectively, in the vast cyclone.—On the thermal laws of the electric sparks produced by ordinary partial discharges of condensers (second note), by M. Villari. The galvanometric deflections caused by incomplete discharges are proportional to the quantities of electricity forming the discharges. The heat generated by the spark is directly proportional to the quantity of electricity forming the spark.—Variations of the magnetic declination deduced from regular observations at Montcalieri in the period 1871-78, by M. Denza. These agree in the main with observations at other Italian places, and at Prague, Christiania, Munich, and Greenwich, pointing to cosmical causes.—On the Thomson galvanometer, by M. Gaiffe. The scale-indications are not proportional to the values of the currents measured, the angles of deflection of the needle being doubled by reflection of the mirror. This source of error he seeks to correct by using a bifilar suspension formed of two cocoon-fibres.—On the potash contained in the clay of arable soils, by M. Perrey. Clay constantly contains

potash varying ordinarily from 2 to 5 per cent., sometimes from 1'8 to 7'3 per cent.—On the tension of dissociation of hydrate of chloral, and on the vapour-tension of anhydrous chloral, by MM. Moitessier and Engel.—Effects of intra-venous injections of sugar and gum, by MM. Moutard-Martin and Richet. Sugar injected into dog's veins always causes polyuria and glycosuria, and does not affect the blood-pressure. Gum has an opposite effect; it diminishes the polyuria previously produced by sugar, and at length completely stops the secretion of urine; it also increases notably the tension of blood in the arteries.—On the phenomena arising from ligature of the inferior vena cava above the liver, by M. Picard.

VIENNA

Imperial Academy of Sciences, October 23, 1879.—The earthquakes of Carinthia and their lines of shock, by Prof. Hoefler.—On the histiogenesis of sclerosis of the posterior fibres of the spinal cord, by Dr. Weiss.—On the forces operative on diamagnets, by Prof. Boltzmann.—Determination of path of the planet Bertha (154) by Herr Anton.

November 6, 1879.—The long-haired common guinea-pig (*Cavia Cobaya longipilis*), by Dr. Fitzinger.—Fish-fauna of the Cauca and the rivers in Guayaquil, by Dr. Steindachner.—Shell-fish fauna of the Galapagos Islands, by Herr Wimmer.—The von Müller collection of Australian fish, by Dr. Klunzinger.—On the humour passages of hyaline cartilage, by Dr. Spina.—Magnetic measurements in Kremsmünster in July, 1879, by Herr Liznar.—On compounds from animal tar: III. Lutidine, by Prof. Barth and Herr Herzig.

November 13, 1879.—Researches on the development of the central nerve-tissue, by Herr Stricker and Dr. Unger.—On the action of the safety-valve in steam boilers, by Herr von Burg.—Firing under water, by Herr Lorber.

November 20, 1879.—The following among other papers were read:—The sporogon of Archidium, by Prof. Leitgeb.—Contributions to a knowledge of the hen's germ at the commencement of brooding, by Herr Koller.—On the last multiplier of differential equations of higher order, by Prof. Winckler.

December 4, 1879.—On the striction line of the hyperboloid as rational space-curve of fourth order, by Herr Migotti.—On processes of degeneration and regeneration in uninjured peripheric nerves, by Prof. Mayer.

December 11, 1879.—On waterspouts observed near Canea, by Herr Miksche.—Researches on the course of conduction in the spinal cord of the dog, by Dr. Weiss.—A contribution to the theory of urine-secretion, by Dr. Gärtner.—On a new isomer of gluconic acid, by Herr Hömig.—On the theory of inconstant galvanic elements, by Prof. Exner.

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