SOCIETIES AND ACADEMIES

London

Royal Society, March 3.—The following papers were read: "Results of the monthly observations of dip and horizontal force made at the Kew Observatory from April 1863 to March 1866, inclusive," by Dr. B. Stewart. The author exhibited tabular statements of dip observations during six years, from which was deduced the existence of a semi-annual inequality, in virtue of which the dip is on an average 0'·27 lower in the six months from April to September, and 0'·27 higher in the six months from October to March than is due to its mean value. This result is in the same direction as that found by Sir E. Sabine for the six years ending March 1863, but is less in amount than the latter, that determined from the first six years exhibiting a range of 1'·31, while that determined from last six years only exhibits a range of 0'·54. From the first six years we deduce a mean dip equal to 68° 20'·07, corresponding to middle epoch April 1, 1860, and from the latter six, a mean dip equal to 68° 6'·62, corresponding to middle epoch April 1, 1866, while the secular change deduced from the first series is 2'·00, and that deduced from the last series is 1'·92, the mean of these two values being 1'·96. If we apply this mean value of the secular change to the mean result corresponding to the epoch April 1, 1860, in order to bring it to the epoch April 1, 1866, we obtain—

$$68° 20'·07 - 11'·76 = 68° 8'·31,$$

whereas that deduced from the second series corresponding to this epoch is 68° 6'·82. The former of these is 1'·69 higher than the latter. As regards the reason of this difference the author does not think it due to any personal equation in the observer. It would appear that the Kew observations present a peculiarity similar to those at Toronto, so that the difference of 1'·69 between the two sets of observations may probably be accounted for by this cause. The probable error of a single monthly determination of the dip, derived from the seventy-two monthly determinations, and after the application of the correction for secular change and annual variation, as derived from the results of these observations, has been made, is ±0'·96. There is, however, reason to believe that this probable error is increased to some extent by periods of disturbance, some of these of considerable duration. In the observations of horizontal force during the first six years, mean value of the horizontal force is equal to 3·8034, corresponding to the middle epoch April 1, 1860, and from the latter six years' observations we have a mean value of horizontal force equal to 3·8360, corresponding to epoch April 1, 1866; also the secular change deduced from the first six years is + ·0053, while that deduced for the second six is + ·0055, the mean of the two being + ·0054. If we apply this mean value of the secular change to the mean result corresponding to epoch April 1, 1860, in order to bring it to epoch April 1, 1866, we obtain 3·8034 + 0·0324 = 3·8358, a value which agrees as nearly as possible with that deduced from the second series, and corresponding to the same epoch which was 3·8360. The coincidence of these two values naturally leads us to imagine that the secular change of the horizontal force does not present the same peculiarity as that observed in the dip. In the observations of total force the mean of the April to September values of the horizontal component of the force in the last six years is 3·8346, corresponding in epoch to January 1, 1866; and the mean of the April to September values of the dip in the same six years is 68° 6'·83. The mean of the October to March values are for the horizontal force 3·8372, and for the dip 68° 6'·41, corresponding to epoch July 1, 1866. We may reduce these to a common epoch by applying to the former dip the correction —0'·96, this being the proportional secular change (as shown by these six years) necessary to reduce the former epoch to the latter. The former dip will therefore become 68°6'·83—0'·96 = 68° 5'·87. Reducing in the same way the horizontal force, we have

$$3·8346 + 0·00275 = 3·83735.$$

The values thus become as follows:—

	Hor. orce.	Dip.
From the April to September observations (reduced to epoch July 1, 1866)	3·83735	68° 5'·87
And from the October to March observations (corresponding to the same epoch)	3·83720	68° 6'·41

The total force derived from the first series will therefore be 10·28717, and that derived from the second series 10·29080, showing thus a difference of 0·00363 in British units as the measure of the greater intensity of the terrestrial magnetic force in the October to March period, than in the April to September period. This is in the same direction, and very nearly of the same amount, as that determined by Sir E. Sabine from the first six years, which exhibited a similar difference of 0·00317 in British units. Thus we find that the two series agree in showing nearly the same semi-annual variation for the total force, while the first period exhibits the greatest semi-annual variation of the dip. It ought, however, to be borne in mind that the two series bear a different relation to the disturbance period, the maximum of disturbances occurring about the middle of the first series, and the minimum near the middle of the second.

"Spectroscopic observations with the great Melbourne Telescope." By A. Le Sueur. The author stated that the spectroscopic observations of the nebulæ of Orion show distinctly that considerable nebulosity exists within and about the trapezium. The author's *telescopic* observations reveal a positive though comparatively faint nebulosity within and about the trapezium; the *spectroscope*, however, shows with much force that this nebulosity not only exists, but is comparable in brightness to that surrounding the trapezium at some distance,—the brightest part of the nebulæ in fact; that, in ordinary observations, therefore, the faintness or apparent complete absence of nebula is mainly due to the disturbing brightness of the four stars, not to any intrinsic extreme faintness or absolute vacuity.

In the examination of Jupiter, the large size of image is brought into prominent play; with the original Cassegrain image the light is barely sufficient, but with the image condensed (at pleasure within certain limits) fair work becomes possible, the spectrum being considerably bright. The lines G, F, *b*, C, D are seen without the slightest difficulty, and many other lines with attention. A marked feature is a nebulous band between C, D; from measures this turns out to be one of the bands examined by Mr. Huggins, 882 of his scale (C_6 of Brewster?). With the slit perpendicular to Jupiter's equator and the advantage of a large image, an admirable opportunity is afforded of noting the behaviour of the lines as they cross the different parts of the surface, a spectroscopic picture of the planet, as it were, being presented beautifully to the eye. The nebulous line C_6 was specially and narrowly watched, but without any satisfactory evidence being elicited;

It is found that the spectrum of η Argo is crossed by bright lines. The mere fact of a bright line spectrum is not very difficult to ascertain on a good night; for although from faintness of the light the phenomenon is necessarily delicate, yet the bright lines occasionally flash out so sharply that the character of the spectrum cannot be mistaken. The most marked lines were made out to be, if not coincident with, very near to C, D, *b*, F, and the principal green nitrogen line. It cannot be determined whether the coincidence is with the magnesium group or the air-band; nothing more definite can be said than that the star line lies within the limits of the group. The comparison spectrum employed does not show F, but the position of the previously adjusted pointer, with reference to air lines in the neighbourhood, leaves little doubt as to the identity of the blue star line with F, due regard being had to the collateral evidence (when such close limits are reached) that C coincides with a red star line. The yellow (or orange?) line in the star has not yet received sufficient attention, it is, however, very near D. With the dispersion employed, D and the bright air line on the less refrangible side of D are well separated; so that, notwithstanding the delicacy of the star line, the author hopes if not to get satisfactory evidence of coincidence with a particular line, at least to eliminate one of the competitors; at present it cannot even be said whether the line may not be slightly more refrangible than D; the limits are, however, very small, placing the bright air group about 1,180 of Mr. Huggins's scale completely outside the possible range. The very faint nebulosity (if any) in the immediate neighbourhood of the star η is incompetent to give a trace of spectral lines with even a wide slit; for a considerable space S and *f* of η no lines at all are visible; the nearest nebula bright enough to show a line (the three usual lines are now easily seen on a good night over the brighter parts) is reached in the direction about 45° N p from η, and even then the distances from η, as judged by the appearance in the spectroscope with η threaded on the thus directed slit, is little less than one minute. This remark is of some importance in connection with the ordinary telescopic observations of the nebula, but is mentioned at this point to relieve any impression which might arise that the nitrogen line seen on the star spectrum is merely the chief nebula line crossing it. In the present state of the inquiry there is little doubt left as to the presence of hydrogen in the star; the other lines may perhaps be accounted for by nitrogen alone, or by nitrogen, magnesium, and sodium. On the whole the weight of collateral evidence will probably be considered to be in favour of the latter combination, with the possibility that for sodium may have to be substituted the substance which produces the line in sun-protuberance spectrum. For although there is no direct evidence as to identity of the line near D, if the coincidence were with the orange nitrogen line, it would be reasonable to expect a line in the star corresponding to the yellow line 1180±, yet none has been made out in that position; again, the second green line has probably less claims for visibility than the orange or yellow lines, yet in the star spectrum this line is not less well seen than that coinciding with the chief nitrogen line; these considerations, though perhaps not entitled to great weight, at least lead in the direction of the above inference. Owing to faintness of the general spectrum no dark lines are made out; one in the red is strongly suspected, and occasionally there is an appearance as if of a multitude over the spectrum generally, but they refuse to be seen separately and certainly. The spectroscope has decided that η in no way influences the configuration as now seen. Is not the presence of nitrogen and hydrogen in the star η a significant fact in connection with these changes, which appear to be nothing less than a destruction of nebula specially in its neighbourhood?

Orion has again been examined with an interesting result; the spectroscope proves that in and about the trapezium nebula exists comparable with the bright surrounding nebula. The stars, sharply focused to give a linear spectrum, being threaded on the slit singly or in pairs, or cautiously removed out of the field, it is seen that the bright lines cross the trapezium with little if at all diminished brilliancy. The ordinary telescopic view is therefore an erroneous one, produced by the disturbing effect of the bright group. Jupiter has been examined (generally on moonlight nights); with this object the original Cassegrain image is too faint for good work, but by interposition of a suitable lens the image is condensed at pleasure within certain limits; with the light thus increased the Fraunhofer lines G, F, *b*, E, D, are always easily seen, C also easily on a clear night; the lines to which special attention has been directed are the telluric lines 914 and 838 (for convenience of reference the numbers in Mr. Huggins's Jupiter and sky diagrams are used throughout.) These are the only lines seen with certainty between C and D. The identity of 914 and 838 rests partly on measures and partly on spark comparison, where, for the identification of 914, it is seen that this line is near to the air band 807 of Mr. Huggins's chemical scale. The line 914 is so easily seen, that having in mind Mr. Huggins's statement concerning the difficulty of discerning it at all, originally very imperfect measures on a bad night, and with the apparatus imperfectly adjusted, misleading in the same direction, this line was at first mistaken for 882, from which, however, it is separated far beyond the limit of error in a proper state of adjustment of apparatus. 882 is not seen at all with Jupiter at considerable altitude. On the night of December 29th, however, between the hours of 12.30 and 1, Jupiter being low, 882 was then seen almost as conspicuous as 914, which did not seem to have perceptibly increased in darkness by the additional absorption of the earth's atmosphere. On the night of December 14th (both objects being near the meridian) the spectroscope was turned on Jupiter and the moon alternately several times. On Jupiter 914 and 838 were easily visible, the former (as usual) the more conspicuous; on the moon no line could be certainly made out between C and D.

March 16.—The following papers were read:—"On the Contact of Conics with Surfaces." By William Spottiswoode, M.A., F.R.S. "Tables of the Numerical Values of the Sine-integral, Cosineintegral, and Exponential Integral." By J. W. L. Glaisher, Trinity College, Cambridge. Communicated by Prof. Cayley, LL.D. "Researches on Solar Physics.—No. II. The Positions and Areas of the Spots observed at Kew during the years 1865-66, also the Spotted Area [of the Sun's visible disc from the commencement of 1832 up to May 1868." By Warren De la Rue, Ph.D., F.R.S., F.R.A.S., Balfour Stewart, LL.D., F.R.S., F.R.A.S., Superintendent of the Kew Observatory, and Benjamin Loewy, F.R.A.S. The paper commences with a continuation for the years 1864-66 of Tables II. and III. of a previous paper by the same authors; it then proceeds to a discussion of the value of the pictures of the sun made by Hofrath Schwabe, which had been placed at the disposal of the authors, and the result is that these pictures, when compared with simultaneous pictures taken by Carrington and by the Kew heliograph, are found to be of great trustworthiness. From 1832 to 1854 the pictures discussed are those of Schwabe, who was the only observer between these dates; then follows the series taken by Carrington, and lastly the Kew series, which began in 1862. A list is given of nine values of the sun's spotted area for every fortnight, from the beginning of 1832 up to May, 1868, and also a list of three-monthly values of the same, each three-monthly value being the mean of the three-fortnightly values which precede one of the three which follow it. These three-monthly values are also given for every fortnight. A plate is appended to the paper, in which a curve is laid down representing the progress of solar disturbance as derived from the three-monthly values; and another curve is derived from this by a single process of equalisation, representing the progress of the ten-yearly period. The values of the latter curve, corresponding to every fortnight, are also tabulated. From this Table are derived the following epochs of maxima and minima of the longer period:—

Minimum	Nov. 28, 1833.	
Maximum	....	Dec. 21, 1836.
Minimum	Sept. 21, 1843.	
Maximum	....	Nov. 1, 1847.
Minimum	April 21, 1856.	
Maximum	....	Sept. 7, 1859.
Minimum	July 14, 1867.	

This exhibits a variability in the length of the whole period. Thus we have between 1st and 2nd minimum...... 9·81 years.
2nd and 3rd do. ......12·58 „
3rd and 4th do. ......10·81 „

Mean of all the periods ....11·07 years.

Another fact previously noted by Sir J. Herschel is brought to light, namely, that the time between a minimum and the next maximum is less than that from the maximum to the next minimum. Thus the times from the minimum to the maximum are for the three periods 3·06, 4·14, and 3·37, while those from the maximum to the minimum are 6·75, 8·44, and 7·44 years. In all the three periods there are times of secondary maxima after the first minimum; and in order to exhibit this peculiarity statistics are given of the light-curve of R Sagittæ and of β Lyræ, two variable stars which present peculiarities similar to the sun. Finally, the results are tested to see whether they exhibit any trace of planetary influence; and for this purpose 54 conjunctions of Jupiter and Venus, and 90 conjunctions of Venus and Mercury have been made use of with the following result, exhibiting the united effect of the sun's conjunctions, the unit of spotted area being one millionth of the sun's visible hemisphere.

Angular separation.	Excess or Deficiency. Jupiter and Venus.	Venus and Mercury.
0 to 30	+ 881	+ 1675
30 to 60	− 60	− 139
60 to 90	− 452	− 1665
90 to 120	− 579	− 2355
120 to 150	− 705	− 2318
150 to 180	− 759	− 1604
180 to 210	− 893	− 481
210 to 240	− 752	+ 547
240 to 270	− 263	+ 431
270 to 300	+ 70	+ 228
300 to 330	+ 480	+ 1318
330 to 0	+ 1134	+ 2283

Chemical Society, March 3.—Prof. Williamson in the chair. "On Refraction Equivalents." By Dr. Gladstone. Three distinct lines of research had led up to the discovery of these equivalents. The first was the influence of temperature on the refraction of light by liquids; the second, the refraction of mixtures or combinations as compared with that of their constituents; and the third, the refractive indices of different members of homologous series of organic compounds. As to the first of these it was found by the joint labours of Dr. Gladstone and the Rev. Pelham Dale, that the refraction and the dispersion decrease as the temperature rises. Further examination showed a close relation between the change of density and the change of the refractive index minus unity, which the investigators termed the "refractive energy," and which is expressed in the language of opticians as $u-1$. This energy divided by the density, that is $\frac{u-1}{d}$ is called the "specific refractive energy," and is, in the case of liquids, a constant, not affected by temperature. This conclusion was subsequently confirmed by the experiments of Landolt, Wüllner, and Kühlman. As to the second line of research, that of the refraction of mixtures, solutions, and simple combinations, the conclusion was arrived at that here also the nearest approximation to the truth was given by $\frac{u-1}{d}$, and this conclusion has been fully confirmed by the careful experiments of Wüllner. The same general expression holds good also in the case of a gas or a solid in solution, and, indeed, it was expected to be so, for water, phosphorus, and sulphur have the same energies in the liquid and solid states. The question now presented itself, does an elementary substance retain its specific power of retarding rays when it is combined chemically with other elements? An affirmative reply was suggested by many considerations. It was, for instance, found that bromoform ($CH\,Br_3$) and bibromide of bromethylene ($C_2H_3Br_3$) have almost the same specific refractive energy as bromine itself. On the other hand, however, the investigators observed that isomeric liquids were not always identical in refractive energy, and that the replacement of hydrogen by oxygen in organic compounds effected a much greater optical change in some instances than in others. Hence the conclusion was drawn that the specific refractive energy of every liquid is composed of the specific refractive energies of its component elements, modified by the manner of combination. The third line of research was that of the refractions of different homologous compounds. The experiments of Delffs, of Landolt, and of Gladstone and Dale, have led to the view that in all the series containing the radicals, methyl and its congeners, the specific refractive energies increase as the series advances, and that the amount of optical change is less between the higher than between the members of the lower series. Landolt, adopting Gladstone and Dale's formula for the specific refractive energy, multiplied it by the atomic weight P; and this $P\frac{u-1}{d}$ he designated the "Refraction Equivalent." According to this representation, the refraction equivalent of a body is the sum of the refraction equivalents of its constituent elements. The great advantage of this kind of expression is, that it permits of the easy comparison of the optical properties of different substances. By making these comparisons, Landolt found that the refraction equivalent of carbon is 5·0; that of hydrogen, 1·3; and that of oxygen, 3·0. Direct experiments have given figures very close to these. The way of calculating the refraction equivalent of a compound from these data may be illustrated by ether. $C_4H_{10}O = 4\,(5·0) + 10\,(1·3) + 3·0 = 36·0$. The refraction equivalent deduced from observation is 36·26. A great variety of liquids have given the same equivalents by calculation as by direct investigation. Yet there are exceptions to this agreement with theory. The whole group of the aromatic hydrocarbons and their derivatives give refraction equivalents much above the calculated numbers. This anomaly must be due to an erroneous representation of the constitution of their nucleus, which cannot be greater than C_6H_3. However, the above method makes it possible to find the refraction equivalent of bodies, which could not otherwise be taken; for instance, of metals. The refraction equivalents of fifty elements have been determined in this way. It is to be remarked that the figures in the following list represent A of the solar system:—

Aluminium	8·4	Iodine	24·5—27·2
Barium	15·8	Iron	12·0—20·1
Bromine	15·3—16·9	Lead	24·8
Calcium	10·4	Magnesium	7·0
Carbon	5·0	Manganese	12·2—26·2
Chlorine	9·9—10·7	Mercury	21·3—29·0
Chromium	15·9—23·0	Nitrogen	4·1— 5·3
Copper	11·6	Oxygen	2·9
Hydrogen	1·3— 3·5	Phosphorus	18·3
Platinum	26·0	Sodium	4·8
Potassium	8·1	Sulphur	16·0
Silicon	7·5— 6·8	Tin	27·0—19·2
Silver	13·5	Zinc	10·2

It will be seen that some of the elements have a double value, and this peculiarity is in most cases coincident with a change of atomicity. Thus, iron in the ferrous salts has the equivalent 12·0, in the ferric salts 20·1, and since the refraction equivalent of iron in potassic ferridcyanide is 11·7, the view suggests itself that the metal is here in the same condition as in the ferrous salts. Great anomalies, however, present themselves in the case of oxygen. Its equivalent in many compounds is 2·9, but in others it comes down to 2·1, and in some cases, as in sulphates and phosphates, it would seem to be a negative quantity. This points to the conclusion that oxygen has the power of greatly modifying the action on light of those elements with which it is combined in a high proportion. On looking over the above list one is struck by the identity of the equivalents of those elements which have the same, or nearly the same, atomic weight. This property is still more prominent when the specific refractive energies of the elements instead of their refraction equivalents are considered. The following pairs may be noted in this respect:—

Iron,	0·214	Aluminium,	0·307	Bromine,	0·191
Manganese,	0·222	Chromium,	0·305	Iodine,	0·193

But the most suggestive comparison is that between the specific refractive energy and the combining proportions of those metals that form salts not decomposable by water. By combining proportion is meant the actual amount which will combine with a certain quantity of a salt radicle. A few of these metals may be quoted here:—

	Specif. refr. energy.	Combining proportion.
Hydrogen	1300	1
Albuminium	307	9·1
Calcium	260	20
Iron	214	28
Sodium	209	23
Potassium	207	39·1
Copper	183	31·7
Silver	125	108
Lead	120	103·5
&c.		

The regularity in the decrease of the numbers in the first column and the corresponding increase in the second column would suggest that the combining proportions of Silver, Lead, &c. ought to be halved in order to bring those elements to about their right places in the list. There is further a remarkable coincidence between the power of a metallic element to refract the rays of light, and its power to saturate the affinities of other bodies; of course, it must be borne in mind that a small combining proportion means a high saturating power.

The names of the officers proposed by the Council of the Chemical Society for election on the 30th March, are:—President: A. W. Williamson. New Vice-Presidents: E. Frankland, A. Matthiessen. New Members of Council: H. Bassett, F. Field, F.R.S.; M. Holzmann, Ph.D.; W. J. Russell, Ph.D.; R. Angus Smith, Ph.D., F.R.S.; John Tyndall, LL.D., F.R.S.

Entomological Society of London, March 7.—Mr. F. P. Pascoe, vice-president, in the chair. The Rev. R. P. Murray and M. J. C. Puls were elected members. Professor Westwood exhibited a number of old locusts, with a view to determine what is the true *Locusta migratoria* of Linnæus. The Rev. H. S. Gorham sent for exhibition specimens of *Sunius neglectus*, a beetle new to Britain, but probably confused in collections with *S. angustatus*. Mr. Albert Müller exhibited a curious acorn-like gall formed on the mid-rib on the underside of the leaf of a species of *Gnetum*. Mr. Janson exhibited a large number of butterflies collected by his son in Nicaragua in November and December last. Mr. Butler exhibited specimens of *Argynnis Adippe* and *Niobe*, in support of his previously expressed opinion that the two forms are but one species. Dr. Wallace exhibited dark varieties of *Melitæa Athalia*, and specimens of *Herminia derivalis*. Mr. Stainton exhibited *Cosmopteryx Sienigiella*, bred in this country from Russian larvæ which fed in reeds. Dr. Wallace exhibited cocoons and silk of several species of silk-producing moths, and addressed the meeting on the progress and science of Sericiculture in this country and in the colonies. The following paper was read: "Descriptions of twelve new exotic species of the Coleopterous family *Pselaphidæ*," by Professor Westwood.

Ethnological Society, March 8.—Professor Huxley, F.R.S., president, in the chair. Captain Campbell, R.E., was announced as a new member. Colonel Lane Fox read a paper "On the opening of two cairns near Bangor, in North Wales." One was situated on the summit of Moel Faban, and contained a cist in which an urn was found, together with several small dressed stones, probably arrow-heads and flakes, worked not in flint, but in the trap and felspathic rocks of the neighbourhood. Other worked stones were found beneath the cist. Professor Ramsay described the lithological characters of the materials. The second cairn examined by the author was called Carnedd Horvel, and contained fragments of an urn surrounded by particles of burnt human bone, but not protected by a cist. Among the speakers who took part in the discussion on this paper were Sir J. Lubbock, Bart., M.P., Professor Ramsay, Mr. J. Evans, Mr. J. W. Flower, Dr. Nicholas, and Mr. R. Hamilton. A paper was then read "On the earliest phases of civilisation," by Mr. H. M. Westropp. The author sought to show that every race passes through an invariable series of phases in definite sequence. These are the barbarous, the hunting, the pastoral, and the agricultural phases, which the author compared with the respective stages of infancy, childhood, youth, and manhood in the individual man. Numerous illustrations were adduced of different races exhibiting these several phases of civilisation in the successive stages of their development.

MANCHESTER

Literary and Philosophical Society, February 22.—Dr. J. P. Joule, president, in the chair, referred to the observations he had made in former years on the progressive rise of the freezing point of one of his thermometers. He had made a further observation, and found that a rise—unmistakeable, though very small—was still taking place after a lapse of twenty-six years since the bulb was blown.—Dr. F. Crace Calvert gave an account of the progress made during the last few months in the production of artificial alizarine, and expressed his opinion that many years must elapse before it can replace madder and its preparations in all their varied applications in calico printing; but ere long the purity of the substance artificially obtained may prove of great service to the calico printer, by enabling him to produce at a cheaper rate than now certain styles of prints as well as new styles and effects. Dr. Schunck remarked that practical success would in a great measure depend on the price of the raw material, anthracene, and on the amount of colouring matter to be obtained from it. The process of manufacture was, however, as far as he could judge, a very simple and easy one, requiring the use of no costly materials. He was convinced that the artificial product was identical with the natural alizarine of madder, the only difference being that the former was generally contaminated with some impurity which prevented its crystallising easily. Purpurine was not formed along with alizarine, as had been supposed. He also exhibited to the meeting some specimens of Turkey-red dyed with artificial alizarine, which had been sent to him by Mr. Perkin, and stated that the latter had already manufactured several tons of the new product. Dr. Schunck referred to a notice in the last number of the *Chemical News*, giving an account of a process for preparing pure alizarine from Turkey-red dyed cotton; and stated that almost the same process was described many years ago by himself. He also claimed to have been the first to point out that Turkey-red, madder pink, and all the finer madder colours are simply compounds of alizarine and fatty acids with bases.

"On the Organic Matter of Human Breath in Health and Disease," by Dr. Arthur Ransome. The vapour of the breath was condensed in a large glass flask surrounded by ice and salt, at a temperature of several degrees below zero. The fluid collected was then analysed for free ammonia, urea, and kindred substances; and for organic ammonia—the method employed being that invented by Messrs. Wanklyn and Chapman for water analysis. The breath of 11 healthy persons and of 17 affected by different disorders was thus examined, and the results were given in two tables. The persons examined were of different sexes and ages, and the time of the day at which the breath was condensed varied. In both health and disease the free ammonia varied considerably; the variation could not be connected with the time of the day, the fasting, or full condition. Urea was sought for in 15 instances—three healthy persons and 12 cases of disease—but it was only found in two cases of kidney disease, in one case of diphtheria, and a faint indication of its presence occurred in a female suffering from catarrh. The quantity of ammonia, arising from the destruction of organic matter, also varied, possibly from the oxidation of albuminous particles by the process of respiration; but in healthy persons there was a remarkable uniformity in the total quantity of ammonia obtained by the process. Amongst adults the maximum quantity per 100 minims of fluid was 0·45 of a millogramme, and the minimum was 0·35. A rough calculation was given of the total quantity of organic matter passing from the lungs in 24 hours—in adults about 3 grs. in 10 oz. of aqueous vapour, a quantity small in itself, but sufficient to make this fluid highly decomposable, and ready to foster the growth of the germs of disease. In disease there was much greater variation in the amount and kind of organic matter given off. In 3 cases of catarrh, 1 of measles, and 1 of diphtheria, the total ammonia obtained was much less than in health—less than 0·2 of a millogramme—a result probably due to the abundance of mucus in those complaints, by which the fine solid particles of the breath were entangled. In two cases of whooping-cough it was also deficient, but as they were both children, the lack of organic matter may have been due to their age. In cases of consumption also the total ammonia was less than in health; but in one case of this disease associated with Bright's Disease a larger amount of organic matter was given off, a portion of it due to urea. In kidney diseases the largest amount of organic matter of all kinds was found in the breath. The ammonia in one case of Bright's Disease was 1·8 millogrammes in 100 minims of fluid, and urea was largely present. Perhaps this fact might be taken as an indication of the need of measures directed to increase the activity of other excretory organs. In one case of ozona or offensive breath, the total quantity of ammonia obtained was greater than in any healthy subject, but the excess was chiefly due to organic matter. One convalescent case of fever was examined, and the total ammonia was found to be deficient. The air of a crowded railway carriage, after 15 minutes' occupation, was also tested by this method, and in about 2 cubic feet 0·3 millogrammes of ammonia and 3 millogrammes of organic matter were found. With reference to the presence of organic matter in the atmosphere, it was pointed out that the subject was in no way a novel one, and that it had, during the last thirty years, been very fully investigated by many observers, more especially by Schwann, Dusch, Schroeder, Helmholtz, Van den Broeck, Pasteur, and Pouchet, but it was shown that it is to Dr. Angus Smith that we owe the discovery of the readiness with which living organisms are formed in the condensed breath of crowded meetings, and the determination of the actual quantity of organic matter in the air of different localities. Mr. Dancer's calculation of the number of spores contained in the air was noticed, but a source of error was pointed out in the readiness with which organisms are developed in suitable fluids, even in the course of a few hours. Observations upon the organic particles of respired air had at different times been made by the author. 1. In 1857 glass plates covered with glycerine had been exposed in different places and examined microscopically. Amongst others in the dome of the Borough Gaol, to which all the respired air in the building is conducted, organised particles from the lungs and various fibres were found in this air. 2. During a crowded meeting at the Free Trade Hall, air from one of the boxes was drawn for two hours through distilled water, and the sediment examined after 36 hours. The following objects were noted:—Fibres, separate cellules, nucleated cells, surrounded by granular matter, numerous epithelial scales from the lungs and skin. 3. The dust from the top of one of the pillars was also examined, and in addition to other objects the same epithelial scales were detected. 4. Several of the specimens of fluid from the lungs were also searched with the microscope. In all of them epithelium in different stages of deterioration was abundantly present, but very few spores were found in any fresh specimen. On the other hand, after the fluid had been kept for a few hours, myriads of vibriones and many spores were found. In a case of diphtheria, confervoid filaments were noticed, and in two other cases, one of measles, and one of whooping cough, abundant specimens of a small-celled torula were found, and these were seen to increase in numbers for two days, after which they ceased to develope. These differences in the nature of the bodies met with probably show some difference in the nature of the fluid given off; but it was pointed out that they afford no proof as yet of the germ theory of disease. They simply show the readiness with which the aqueous vapour of the breath supports fermentation, and the dangers of bad ventilation, especially in hospitals. Dr. E. Lund and Dr. H. Browne stated that they had also made experiments, the results of which were, in general, confirmatory of those obtained by Dr. Ransome.

Microscopical and Natural History Section, January 31.—Mr. John Watson, president, in the chair. Mr. Charles Bailey read a paper "On the natural ropes used in packing cotton bales in Brazil."—Mr. J. Sidebotham exhibited some photographs of Pholas-bored Rocks, and said in reference to a paper by Mr. R. D. Darbishire on rocks bored by Pholas at the Little Orme's Head, that last spring he found many rocks so bored on both the Great and Little Ormes. The holes are most abundant near the tops of the mountains, and none whatever are met with very low down. At first sight the holes on the surface of the rocks having been weather-worn, and sometimes connected by channels with the natural fissures in the rock, it is difficult to say which or whether any of the holes have been caused by boring shells. —An interesting collection of Australian plants from Dr. Mueller, of Melbourne, was exhibited by Mr. H. A. Hurst.

EDINBURGH

Royal Society, March 7.—William Forbes Skene, vice-president, in the chair. The following communications were read: "On the Rate of Mortality of Assured Lives as experienced by Ten Assurance Companies in Scotland from 1815 to 1863," by James Meikle, actuary to the Scottish Provident Institution, communicated by Prof. Tait. In 1863 ten assurance companies contributed their mortality experience, embracing nearly 12,000 deaths, and published the result in May last. The present paper contained observations on the nature of that experience. After comparing the mortalities of the male population of England and Scotland, in which the mortality of males in Scotland was greater than in England up to about the age of thirty-five, the mortality of assured males was compared therewith, and also with the expectations of the Carlisle and the Actuaries' tables, the most general bases of life assurance computations. Assured life experience was shown to be greatly more favourable than the Carlisle up to about the age of fifty, thereafter less favourable; it was slightly more favourable than the Actuaries' at nearly all ages. Similar comparisons were made of the mortality of females. The whole observations on the lives were then thrown into various forms, so as to exhibit the effects of the selection exercised by the offices in assuring only healthy lives; and, after casting out the experience of the years when selection has its greatest force, comparing the remaining observations with the mortality of the population. The rate of mortality on policies effected "*with* participation in profits" was shown to be very much *higher* than on policies effected "*without* participation." The mortality on imperfect lives (those not assured at ordinary rates) was also discussed, and the amount of annual premium required to assure 100*l.* at death given for several classes of diseased lives. Interesting comparisons were also given of the causes of death of assured lives and of the population. It appears that assured lives have died in greater proportion from zymotic complaints, diseases of the brain, heart, and liver; while the populations have died in greater ratio from tubercular and lung diseases. The paper concluded with a description of the manner in which some of the results were adjusted and interpolated. The whole was very fully illustrated by diagrams, and called forth an interesting discussion.—"Brief Notes on Indian Society and Life in the Age when the Hymns of the Rigveda were composed," by John Muir. After stating that although the religious conceptions of the Indians of the Vedic era were in a comparatively simple and undeveloped stage, it would be a mistake to suppose that they had not made considerable advances in civilisation, the writer proceeded to give some account of the country which they occupied, and of the amount of opulence possessed by their kings, and to adduce a variety of particulars illustrative of their social and domestic relations and manners, their dress, food, drink, professions, relating to the tame and wild animals known to them, to their wars, armies, armour, and weapons, and to their poetry and incipient speculation. Some of the topics treated of were illustrated by metrical translations from the hymns of the Rigveda—(1) in praise of charity and liberality, (2) relating to the variety of men's tastes and pursuits, (3) satirically comparing the Brahmins with frogs reviving at the beginning of autumn, (4) descriptive of the miseries of gambling, (5) in celebration of warlike prowess and its instruments, and (6), containing a specimen of early speculation.

DUBLIN

February 28.—Sir Robert Kane, vice-president, in the chair, Professor J. P. O'Reilly exhibited a model and described a plan of a moveable barometer. The secretary read a note supplementary to their former paper "*Eozoon Canadense*, a mineral Pseudomorphite," by Professors W. King and T. H. Rowney, of Queen's College, Galway.

Natural History Society, March 2.—Rev. Professor Houghton, in the chair. Professor Houghton read a paper on the "Pathological lesions observed in the stomach of a lioness." —Professor Traquair exhibited fine specimens of *Calamosicthys* from Old Calabar, and Professor Macalister exhibited a specimen of *Ameida vulgaris*, from Mangerton, county Kerry.

PARIS

Academy of Sciences, March 7.—M. de Saint-Venant read a memoir on the establishment of the equations of the interior movements effected in solid ductile bodies beyond the limits at which elasticity can restore them to their former state. Papers were also communicated by M. Brioschi on the bissection of hyperelliptical functions, by M. Bourget on the algebraical development of the perturbative functions, and by M. Lucas on the calculation of the physical parameters and principal axes in a certain point of an atomic system.—M. Becquerel communicated a memoir on the electromotive forces of various substances, such as pure carbon, gold, platinum, &c., in the presence of water and of various liquids, in which he described the effects produced by plates of the substances above mentioned in contact with distilled water and various solutions.—M. Dubrunfaut presented some remarks upon the colours of rarefied gases submitted to spectrum analysis. He remarked upon the luminosity of hydrogen in Geissler's tubes at various degrees of tenuity, and stated that at its maximum attenuation a blood-red colour is characteristic of pure hydrogen, and that it communicates a similar coloration to the gas surrounding it. He also noticed the variation in the intensity of coloration of hydrogen, according to the calibre of the tubes through which the current passes. The purest nitrogen was stated to give a yellow tint, but usually the peculiarities of this gas are masked by the presence of water or mercury. The Torricellian vacuum was said to furnish the spectra of hydrogen, nitrogen, and mercury. The author also remarked upon some recent communications to the Academy on this subject.—A note by M. J. M. Gaugain on the electromotive force developed by platinum when in contact with various liquids was presented by M. E. Becquerel. The author stated that when one of two plates of platinum is taken out of acidulated water, washed in distilled water and restored to its place, a current is developed, which he ascribed to the presence of the water. He discussed the probable modes of action of this water, and inclined to the opinion that the plate still plunged into acidulated water forms a coat more positive than the platinum itself, which combination is destroyed by the water. He stated, however, that the electro-motive force is greatly increased by the exposure of the washed plate to a temperature of 150° C (=302° F.)—In a note on the illumination of transparent bodies, M. Soret adduced a further evidence in favour of his opinion that the presence of suspended particles takes a preponderant part in these phenomena.—M. Leroy de Boisbandeau communicated some remarks, illustrated by sketches, upon some curious icicles observed by him on the sides of a stone tank.—M. Aug. Houzeau noticed the absence of oxygenated water in the snow which fell at Rouen on several days during the past winter.—A note by Mr. Thudichum was presented, in which the author described an acid which, he stated, exists normally in the urine, and which he proposed to name *Kryptophanic acid.*—M. Jouglet communicated a note on the action of ozone upon nitro-glycerine and other explosive compounds. He found that nitro-glycerine, dynamite, iodide and chloride of nitrogen and some other bodies exploded when put into a vessel containing ozone, whilst picrate of potash was slowly decomposed, and gunpowder was sensibly altered in six weeks.—A note by M. Sacc on the distillation of tartaric acid was presented.—Notes on earthquake shocks observed at Lima and Ancona were communicated by the Minister of Public Instruction.—M. H. Sainte-Clair Deville presented a note by Father Denza, giving an account of a storm of sand accompanying rain and snow, which occurred in various parts of Italy on the 13th and 14th of February. The author remarked upon the periodicity of the phenomenon, and noticed its occurrence in various places; the sand, in all cases, appeared to be identical, and was considered by the author to come from the African deserts. —A note by M. H. Magnan on the cretaceous formation of the French slope of the Pyrenees and of Corbières, and especially on the Neocomian, Aptian, and Albian strata of that region, was presented by M. Daubrée.—MM. A. Roujou and P. A. Julien communicated a note on striæ observed on blocks of Fontainebleau sandstone and other rocks imbedded in the diluvium of the neighbourhood of Paris. These were stated to be the first striated blocks observed near Paris. M. Elie de Beaumont made some remarks upon these blocks. — M. A. Trécul communicated the fourth part of his remarks upon the position of the tracheæ in the ferns and on the ramification and radicular propagation of the rhizomes of some of those plants.—M. Duchartre presented a note by M. E. Prillieux on the influence of blue light upon the production of starch in chlorophyll. The author remarked that the production of starch was generally supposed to be due to the action of the yellow rays, and that blue light had no such effect. He considered that the results upon which this opinion was founded were due to the greater brilliancy of the yellow light, and by exposing a plant of *Spirogyra* deprived of starch to a more brilliant blue light, he found that formation of starch took place.—M. Duchartre also communicated a note by M. C. Cave on the free central placenta of the *Primulaceæ*, in which the author adduces as a further proof of the axial nature of that organ, that, on examination, the parts of recent formation are found to be outside the medullary sheath.—M. Auguste Duméril described some peculiar organs of the branchial apparatus in the Rays belonging to the genus *Cephaloptera*. These organs are the *prebranchial appendages* discovered by M. P. Panceri in *C. giorna*, which M. Duméril had detected in the large Indian *C. Kuhlii*. He stated that they occurred in no other fishes.—M. Pouchet noticed a transformation of the nests of the house martin (*Hirundo urbica*), and maintained that the nests of birds, instead of being, as generally supposed, constructed in the same way from century to century, really undergo certain progressive modifications of structure. In the case of the house martin, he stated that within the last forty years that bird has adopted a new form for its nests. The old nests are in the form of the quarter of a hemisphere, with a very small circular aperture for entrance. The improved nests, according to M. Pouchet, are in the form of the quarter of a hemi-ovoid with the poles much elongated, and the entrance is by a long transverse slit.—A second note on the tracheæ and differential characters of the lungs in birds, by M. Campana, was presented by M. C. Bernard. The author described the various modes of interbronchial communication, the mode of insertion of the pneumatic receptacles upon the lung, and the structure of the parenchyma of the organ.—M. Milne-Edwards communicated an extract from a letter from the Abbé David, giving the diagnosis of a new species of *Crossoptilon* (*C. cærulesceus*) discovered by him at Sse-tchuaro.—A note by M. Demarquay, on the reproduction and union of divided tendons was communicated by M. J. Cloquet. The author maintained that the regeneration of a divided tendon is effected by the proliferation of the elements on the inner surface of its sheath, in a manner analogous to the reproduction of bone by the periosteum. M. Dupuis presented some remarks on the confusion which has often occurred between the physicist, J. A. C. Charles, and the geometrician, J. Charles, and communicated some particulars relating to the biography of the two Academicians.

SYDNEY

Royal Society of New South Wales.—Mr. F. B. Miller, F.C.S., one of the assayers of the Sydney Royal Mint, described the practical results of his method for separating silver and gold directly by the use of chlorine gas, a process of which an account was given to the Chemical Society rather more than a year ago. At the Sydney Mint 6,820,198 ounces of gold have been received for coinage from the date of its establishment in May 1855 to December 31, 1868. The average composition of this gold would be about $94\frac{1}{8}$ per cent. of gold, 5 per cent. of silver, and $\frac{3}{8}$ per cent. of base metals; the gross amount of silver contained in the gold would be about 334,190 ounces, so that about 24,750 ounces of silver pei annum have been lost to the colony for the want of a simple process of refinage. The gold now obtained in Queensland, as also that now brought from New Zealand, contains a much larger proportion of silver, so that the present loss to the colony is more nearly 42,000 ounces per year. The experience of the Sydney Mint proves that on the average there is a marked deterioration in the gold proceeding from Victoria, where the fineness is 96 per cent., northwards through New South Wales, where the average is $93\frac{1}{2}$ per cent., to Queensland, average $87\frac{1}{4}$ per cent. The silver can now be readily separated by passing a stream of chlorine gas into the melted gold for about an hour and a half, as it lies in a crucible heated in an ordinary melting furnace. The chlorine is at first rapidly absorbed, and the process is completed when a brownish yellow vapour appears. The chlorine is conveniently evolved from a self-acting generator, and 2,000 ounces of gold are readily refined in five hours, by three melting furnaces, 98 per cent. of the gold being delivered ready for coinage on the same day. The gold thus refined is perfectly tough, and contains only about one-half per cent. of alloy. The ultimate loss of gold is found to be only 19 parts in 100,000; the loss of silver is 240 in 100,000. The cost of refinage, including the above loss, but excluding rent of premises and expenditure, is five farthings per ounce. The silver is obtained in the form of fused chloride, and is reduced to the metallic state by plates of zinc combined with slabs of the chloride into a galvanic arrangement, devised by Dr. Leibriss. In twenty-four hours the chloride is completely reduced to the state of spongy silver, and 1,400 or 1,500 ounces could thus be readily treated in a day. No acid is required, and the zinc consumed is only 25 per cent. of the chloride reduced. The whole process, having been thoroughly tested at the time, is to be brought into active operation at once. It is already employed by some of the banks in Australia and New Zealand.

DIARY

THURSDAY, MARCH 17.

ROYAL SOCIETY, at 8.30.—On the Law which Regulates the Relative Magnitude of the Areas of the Four Orifices of the Heart: Dr. Herbert Davies. — On the Estimation of Ammonia in Atmospheric Air: H. T. Brown.

ROYAL INSTITUTION, at 3.—Chemistry of Vegetable Products: Prof. Odling.

LINNEAN SOCIETY, at 8. — The Flora and Fauna of Isle Ronde, near Mauritius: Sir Henry Barkly.—On Algæ found in the North Atlantic Ocean: Dr. Dickie.

ZOOLOGICAL SOCIETY, at 4.

CHEMICAL SOCIETY, at 8.—On Artificial Alizarine: W. H. Prekin, F.R.S.—On the Combination of Carbonic Anhydride with Ammonia and Water: Dr. Divers.

NUMISMATIC SOCIETY, at 7.

SOCIETY OF ANTIQUARIES, at 8.30.—On Ancient Round Barrows: Dr. Thurnam.

FRIDAY, MARCH 18.

PHILOLOGICAL SOCIETY, at 8.15.

ROYAL INSTITUTION, at 8.—On the Subway to France; J.F. Bateman, F.R.S.

SATURDAY, MARCH 19.

ROYAL INSTITUTION, at 3.—The Sun: J. Norman Lockyer, F.R.S.

MONDAY, MARCH 21.

LONDON INSTITUTION, at 4.

ROYAL ASIATIC SOCIETY, at 3.

ENTOMOLOGICAL SOCIETY, at 7.

TUESDAY, MARCH 22.

ROYAL INSTITUTION, at 3.—Nervous System: Prof. Rolleston, M.D., F.R.S.

ETHNOLOGICAL SOCIETY, at 8.—On Current British Mythology and Oral Tradition; Mr. Campbell of Islay.

INSTITUTION OF CIVIL ENGINEERS, at 8.

ROYAL MEDICAL AND CHIRURGICAL SOCIETY, at 8.30.

WEDNESDAY, MARCH 23.

GEOLOGISTS' ASSOCIATION, at 8.

SOCIETY OF ARTS, at 8.—On Surface Decoration: W. Pitman.

GEOLOGICAL SOCIETY OF LONDON, at 8.—On the Discovery of Organic Remains in the Caribbean series of Trinidad: R. J. Lechmere Guppy, F.L.S., F.G.S. — On the Palæontology of the Junction-beds of the Lower and Middle Lias in Gloucestershire: Ralph Tate, F.G.S.—On the Geology of the district of Waipara River in New Zealand: T. H. C. Hood, F.G.S.

THURSDAY, MARCH 24.

ZOOLOGICAL SOCIETY, at 8.30.—On the Birds of Veragua: Osbert Salvin.—Exhibition of a metamorphosed Axolotl: W. B. Tegetmeier.—On two rare species of Pheasants recently added to the Society's Collection: Mr. Sclater.

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