was confirmed on the former of these dates by each of three photographs. Two more stars have been found having a similar periodicity— β Aurigæ and δ Ophiuchi. The hydrogen lines of ζ Ursæ Majoris appear to be broader when the K line is double than when it is single. Several other lines are also seen double when the K line is double. Measures of the plates gave a mean separation of 0.246 millionths of a millimetre for a line whose wave-length is 448.1, when the separation of the K line, whose wave-length is 393.7, was 0.199.

The explanation of this phenomenon proposed by Prof. Pickering is that the brighter component of this star is itself a double star having components nearly equal in brightness, but too close to have been separated as yet visually, and some interesting results have been worked out which appear to support this hypothesis.—*American Journal of Science*, January 1890.

SPECTROSCOPIC OBSERVATIONS OF ALGOL.—A note on the motion of this star in line of sight has previously appeared (*NATURE*, vol. xli. p. 164). The detailed investigation of the six photographs taken at Potsdam is given by Prof. Vogel in *Astronomische Nachrichten*, No. 2947, from which the following is taken. Motion towards the earth is represented by a minus sign, and a motion of recession by a plus sign; both are expressed in geographical miles per second:—

Potsdam mean time.	Distance from minimum.	Motion in line of sight.
h.	h.	
1888, Dec. 4, 6.6	11.4 after.	-5.0
1889, Jan. 6, 5.7	22.4 before.	+6.9
„ 9, 5.5	19.4 before.	+7.5
Nov. 13, 9.3	13.3 after.	-5.6
„ 23, 9.0	22.3 before.	+6.2
„ 26, 8.5	19.6 before.	+6.8

From these results it will be seen that, before minimum, Algol has an average motion of recession of 6.8 geographical miles per second, but after minimum it approaches the earth with an average velocity of 5.3 geographical miles per second. A reduction of the measures by the method of least squares shows the velocities per second to be—

Before the minimum, +5.3 geographical miles,
After the minimum, -6.2 „

which give an average motion of recession or approach = 5.7 miles. The entire system is found to be moving towards the earth with a velocity of 0.5 geographical miles per second.

GEOGRAPHICAL NOTES.

AT a meeting of the South Australian branch of the Royal Geographical Society, on November 1, 1889, Mr. Tietkens gave an account of his recent explorations in Central Australia. His expedition was despatched by the Central Australian Exploring and Prospecting Association, and consisted of a party of five persons, including a black tracker and a native boy. At one point of his journey, when the party came within sight of “an imposing range,” Mr. Tietkens hoped to find a watercourse flowing from its slopes to Lake Amadeus. He was disappointed. No watercourse worth mentioning was discovered, nor any spring or place where water could collect. Mr. Tietkens discovered several ranges of hills, to which he gave names. One of the pleasantest places found by him he called Gill’s Creek, after the hon. treasurer of the South Australian branch of the Royal Geographical Society. Here a stream flows from a range of hills through a gorge or glen of sandstone formation. “This,” he says, “was a most beautiful spot, where a few days could be spent profitably, so the camels were unloaded, and Billy and myself went up the creek to explore its wonders. We found that the creek separated into three distinct channels. Following the principal one, we found the creek to be running through a glen with perpendicular cliffs 80 or 100 feet high on each side, and fully three miles in length. We returned to our charmingly situated camp late in the afternoon. . . . The water will not be found to be always running, but in the glen at the head of the creek, and which I have named after my sister Emily, large deep pools will be found, four or five chains long, 10 and 15 feet deep, and so shaded by rocks from the sun that they cannot be looked upon as otherwise than permanent.” After the read-

ing of the paper Mr. G. W. Goyder, Surveyor-General, expressing gratitude to Mr. Tietkens, said that although as an effort to increase the extent of Australian mineral and pastoral resources Mr. Tietken’s expedition might have been a comparative failure, yet the route which he had travelled might serve as a most useful base for after-comers. His journey showed that no large large river, as had been hoped, flowed into Lake Amadeus, and only gave another proof that the interior of Australia consists of a series of low mountains with shallow basins, which in wet seasons form lakes and in dry seasons evaporate.

MESSRS. GEORGE PHILIP AND SON have issued an excellent map showing all Stanley’s explorations in Africa from 1868 to 1889. Each expedition is distinctly marked in colour, and dated on the map; and a condensed account of the explorer’s travels and discoveries is provided by Mr. E. G. Ravenstein.

THE SOURCES OF NITROGEN IN SOILS.¹

THE number of this half-yearly Journal, issued last April, contains nineteen valuable contributions, covering a considerable portion of the large subject of agriculture. Many of them are of purely practical import, such as the report upon the previous year’s prize farm competition, on implements exhibited at the Nottingham meeting, and on the Exhibition of thoroughbred stallions of February last. Among the articles of special scientific interest may be named “The History of a Field newly laid down to Permanent Grass,” by Sir J. B. Lawes, F.R.S.; “Grass Experiments at Woburn,” by W. Carruthers, F.R.S.; “The Composition of Milk on English Dairy Farms,” by Dr. Paul Veith, and the Annual Reports of the scientific staff of the Society. The Journal contains 380 closely-printed pages, is well illustrated, and replete with tables and statistics. Among such a mass of information, all of which possesses important economic value, it is by no means easy to make a selection for special notice. The changes within the soil, in the formation of a meadow by Sir John Lawes, are, however, worthy of close attention at a time when grazing and stock-feeding appears to be the most popular remedy for the agricultural depression under which the country has so long suffered. These observations are also important scientifically, as they throw light upon the interesting question as to the sources of nitrogen in all soils. The gradual improvement of grass land, from the period when it is first laid down until it assumes the character of old pasture, is a well-known agricultural fact. The gradual increase in the amount of nitrogen per acre in the meadow selected by Sir John Lawes throws light upon this practical observation, and is recorded as follows:—“There can be no doubt that there has been a considerable accumulation of nitrogen in the surface soil during the formation of the meadow (1856 to 1888), amounting in fact to an average of nearly 52 pounds per acre per annum over the last twenty-three years. The question arises, Whence has this nitrogen been derived?” This is, as is well known, a controverted point. The balance in favour of this accumulation of nitrogen within the soil is still large, even after every source of nitrogen in fertilizers employed, foods fed upon the land by live stock, rainfall, and from every other possible source is taken into account. Therefore, Sir John comes to the conclusion that the gain of nitrogen in the surface soil must have had its source either in the subsoil, the atmosphere, or both. There is much experimental evidence pointing to the conclusion that at any rate some deep-rooted leguminous plants derive a considerable quantity of nitrogen from the subsoil. Reasoning upon the question as to how far the whole of the accumulated nitrogen in the surface soil has been derived by deeply-searching roots from the subsoil, Sir John says, “On this point we think it may safely be concluded, from the results of the experiments of Boussingault and of those made at Rothamsted, many years ago, that our agricultural plants do not themselves directly assimilate the free nitrogen of the air by their leaves. But in recent years the question has assumed quite a new aspect. It now is, Whether the free nitrogen of the atmosphere is brought into combination within the soil under the influence of micro-organisms, or other low forms, and so serving indirectly as a source of nitrogen to plants of a higher order? Thus Hellreigel and Wilfarth have found, in experiments with various leguminous plants, that if a

¹ “The Journal of the Royal Agricultural Society of England,” April 1889. (John Murray, Albemarle Street.)

soil free of nitrogen have added to it a small quantity of soil-extract containing the organisms, the plants will fix much more nitrogen than was otherwise available to them in the combined form. It further seemed probable that the growth and crop residue of certain plants favoured the development and action of special organisms. It is admittedly not yet understood, either in what way the lower organisms affect the combination, or in what way the higher plants avail themselves of the nitrogen thus brought into combination. . . . Should it be firmly established that such an action does take place in the case of certain plants, though not in that of others, it is obvious that part, at any rate, of the gain of nitrogen by the soil supporting the mixed herbage of grass land may be due to the free nitrogen of the air brought into combination under the influence of the action supposed." This must be regarded as an important concession to the view that nitrogen may be derived for the purposes of plant nutrition from the inexhaustible ocean of the atmosphere, and it will probably not be long before the vexed question of the sources of nitrogen in soils will be placed upon a more satisfactory basis.

JOHN WRIGHTSON.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 5, 1889.—"A New Form of Wedge Photometer." By Edmund J. Spitta.

The author explained that his attention was called to the necessity of devising an arrangement of this nature during a series of experiments upon which he has for some time been engaged to ascertain the cause or causes of the discrepancy previously shown to exist when points of light are photometrically compared with objects of sensible size ("On the Appearances presented by the Satellites of Jupiter during Transit," *Monthly Notices R.A.S.*, vol. 48). This investigation has served to indicate that a portion of the error to which reference has been made arises from the wedge form itself when employed upon a disk of any appreciable area, for it will be remembered that hitherto this instrument has only been employed upon points of light such as is exhibited by the stars. Woodcuts are given to explain how this takes place, but it may be briefly stated, that as the field of view in a single wedge photometer is of necessity variable in intensity of absorption, so the preceding limb of a disk is not extinguished at the same part of the wedge, and so not at the same "wedge-reading," as the following limb. Hence when comparing two different sized disks it is not difficult to understand that an error in the "wedge-interval," technically so called, must inevitably occur. To meet this difficulty, the error resulting from which will of necessity vary with the size of the area under consideration, the new photometer has been devised.

It essentially consists of two wedges of neutral tinted glass, arranged to pass one another in equal proportions by the turning of a single milled headed screw. A little consideration suffices to show that by this exceedingly simple means, the field of view in the photometer must be absolutely uniform in density throughout its extent, but that its power of absorption can be increased or diminished by the shifting of the wedges in the manner described. Another improvement is submitted by the addition of a wheel of tinted glasses of varying density, which, by revolving in front of the eye-piece, enables the operator to employ the photometer upon objects having a wide range of intensity. The instrument in its complete form, is mounted on the *occluding eye-piece* (*Monthly Notices R.A.S.*, vol. 45) to afford the observer a means of hiding any object or objects not under examination for the time being, which it is needless to point out is a matter of great consideration in all photometric comparisons.

Mathematical Society, January 9.—J. J. Walker, F.R.S., President, in the chair.—The following communications were made:—On the deformation of an elastic shell, by Prof. H. Lamb, F.R.S.—On the relation between the logical theory of classes and the geometrical theory of points, by A. B. Kempe, F.R.S.—On the correlation of two spaces, each of three dimensions, by Dr. Hirst.—On the simultaneous reduction of the ternary quadric and cubic to the forms $Ax^2 + By^2 + Cz^2 + Dzw^2$, $ax^3 + by^3 + cz^3 + dw^3$, by the President (Sir J. Cockle, F.R.S., Vice-President, in the chair).

PARIS.

Academy of Sciences, January 13.—M. Hermite in the chair.—On some new fluorescent materials, by M. Lecoq de Bois-

audran. In continuation of his recent communication the author has investigated zircon and $Z\beta$; tin dioxide and samaria; tantalum pentoxide and samaria; tin dioxide and $Z\alpha$; tantalum pentoxide and $Z\alpha$; tin dioxide and $Z\beta$; tantalum pentoxide and $Z\beta$. All these fluorescent substances are fresh examples of the number of spectra obtained from the same active material with different solid solvents. In combination with the agents the solvents must naturally always modify the wave-lengths of the bands as well as their constitution, while still leaving to the various spectra of the agents a family likeness, whereby their common origin may at once be recognized. But if the identity or diversity of two active materials has to be determined by *exact wave-length measurements*, then it becomes essential to operate with absolutely similar solid solvents.—Multiple resonances of M. Hertz's electric undulations, by MM. Edouard Sarasin and Lucien de la Rive. Certain experiments are here described, which tend to throw doubt on Hertz's well-known hypothesis on the undulatory propagation of electric induction. The reading of the paper was followed by some remarks by M. Cornu, who pointed out that it would now be necessary to receive with the greatest reserve the theoretical consequences drawn by M. Hertz from his remarkable researches, more especially as regards the measurement of the velocity with which the induction is propagated in a rectilinear conductor. His experimental method will have to be subjected to much careful study before it can be accepted as a demonstration of the identity of light and electricity.—On the relation between the electric and thermal conductivities of the metals, by M. Alphonse Berget. In a previous paper the author described an easy method for measuring, by means of simple determinations of temperature, the thermal conductivity of the different metals relative to that of mercury, whose absolute value had already been determined. He has now extended these determinations to copper, zinc, iron, tin, lead, and several other metals. The tabulated results show that the order of the conductivities is the same for heat and electricity, but that the relation of the mean coefficients of thermal and electric conductivity is not absolutely constant. Hence the law of their proportionality is only approximately correct, and subject to somewhat the same conditions as Dulong and Petit's law of specific heats.—Heat of formation of platinum tetrachloride, by M. L. Pigeon. A process is described for obtaining this substance in considerable quantities, and the heat of formation of the anhydrous chloride is determined at + 20.5 calories. To complete its thermochemical study M. Pigeon is now endeavouring to determine its heat of solution in water and that of its hydrate.—On the combinations of gaseous phosphoretted hydrogen with boron and silicon fluorides, by M. Besson. The boron compound has the formula $2BF_3 \cdot PH_3$, and is decomposed by water with liberation of gaseous phosphoretted hydrogen. The silicon compound was obtained in the form of small and very bright white crystals, their composition corresponding to two volumes of phosphoretted hydrogen gas to three of silicon fluoride or thereabouts. These and some other compounds that remain to be studied render the analogy between phosphoretted hydrogen gas and ammonia still closer.—On the state of equilibrium of a solution of a gas in a liquid, different portions of which are kept at different temperatures, by M. P. Van Berchem. These researches were made with hydrochloric acid and ammonia, their high coefficient of solubility facilitating the detection of slight differences of concentration. The results show that there exists a special state of equilibrium for solutions of gases if the lower part of the solution is cooled, and the upper part heated.—Note on the rotatory power of matezite and matezo-dambosse, by M. Aimé Girard. Some numerical errors in the author's former papers on the rotatory power of these bodies (*Comptes rendus*, lxxvii. p. 995) are here rectified, and the author's fresh experiments confirm his previous conclusion that their rotatory power is absolutely identical.—Papers were submitted by M. Emile Picard, on the employment of successive approximations in the study of certain equations with partial derivatives; by MM. Maquenne and Ch. Tanret, on a new inosite ("racemo-inosite"); by M. Edouard Heckel, on the utilization and transformations of some alkaloids present in corn during germination; by M. A. Giard, on the relationship of the annelids and mollusks; by M. Léon Vaillant, on the bichique (*Gobius* and *Sicydium*) fisheries in the island of Réunion; by M. A. Vaissière, on *Prospistoma variegatum* of Madagascar; and by M. Salomon Reinach, on the volcanic eruptions supposed to have taken place in France during the fifth century A.D.