benzene. It is curious that when pure benzene is allowed to react upon pure $SeCl_4$, the latter body undergoes precisely the same decomposition as when heated to 360°, the liberated chlorine reacting with the benzene to form several chlorbenzenes and all the selenium remaining in the form of Se_2Cl_2. If, however, the benzene and selenium tetrachloride are brought together in presence of that most useful of intermediate reagents, aluminium chloride, quite a different series of changes occur. On treating the mixture with water, and separating and distilling the oil obtained, three distinct fractions may be collected The first, which passes over at 131°–133°, consists of monochlor benzene, C_6H_5Cl. The second, distilling at 227°–228° under a pressure of only a few millimetres of mercury, consists of phenyl selenide, $(C_6H_5)_2Se$, corresponding to phenyl sulphide, $(C_6H_5)_2S$, and phenyl oxide, $(C_6H_5)_2O$. It is a yellow oil of sp. gr. 1·45 at 19°·6. The third fraction, boiling between 245° and 250° under the same reduced pressure, consists of another new compound of the composition $Se_2(C_6H_5)_3C_6H_4Cl$. This substance is a red oil of sp. gr. 1·55 at 19°·6. On allowing this red oil to stand it deposits yellow crystals of a compound of powerful odour, which may be obtained recrystallized from alcohol in long rhombic prisms. On analysis this substance turns out to be seleno-phenol, C_6H_5SeH, analagous to thiophenol and mercaptan, both of evil odour. Like all the hitherto investigated mercaptans, its alcoholic solution readily reacts with salts of mercury and silver. Analysis of the silver salt leads to the formula C_6H_5SeAg. The reactions by which phenyl selenide and seleno-phenol are respectively produced are believed by M. Chabrié to be as follows:—

$$2C_6H_6 + SeCl_4 = (C_6H_5)_2Se + 2HCl + Cl_2,$$
$$C_6H_6 + SeCl_4 = C_6H_5SeH + 2Cl_2.$$

THE additions to the Zoological Society's Gardens during the past week include a Black-headed Gull (*Larus ridibundus*), British, presented by Mr. E. Hart, F.Z.S.; a Chinese Jay Thrush (*Garrulax chinensis*) from China, presented by Sir Harry B. Lumsden, C.B., K.C.S.I., F.Z.S.; a King Parakeet (*Aprosmictus scapulatus* ♂) from Australia, presented by the Rev. A. J. P. Matthews, F.L.S.; a Peregrine Falcon (*Falco peregrinus*) from Scotland, presented by Mr. Geo. W. Landels; a Vulturine Eagle (*Aquila verreauxi*), a Jackal Buzzard (*Buteo jacal*), a White necked Raven (*Corvultur albicollis*) from South Africa, presented by Mr. Marshall; a Pigmy Cormorant (*Phalacrocorax africanus*), a Moorhen (*Gallinula chloropus*), two Shining Weaver Birds (*Hypochera nitens*), four Black-bellied Weaver Birds (*Euplectes afer* 2 ♂ 2 ♀), two Abyssinian Weaver Birds (*Ploceus abyssinicus* ♂ ♂), four Red-beaked Weaver Birds (*Quelea sanguinirostris* 2 ♂ 2 ♀), four Cutthroat Finches (*Amadina fasciata* 2 ♂ 2 ♀), four Orange-cheeked Waxbills (*Estrelda melpoda*), a Paradise Whydah Bird (*Vidua paradisea* ♂) from West Africa, an Indian Silver-Bill (*Munia malabarica*) from India, two Cardinal Grosbeaks (*Cardinalis virginianus* ♂ ♂) an Indigo Bird (*Cyanospiza cyanea* ♂) from North America, purchased.

OUR ASTRONOMICAL COLUMN.

OBJECTS FOR THE SPECTROSCOPE.

Sidereal Time at Greenwich at 10 p.m. on January 23 = 6h 12m. 44s.

Name.	Mag.	Colour.	R.A. 1890.	Decl. 1890.
			h. m. s.	° ′
(1) G.C. 1225	—	—	5 36 5	+ 9 2
(2) LL. 12169	7	Yellowish-red.	6 15 58	−11 46
(3) θ Canis Maj. ...	5	Yellow.	6 48 38	−11 53
(4) γ Geminorum ...	2	White.	6 31 24	+16 30
(5) 74 Schj.	6	Reddish-yellow.	6 19 12	+14 46
(6) U Cancri	Var.	Reddish.	8 29 28	+19 16
(7) R Draconis	Var.	Yellowish-red.	16 32 22	+66 59

Remarks.

(1) The General Catalogue description of this nebula is as follows: "Planetary nebula; pretty bright, very small, very little extended." So far as I know, the spectrum has not yet been recorded, but if it is of the same nature as other planetary nebulæ, bright lines may be expected. The character of the chief line, near λ 500, if visible, should be particularly noted.

(2) Dunér classes this with stars of Group II., but states that the type of spectrum is a little uncertain. He notes, however, that the bands 2, 3, and 7 are visible, so there seems to be no reasonable doubt about the type. The probability is that it is either an early or late star of the group, in which case we should not expect to find all the bands fully developed. The star has been provisionally placed in species 2 of the subdivision of the group, but further observations are at once suggested to determine whether this is right or wrong. If right, the bright flutings of carbon should be fairly prominent, as it is probably due to the masking effects of these flutings that some of the dark bands are absent. The carbon flutings near 517 and 474, seen in the spectrum of a bunsen or spirit-lamp flame, should therefore be particularly looked for. It is possible, too, that in the earlier stars of the group the hydrogen lines may appear bright, as the swarms are only a little more condensed than those constituting stars with bright lines, so that the interspacial radiation may more than balance the absorption.

(3) According to the observations of Konkoly, this is a good example of stars of the solar type. The usual observations, as to whether the star belongs to Group III. or to Group V., are required.

(4) A star of Group IV. (Gothard). The main point to be noted in stars of this class is the relative intensities of the lines of hydrogen and those of iron, magnesium, and sodium, for the purpose of arranging them in a line of temperature. If possible, the criterion lines which indicate increasing or decreasing temperature should also be noted, as in the stars which have hitherto been classed as of the solar type.

(5) This is a star of Group VI., showing the usual carbon flutings and the subsidiary bands 4 and 5 (Dunér). In some stars of the group of smaller magnitude, a greater number of secondary bands have been noted, and it seems possible, therefore, that 74 Schj. may not have been observed under the most favourable conditions. Further confirmatory observations are therefore necessary before conclusions as to the specific differences between the different stars of the group can safely be drawn.

(6) The spectrum of this variable has not yet been recorded. The period is 305·7 days, and the range from 8·2–10·6 at maximum to < 13 at minimum (Gore). The maximum occurs on January 23.

(7) This variable star has a period of 244·5 days, and ranges from 7–8·7 at maximum to < 13 at minimum. The spectrum is of the Group II. type, and the range of variability is such that the appearance of bright lines at maximum may be expected, as in R Leonis, &c., observed by Mr. Espin. The maximum occurs on January 25. A. FOWLER.

THE CLUSTER G.C. 1420 AND THE NEBULA N.G.C. 2237.—Dr. Lewis Swift, in the *Sidereal Messenger* for January 1890, calls attention to a wonderful nebulous ring entirely surrounding this cluster. The ring was discovered by Prof. Barnard last year (*Astr. Nach.*, 2918), and its average outer diameter estimated as not less than 40′, so that in comparison the ring nebula in Lyra is a pygmy. Although Dr. Swift discovered, in 1865, a large diffused nebula north-preceding the star-cluster G.C. 1420, his attention was first directed to the ring structure by Prof. Barnard in January 1889.

The nebula N.G.C. 2237 is in the constellation Monoceros; its position is R.A. 6h. 24m. 48s., Decl. + 5° 8′; hence it will soon be favourably situated for observation, and Dr. Swift hopes that Mr. Isaac Roberts will be induced to photograph it, as a change both in brightness and form is suspected.

ON THE SPECTRUM OF ζ URSÆ MAJORIS.—An examination of seventy photographs of the spectrum of this star, taken on as many different nights at Harvard College, and beginning on March 27, 1887, has led Prof. Pickering to conclude that the K line is double at intervals of 52 days, and that, for several days before and after it is seen to be double in the photographs, it presents a hazy appearance. From the period assigned, it was predicted that the line should be double on December 8, 1889, and January 30, 1890, and the duplicity 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 b 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. h.	Distance from minimum. h.	Motion in line of sight.
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 reading 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 acccumulation 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.)