of distinction, accompany an article by Mr. T. Dreiser. The marble quarries at Monte Sagro, in the vicinity of Carrara, are described and illustrated by Mr. E. St. John Hart. Two series of photographs of a cat and dog jumping over an obstacle are contributed by Mr. A. C. Banfield. Dr. See's views upon the mode of formation of stellar systems are expounded in another article. Mr. George Griffith describes the line where the day changes, near the 180th degree of longitude, making it the text of an article upon the places where the twentieth century will commence; and Mr. Walter Wellman describes some of his Arctic experiences. Six pretty photographs of birds are reproduced in the *English Illustrated Magazine*.

THE use of gas thermometers at high temperatures is the subject of an interesting paper by Messrs. Holborn and Day (*Wied. Ann.* 68, 817). Experiments with porcelain vessels, glazed and unglazed, have shown that this material is unsuitable for the construction of the containing vessel, especially when the gas used is hydrogen. Platinum iridium vessels (10 or 20 per cent. Ir) containing nitrogen appear to be very trustworthy; after the thermometer has been heated to 1100° C. for a considerable time, the indications of the instrument at low temperatures remain unaltered. The thermo-elements usually employed for the measurement of high temperatures have been carefully compared with this gas thermometer, and the electromotive force represented as a quadratic function of the temperature. With these thermo-elements the melting-points of a series of metals have been determined, so that the calibration and control of other elements is made independent of the standard nitrogen thermometer. The authors claim that the error in the determination of high temperatures (up to 1150° C.) does not exceed 1° C. The influence of air on the melting-points of copper and silver is interesting, as is evident from the following numbers—copper (pure) 1084·1° C., (in air) 1064·9° C.; silver (pure) 961·5° C., (in air) 955° C.

WE learn from the Marine Biological Laboratory at Plymouth that a male specimen of *Squilla desmarestii*, 2¾ inches long, was brought in last week by a shrimper who had been trawling inside Plymouth Breakwater. The rarity of this Stomatopod in Devonshire waters is shown by the fact that this is only the second specimen that has been taken at Plymouth since the laboratory opened in 1888, the other, a small one ¼-inch long, having been taken in the tow-net about three years ago.

THE additions to the Zoological Society's Gardens during the past week include two Puff Adders (*Bitis arietans*), a Yellow Cobra (*Naia flava*), two Delalande's Lizards (*Nucras delalandii*), thirty-two Spotted Slow Skinks (*Acontias meleagris*), three Rough-keeled Snakes (*Dasypeltis scabra*) three Smooth-bellied Snakes (*Homalosoma lutrix*), three Crossed Snakes (*Psammophis crucifer*), five Rhomb-marked Snakes (*Trimerorhinus rhombeatus*), two Coppery Snakes (*Prosymna sundevalli*), a Lineated Snake (*Boodon lineatus*) from South Africa, presented by Mr. J. E. Matcham; six Yellow-legged Frogs (*Rappia horstockii*) from South Africa, presented by Mr. W. L. Sclater; a Black Rat (*Mus rattus*), British, presented by Mr. E. Wormold; two Bactrian Camels (*Camelus bactrianus*, ♂ ♀) from Siberia, a Moose (*Alces machlis*, ♂) from North America, two Ashy-black Macaques (*Macacus ocreatus*) from the East Indies, a Golden-headed Marmoset (*Midas chrysomelas*) from South-east Brazil, a Red-footed Lemur (*Lemur rufipes*) from Madagascar, a Rufous-necked Wallaby (*Macropus ruficollis*) from New South Wales, four Westerman's Eclectus (*Eclectus westermani*) from Moluccas, a Plain-coloured Amazon (*Chrysotis inornata*) from South America, a Mongolian Pheasant (*Phasianus mongolicus*, ♂) from Mongolia, a Blackbird (*Turdus merula*, pied. var.), European, deposited.

OUR ASTRONOMICAL COLUMN.

LOCAL CONDITIONS FOR OBSERVATION OF THE TOTAL SOLAR ECLIPSE, 1901, MAY 17–18.—A pamphlet has been received containing information for observing parties and summaries of the climatological conditions along the track of the moon's shadow during the total solar eclipse in May 1901. The work is the report of a committee of the society, Koninklijke Natuurkundige Vereeniging in Nederlandsch-Indië, appointed at the request of the Government at Batavia.

With the exception of Batavia, which is out of the eclipse track, there is no regular meteorological service in the Malay Archipelago. Regular observations of rainfall, however, have been made during the period 1879–1900 at about 220 different places. As this factor alone does not give sufficient evidence as to the suitability of a place for observation of a total solar eclipse at noon, special series of climatic data have been obtained during the months of April, May and June 1900, in several places well situated for the purpose.

Twenty-two stations have been selected, extending from Padang, on the west coast of Sumatra, to Amboyna and Saparua, at the eastern extremity of the Celebes group. Tables are given showing the cloudiness of the sky, mean rainfall, daily and hourly rainfall.

As regards general condition of sky during May, the west coast of Sumatra appears to have the worst reputation, the percentage clearness being only 28 per cent., as against 50 per cent. for the Macasar Sea between Borneo and Celebes.

As regards rainfall, the western stations are apparently the better, Padang averaging fifteen rainy days in May, while at Amboyna there are twenty-seven. The actual rainfall is little or no indication of weather condition, as excessive rains do not involve a period of clouded sky; on the contrary, the atmosphere is cleared from dust by heavy rains, so that in the rainy season the sky is much more transparent than during the dry season. Several suggestions with respect to the accommodation at the various localities may be useful to observers.

The most convenient stations will probably be on the west coast of Sumatra. *Padang* is the residence of the Governor, is in weekly communication with Europe, has a telegraph office and four hotels.

Painan is situated south of Padang on the sea shore; it has no harbour, but is easily reached by land from Trusan Bay, where there is good anchorage.

Solok, in the interior, at an elevation of 1300 feet above sea-level, has a telegraph office and small hotel, and is connected with Padang by rail.

Pulo Lalang, an islet of the Lingga group, lies close to the central line, and possesses good anchorage for small vessels, which could be hired at Singapore.

Pontianak, on the west coast of Borneo, is in direct communication with Singapore once or twice weekly. It has a small hotel. The soil is said to be very swampy and unsuitable for large instruments.

Macasar, the capital of Celebes, has a telegraph office and two hotels, and is in direct communication with Singapore once a week.

Amboyna and *Saparua* are only in communication once or twice a month unless with special service.

As soon as a station is selected, arrangements should be made for securing the support of the civil officials, application being made in the first instance to the Governors or Residents. For temporary establishments bamboo and other materials are obtainable on the spot, and are inexpensive. Skilful craftsmen are not available except in the principal places. Portland cement may be purchased at Padang, Batavia, Surabaya and Macasar. No Customs duties are levied on instruments in the Dutch Colonies.

"ANNUAIRE ASTRONOMIQUE, &c., FOR 1901."—This well-known little annual volume, which is compiled by M. Camille Flammarion, will be found as useful as ever for the coming year. One finds in it all the more important details and events of celestial phenomena. Thus, we are given the facts about the coming solar and lunar eclipses, the chief tables of the solar system, charts of the sky for each month, showing the paths and positions of the planets. Further, there are several short notices on such subjects as solar spots, atmospheric observations, the eclipse of 1900, meteor observations, terrestrial magnetism, meteorological tables, &c. As a handy *vade mecum* for those who possess and use small equatorials, this annual should be specially very welcome.

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"THE HEAVENS AT A GLANCE," 1901.—This handy little publication (now in its fifth year of issue) is practically a card calendar devoted to astronomical particulars, and is designed to serve as a handy remembrancer as to the phenomena predicted for any period, any further details required being obtained from a more bulky volume of reference. Besides the daily phenomena of importance, monthly summaries of the aspects of constellations, sun's declination, moon's phases, and positions of planets are given. This occupies about half of the sheet. The remainder is devoted to a series of useful descriptive notes and statistics of various celestial objects, including special features on the moon's terminator during the lunation, elongations and oppositions of the planets, data for eclipses, meteor shower radiants, and the coordinates of a selection of the brightest stars. This card should be especially useful to amateurs who find the larger reference books too cumbersome. It may be obtained from the compiler, Mr. Arthur Mee, F.R.A.S., Tremynfa, Llanishen, near Cardiff.

"COMPANION TO THE OBSERVATORY" FOR 1901.—This useful contribution to the astronomer's library has recently been issued, and will doubtless be accorded its usual welcome. The contents, occupying 36 pages, have from experience been so condensed as to leave out no information likely to be wanted by the general worker that little or no alteration has been made in the arrangement. Beginning with particulars of the sun's times of rising, setting, its declination, mean and sidereal time, and phases of the moon for every week, there follows a calendar showing the times of rising, southing and setting of the moon, and the longitude of the terminator for each day of the year; a list of the principal radiant points of meteors, compiled by Mr. Denning; ephemerides for all the planets, including the minor planets Ceres, Pallas and Vesta; and times of elongation, stationary points, &c.; solar and lunar eclipses, occultations; phenomena of the satellites of Mars, Jupiter, Saturn, Uranus and Neptune; ephemeris containing data for physical observations of the sun; mean places of variable stars, with epochs of maxima and minima; particulars of 115 double stars.

ARGON AND ITS COMPANIONS.[1]

THE discovery of krypton and neon was announced to the Royal Society in the early summer of 1898; and subsequently atmospheric air was found to contain a heavier gas to which the name of xenon was applied. Mr. Baly, in the autumn of the same year, called attention to the presence of helium lines in the spectrum of neon, an observation which confirms that made by Prof. Kayser, of Bonn, and by Dr. Friedländer, of Berlin.

At the same time we imagined that we had obtained a gas with a spectrum differing from that of argon and yet of approximately the same density; to this gas we gave the name metargon. It has now been found that the presence of the so-called metargon is to be accounted for by the fact that in removing oxygen from the mixture of these gases, which was then in our hands, phosphorus containing carbon was employed; this mixture when burned in oxygen yields a spectrum to some extent identical with that furnished by carbon monoxide, but differing from it inasmuch as lines of cyanogen are also present. We have no doubt that the so-called metargon, the spectrum of which is visible only at high pressure, and only when impure phosphorus has been employed to remove oxygen, must be attributed to some carbon compound. In spite of numerous experiments we have not yet succeeded in producing any gas in quantity which yields this composite spectrum. It is only to be obtained by a mixture of carbon monoxide with cyanogen.

To obtain the heavier gases krypton and xenon, a large amount of air was allowed to evaporate quietly; the residue was freed from oxygen and nitrogen, and then consisted of a mixture of krypton, xenon and argon, the last forming by far the largest portion of the gas; this mixture was liquefied by causing it to flow into a bulb immersed in liquid air, and the bulk of the argon was removed as soon as the temperature rose, the krypton and the xenon being left behind. By many repetitions of this process we were finally successful in separating these three gases from each other. While krypton has a considerable vapour-pressure at the temperature of boiling air, the vapour-pressure of xenon is hardly appreciable, and this afforded a means of finally separating these two gases from one another; in the complete paper the operations necessary to separate them are fully described.

For neon the process of preparation was different. The air liquefier furnished a supply of liquid air; the gas escaping from the liquefier consisted largely of nitrogen; this mixture was liquefied in a bulb immersed in the liquid air which the machine was making. When the bulb had been filled with liquid nitrogen a current of air was blown through the liquid until some of the gas had evaporated. That gas was collected separately, and deprived of oxygen by passage over red-hot copper; it contained the main portion of the neon and the helium present in the air. The remainder of the nitrogen was added to the liquid air used for cooling the bulb in which the nitrogen was condensed. Having obtained a considerable quantity of this light nitrogen it was purified from that gas in the usual manner, and the argon containing helium and neon was liquefied. By fractional distillation it was possible to remove the greater portion of the helium and neon from this mixture of gases, leaving the argon behind. Many attempts were made to separate the helium from the neon. Among these was fractional solution in oxygen, followed by a systematic diffusion of the two gases; but it was not found possible to raise the density of the neon beyond the number 9·16, and its spectrum still showed helium lines. It was not until liquid hydrogen, made by an apparatus designed and built by one of us (M. W. T.), had been produced in quantity, that the separation was effected; the neon was liquefied or perhaps solidified at a temperature of boiling hydrogen, while the helium remained gaseous. A few fractionations serve to produce pure neon; we did not attempt to separate the helium in a pure state from this mixture.

That these are all monatomic gases was proved by determination of the ratio of their specific heats by Kundt's method; the physical properties which we have determined are the refractivities, the densities and the compressibilities at two temperatures, and of argon, krypton and xenon the vapour-pressures and the volumes of the liquids at their boiling points.

The results are as follows:—

	Helium.	Neon.	Argon.	Krypton.	Xenon.
Refractivities (Air = 1) ...	0·1238	0·2345	0·968	1·449	2·364
Densities of Gases (O = 16)	1·98	9·97	19·96	40·88	64
Boiling-points at 760 mm.	?	?	86·9° abs.	121·33° abs.	163·9° abs.
Critical temperatures ...	?	below 68° abs.	155·6° abs.	210·5° abs.	287·7° abs.
Critical pressures	?	?	40·2 metres	41·24 metres	43·5 metres
Vapour-pressure ratio ...	?	?	0·0350	0·0467	0·0675
Weight of 1 c.c. of liquid	?	?	1·212 grammes	2·155 grammes	3·52 grammes
Molecular volumes	?	?	32·92	37·84	36·40

The compressibilities of these gases also show interesting features. They were measured at two temperatures—11·2° and 237·3°; the value of P.V. for an ideal and perfect gas at 11·2° is 17,710 metre-cubic-centimetres, and at 237·3° to 31,800. This is, of course, on the assumption that the product remains constant whatever be the variation in pressure. Now with hydrogen at 11·2° C. the product increases with the rise of pressure; with nitrogen, according to Amagat, it first decreases slightly and then increases slightly. With helium the increase is more rapid than with hydrogen; with argon there is first a considerable decrease followed at very high pressures by a gentle increase, although the product does not reach the theoretical value at 100 atmospheres pressure; with krypton the change with rise of pressure is a still more marked decrease, and with xenon the decrease is very sudden. At the higher

[1] A paper by Prof. William Ramsay, F.R.S., and Dr. Morris W. Travers. Read at the Royal Society on November 15.

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