OUR ASTRONOMICAL COLUMN.

AN ASTEROID-ORBIT OF GREAT ECCENTRICITY.—Prof. E. C. Pickering announces that from an examination of a plate taken on August 14, 1901, with the Bruce telescope, Dr. Stewart found an asteroid having the great southern declination, $-62°$. Fourteen photographs were taken up to November 13, furnishing approximate positions for the computation of the orbit. A circular orbit was first calculated, which gave the surprising result that the heliocentric diurnal motion exceeded 2200″, indicating a distance from the sun less than that of any known asteroid. Prof. Newcomb furnishes the following elements:—

Epoch 1901, October 2·627 G.M.T.

$M = 358° 30'$			$\phi = 22° 8'$
$\omega = 301 19$	1900.0		$\mu = 860''$
$\Omega = 35 48$			$\log a = 0·4103$
$i = 18 38$			Period $= 4·13$ years.

The uncertainty of the elements ω and Ω may be about $\pm 1°$.

It would thus appear that the ellipticity of this new planet is in considerable excess over that of any previously known asteroid. The only others for which ϕ exceeds 20° are:—

Eva (164)	20°	19′
Istria (183)	20	27

The new asteroid was near perihelion at the time of its discovery, moving rapidly round the sun at a distance of about 1·6. It is rapidly moving north, and will soon be available for observation from northern observatories, as shown by the following approximate ephemeris for Greenwich midnight:—

1901.	R.A. h. m.	Decl. ° ′
Dec. 21·5	23 11·3	-11 42
Jan. 10·5	23 51·8	-3 47
,, 30·5	0 31·9	$+3$ 26

BRIGHT METEOR OF DECEMBER 16.—An exceedingly brilliant meteor was observed at South Kensington on the evening of Monday, December 16, about 6·45 p.m. Starting from near α Persei, about 60° elevation, it travelled in a northerly direction inclining downwards until, after a path of about 30°, it disappeared beneath the Pole star. The meteor was two or three times brighter than Capella, and appeared of a similar tawny yellow colour, although this might have been mainly due to the slight fog prevailing at the time. The trajectory was practically rectilinear and the movement very slow.

THE INERT CONSTITUENTS OF THE ATMOSPHERE.[1]

THE discovery of an element always awakens interest; for the total number of the known elements does not exceed seventy-five, and all the various forms of matter which exist on this globe are necessarily composed of these elements.

Elements must not be regarded as isolated entities, each self-dependent, having no relations with its compeers; on the contrary, all the elements exhibit certain connections with their neighbours; and there is to be traced an orderly progression from one class of elements, strongly electro-positive in character, metallic in appearance, very inflammable when heated in the air, and at once attacked by water, to another class, highly electro-negative, transparent, unattackable by oxygen, and without perceptible action on water, through a number of connecting links, each of which serves to soften the transition.

These elements have been arranged in series, and it is by considering the method of arrangement that our interest is awakened.

The revival of the hypothesis of the atomic constitution of matter by Dalton and of his attempt to determine the atomic weights of the elements was not long in provoking the guess that perhaps there could be found some connection between the numbers representing the relative atomic weights of kindred elements. But, as is well known, the state of knowledge in Dalton's day was not sufficiently advanced to enable him to attribute to elements their correct relative atomic weights; and it was not until the eminent professor of chemistry in Rome, Cannizzaro, whose jubilee has recently been celebrated, pointed out the bearing on Dalton's numbers of all the facts accumulated up to the year 1856 that the close relationship between the atomic weights and the properties of the elements was suggested by John Newlands. Some years later Lothar Meyer and Dmitri Mendeléef amplified and elaborated the ideas which had first been propounded by Newlands; and the periodicity of the atomic weights and the gradual variation of the properties of the elements and their compounds were established on a firm basis.

The division of the elements into metals and non-metals corresponds broadly with another well-marked division—that into basic and acidic. Generally speaking, it is the oxides of the metallic elements which react with water to form bases, and those of the non-metals which form acids with water. According to modern ideas, bases, by the mere act of solution in water, are supposed to be split up into portions, for which the term ion, invented by Faraday, has been retained; one ion is charged by the process of solution with a positive charge, and that portion is usually a metal; the other portion, which consists of one or more groups of hydrogen and oxygen in combination, termed "hydroxyl"—OH—has a negative charge. A base, indeed, is a compound which splits in this manner. On the other hand, an acid, when dissolved in water, undergoes an analogous split; but in this case the electro-positive ion is always hydrogen, while the electro-negative ion may either be an element such as chlorine, or a group of elements such as exist in nitric acid (NO_3).

The order of the various elements in the electric series has been determined; and not merely determined, but to each has been attached a numerical value. This value is identical with what is termed "chemical affinity"; and it represents the electric potential of the element with reference to an arbitrary starting-point, which does not differ much from that of nickel, an element closely related to iron. Only a few such values have as yet been determined numerically; instances may be chosen from the magnesium group, where the numbers run: Magnesium $= +1·2$; Zinc $= +0·5$; Cadmium $= +0·19$; or from the fluorine column, where the numbers are: Fluorine $= -2·0$; Chlorine $= -1·6$; Iodine $= -0·4$. In each case the potential, positive or negative, is the highest for the element with smallest atomic weight, and decreases with increase of atomic weight, for elements in the same column. The order of some of the elements is: Cs Rb K Na Li Ba Sr Ca Mg Al Mn Zn Cd Fe″ Co Ni Pb H Cu Ag Hg′Pt″″ Au‴; and for electro-negative ions, S″ O″ I Br Cl F; the first element, cæsium, being the most electro-positive, and the last, fluorine, the most electro-negative.

The order given above corresponds fairly well with the order in the periodic table, passing from left to right. But, as in the table, the atomic weights follow each other continuously round the cylinder or round the spiral, the abrupt change from elements of an extreme electro-negative character, like fluorine to sodium, an element of highly electro-positive character, or from chlorine to potassium, has always appeared remarkable. The old dictum, *Natura nihil fit per saltum*, if not always true (else we should have no elements at all, but a gradual and continuous transition from one kind of matter to another—a condition of affairs hardly possible to realise), has generally some spice of truth in it; and it might have been predicted (and the forecast seems to have been made obscurely by several speculators) that a series of elements should exist which should exhibit no electric polarity whatever. Such elements, too, should form no compounds, and, of course, should display no valency; they should be indifferent, inactive bodies, with no chemical properties.

The discovery of argon in 1894, followed by that of terrestrial helium in 1895, and of neon, krypton and xenon in 1898, has shown the justice of the foregoing remarks. Inasmuch as the methods employed for the isolation of these elements illustrate their properties and confirm the views as to their inertness and lack of electric polarity, I propose to sketch shortly the history of their discovery.

An accurate investigation of the density of atmospheric nitrogen and of nitrogen prepared from its compounds led Lord Rayleigh to inquire into the cause of the density of the nitrogen of the atmosphere exceeding that of "chemical nitrogen" by about one part in two hundred, whereas the accuracy of his experiments was such that it would have excluded an error of one part in five thousand. I need not here allude to the reasons which were at first put forward to account for this anomaly; suffice it to say that they offered no

[1] Abstract of an evening lecture delivered at the meeting of the British Association at Glasgow, September 13, by Prof. W. Ramsay, F.R.S.