worth while to investigate under what conditions adsorbed hydrogen acquires the property of passing into the ionic state. The experimental method has been described in a previous paper [*Z. physik. Chem.*, **150**, 421 (1930)]. The charcoal[1] was outgassed at 950° for forty-eight hours and then cooled to the temperature of hydrogen adsorption. After a certain quantity of hydrogen had been adsorbed, the charcoal was brought at room temperature into contact with an outgassed solution of sodium hydroxide and after five hours the change of concentration determined. These experiments showed that hydrogen adsorbed at low temperatures (20–100°) is not exchanged against sodium ions, whereas hydrogen adsorbed in the temperature region of activated adsorption (300° and 800°) readily reacts with the alkaline solution. In this case, if the quantity adsorbed is small, the whole of the adsorbed hydrogen is exchanged. In one experiment 1 g. of charcoal adsorbed 0.100 millieq. of hydrogen at 300° and afterward, 0.090 millieq. of alkali; in another (temperature of hydrogen adsorption 800°) the corresponding quantities were 0.064 and 0.066. If the amount of adsorbed hydrogen becomes larger, only a part of it is exchanged.

The adsorption of alkali depends only on the quantity of hydrogen adsorbed at high temperature. An excess of hydrogen in the gaseous phase during the interaction between the charcoal and the solution has not the slightest influence on the results of the experiments and if the charcoal has not been previously heated in hydrogen until activated adsorption sets in, the adsorption of alkali is nil.

The fact that hydrogen adsorbed at high temperatures can be exchanged at room temperature quantitatively against sodium ions seems to prove definitely that the hydrogen remains on the charcoal surface (probably in an atomic form) and does not diffuse into the interior of the solid.

(1) We used activated sugar charcoal prepared as described by Bruns and Frumkin [*Z. physik. Chem.*, **141**, 145 (1929)]. It contained 0.05% ash. A control experiment carried out with a charcoal specimen with an ash content of only 0.005%, which was prepared from distilled materials [*cf.* Low, *Phys.*, **2**, 505 (1932)] gave the same results.

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AN ARRANGEMENT OF ATOMIC NUCLEI AND THE PREDICTION OF ISOTOPES

Sir:

The regularities observed in the existence and abundance of atomic nuclei have been commented on by Harkins, Beck, Barton, Latimer, Johnston, Urey and others.[1] From such regularities attempts have been

(1) Harkins, THIS JOURNAL, **39**, 859 (1917); **42**, 1976 (1920); **43**, 1050 (1921); *Phys. Rev.*, **15**, 85 (1920); *Phil. Mag.*, **42**, 305 (1921); *Chem. Rev.*, **5**, 371 (1928); Beck, *Z. Physik*, **47**, 407 (1928); Barton, *Phys. Rev.*, **35**, 408 (1930); Latimer, THIS JOURNAL, **53**, 981 (1931); Johnston, *ibid.*, **53**, 2866 (1931); Urey, *ibid.*, **53**, 2872 (1931).

made to predict the existence of isotopes. In his book, "Constitution of Atomic Nuclei and Radioactivity," Gamow, also, publishes a series of

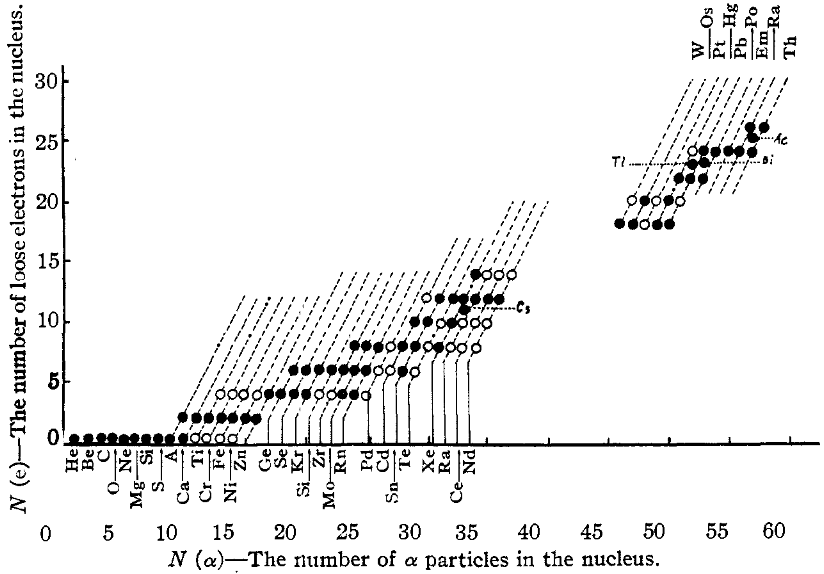

Fig. 1.—Arrangement of the nuclei of the 4 N type.

figures, and, like Johnston, he classifies all the known nuclei into the four well-known types $4n$, $4n + 1$, $4n + 2$ and $4n + 3$, and shows the number of loose electrons in each nucleus.

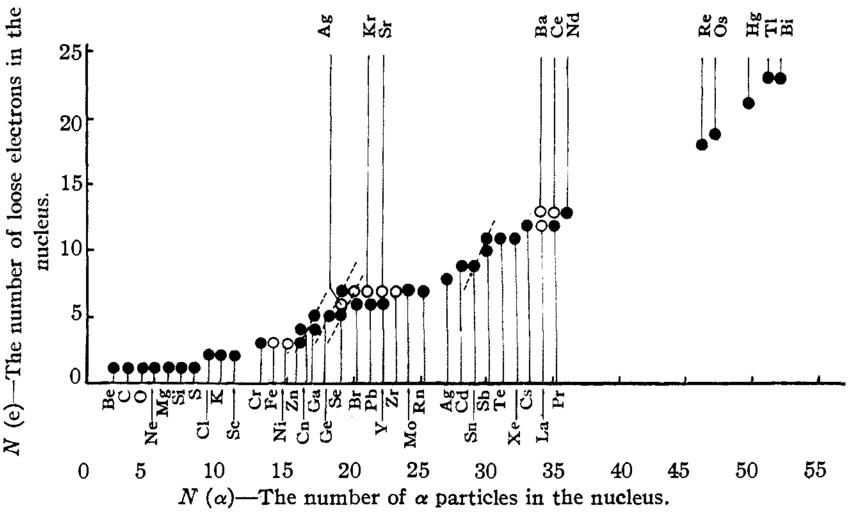

Fig. 2.—Arrangement of the nuclei of 4 N + 1 type.

In the following, Gamow's figures have been reproduced after putting in the nuclei that have been recently reported to have been discovered.

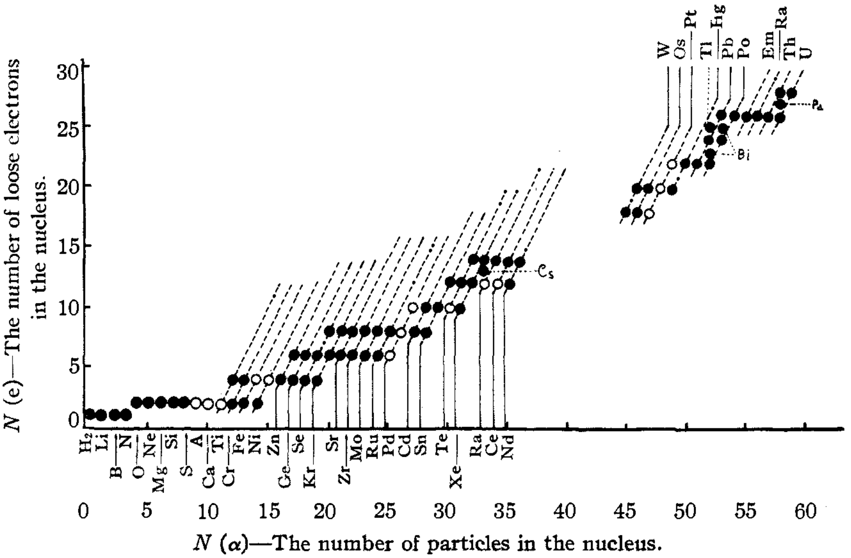

Fig. 3.—Arrangement of the nuclei of 4 $N + 2$ type.

The known nuclei are indicated by circular dots. From the regularity of the various figures the existence of the nuclei shown by circles is apparent.

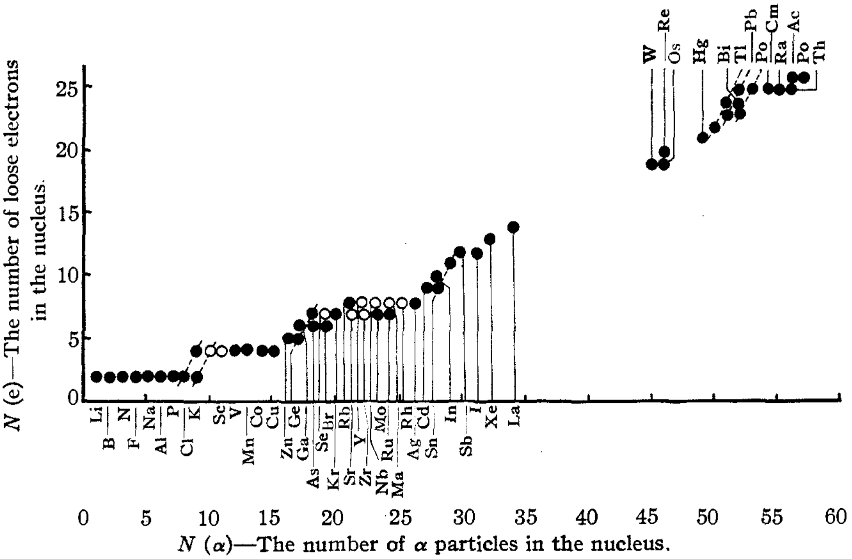

Fig. 4—Arrangement of the nuclei of 4 $N + 3$ type.

In this way the following additional isotopes of elements can safely be predicted to occur: A 38; Ca 42; K 43; Ti 44, 46 and 52; Sc 47; Cr 48 or 56; Fe 56, 60, 57 and 58; Ni 56 or 64, 61 and 62; As 77; Se 79 and 81; Sr 84, 87 and 89; Kr 85; Zr 88, 91 and 93; Y 91; Nb 95; Ma 99; Rh 103; Pd 100, 102, 104, 106, 108 and 110; Cd 108 and 120; Te 116, 120, 122 and 124; Ba 128, 132, 134 and 140; Ce 132, 136, 138, 141 and 144; Nd 136, 140 and 148; La 137; W 188; Pt 190 or 198, 192, 194 and 196; Pb 204 and Hg 208.

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RECEIVED JUNE 12, 1933 PUBLISHED JULY 6, 1933

TETRAARYLARSONIUM HALIDES

Sir:

Alkyltriarylarsonium compounds have been prepared in considerable number but it seems that the tetraarylarsonium type has not been described hitherto.

It has been found that tetraarylarsonium halides can be obtained readily by interaction of an arylmagnesium halide with a triarylarsine oxide and subsequent treatment of the reaction mixture with a halogen acid: for example, addition of hydrochloric acid to the product formed from phenylmagnesium bromide and triphenylarsine oxide yields tetraphenylarsonium chloride (m. p. 272–274°); by the use of hydrobromic or hydriodic acid the corresponding bromide (m. p. 273–275°) and iodide (m. p. 292–293°) are obtained.

These halides are beautifully crystalline compounds and the halogen is not removed by brief treatment with alcoholic sodium hydroxide or molecular silver.

An extensive investigation of these compounds is in progress.

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HIGHER VALENCE STATES OF SILVER

Sir:

Recently considerable attention has been given to the higher valence states of silver, but no reports have appeared on bivalent silver in the form of anhydrous fluoride, although as early as 1891 Moissan stated that silver is attacked by fluorine at 100°, and at red heat the two elements combine with incandescence.