A NEW PATTERN OF THE PERIODIC TABLE

by

Brajendra Nath Tripathi

Defence Science Laboratory, Delhi

ABSTRACT

A new pattern of the Periodic Table is described which incorporates all the points for which various models of two or three dimensional periodic tables have been proposed from time to time.

Introduction

The periodic system of the elements is a very comprehensive system of classification. Ever since the publication of the Periodic Table by Mendeleev, it has been represented in a number of different ways either to remove the present anomalies and shortcomings or to introduce some additional important points or simply to present a different pattern. But all the complexities of periodicity could never be simply charted and differences of opinion as to the best representation have always existed probably because of the inadequate definition and applicability of the Periodic Law. The complete significance and the implications of the Periodic Law were apparent only after the knowledge of the electronic structure of the atoms. The most of the properties of the elements are the direct consequences of their electronic structures. The elements exhibiting similar properties are similar in structure. The electronic structure of the elements exhibits periodically recurring homologies. A correlation of physico-chemical and structural periodicities has given a very sound base to the Periodic Law. Hence the representation of the periodic table in a form related with the atomic structure should be expected to be more complete than any other form.

Several patterns of the Periodic Table based on electronic structure have been proposed, [1, 2, 3, 4] but a new form described here is distinctly much more advantageous. It incorporates all the important points for which several patterns of the table have been proposed. It also covers some additional points which are not presented by any other periodic table proposed so far.

The Principle

The pattern of this Periodic Table is devised on the principle that electron configuration of each element is represented by the various positions of the elements as the positions of the electrons up to that element, when the various orbits are represented by the circumferences of the concentric circles.

The Atomic Structure

The electron configurations of the elements up to the atomic number 103 have been taken to be constituted by the gradual increment of the electrons in the following order $3en^0\ 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 5d^1 4f^{14} 5d^{2-10} 6p^6$ $7s^2 6d^1 5f^{14}$

Neutron has also been included as an element of atomic number O. The electron configurations of the most of the elements have been established with certainty. But in the cases of Lanthanides and Actinides, which involve the electrons in 4f and 5f orbitals respectively the electron configuration of several members is still uncertain. Because of the number of physico-chemical evidences their configurations are regarded as formed by gradual increment of electrons in f orbital [5, 6]. The electronic structures for 12 elements represented as above appear to be in definite conflict with the spectroscopic data. In Cr, Cu, Nb, Mo, Tc, Ru, Rh, Ag, Pt and Au the difference is in the placement of one electron in one of the contiguous orbitals and in Pd and Ir the difference is for two electrons.

In all the above cases the difference of energy between the accepted or probable and the adopted configurations is within the range of the chemical binding energies. Hence it is quite probable that during the production of emission spectra from which the accepted configurations have been deduced, most of the above elements have failed to regain their true ground states [7]. Therefore the adopted configurations, which are in the regular sequence with other elements are quite justified.

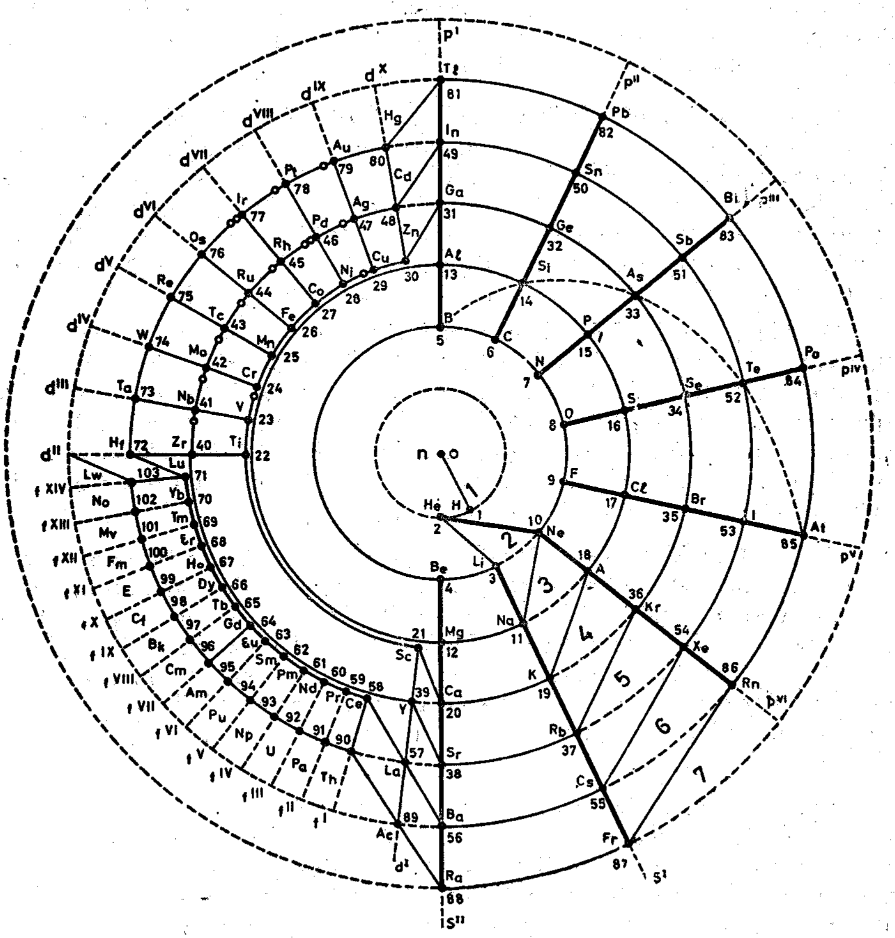
Formation of the Periodic Table

Seven concentric circles representing KLMNOPQ or 1,2,3,4,5,6 and 7 orbits are drawn. A vertical line through the common centre divides the circles into two halves. The semicircles on the right are further subdivided into seven equal segments. The radii are termed p^{I}, p^{II}, p^{III}, p^{IV}, p^{V}, p^{VI}, s^{I}, and s^{II} respectively. The upper left quadrant is divided equally into nine segments and the radii are termed d^{II} to d^{x}. The lower left quadrant is similarly divided into sixteen segments and the radii are termed d^{I} and f^{I} to f^{XIV}. The points of intersection of these radii with various appropriate circles are the positions of the appropriate elements (or electrons). The position of each element is indicated by the position of the last electron which distinguishes the element with its previous member.

The periodic table is drawn in the form of a curve starting from the centre which is the position of the neutron, and moving in such a way that the various positions of the elements formed by the gradual increment of the electrons in the same orbital are connected together by the curve moving along the circumference. When the next element is formed by incoming of the electron in the next higher or incomplete lower orbit, the two positions are joined by straight lines. The paths of the curve Mg to Al & Sc to Zn are identical in this scheme. If they are so shown they must introduce a confusion. Hence the path Sc to Zn is shown along a circle having a little greater radius. Similar is the case with the part of the curve from Ce to Lu. The blank points preceding the positions of a few elements in the d. block indicate the presence of additional electrons in the d orbital and their consequent absence in the previous s orbital indicating thereby the probable electronic structure.

Tie Lines

All the elements from Li onwards lying on the same radii are connected by the tie lines. The tie line connecting the noble gases is extended to He. The tie lines of sp block series are prominent, d block less prominent and f block least prominent in order to exhibit the typical behaviour of variation and similarity of properties in sp, d and f block. The tie lines of f^{I}, f^{VII} and f^{XIV} are more prominent than the rest in f block in order to exhibit the presence of two periodic series in the Lanthanides and Actinides. A less prominent curve connecting B, Si, As, Te, At is also drawn which divides the metal and the non-metal elements of the p block and indicates the direction of extra group similarities.



THE PERIODIC TABLE

Advantages and Specialities

This periodic table incorporates the following advantages and specialities—

(1) *The position of Neutron*—The inclusion of Neutron in the periodic table has been advocated by some authors who have placed it with Noble gases[8, 9]. But neutron is singularly different from all other elements in its properties. It is also known to decay spontaneously into electron and proton [10]. Hence its position in this periodic table at the centre, completely isolated from all other elements is most suitable.

(2) *The position of Hydrogen*—Throughout the history of the periodic table Hydrogen has been a very controversial element for the allocation of its position. Some authors have placed it along with alkali metal [11, 12, 13] some with halogens[4] some with both [14] and some with neither[15]. Hydrogen having the electron configuration $1s^1$ resembles other s^I elements only in its spectroscopic characteristics. It invariably reacts by completing $1s^2$ or He configuration and hence partly resembles p^V elements or halogens which also require one electron to complete p^{VI} or noble gas configuration. Therefore Hydrogen is not a protologue of any group of elements. Its position in this Table is in conformity with the above observations.

(3) *The position of Helium*—Helium shows perfect physico-chemical resemblance with other noble gases and hence usually placed in their group but spectroscopically resembles alkaline earth metals. For this reason it has also been placed by some authors at entirely separate position or with alkaline earth metals [12, 13, 16]. Its position in this periodic table incorporates both the view points. Its position exhibits special properties associated with $1s^1$ and $1s^2$ electrons by the changed pattern of curve connecting He—Li.

(4) *The position of Lanthanum and Actinium*—It has been pointed out that spectroscopists usually do not include Lanthanum in the subsequent series of Lanthanides as the absence of 4 f electron leads to relatively simple spectrum, very different from that of the other elements in the series[5]. Because of the absence of 5 f electron Actinium has also been considered separate from Actinides. In this table both the elements are separate from the subsequent series of f-elements.

(5) *The transitional elements*—The resemblance between the transitional or d elements and the regular or sp elements is only slight and all attempts in which both of them have been kept together have obscured the true pattern of the periodic table. This periodic table because of the pattern of the depiction presents the transitional nature of these elements as the part of its curve containing these elements is formed by the inward movement indicating thereby that a series of such elements intercepts before a homologue of next regular element is obtained.

The transitional elements exhibit the periodic variation as well as resemblance of properties both almost equally prominent. This table presents both the view points. The resemblance is clearly exhibited by the nature of the part of the curve containing these elements and the nearness of the positions of the successive members as compared with the angular distance between the consecutive sp elements.

(6) *The Lanthanides*—In many periodic tables, the Lanthanides have been given only one position as if they are all isotopic elements with identical properties. But the fact is that these elements exhibit the similarity as well as faint periodicity of properties [17]. Hence they cannot be considered as isotopic elements. This periodic table depicts the Lanthanides as a series of elements transitional between d^I and d^{II} elements.

(7) *The Actinides*—The Actinides form a series of elements exhibiting much similarity and faint periodicity, more prominent than Lanthanides. They have been placed similar to the Lanthanides.

(8) *Exhibition of the pattern of variation and resemblance*—This periodic table exhibits the pattern of variation and resemblance with a remarkable degree of accuracy. The representative elements showing a regular variation of properties in a very marked way form a separate block of sp elements, while the transitional elements show the variation and similarity, both equally prominent, form another block of d elements and the inner transitional elements exhibiting similarity of properties in a very marked way and faint variation form another block of f-elements. Whenever a d series intervenes between s^{II} and p^{I} elements, their positions are formed by the inward movement of the curve. This shows their transitional nature. As the angular distance between d—elements is much less as compared with that between sp elements, it is indicated that the variation of properties in this block will be much less as compared with the variation in sp block. Similarly inner transition nature and close similarity of properties in f block can be interpreted.

(9) *The atomic structure and related properties*—The atomic structure of each element can be accurately derived from its position in this table by considering the various positions of the atoms as electrons up to that element, circumferences as orbits, s, p, d and f segments as orbitals and the radii numbers as the number of electrons in the orbital. The blank points associated with some d-elements exhibit the probable structure. Thus it can also be termed as electronic structure table. As such it is capable of exhibiting the pattern of the variation and similarity of properties associated with orbital electrons of the atoms, namely the nature and direction of valence bonds, the stability sequence for atomic orbitals, the nature of the development of matter, the electronic spectra of atoms etc.

(10) *The New periods*—All the elements are divided into seven periods. The period of neutron, the only member of its period is termed zero. The number of the elements in the successive periods are 2, 8, 18, 32, 32, 9 and 2. All the members of one period are not in the order of regularly increasing atomic numbers. Whenever the orbital of the distinguishing electron changes, the atomic number of the element abruptly increases in cases of s^{II} to d^{I} or d^{I} to f^{I} or decreases in the cases of f^{XIV} to d^{II} or d^{X} to p^{I} change. Such periods are quite different from the traditional type. In view of the fact that most of the properties of an element have a direct correlation with the position of the distinguishing electron, the indication of the period of an element by its orbit number is quite justified.

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