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RESEARCH ARTICLE

THE CONTRADICTION OF THE TABLE OF D. I. MENDELEEV AND THEIR ELIMINATION

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Abstract

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This paper deals with a new approach in the formation of periods in the Mendeleev’s Periodic Table. Using a newly suggested formula and newly suggested quantum states for the external electron shells of atoms of chemical elements, the author proposed the reconfiguration of periods in the Mendeleev’s table. The reducing of the number of periods in the table is assumed, andthe material represented in the paper proves it.The following order of formation of electron layers is suggested: the principle quantum number (n), followed by the quantum state of electrons (first and second) which constitute the electron configurations of subperiods, and only after that - the remaining quantum orbitals (s, d, f, and p). [N.K.Akhmetov.**Some ideas on the Mendeleev's table**.32793-nsj-20170821.Journalof American Science, 2017 (15x) (ISSN 1545-1003 (print); ISSN 2375-7264 (online), http://www.jofamericanscience.org).].

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Introduction:-

For almost 150 years up till now, chemical engineers of all the world have been using the periodic law discovered by D. I. Mendeleev and its graphic representation in the form of the Mendeleev’ Table [1]. After a significant addition made a bit more than a hundred years ago stating that the periodicity in the distinction of chemical properties of elements does not depend on the mass but on the charge of their atomic nuclei, we have been using the periodic table so far almost without any essential changes in the substance and content. This is another emphasis upon its great significance for the chemical science.All the more so as it is one of the few laws of science which has no full-fledged mathematical formulation. The periodic table is a visual aid which demonstrates the link between the electron structure of the atoms of chemical elements and the location of these elements in the table. It explains the specifics of chemical properties depending on the structure of electron shells of atoms. And it also proves the primary structure of these electron shells [3,4].

Results and Discussions:-

Used by chemiststhe Mendeleev’s Table (figures 1) has its specific contradictions which do not let show its potential to the full. For instance, the essential contradiction is the unconformity between the sequence of infilling specific series of orbitals of various chemical elements related to various n (principal quantum numbers, or energy levels).

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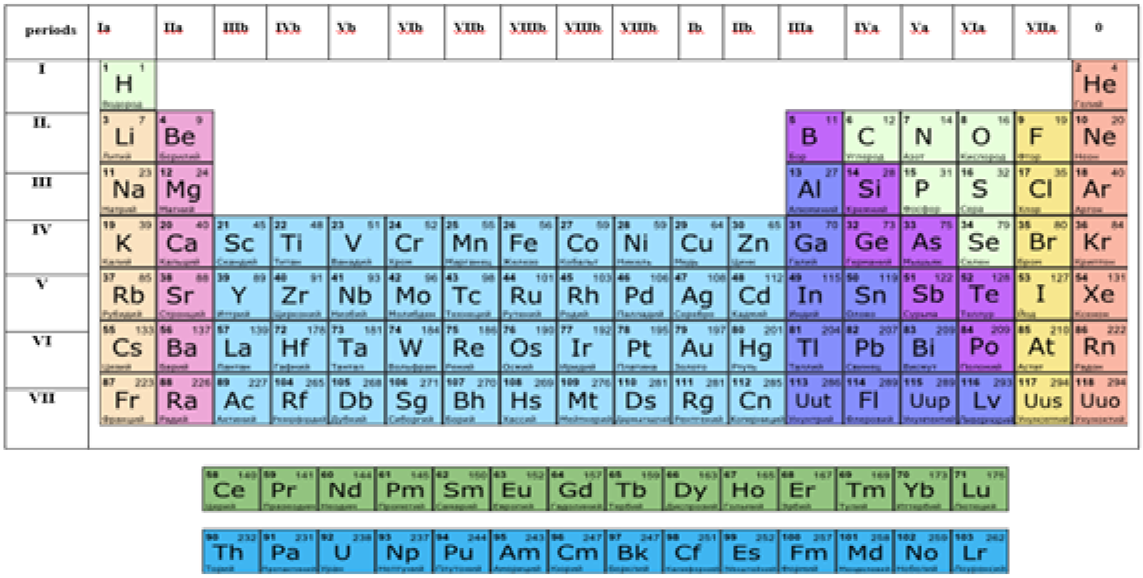


periods	Ia	IIa	IIIb	IVb	Vb	VIb	VIIb	VIIIb	VIIIb	VIIIb	Ib	IIb	IIIa	IVa	Va	VIa	VIIa	0
I	H																	He
II.	Li	Be											B	C	N	O	F	Ne
III	Na	Mg											Al	Si	P	S	Cl	Ar
IV	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
V	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
VI	Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
VII	Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Uut	Fl	Uup	Lv	Uus	Uuo

Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

Figure 1:- Long version of the traditional Mendeleev's table.

This state of affairs was largely due to the fact that when creating the Periodic Table of Mendeleev, scientists did not yet discover the basic elementary particles and the structure of the atom itself was unknown. As a result, chemists, researchers lacked reliable data to obtain the correct conclusions and they made them based only on the structure of the table itself [2,3,4,5]. At the same time, the unsuccessful situation was complicated by the fact that the final structure of the table acquired a similar to the modern appearance only after the discovery of elements of the family of ideal (or noble) gases. It was then that the important conclusion was made that the structure of all periods begins with an alkali metal, and ends with an inert gas. Due to this, it became apparent that the same number of chemical elements were present, repeated sequentially in pairs, in the periods proposed by Mendeleev's table. It was almost impossible to give a complete scientific explanation to this then, as there was still no proper description of the electronic structure of the atoms of the elements and the relationship of this structure to the position of the elements in the Periodic Table. Therefore, the first problem to be solved then was the problem of explaining why the total number of chemical elements in the periods of the proposed table changes in the following known sequence: 2; 8; 8; 18; 18; 32 and 32. This explanation was partially given in the assumption adopted by chemists that this sequence is a group of numbers, which in turn can be transformed into the following series: $2*1^2$; $2*2^2$; $2*2^2$; $2*3^2$; $2*3^2$; $2*4^2$; $2*4^2$ [6]. In this sequence of this group of numbers, it is already possible to see a certain quantitative pattern of the increase in the number of elements in periods, but without proper theoretical substantiation. Thus, in the calculations of all periods, the number 2 is constantly present, the appearance of which has no explanation, the presence of a square of a degree is also not explained, as is the relationship between the period number and the number of chemical elements in it. With the exception of the first and second periods. Later, with the growth of our knowledge of the structure of the atoms of the elements, the electron shells in them, the following problem arose - the need to explain the dependence of the electronic structure of atoms of chemical elements on their place in the corresponding period of the Periodic Table. At the same time, it is worth noting that the general approach to calculating the number of electrons in a period (based on the above group of numbers) was also mainly transferred to counting the number of electrons they have, if we go to the well-known formula I. $N= 2n^2$ (I)

The combination of these two positions had its additional positive effect. He made it possible to give a relative physical meaning to a simple series of numbers erected sequentially in a square in the series of groups of numbers, considered earlier, as identical to the main quantum number or period number [6]. But the main disadvantage of this approach and assumptions still remained, Since formula I does not give a complete quantitative and qualitative coincidence, when comparing the calculated values with the existing structure of the periods of the periodic table. Many questions also arise from the very receipt of formula I, in which there are enough empirical assumptions and admissions. As a result of all this, when using the periodic table to explain the physical and chemical properties of the elements, certain difficulties and ambiguities arise.

At the same time, as is known, the principal quantum number also denotes the number of respective period in the Mendeleev’s Table. Calculated amounts of electrons for various values of n are represented in Table 1.The data of Table 1 represent the comparison of n and the number of chemical elements in the periods of the Mendeleev’s table.

Table 1:- Comparison of the chemical elements number in periods with the number of electrons calculated with formula (I).

n	**N**	**Number of elements in the respective period**
1	2	2
2	8	8
3	18	8
4	32	18
5	50	18
6	72	32
7	98	32

Table I shows that the total number of elements in most periods does not correspond to the calculated number of electrons for the same period. The number of electrons calculated by the formula I becomes greater than the charges of the atomic nuclei of the elements of the period, and this can not be in principle because of the electron neutrality of the atom of the element. This state of Affairs allows us to conclude that for large values of the main quantum number and the sequence number of the period, the formula (I) at least does not work.The contradiction also arises when considering the sequence of filling by electrons of their electronic orbitals. So 3d electrons of the third main quantum number begin to fill their orbitals only after 4s electrons belonging to the fourth period. Although logically they belong to a different energy level and their filling should have occurred earlier. There are other similar examples.

The aforementioned contradictions, at the present time, are almost not even discussed by chemists and in the course of recent decades continue to be taken for the final version. Such conservatism, in this case, largely plays a negative role, not allowing complete clarity in the structure of the periods and in the structure and sequence of filling the electronic shells of atoms of chemical elements in the Periodic Table. Therefore, first of all, it is necessary to give an explanation of why formula I allows one to quantify correctly only elements of periods I and II, and the rest are not. Accordingly, it is necessary to explain the presence of the accompanying number of electrons on the electron layers of the atoms of these elements, depending on the period number. Since these issues are closely intertwined and interrelated, the solution of one of them is automatically resolved by the other. Although it should be noted that the correct scientific and theoretical substantiation of the structure, structure and sequence of filling the electronic shells of atoms of chemical elements is a more difficult task. At the same time, the behavior of electrons on the corresponding electron shells depends on a number of factors influencing their behavior, the stronger the farther this shell is from the atomic nucleus. Of course, the primary in this question is apparently the elucidation of the electronic structure of the atoms of the elements, the sequence of its filling. And then a discussion of the justification for the number of chemical elements in the corresponding period.

The very structure of each electron layer separately requires special discussion. At least even at a qualitative level, without regard to quantitative calculations, which are hardly possible at present. Indeed, according to modern chemical concepts, the position of an electron in an atom can be characterized only by the probability of finding it at some point relative to its nucleus. Moreover, this probability is somehow qualitatively associated with the implementation of the Pauli principle for each of the available electrons. That is, the probability of finding an electron in the space around an atom is not arbitrary, but still depends on the set of its quantum numbers, the main of which is the n-principal quantum number. Therefore, it is possible to draw an important conclusion from this that the possible probability of electrons belonging to more than one principal quantum number falling into one and the same point will still differ. Or in other words, electrons having different, different from each other, other quantum numbers should differ, meeting the requirements of these numbers.In other words, it can be assumed that within a single energy level (the main quantum number) in the atom there exists a complex, strictly structured system of electrons corresponding to this level. Being on the same energy level, these electrons differ from each other only by a different set of other quantum numbers and therefore the probability of their being in space relative to the nucleus of an atom should, in principle, differ. Of course, this probability of finding is also affected by the electrostatic interaction between the charges of the electrons themselves, which becomes more complex with the increase in the number of these electrons. But the main thing is still the fact that the probability of finding an electron in space around the nucleus of an atom strictly depends on the relationship of all these factors, of which the primary quantum number is primary, and the rest are secondary.

Thus, based on the above, the need to address these contradictions of the periodic table is long overdue and requires its detailed analysis. This is very important from the teaching and methodological side, since when acquainting students with the properties of the table, they especially need an understanding of the inner meaning of its content and functioning.

In (figure 1) and (Table 1) that there exists a certain sequence in the table. This sequence is that the periods 2 c 3; 4 c 5; 6 c 7 duplicate the amounts of chemical elements contained in them.Such a recurrence in certain intervals allows drawing a conclusion on the existence of common principles in the constitution of electron shells of atoms of these respective periods. In the general case, such a repetition was noted by the American chemist G.N.Lewis who demonstrated that infill of electron shells with electrons is running in successive layers, following the general principles of construction of their electron configurations [7].

According to Lewis and independently of him, who also proposed the general principle of formation of chemical compounds of Kossel [8], the reason for the special stability of electronic configurations is the tendency of atoms of various chemical elements to have eight electrons in the outer electron shell or in inert gases. This aspiration of atoms of elements, called the octet rule, can serve as a qualitative explanation of the structure of the outer electronic layers of elements.Since in reality, the outer electron layers of inert gases have a similar structure to each other, consisting of 2s and 6p electrons. Most likely, at the same time, these external electrons form a complete sphere in the shape of a sphere as a whole, which determines the chemical strength of this configuration. Other possible electrons of this external level (d- and f-electrons) play, apparently, an auxiliary role and are more involved in the formation of the metallic properties of the corresponding elements.Therefore, the periodic dependence of the chemical properties of elements on the similar structure of their electron shells was possible. In any case, the dependence of the structure of the outer electronic layers of the atoms of the elements on the position of these elements in the periods of the periodic table has a deeper meaning, requiring additional explanation.

In the case of the Mendeleev's Table, the key point, in our opinion, is that complete periods comprise 2, 8, 18, and 32 chemical elements each. Therefore, these elements must correspond to the corresponding quantity of electrons on the external electron shells should match them. In such case, the energy states of these electron shells should differ enough from one another, but only on condition, the electron shells contain different quantities of electrons. In case of the equal amount of electrons on the electron shell, we can assume that they relate to an energy level shared for them thus forming sequential two sublayers (sublevels) but within the same a principal quantum number. In other words, unlike widely known conclusions the Mendeleev's table, we assume the option of separation of respective energy levels into two sublevels. Since the principle quantum number corresponds to the period number in the Mendeleev's table, counting the number of electrons on these sublevels has a particular interest to us. To perform such counting of electrons the using of the following new formula is suggested:

$$N= (2n)^2 \quad \text{(II)}$$

where
N – the total number of electrons on the external layer of the respective period;
n – the principle quantum number (period number);
2 – the number of sublevels in a period;
thesquare poweris an empirically fitted number which allowed to perform the total counting of electrons of the respective level.

Equation (II) is easy obtained from the obvious conclusion that the number of electrons in the corresponding outer electron shell is directly proportional to the value of the principal quantum number (n) and is directly proportional to the product of n by the number of sublevels (2) on this electron shell. In this case, the square of the power in equation (II) makes it possible to substantiate the qualitative and, most important, quantitative completeness of this equation.Using equation (II), through division of N by 2 (the number of sublevels), it is easy to calculate the number of electrons at each of the sublevels.

We carried out calculations for various values of n, which yielded the following results represented in (Table 2). Table 2 demonstrates a distinct sequence in the structure of electron shells of the atoms of elements. Particularly, two sublevels with the same numbers of electrons on them belong to each of the energy levels. But most important is that these sublevels sequentially, by the number of electrons on them, correspond to the periods of the Mendeleev's table applied by us. That is also represented in (Table 2).

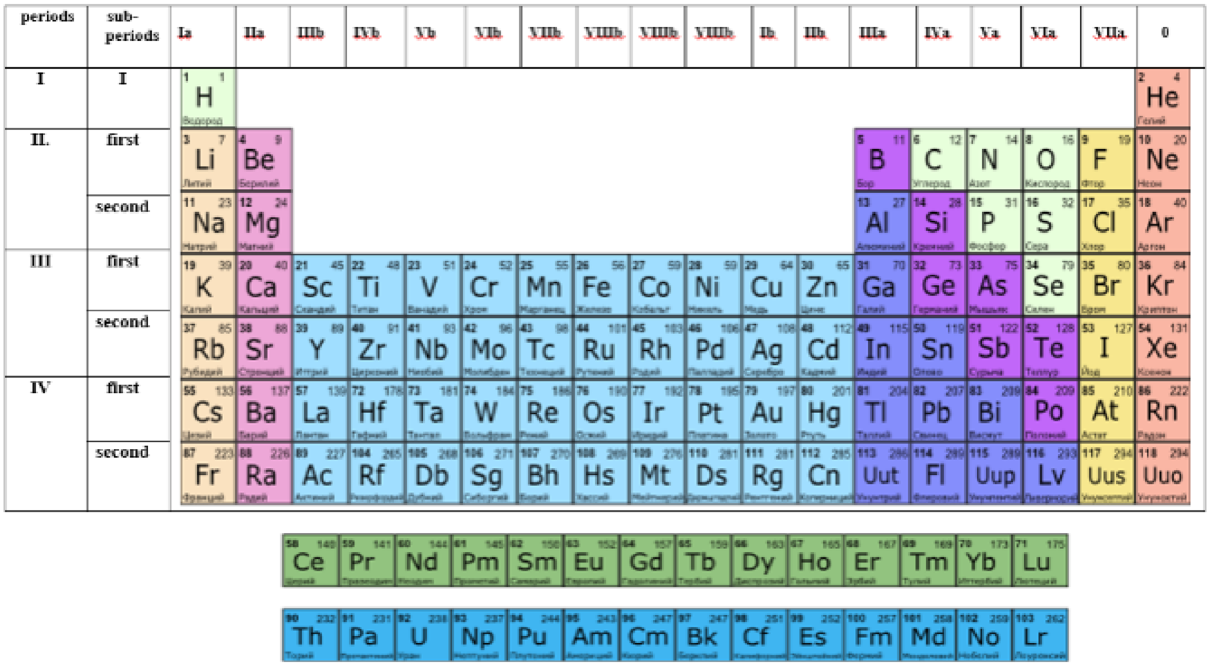
Table 2:- Comparison of the number of electrons in periods, as was calculated with formula II, and concomitant findings.

n	N	The number of electrons on sublevels as calculated with formula (2)	Distribution of elements by the periods of the Mendeleev's table.	Suggested period numbers of the Mendeleev's table
1	2	2 *	2 (I period)	I
2	16	**8**(**first**) **8** (**second**)	**8**(**2** period) **8** (**3** period)	II.
3	36	**18** (**first**) **18** (**second**)	**18** (**4** period) **18** (**5** period)	III
4	64	**32** (**first**) **32** (**second**)	**32** (**6** period) **32** (**7** period	IV
5**	100	**50** (**first**) **50** (**second**)	**50** (**8** period) **50** (**9** period)	V

*- In the first period, there are merely 2 electrons and apparently the filling of the electron layer begins with the second sublayer.
**- Does not exist in nature

Thus, if we assume the possibility of division of energy levels into two sublevels, as is generally adopted by chemical engineers, there arise grounds for qualitative rearrangement of periods in the Mendeleev's table. The major ground for that can be the rule an infill of electron shells should run sequentially, following the general principles of building their electron configurations [6,7].

The main rationale for this can be the requirement that the filling of the electron shells should proceed sequentially, in compliance with the general principles for constructing their electronic configurations. Numbers of periods, as that should be, need to be equated to the value of the principal quantum number n and to the correspondence with other calculations represented in (Table 2).



periods	sub-periods	Ia	IIa	IIIb	IVb	Vb	VIb	VIIb	VIIIb	VIIIb	VIIIb	Ib	IIb	IIIa	IVa	Va	VIa	VIIa	0
I	I	1 1 H																	2 4 He
II.	first	3 7 Li	4 9 Be											5 11 B	6 12 C	7 14 N	8 16 O	9 19 F	10 20 Ne
	second	11 23 Na	12 24 Mg											13 27 Al	14 28 Si	15 31 P	16 32 S	17 35 Cl	18 40 Ar
III	first	19 39 K	20 40 Ca	21 45 Sc	22 48 Ti	23 51 V	24 52 Cr	25 55 Mn	26 56 Fe	27 59 Co	28 59 Ni	29 64 Cu	30 65 Zn	31 70 Ga	32 73 Ge	33 75 As	34 79 Se	35 80 Br	36 84 Kr
	second	37 85 Rb	38 88 Sr	39 89 Y	40 91 Zr	41 93 Nb	42 96 Mo	43 98 Tc	44 101 Ru	45 103 Rh	46 106 Pd	47 108 Ag	48 112 Cd	49 115 In	50 119 Sn	51 122 Sb	52 128 Te	53 127 I	54 131 Xe
IV	first	55 133 Cs	56 137 Ba	57 139 La	72 178 Hf	73 181 Ta	74 184 W	75 186 Re	76 190 Os	77 192 Ir	78 195 Pt	79 197 Au	80 201 Hg	81 204 Tl	82 207 Pb	83 209 Bi	84 209 Po	85 210 At	86 222 Rn
	second	87 223 Fr	88 226 Ra	89 227 Ac	104 265 Rf	105 268 Db	106 271 Sg	107 270 Bh	108 269 Hs	109 276 Mt	110 281 Ds	111 281 Rg	112 285 Cn	113 286 Uut	114 289 Fl	115 289 Uup	116 293 Lv	117 294 Uus	118 294 Uuo

58 140 Ce	59 141 Pr	60 144 Nd	61 145 Pm	62 150 Sm	63 152 Eu	64 157 Gd	65 159 Tb	66 163 Dy	67 165 Ho	68 167 Er	69 169 Tm	70 173 Yb	71 175 Lu

90 232 Th	91 231 Pa	92 238 U	93 237 Np	94 244 Pu	95 243 Am	96 247 Cm	97 247 Bk	98 251 Cf	99 252 Es	100 257 Fm	101 258 Md	102 259 No	103 262 Lr

Figure 2:- The reconfigured long version of the Mendeleev's table.

Then the Mendeleev's table will take the form shown in (figure 2).

Since sublevels with the same number of electrons are close among one another by their electron structure, they should be distinguished depending on the sequence of the infill of their electron sublayers. To that end, the words (first) or (second) should be inserted into their electron formula befor the respective sublevel. Thus, we introduce two new provisionally named quantum states for electronic layers of all the periods except the first. For instance, for Boron the electron formula will take the following form: B-$1s^2$ first$2s^22p^1$, and for Silicon: Si- $1s^2$first$2s^22p^6$ second $2s^22p^2$ and so on.

In general, the listed additions into the Mendeleev's table shown in (figure 2) should be better examined in the example of a long version of this table. The suggested innovations are distinctly seen in that version. In particular, the order of infill of the respective periods of the table with electrons becomes clear. At the same time, for instance, infill of the second period will be running sequentially for similar first and second sublevels containing 2s and 6p electrons each. In the Mendeleev's table, these sublevels were independent (2 and 3 periods) and for that reason, there was no proper explanation to the absence of 3d electrons in third period and presence of 3d electrons in the electron formulas of elements of 4th period of the classical Mendeleev's table. Merging of the 4 and 5 periods of the traditional Mendeleev's table into one common 3 period, as per our suggestion, allows correcting that issue and bringing the sequence of infill of the electron shells of atoms of that suggested period into a proper order of priorityIn both subperiods of the period, the sequence of infill will be similar and consecutive first$3s^23d^{10}3p^6$ and second $3s^23d^{10}3p^6$. In our opinion, precisely the same will occur during the merging of 6 and 7 periods of the existing system into one common 4 period. But in that case we will have to take the existence of f electrons into account. However, that will in no way affect the order of priority and sequence of infill of the period subperiods with electrons.

The additions to the Mendeleev's table suggested by us also make it possible to draw a conclusion on the sequence of infill of electron orbitals of element atoms. As far as one can see, and as follows from (figure 2), infill of the electron shells starts with s-orbitals, then (except the elements of 2 period) the d and f orbitals are filled, and only p orbitals are filled at the end. Such an order of infill is quite logical since all the major distinctive chemical properties of metals and non-metals are generally related just to the electrons of s, p orbitals. As regards the d and f orbitals, the chemical properties of most metals which take a special place in the periodic table (figure 2) relate to these orbitals.

At a qualitative level, the number of electrons in the outer electron shell of the atoms of the elements, calculated from the leveling (II), can also help comparing the rotational moments of electrons in different electron orbits. That is, having the corresponding different principal quantum numbers.

In accordance with the first postulate of the theory of Bohr, there are certain orbits in which an electron can rotate without loss of energy and, as a consequence, without emitting light. According to Bohr and such orbits, such orbits are those for which the torque is equal to an integer multiple of h / 2π. Where, h is the constant "Plank's quantum of action". Therefore, this postulate formulates the first quantum Bohr condition [9]:

$$P = n\frac{h}{2\pi} \quad \text{(III)}$$

Here: P is the angular momentum, and n is the quantum number of the electron orbit. From equation (III) it follows that the moment of rotation of an electron in different orbits depends only on the quantum number of the electron orbit, since the ratio h / 2π is always a constant.

But these arguments were proposed by Bohr for the hydrogen atom, although the corresponding behavior of electrons in many-electron atoms of elements is no less interesting. Therefore, taking the cumulative conclusions and suggestions of Bohr, Lewis, Kossel and others as a basis, it is generally possible to assume that the electron shell of atoms having a repeated layered structure is nevertheless closer in its main feature to the spherical spherical shape. Then, with a sufficient degree of approximation, we use the formula for determining the surface area of a ball

$$S = 4\pi r^2 \qquad \text{(IV)}$$

we can calculate the hypothetical surface areas of the outer electronic layers of the atoms of the elements at the corresponding periods of the periodic table. These calculations are shown in Table III, where, for comparison, the quotient separation of these areas of the surfaces of the corresponding electronic subshells by the numbers of electrons on these subshells, calculated according to the first proposed formula (II) and the data of Figure 2, is also given.

Period	$S = 4\pi r^2$	S/n (number of electrons) relation to number π
I	$4 \cdot 3{,}14 \cdot 1^2 = 12{,}56$	12,56/2=6,28 2π
II	$4 \cdot 3{,}14 \cdot 2^2 = 50{,}24$	50,24/8=6,28 2π
III	$4 \cdot 3{,}14 \cdot 3^2 = 113{,}04$	113,04/18=6,28 2π
IV	$4 \cdot 3{,}14 \cdot 4^2 = 200{,}96$	200,96/32=6,28 2π

Table III:- Calculation data for the conditional hypothetical areas of the surfaces of the outer electron shells and their comparison with the corresponding number of these electrons.

From the data of Table III, we can assume a very important conclusion that the rotational moment noted in the first quantum condition of Bohr or h / 2π also retains its importance for electron orbits with a higher quantum number. This can be seen from the result of dividing the conditional hypothetical areas of the surfaces of the corresponding electron shells by the number of electrons on them. The quotient of this division for all π is 2π. This indirectly can confirm the sequence of similarity of the moments of rotation for electrons belonging to different electron shells.Since the value of 2π is their component in a constant factor of equation (III). In principle, this expands the possible implementation of the first postulate and can serve to explain the behavior of electrons in external electron shells and in other atoms of chemical elements. In other words, the partial separation of the total (conditional) surface and corresponding electron shells by the number of electrons on this shell, equal to 2π for all cases, can serve as evidence of the similarity in the behavior of electrons for the existing hypotheses of their behavior.

Therefore, all the above allows highlighting the following points:
- a new order of building the periods of the Mendeleev's table has been suggested on the base of changing the structure of the periods;
- into the periods, except the first one, two subsequent periods from the existing Mendeleev's table have been merged as subperiods. To differentiate subperiods, designations of their quantum states as first and second have been suggested.

As a result, the numbers of periods are reduced to four. Introduction of the first and second subperiods allows meeting the requirement of the Pauli exclusion principle in new conditions. At the same time, the principle quantum number of the chemical elements of a period, which characterizes the energy of electron shell, remains unchanged, but the suggested quantum states of sublevels denoted as first and second do change. So, the provision stating that electrons can be inside the atom at strictly admitted orbits holds and is complemented by introduction of the notion "quantum state of a sublevel" to the already existing ones. Then the order of formation of electron layers will be as follows: the principle quantum number (n), followed by the quantum state of a subperiod (first or second) in a period, and then all the remaining quantum orbitals;

Under the definition of a quantum state of sublevels, we propose to adopt an additional quantum characteristic for the behavior of an electron, together with other quantum numbers, describing the probability of its finding relative to the atomic nucleus of a chemical element. An introduction to the theory and practice of the chemistry of these quantum states makes it possible to more clearly structure the description of the electronic structure of elements.They are another indirect confirmation of the disparity of the existing set of quantum numbers available to describe the behavior of electrons in an atom. At the same time, they allow us to relate to each other: the main quantum number; other quantum numbers; the number of periods in the periodic table; the number of chemical elements in the periods and the structure of their outer electron shells.

The "quantum state" expression which is suggested for designating of two sequentially infilled sublevels in each of the newly viewed periods where the configuration of electron subshell corresponding thereto is retained and duplicated.

The introduction of new quantum states "first" and "second" into circulation is consistent with some of the suggestions outlined in the work of B.F. Makhov. [10] In it, on the basis of the Symmetric Quantum Periodic System of Neutral Atoms (CK – PSA) developed by the author, a partial mathematical expression of the Periodic Law of Mendeleev is proposed. At the same time, its new formulation looks like this: "characteristics of neutral atoms of elements are in periodic dependence on the magnitude of the intensity (α Z) of the alternating electromagnetic field (EMF) created by their nuclei”.That is, instead of the magnitude of the electric charge of the atomic nucleus (e Z), the magnitude of the intensity (e Z) is used, which is included in the α-constant fine structure. In quantum electrodynamics, the “effect” of electromagnetic interaction is characteristic [11].

Calculation of equations of communication, quantum numbers, taking into account the rules of V.M. Klechkovsky [12] and D.N. Trifonov [13], identified two bundles of quantum numbers. One of which is periods in (SC-PSA) (they are all paired and form dyads), and the other horizontal group is a series of consecutive atoms, up to 4 in a period, representing sequences of f-, d-, p- and s- elements.In other words, these bundles allow for the presence of several quantum states at a single quantum energy level. And also, in general, the sequence of locations of the above mentioned horizontal rows contained in the periods is determined.

In our opinion, the calculations presented in [14] have a certain value, especially in the field of the individual quantum states implying the existence at the quantum level. But the author was somewhat carried away by the mathematical model, not comparing it directly with the periodic table itself. But the table is a graphic representation of the periodic law of Mendeleev.And with such a comparison, the shortcomings and improvements of the proposed mathematical model immediately appear, since they do not give an opportunity to properly characterize the features of the table itself. But for the changes we propose in the article, the main conclusion of this model, the possibility of the existence of separate quantum states, is quite sufficient. What we offer in the form of "first" and "second" quantum states.

When discussing, tetrahedral numbers (Zm = 0; 4; 20; 56; 120) indirectly associated with some minimum quantum energy levels for a dyad may also be useful, so-called by the author. The tetrahedron of the medium of other spatial bodies has a minimum surface area with a fixed volume. These tetrahedral numbers correspond in the periodic table to the chemical elements: Be, Ca, Ba. That is, the elements after which, in our opinion, the subsequent elements begin filling in a new layer of electronic orbitals (respectively, s-, p, d- and f-).

It is worth noting that the layered in the energy and, most importantly, structurally electronic structure of the atoms of the elements is confirmed by the structure of their X-ray spectra. Opened in 1913 by GD Mosley's law [15] linked the purity of the lines of the characteristic X-ray spectra of chemical elements with their sequence number in the periodic system. And the basic laws of this connection were then interpreted by Kossel in 1914 [8]. Although here it is necessary to distinguish and remember that the nuclear charge or serial number is an atomic constant, and the periodically changing properties of the elements are associated with the electron shells of the atoms.

Mosley found that when moving from one chemical element to another, the frequency of X-ray radiation will increase in order in exactly the same way as the number of the element will increase. But Mosley and other researchers did not explain the nature of the sequence of filling the electron shells of the atoms of the elements, focusing only on the nature of the X-ray radiation itself. Although the law of Mosley just confirms the strict sequence and sequence in filling the electron shells of atoms.For example, a comparison of the spectra and chemical properties of alkali metals shows that each subsequent alkali metal has a new level of electron energy. And this level of energy exceeds the level of the previous inert gas in a new qualitative state. This knowledge made it possible to discover new chemical elements of hafnium (1922) [16] and rhenium (1925) [17], only on the basis of their characteristic x-ray radiation, in the presence of foreign elements accompanying them in nature. Therefore, according to each configuration of inert gas in chemistry, certain energy levels are identified for: helium — K level, neon — L; argon - M; Krypton - N; xenon - o and radon - p level.

But the main thing for us is the Mosley law confirms the strict sequence of filling the electronic orbitals of the elements in periods proposed by us. First, s-, then d-, f- and only then p-elements.

It should be also added that formula (II) and the changed Mendeleev’s table (figure 2) allows counting the hypothetic quantities of g-orbitals and electrons of the V period. (Table 2) represents the number of electrons (50) at each of the hypothetic sublevels of that period. And since the s, d, f- and p-orbitals have 32 electrons in the total, then the difference in 18 electrons makes the total number of electrons at the respective 9 g-orbitals.

Conclusion:-

Thus, in this article:

- new quantum states and a new formula for counting the number of electrons on the external electron shell of the elements of periods and subperiods has been put forward;
- it has been revealed that at the start of all the periods of the modified table there occurs infilling of S-orbitals, then p-orbitals in the 2 period, since d and f orbitals are not there in this period. However, in the 3 and 4 periods there the d and f orbitals are infilled at first, and only after that - the respective p-orbitals are infilled. At the same time, in all the cases the sequence of infilling of orbitals occurs in a strict order.
- it is shown that the order of filling the outer electron orbitals of the atoms of elements by electrons corresponds to the order of the sequence of finding elements in the periodic system, calculated according to the Mosley law.
- as a result, the performed calculations and reconfigurations made it possible to strictly structures and synchronize the sequences of infilling the electron shells of atoms in chemical elements with their locations in the changed Mendeleev's table.

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