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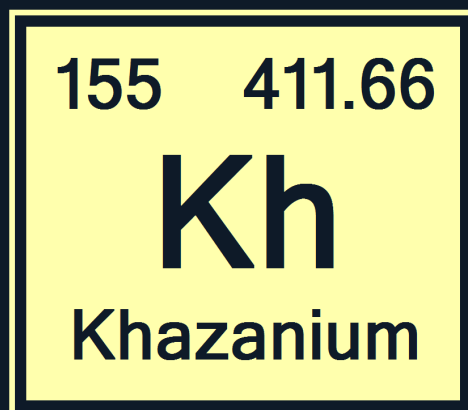
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# Upper Limit in Mendeleev's Periodic Table

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## Element No.155

by Albert Khazan



Third Edition — 2012

AMERICAN RESEARCH PRESS

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ALBERT KHAZAN

Upper Limit  
in Mendeleev's Periodic Table  
— Element No.155

Third Edition  
with some recent amendments  
contained in new chapters

Edited and prefaced by  
DMITRI RABOUNSKI  
Editor-in-Chief  
of Progress in Physics and  
The Abraham Zelmanov Journal

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Rehoboth, New Mexico, USA  
— 2012 —

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Powered by BaKoMa-T<sub>E</sub>X.

ISBN 978-1-59973-265-7

American Research Press, Box 141, Rehoboth, NM 87322, USA  
Standard Address Number: 297-5092  
Printed in the United States of America

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## Foreword of the Editor

Commencing in 1869, when Dmitri Mendeleev first announced his Periodic Table of Elements, many scientists were puzzled with the question: is there a natural end of the Periodic Table, or it may continue with more and more heavy elements? To answer this question, most scientists call for Quantum Mechanics. According to the up-to-date concept of modern physics, stability of both atomic nuclei and the atoms is determined by the quantum mechanical laws. Concerning the instable (super-heavy) elements, which occupy the end of the Periodic Table, this means follows: the more nucleons consist a super-heavy nucleus, the shorter is its lifespan. Reasoning in this way, the theorists conclude, very right, that there should be an upper limit of the atomic mass, exceeding whom the nucleus cannot exist. In other word, there should be a last (ultimate heavy) element of the Periodic Table which ends the Table. On the other hand, the quantum mechanical laws being based on probability do not point out such a boundary, but merely decrease the probability with the increasing atomic mass. So, Quantum Mechanics does not say something definite on the upper limit of the Periodic Table, and the last element.

In this background, the research suggested in this book seems much, much more profitly. Dr. Albert Khazan, who conducts this research from already 1965 until the present day, followed in absolutely another way than that based on the terms of stability of the elements. He created graphical dependencies between particular characteristics of the elements (such as their atomic mass, contents, etc.), then immediately found that the arcs have the form of hyperbolas. He suggested to refer to it as the “law of hyperbolas in the Periodic Table of Elements”. After that, he studied how the hyperbolas behave with the increase of the atomic mass. This led him to the fundamental discovery: tops of the hyperbolas, created for both known elements and hypothetical super-heavy elements approach an ultimate hyperbola which corresponds to an element whose number is 155, while atomic mass is 411.66. This means that there is not heavier elements than element 155, which thus ends the Periodic Table. As a result, Dr. Khazan suggested a new version of the Periodic Table, which is corrected in the region of super-heavy elements, and includes element 155.

I therefore very support the suggestion, which first appeared years

ago among the scientific community: to refer further to element 155 as “Khazanium”, after its predictor Dr. Albert Khazan.

What other profit than theory can be found due to this study? First, we now can be sure that the “nuclear snooker” by whom the experimentalists synthesize super-heavy elements (they recently discovered element 118) has its natural end in element 155. No more elements will be possible in the nature. This is true concerning the elements consisting the Periodic Table — the regular proton-neutron nuclei surrounded with the electronic shells (we now have no idea about other forms of elementary atomic substance).

Second, due to the hyperbolic law discovered in the Periodic Table, we can further calculate exact theoretical values of the particular characteristics of the elements. They may differ from the approximate numbers, obtained experimentally and contained in the cells of the Periodic Table. In other word, we can update the current version of the Periodic Table with more precise numerical data, thus giving profit to commercial production of chemical compounds (especially — in the part of the rare-earth and heavy elements, see the book for detail).

With these I am pleased to present this book, whose author — Dr. Albert Khazan — is very known to me due to the years on friendly acquaintance.

April 9, 2012

*Dmitri Rabounski*



## Preface to the 1st Edition

The main idea behind this book is that Mendeleev's Periodic Table of Elements is not infinitely continuous when it comes to super-heavy elements, but it has an upper limit (a heaviest element). This upper limit has theoretically been discovered during my many years of research, produced on the basis of a hyperbolic law found in the Periodic Table. According to the hyperbolic law, the content of an element in different chemical compounds (per one gram-atom of the element) can be described by the equation of an equilateral hyperbola. This statement is true throughout the Periodic Table, for both known chemical elements and still unknown ones (their molecular masses are, so far, only theoretical). This statement is very certain, because the hyperbola can be created for any set of numbers connected by the equation.

Proceeding from this statement, and on the basis of the common properties of equilateral hyperbolas, I have obtained a single real line which connects the peaks of the hyperbolas. This line intersects with  $Y = 1$  in a point, whose coordinate meets the peak of the atomic mass allowed for the hyperbolas, is an actual upper limit of the Periodic Table (with atomic mass 411.66). While looking at this upper point, Lagrange's theorem has been used. Also, auxiliary research on the calculation of the scale coefficients has been made. All these have led to the aforementioned result.

While doing this research, I kept in mind that a subjective element might be present. Therefore, I was also looking for other data, in verification of the upper limit. Such data were found. As a result of my auxiliary research, the element Rhodium has been analyzed in the Periodic Table: for this element, the hyperbola's peak draws atomic mass twice, and meets the  $Y = 1$  line which crosses the real axis at a point wherein  $X = 411.622$ . This result deviates from the aforementioned calculation of the upper limit in only several thousandth of the share of the percent. Hence, all previous theoretical considerations about the upper limit have become verified, and the heaviest element with atomic mass 411.622 has number 155 in the Periodic Table. Besides, this fact allows for the use of the heaviest element as a reference point in nuclear reactions during the synthesis of super-heavy elements.

Because these studies have been made in the first quadrant, for the positive branches of hyperbolas, I have turned my attention to a possibility to check all these in the remaining quadrants. As a result, the

hyperbolic law has been successfully verified in only the second quadrant, which is absolutely symmetric with respect to the first one. This result has led me to a conclusion that, given negative atomic and molecular masses, and positive values of  $Y$ , the second quadrant is inhabited by anti-elements consisting of anti-substance.

All the aforementioned results have originated during my 40 years of research on chlorides of several refractory metals, e.g. Wolfram, which, being multivalent compounds, needed special equipment and technology for separation in their condensation. The obtained sublimants contained, in part, a mix of chlorides which were a source for extraction of the elements of the metal under study. Then, the obtained elements of the metal were compared to a calculated curve. As I discovered later, this research method is true along all the elements of the Periodic Table.

In 1971, I obtained a PhD degree on the chloride compounds of Wolfram and those of the other rare refractory metals. Further development of the theory, which involved finding proofs, required many years of research. Meanwhile, it was successful. My first report on the upper limit of the Periodic Table of Elements appeared in 2005 on the internet. Then numerous publications were subsequently made in newspapers, by interested reporters who specialized in the science news column. In 2007–2009, the American scientific journal *Progress in Physics* published a series of my scientific papers wherein I gave the presentation of my results on the hyperbolic law in the Periodic Table, and the upper limit (heaviest element) in it, in all necessary detail. Besides, many presentations have been given by me at meetings of the American Physical Society (see Appendix A).

I should emphasize the rôle of Dmitri Rabounski, the Editor-in-Chief of *Progress in Physics*, who invited me for publication. I am thankful to him for his editorial and friendly assistance, and also for the enlightening discussions.

At the end of this Preface, I would like to express my heartfelt gratitude to my wife Ludmila, my son Leonid, and his wife Oxana, who continuously supported me while undertaking the research, and who are still taking care of me. I will keep all enthusiasts of this book, and their friendly participation in the discussion of the obtained results, in my hearth.

My hope is that this book, which is a result of many sleepless nights, will pave a new road for the future of fundamental science.

New York, February, 2009

*Albert Khazan*

## Preface to the 3rd Edition

Despite much success and achievements of the synthesis for super-heavy elements (10 new elements were obtained during the last 25 years), neither the physicists nor the chemists, the experts in Mendeleev's Periodic Table of Elements, answered the most important fundamental question: is the Table of Elements bounded and, if yes, where it ends?

The complicate calculations produced, by the most theorists, on the basis of Quantum Mechanics, have not answered this question till now. The mathematical methods of Quantum Mechanics are based on the physical conditions which regulate substance in micro-scales. Therefore, I turned my attention to the physical conditions observed in macro-scales, which are the subjects of study of the regular physics and chemistry. Thus, after the decades of my studying the physics and chemistry of chemical reactions, produced on many chemical compounds, the Law of Hyperboles was discovered in the Periodic Table of Elements. The essence of the hyperbolic law is as follows. Given any chemical compound, the contents of any element in it (per 1 gram-atom), including the contents of even unknown elements, whose atomic masses can be set up arbitrarily, is described by the equation of an equilateral hyperbola  $Y = K/X$ . The tops of all the arcs are distributed along a real axis crossing the line  $Y = 1$  in the point of abscissa 411.66, which manifests the actual atomic mass of the last (heaviest) element of the Periodic Table. Thus, the number of the last element, 155, was calculated. To get the result, in the first stage, Lagrange's theorem was used, and the scaling coefficient for matching different coordinate systems was calculated.

Because the aim to get a truly scientific result, verified by independent data, I produced some additional studies of the discovered hyperbolic law. Thus, the adjacent hyperbolas of the fraction-linear functions in the Periodic Table, which play an important rôle in the hyperbolic law, were studied. Proceeding from the additional studies, it was found that only the element Rhodium has atomic mass connected to the last element's atomic mass. The found dependencies allowed to be sure in the independent verification of the hyperbolic law, with deviations from it to within only several thousandth of the share of one percent. I also showed that the hyperbolic law and the last element play an important rôle in physics and chemistry. In particular, they are useful in the synthesis of new super-heavy elements, in the determination of the

numbers of isotopes in the periods of the Periodic Table, and also in the foundations of the existence of anti-elements and anti-substances in general.

Thus, on the basis of that has been found in the studies, and first commencing in the moment when the Periodic Table of Elements was invented in 1869, I was able to give a clear answer to the question about the upper limit of the Periodic Table: there is the last (heaviest) element, whose location is Period 8, Group 1; its atomic mass is 411.66, its number is 155.

As a result, the Periodic Table has reached a complete form, where all elements of Period 8 occupy their seats, according to their numbers and atomic masses.

Already 40 years ago some scientists claimed that elements whose numbers are higher than 110 are impossible. The experimental technics got much progress during the decades, so element 118 was registered. Now, with the results presented here, the theoretical physicists can make new developments in the theory of atomic nuclei and electronic shells proceeding from the common number of elements, which is 155.

New York, March, 2012

*Albert Khazan*

## Chapter 1

# Upper Limit in the Periodic Table of Elements

### §1.1 Introduction. Mathematical basis

The periodic dependence of the properties of the elements on their atomic mass, as discovered by D. I. Mendeleev in 1869, predicted new elements in appropriate locations in the Periodic Table of Elements.

Progress in synthesis and in the study of the properties of the far transuranium elements has increased interest in the question of the upper limits of the Periodic Table. G. T. Seaborg, J. L. Bloom and V. I. Goldanskii emphasized that the charge of the atomic nucleus and the position occupied by the element “define unambiguously the structure of electron jackets of its atoms and characterize the whole set of its chemical properties”. They suggested the existence of nuclei containing 114, 126 and 164 protons, 184, and 258 neutrons and the Table arrangement of the relevant elements [1, 2].

The objective of this study is to determine the possible number of chemical elements, along with atomic masses and atomic numbers upto the final entry in the Periodic Table.

The calculations were performed on the basis of IUPAC [3] table data for all known elements. The basic principle resides in the idea that the proportion of the defined element  $Y$  in any chemical compound of molecular mass  $X$  should be related to its single gram-atom. In this case, if  $K$  is the atomic mass, the equation  $Y = K/X$  would represent a rectangular hyperbola in the first quadrant ( $K > 0$ ). Its asymptotes conform to the axis coordinates, and semi-axis  $a = b = \sqrt{2|K|}$ . The peak of the curve should occur on the virtual axis inclined at an angle of  $45^\circ$  to the positive direction of the abscissa axis. The necessary conditions associated with this chemical conception are:  $Y \leq 1$  and  $K \leq X$ .

The foregoing equation differs only in the atomic mass for each element of the Periodic Table and allows calculation of the proportion of the element in any compound. Accuracy plotting the curve and the associated straight line in the logarithmic coordinates depends on the size of the steps in the denominator values, which can be entirely random but

must be on the relevant hyperbola in terms of  $X$ . Consequently, it can be computed without difficulty by prescribing any value of the numerator and denominator. In Table 1.1a are given both known Oxygen containing compounds and random data on  $X$  arranged in the order of increasing molecular mass. Fig. 1.1 depicts the hyperbola (the value of the approximation certainty  $R^2 = 1$ ), calculated for 1 gram-atom of Oxygen.

Estimation of the unobserved content in the chemical compound as determined by the formula is expressed on the plot by the polygonal line (Table 1.1b, Fig. 1.1). It is obvious from the Fig. 1.2 that the hyperbolic function of the elemental proportion in chemical compounds plotted against molecular mass, by the example of the 2nd Group, is true ( $R^2 = 1$ ). In the logarithmic coordinates (Fig. 1.3) it is represented as the straight lines arranged in the fourth quadrant (to the right of Hydrogen) all with slope 1. With the view to expansion of the basis of the arguments, this example is given for the 1st Group including "Roentgenium" No. 111, a more recently identified element, and the predicted No. 119 and No. 155. The real axis is shown here, on which the peaks of all hyperbolas of the Periodic Table are arranged (see below).

## §1.2 Using the theorem of Lagrange

It is clear from the Fig. 1.2 that with the rise of the atomic mass the curvature of the hyperbola decreases (the radius of curvature increases), and the possibility to define its peak, for example, by means of graphical differentiation, becomes a problem due to errors of both subjective and objective character (instrument, vision and so on). Therefore, to estimate the curve peak of the hyperbola the mathematical method of the theorem of Lagrange was used [4].

For example, the coordinates of the peak for Beryllium are as follows:  $X = 60.9097$ ,  $Y = 0.14796$ , the normal equation is  $Y = 0.0024292X$ . Taking into consideration that the semiaxis of the rectangular hyperbola  $a = b = \sqrt{2|K|}$ , the coordinates of the point  $X_0 = Y_0 = \sqrt{K}$ .

Let us examine this fact in relation to elements with the following atomic masses ( $K$ ): Beryllium Be (9.0122), random Z (20), Chromium Cr (51.9961), Mercury Hg (200.59), No. 126 (310), random ZZ (380), No. 164 (422), random ZZZ (484). In this case  $X_0 = Y_0 = \sqrt{K}$ , and correspondingly, 3.00203, 4.472136, 7.210825, 14.16298, 17.606817, 19.493589, 20.54264, 22.

The obtained values are the coordinates of the rectangular hyperbola peaks ( $X_0 = Y_0$ ), arranged along the virtual axis, the equation of which is  $Y = X$  (because  $\tan \alpha = 1$ ).

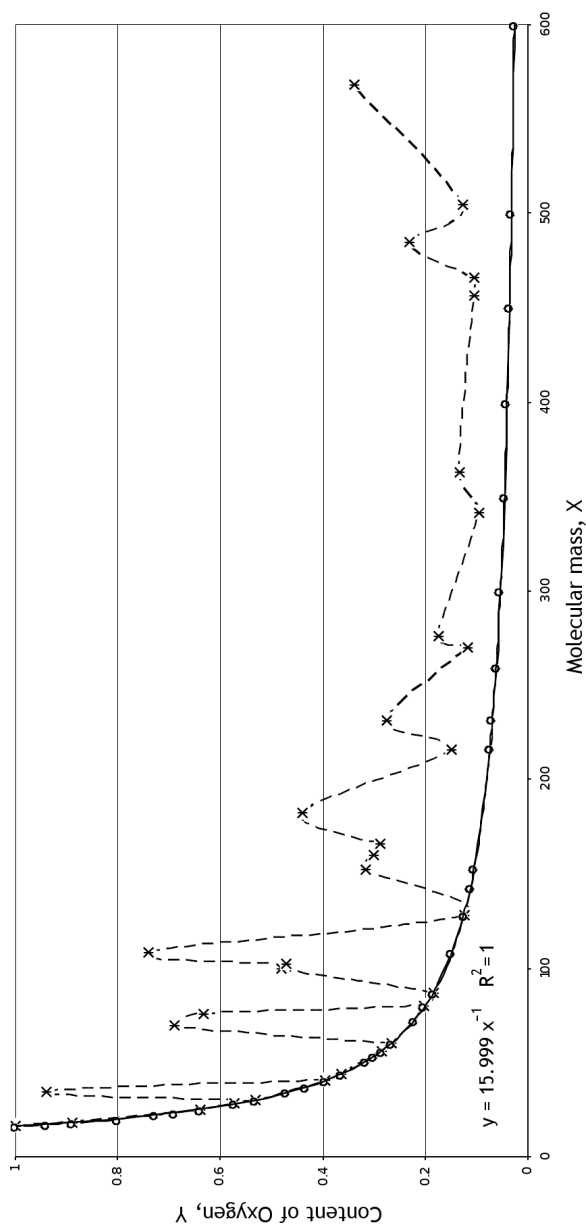


Fig. 1.1: Oxygen content versus the molecular mass of compounds on estimation to 1 gram-atom (hyperbola  $y = k/x$ ) and the total amount of O (maxima, leaders). The molecular mass in the table is given according to its increase.

$K$	$X$	$Y = \frac{K}{X}$	$\ln X$	$\ln Y$	Compound	Compound	$X$	$Y = n \frac{K}{X}$
15.9994	15.999	1	2.77255	0	O	O	15.9994	1
15.9994	17.007	0.9408	2.83363	-0.0611	$\frac{1}{2}\text{H}_2\text{O}_2$	$\text{H}_2\text{O}$	18.015	0.88811546
15.9994	18.015	0.8881	2.8912	-0.1187	$\text{H}_2\text{O}$	$\text{BeO}$	25.01	0.63972011
15.9994	20	0.8	2.99573	-0.2232	—	$\text{CO}$	28.01	0.57120314
15.9994	22	0.7272	3.09104	-0.3185	—	$\text{NO}$	30.006	0.53320669
15.9994	23.206	0.6895	3.14441	-0.3719	$\frac{1}{3}\text{B}_2\text{O}_3$	$\text{H}_2\text{O}_2$	34.01	0.94089974
15.9994	25.01	0.6397	3.21928	-0.4467	$\text{BeO}$	$\text{MgO}$	40.304	0.39698293
15.9994	28.01	0.5712	3.33256	-0.56	$\text{CO}$	$\text{N}_2\text{O}$	44.012	0.36353722
15.9994	30.006	0.5332	3.4014	-0.6288	$\text{NO}$	$\text{CaO}$	56.077	0.28532197
15.9994	33.987	0.4708	3.52598	-0.7534	$\frac{1}{3}\text{Al}_2\text{O}_3$	$\text{COS}$	60.075	0.26633375
15.9994	37	0.4324	3.61092	-0.8384	—	$\text{B}_2\text{O}_3$	69.618	0.68947686
15.9994	40.304	0.397	3.69645	-0.9239	$\text{MgO}$	$\text{N}_2\text{O}_3$	76.01	0.63149586
15.9994	44.012	0.3635	3.78446	-1.0119	$\text{N}_2\text{O}$	$\text{CuO}$	79.545	0.20114401
15.9994	50.663	0.3158	3.9252	-1.1526	$\frac{1}{3}\text{Cr}_2\text{O}_3$	$\text{Cl}_2\text{O}$	86.905	0.18410908
15.9994	53.229	0.3006	3.9746	-1.2021	$\frac{1}{3}\text{Fe}_2\text{O}_3$	$\text{CrO}_3$	99.993	0.4800336
15.9994	56.077	0.2853	4.02673	-1.2542	$\text{CaO}$	$\text{Al}_2\text{O}_3$	101.96	0.47077285
15.9994	60.075	0.2663	4.09559	-1.323	$\text{COS}$	$\text{N}_2\text{O}_5$	108.008	0.74068588



$K$	$X$	$Y = \frac{K}{X}$	$\ln X$	$\ln Y$	Compound	Compound	$X$	$Y = n \frac{K}{X}$
15.9994	71.844	0.2227	4.2745	-1.5019	FeO	CdO	128.41	0.12460089
15.9994	79.545	0.2011	4.37632	-1.6038	CuO	Cr <sub>2</sub> O <sub>3</sub>	151.99	0.31581025
15.9994	86.905	0.1841	4.46482	-1.6923	Cl <sub>2</sub> O	Fe <sub>2</sub> O <sub>3</sub>	159.687	0.30058803
15.9994	108.6	0.1473	4.6877	-1.9151	$\frac{1}{3}$ La <sub>2</sub> O <sub>3</sub>	Co <sub>2</sub> O <sub>3</sub>	165.86	0.2894007
15.9994	128.41	0.1246	4.85523	-2.0827	CdO	V <sub>2</sub> O <sub>5</sub>	181.88	0.43985045
15.9994	143.09	0.1118	4.96348	-2.1909	Cu <sub>2</sub> O	WO <sub>2</sub>	215.84	0.14825797
15.9994	153.33	0.1043	5.03257	-2.26	BaO	Fe <sub>3</sub> O <sub>4</sub>	231.53	0.27642206
15.9994	216.59	0.0739	5.37801	-2.6055	HgO	UO <sub>2</sub>	270.027	0.11850667
15.9994	231.74	0.069	5.44562	-2.6731	Ag <sub>2</sub> O	Ag <sub>2</sub> CO <sub>3</sub>	275.75	0.174064
15.9994	260	0.0615	5.56068	-2.7881	—	UO <sub>2</sub> Cl <sub>2</sub>	340.94	0.0938546
15.9994	300	0.0533	5.70378	-2.9312	—	Gd <sub>2</sub> O <sub>3</sub>	362.5	0.132409
15.9994	350	0.0457	5.85793	-3.0854	—	Tl <sub>2</sub> O <sub>3</sub>	456.764	0.10508709
15.9994	400	0.04	5.99146	-3.2189	—	Bi <sub>2</sub> O <sub>3</sub>	465.96	0.103009
15.9994	450	0.0356	6.10925	-3.3367	—	Re <sub>2</sub> O <sub>7</sub>	484.4	0.231205
15.9994	500	0.032	6.21461	-3.4421	—	Tl <sub>2</sub> SO <sub>4</sub>	504.8	0.1267781
15.9994	600	0.0267	6.39693	-3.6244	—	Ce <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>	568.43	0.33776

Table 1.1: Content of Oxygen  $Y$  in compounds  $X$  per gram-atom (Table 1.1a) left and summarized O (Table 1.1b) on the right.

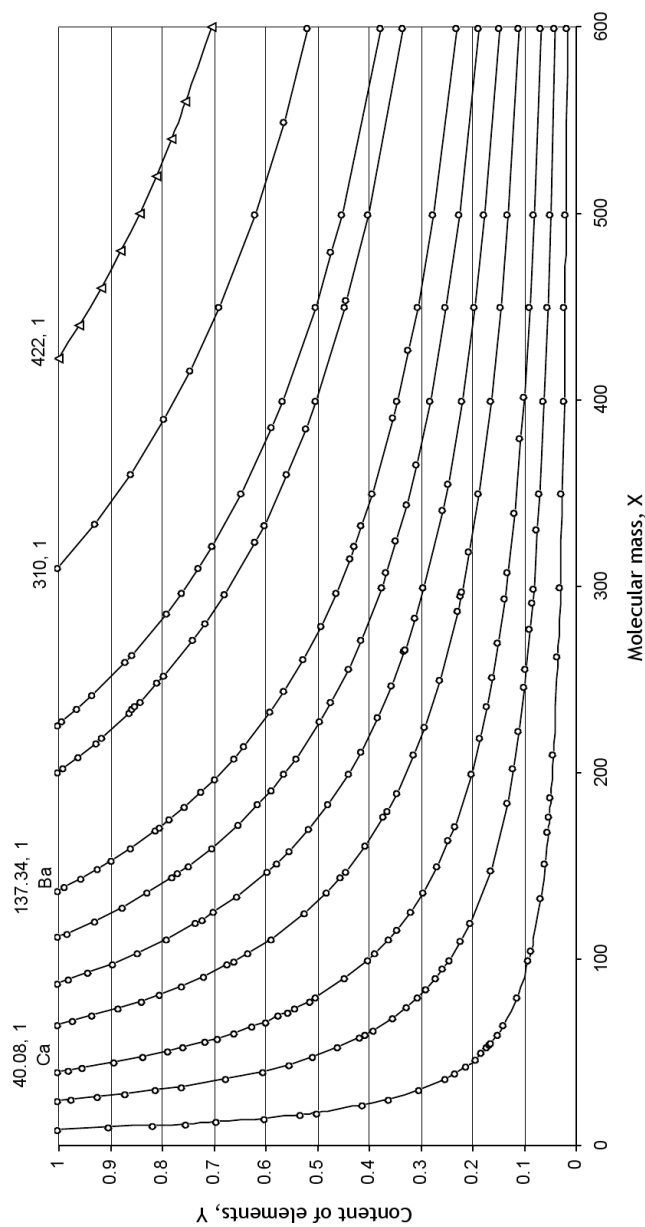


Fig. 1.2: Element proportion in chemical compounds against molecular mass ( $y = k/x$ ) on the example of the 2nd Group of the Periodic Table, plus No. 126 and No. 164.

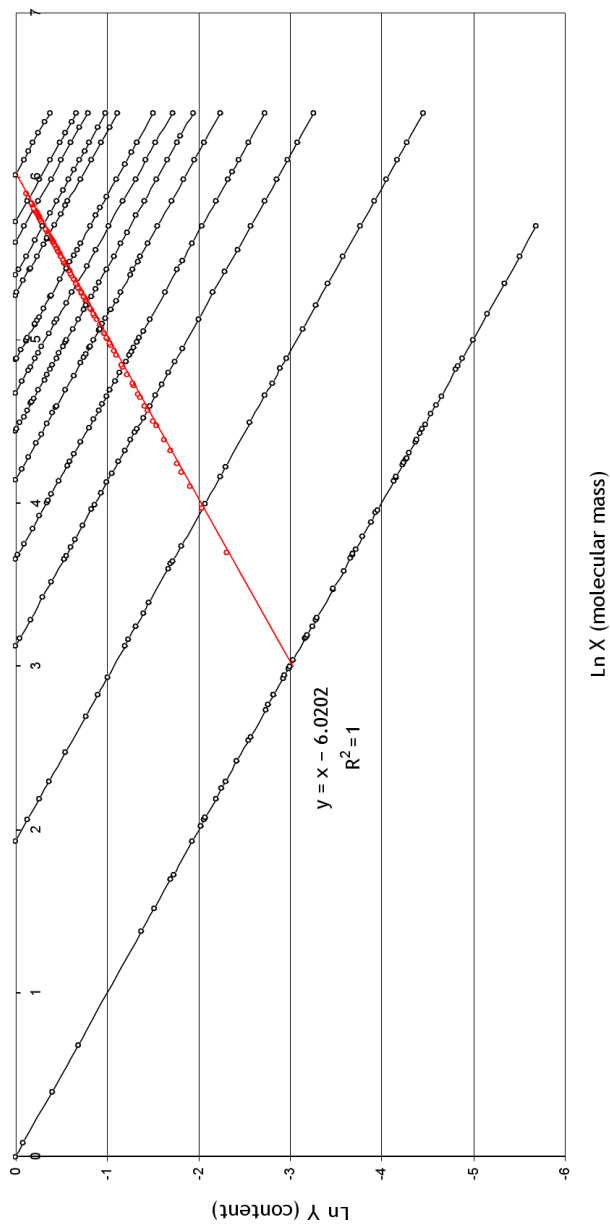


Fig. 1.3: Element content versus the molecular mass in chemical compounds of the 1st Group and No. 111, calculated No. 119, No. 155; + virtual axis.

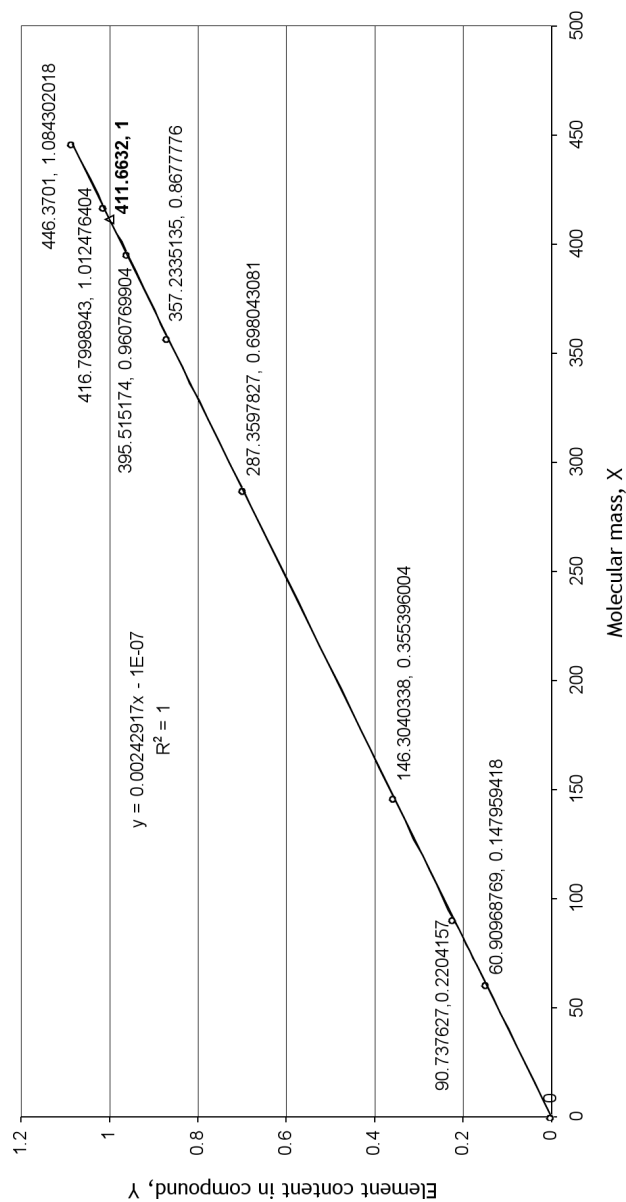


Fig. 1.4: The virtual axis of the hyperbolas  $y = k/x$ , after transformation of the data with application of the scaling coefficient.

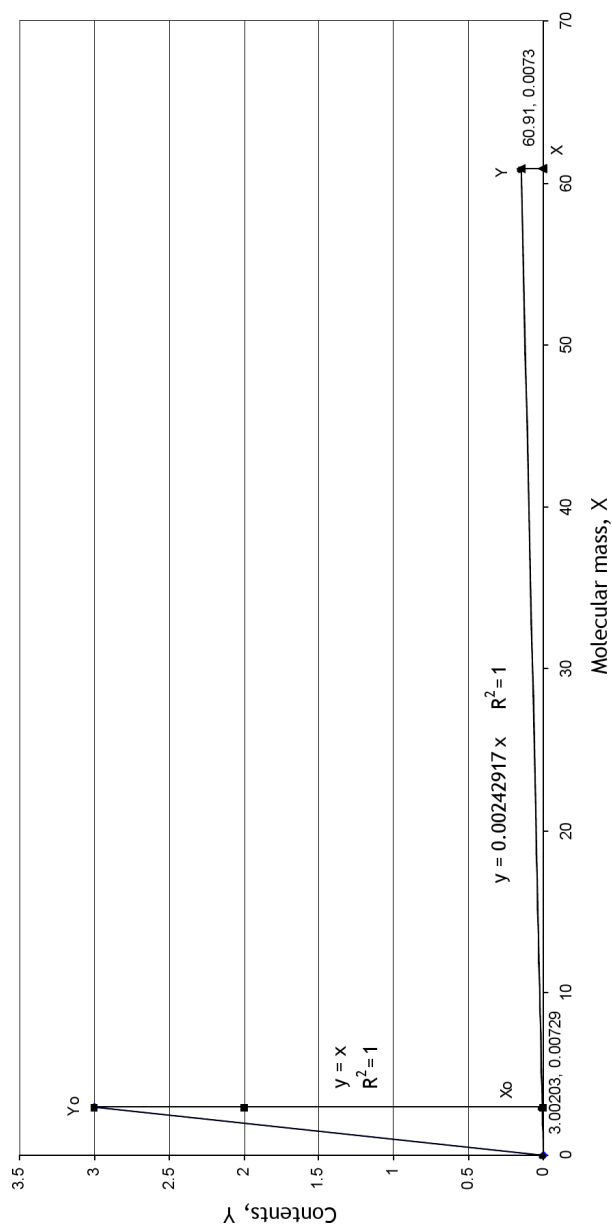


Fig. 1.5: Inversely proportional dependency in coordinates at calculation of the scaling coefficient.

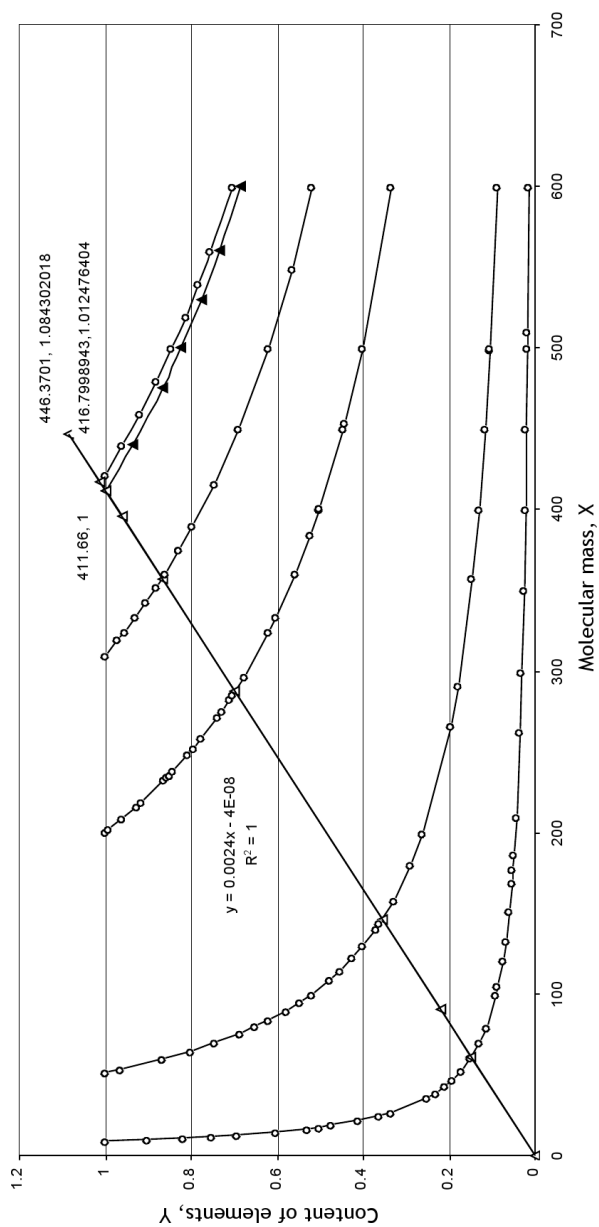


Fig. 1.6: Element content versus the compound's molecular mass and the hyperbola virtual axes of type  $y = k/x$  for the entire Periodical Table. Additionally No. 126, No. 164 and that rated on (ZZZZ) are introduced.

### §1.3 The point of crossing and the scaling coefficient

Our attention is focused on the point of crossing of the virtual axis with the line  $Y = 1$  in Fig. 1.4 when the atomic mass and the molecular mass are equal, i.e.  $K = X$ . It is possible only in the case when the origin of the hyperbola and its peak coincide in the point with the maximum content  $Y$  according to the equation  $Y = K/X$ .

The atomic mass of this element was calculated with application of the scaling coefficient and the value of the slope of the virtual axis (the most precise mean is 0.00242917):  $\tan \alpha = Y/X = 0.00242917$ , from which  $X = Y/\tan \alpha$ . Due to the fact that at this point  $K = X$  we have:  $Y/\tan \alpha = 1/\tan \alpha = 411.663243$ . This value is equal to the square of the scaling coefficient too:  $20.2895^2 = 411.6638$ ,  $\Delta = 0.0006$ .

The coefficient was calculated from matching of the coordinates of the peak hyperbola for Beryllium:  $X_0 = Y_0 = \sqrt{K}$  and  $X = 60.9097$ ,  $Y = 0.14796$ . Using this data to construct two triangles (Fig. 1.5), one easily sees an inversely proportional relationship:  $X/X_0 = Y_0/Y$ , whence  $X/X_0 = 60.9097/3.00203 = 20.2895041$  and  $Y_0/Y = 3.00203/0.14796 = 20.28947013$ ,  $\Delta = 0.000034$ .

The calculated value  $M = 20.2895$  is the scaling coefficient. With its help the scale of system coordinates can be reorganised.

Now if one rectangular hyperbola peak is known,  $X_0 = Y_0 = \sqrt{K}$ , then the new coordinates will be:  $X = X_0 M$  or  $X = M\sqrt{K}$ ,  $Y = \sqrt{K}/M$ . Furthermore,  $\tan \alpha_0 = Y_0/X_0 = 1$ , so  $\tan \alpha = Y/X = 1/M^2$ . At the same time at  $Y = 1$  and  $K = X$ , we obtain  $X = Y/\tan \alpha$  or  $K = Y/\tan \alpha = 1/\tan \alpha = M^2$ .

The results obtained are plotted in Fig. 1.6 in comparison with the hyperbolas of such elements as Be, Cr, Hg and the hypothetical No. 126 (atomic mass = 310), No. 164 (atomic mass = 422), ZZZZ (atomic mass = 411.66). It is obvious that it is practically impossible to choose and calculate precisely the curve peak for an atomic mass exceeding the value 250 without the use of the mathematical method adduced herein.

The rated element ZZZZ is the last in the Periodic Table because the hyperbola No. 164 after it crosses the virtual axis at the point which coordinates are:  $X_0 = Y_0 = \sqrt{422} = 20.5426386$ .

After scaling we have  $X = 20.2895 \times 20.5426386 = 416.8$  and  $Y = 20.5426386/20.2895 = 1.0125$ , but this makes no sense because  $Y$  cannot exceed the value 1. In addition, the hypothetical atomic mass 422 occurred higher than the molecular mass 416.8, i.e.  $X < K$ , but that is absurd. Similarly, it is obvious from Fig. 1.3 how the virtual axis (the equation  $Y = X - 6.0202$  where  $Y = \ln y$ ,  $X = \ln x$ ) crossing all the

logarithmic straight lines at the points corresponding to the hyperbola peaks, takes the value  $\ln X = 6.0202$  at  $\ln Y = 0$ , or after taking logarithms,  $X = 411.66$ ,  $Y = 1$ .

#### §1.4 The atomic (ordinal) number

To determine important characteristics of the atomic number some variants of graphical functions of the atomic mass versus the nucleus of all the elements were studied, including No. 126. One of them is exponential, with the equation  $Y = 1.6091 e^{1.0992x}$  (where  $Y$  is the atomic mass,  $x$  is  $\ln \text{No}$ ) at  $R^2 = 0.9967$ . After taking the logarithm of the both sides and inserting the atomic mass of 411.66 we have No. 155. The calculations also demonstrated that the ordinal No. 126 should have the atomic mass 327.2 but not 310.

Finally, the following atomic masses were obtained: No. 116 — 298.7, No. 118 — 304.4, No. 119 — 307.2, No. 120 — 310, No. 126 — 327.3, No. 155 — 411.66.

#### §1.5 The new law

Based on the foregoing, the heretofore unknown hyperbolic law of the Periodic Table of Elements is established. This law is due to the fact that the element content  $Y$  when estimated in relation to 1 gram-atom, in any chemical combination with molecular mass  $X$ , may be described by the adduced equations for the positive branches of the rectangular hyperbolas of the type  $Y = K/X$  (where  $Y \leq 1$ ,  $K \leq X$ ), arranged in the order of increasing nuclear charge, and having the common virtual axis with their peaks tending to the state  $Y = 1$  or  $K = X$  as they become further removed from the origin of coordinates, reaching a maximum atomic mass designating the last element.

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## Chapter 2

# Effect from Hyperbolic Law in Periodic Table of Elements

### §2.1 Introduction. Mathematical basis

In Chapter 1 we showed that the  $Y$  content of any element  $K$  in a chemical compound is decreasing in case molecular mass  $X$  is increasing in the range from 1 upto any desired value in compliance with rectangular hyperbolic law  $Y = K/X$  [5]. Simultaneously, fraction  $(1 - Y)$  is increasing in inverse proportion in compliance with formula  $1 - Y = K/X$  or

$$Y = \frac{X - K}{X}. \quad (2.1)$$

It is known that the function

$$y = \frac{ax + b}{cx + d} \quad (2.2)$$

is called a linear-fractional function [6, p. 991]. If  $c = 0$  and  $d \neq 0$ , then we get linear dependence  $y = \frac{a}{d}x + \frac{b}{d}$ . If  $c \neq 0$ , then

$$y = \frac{a}{c} + \frac{bc - ad}{c^2} \cdot \frac{1}{x + \frac{d}{c}}. \quad (2.3)$$

Supposing that  $X = x + \frac{d}{c}$ ,  $\frac{bc - ad}{c^2} = k \neq 0$ ,  $Y = y - \frac{a}{c}$ , we get  $Y = k/X$ , i.e. rectangular hyperbolic formula which center is shifted from coordinates origin to point  $C(-\frac{d}{c}, \frac{a}{c})$ .

As we can see, formula (2.1) is a special case of the function (2.2), cause coefficient  $d = 0$ . Then, determinant  $D(ad - bc)$  degenerates into  $-bc$ . There exists a rule: when  $D < 0$ ,  $K > 0$ , real axis together with  $X$  axis (abscissa axis) makes an angle  $+45^\circ$ ; and if  $D > 0$ , then the angle is  $-45^\circ$ . In our case  $D = a \times 0 - (-K) \times 1 = K$ . Therefore, real axis, on which tops of all new hyperbolas will be located, shall be in perpendicular position to the axis  $Y = K/X$ . At that, the center is shifted from the coordinates origin  $C(0; 0)$  to the point  $C(0; 1)$ . That means,

in our case, semi-axes

$$a = b = \sqrt{\frac{2|D|}{c^2}} = \sqrt{2K}. \quad (2.4)$$

Then the coordinates of the top of the other hyperbola Beryllium will be:  $X_0 = Y_0 = \sqrt{K} = \sqrt{9.0122} = 3.00203$  and  $X' = 60.9097$ ,  $Y' = 1 - Y = 1 - 0.14796 = 0.85204$ .

In order to avoid possible mistakes let us use the following terminology: hyperbola of  $Y = K/X$  kind is called straight, and linear-fractional — an adjoining one.

Fig. 2.1 demonstrates these curves which represent five elements from different groups: Chlorine (No. 17), Zirconium (No. 40), Wolfram (No. 74), Mendeleevium (No. 101), and the last one (No. 155). Peculiarity of the diagrams is symmetry axis at content of elements equal to 0.5. It is clear that both hyperbolas of the last element and ordinate axis limit the existence area of all chemical compounds related to one gram-atom.

Previously, we proved that all the elements of Periodic System can be described by means of rectangular hyperbole formulas. That is why, it is quite enough to present several diagrams in order to illustrate this or that dependence. The same is valid for linear-fractional functions which curves are directed bottom-up. If we put the picture up by symmetry axis, we shall see that they fully coincide with straight hyperbolas. At the cross point of straight and adjoining hyperbolas on this line, abscissa is equal to doubled atomic mass of the element. Coordinates of another cross points for each pair of hyperbolas have the following parameters:  $X$  is equal to the sum of atomic mass of two elements ( $K_1 + K_2$ ), and  $Y$  has two values  $\frac{K_1}{K_1 + K_2}$  and  $\frac{K_2}{K_1 + K_2}$ . Mentioned above is valid upto the upper bound of the Periodic Table inclusive.

As we can see on Fig. 2.2, (A00) and (B01) are real axes of straight and adjoining hyperbolas accordingly; and, AC and BD, (00E) and (01E) are tangents to them. Real axes are perpendicular to each other and to tangents. And all of them are equal to each other. Diagonals (00D) and (01C) divide straights AE and BE in halves.

There are formulas of mentioned lines. Cross points of these lines are also calculated. Abscissa of cross sections are values divisible by atomic mass of the last element: 0; 205.83; 274.44; 329.328; 411.66; 548.88; 617.49; 823.32 (0; 0.5; 0.667; 0.8; 1.0; 1.333; 1.5; 2.0).

For reference, Fig. 2.3 demonstrates graphical construction for Wolfram.

We can see, that knowing real axes (normal to the top of hyperbolas), it is very easy to build up tangents to any element, if required, in order

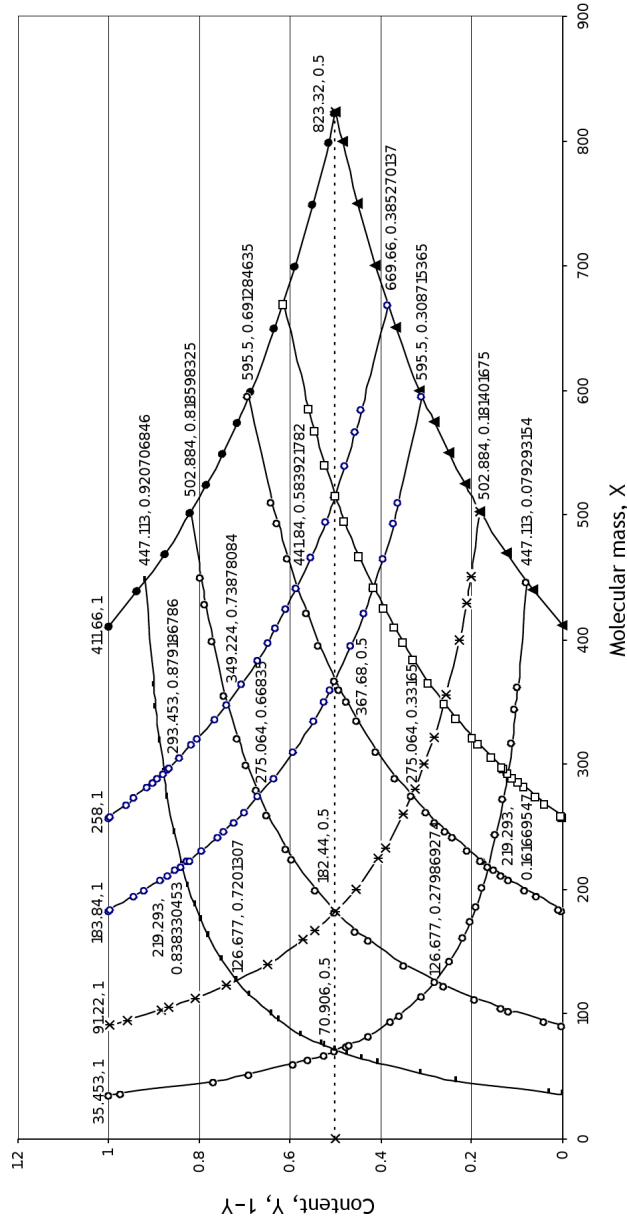


Fig. 2.1: Dependence of Y and 1 - Y content from molecular mass in straight and adjoining hyperbolas accordingly.

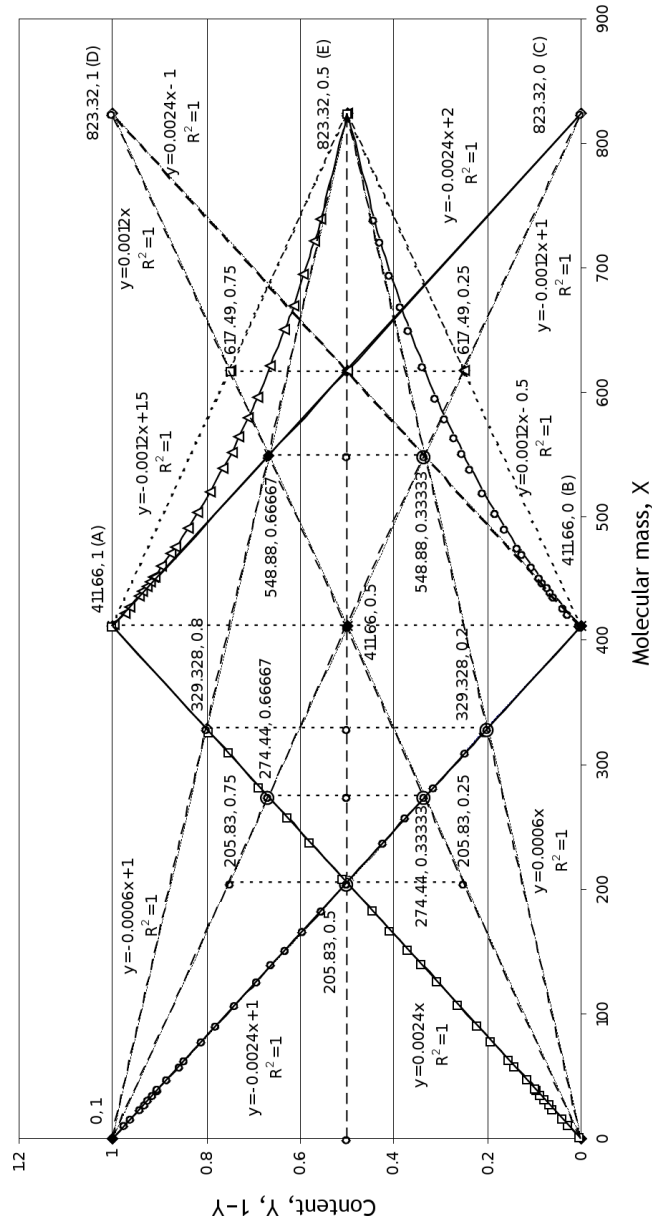


Fig. 2.2: Main lines of straight and adjoining hyperbolas of the last element: real axes, tangents, diagonals etc.

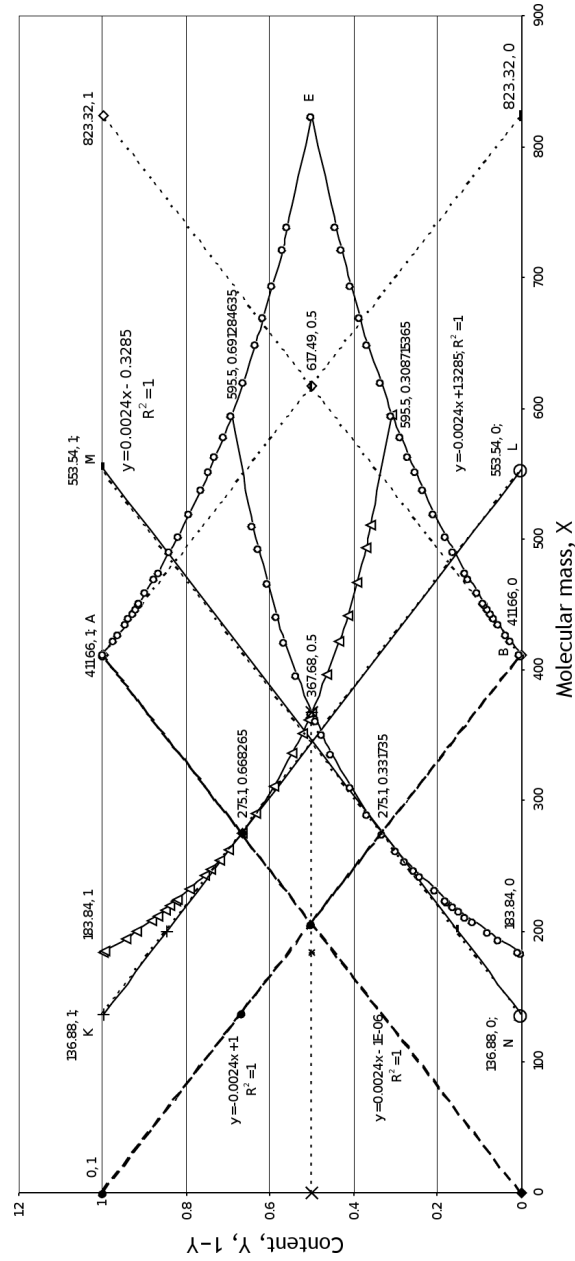


Fig. 2.3: Hyperboles of the last element and Wolfram, their cross points and tangents.

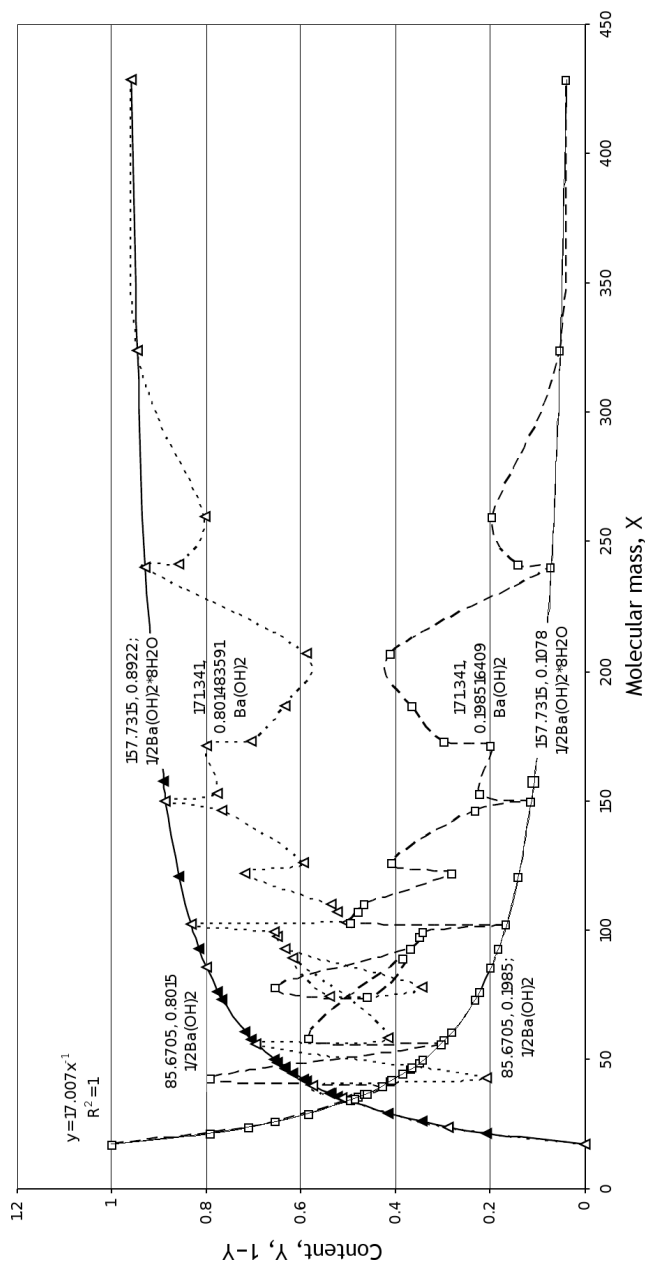


Fig. 2.4: Dependence of content of Y (OH) and 1 - Y in hydroxides from their molecular mass counting on 1 gram-mole OH (of hydroxide). Broken curves are overall (summarized) content of OH in a chemical compound.

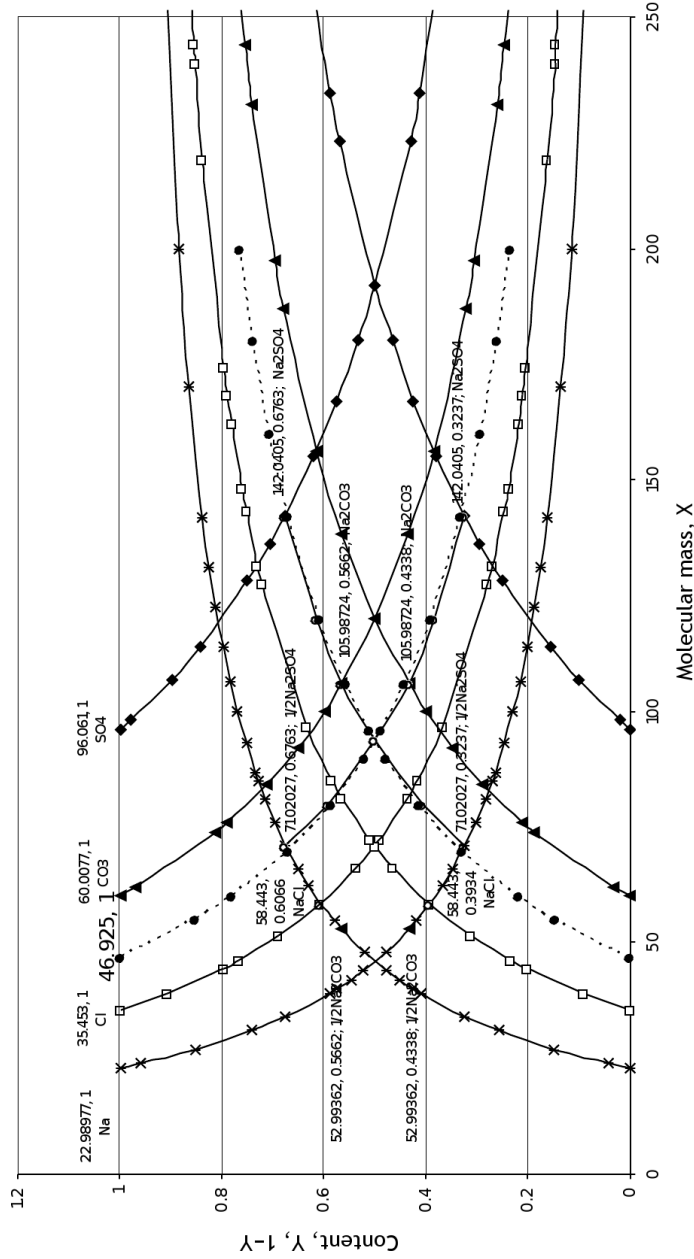


Fig. 2.5: Application of mathematic methods at calculating of the diagram containing hyperbolas of Sodium, Chlorine and groups CO<sub>3</sub>, SO<sub>4</sub>. Building up of a new hyperbola based on these data.

to check accuracy of chosen tops. For that, it is necessary to calculate formula of the straight which passes through the point  $M_1(X_1; Y_1)$  and parallel  $Y = aX + b$ , i.e.

$$Y - Y_1 = a(X - X_1) . \quad (2.5)$$

## §2.2 Application of the law of hyperbolas for chemical compounds

As it has already been mentioned above, the law is based on the following: the content of the element we are determining in the chemical compound should be referred to its gram-atom. It was shown in detail by the example of Oxygen. In compliance with the formula  $Y = K/X$  element is a numerator, and any compound is a denominator. For example, in order to determine content of Sodium (Na) in compounds with molecular mass NaOH (39.9967),  $\text{Na}_2\text{CO}_3$  (105.9872),  $\text{Na}_3\text{PO}_4$  (163.941), NaCl (58.443),  $\text{Na}_2\text{SO}_4$  (142.0406) it is necessary, before the formula, to put coefficients, reducing amount of Sodium in it to a unit:  $1, \frac{1}{2}, \frac{1}{3}, 1, \frac{1}{2}$ , accordingly. Then, numerically, part of element ( $Y$ ) will be 0.5748, 0.4338, 0.4207, 0.3934, and 0.3237. I.e., it is in one range with decreasing, and value  $(1 - Y)$  with increasing. Both these curves (in pairs) which are built based on these data are referred to one element.

Method of rectangular hyperbolas is worked out in order to determine the last element of Mendeleev's Periodic Table. But its capabilities are much bigger.

Let us build straight and adjoining hyperbolas for Sodium, Chlorine and also for groups  $\text{CO}_3$  and  $\text{SO}_4$ , which form, accordingly, carbonates and sulphates. As we can see in the formula  $Y = K/X$  they replace elements in a numerator. We already said that hyperbolas can be formed by any numbers within location of their tops on a real axis. However, there is a rule for groups, similar to that of 1 gram-atom of the element: their quantity in calculated compounds should not exceed a unit. Otherwise we get a situation shown on Fig. 2.4.

As we can see, it is necessary to put coefficient  $\frac{1}{2}$  before the formula of hydroxide at bivalent Barium. Then, his compounds will be on hyperbolas. In case of non-observance of this rule, their points will be on broken line (circle).

Now we can start to solve a problem of building up new hyperbolas, based on existing ones (Fig. 2.5).

Let's mark on them several general points related to the known compounds. On Sodium curves there are two points (on each curve)



$\frac{1}{2}\text{Na}_2\text{CO}_3$  and  $\frac{1}{2}\text{Na}_2\text{SO}_4$ , which are also located on respective hyperbolas but without the coefficient  $\frac{1}{2}$  ( $\text{Na}_2\text{CO}_3$  and  $\text{Na}_2\text{SO}_4$ ). Thus, the point  $\frac{1}{2}\text{Na}_2\text{SO}_4$ , located on the straight hyperbola of Sodium, and its cross points with hyperbolas  $\text{CO}_3$  and  $\text{SO}_4$  form imaginary broken line located between Chlorine and  $\text{CO}_3$ .

In a similar manner it works with adjoining hyperbolas. Let's build a formula (by three points)  $Y = 63.257 X^{-1.0658}$  of a power function (or  $\ln Y = 4.1472 - 1.0658 \ln X$ ). With the help of mentioned formula we will find some more coordinates, including (obligatory) their crossing center (93.85; 0.5). Then we divide the abscissa of this point by 2 (straight and adjoining hyperbolas cross at doubled value of atomic mass) we get  $X$ , equal to 46.925, and that is a numerator in a formula of new hyperbolas ( $Y = 46.925/X$ ).

### §2.3 Conclusions

Method of rectangular hyperbolas makes it possible to do the following:

- Create mathematical basis for using hyperbolas of the kind  $Y = 1 - \frac{K}{X}$  in chemistry;
- Determine existence area of the chemical compounds;
- Calculate formulas of the main lines and cross points of all the hyperbolas, including the last element;
- Show the possibility of building up hyperbolas whose numerator is a group of elements, including the rule of 1 gram-atom (in this case it is 1 gram-mole);
- Calculate and to build unknown in advance hyperboles by several data of known chemical compounds located on respective curves;
- Control (with high accuracy) the content of synthesized substances;
- Design chemical compounds.

Due to the fact that it is inconvenient to call each time the element 155 the "last element" and by the right of the discoverer we decided to call it **KHAZANIUM (Kh)**.

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### Chapter 3

## The Rôle of the Element Rhodium in the Hyperbolic Law of the Periodic Table of Elements

### §3.1 Introduction

The method of rectangular hyperbolas assumes that their peaks (i.e. vertices) should be determined with high accuracy. For this purpose the theorem of Lagrange and the coefficient of scaling calculated by the Author for transition from the system of coordinates of the image of a hyperbola, standard practice of the mathematician, and used in chemistry, are utilized. Such an approach provides a means for calculating the parameters of the heaviest element in Mendeleev's Periodic Table.

In the first effect of the hyperbolic law it is shown that to each direct hyperbola corresponds an adjacent hyperbola: they intersect on the line  $Y=0.5$  at a point the abscissa of which is twice the atomic mass of an element [7]. This fact is clearly illustrated for Be, Ca, Cd in Fig. 3.1.

Upon close examination of the figure deeper relationships become apparent:

- From the centre of adjacent hyperbolas ( $X=0, Y=1$ ) the secants have some points of crossing, the principal of which lie on the line  $Y=0.5$  and on the virtual axes (peaks);
- The secants intersect a direct hyperbola in two points, with gradual reduction of a segment with the increase in molecular mass;
- Behind the virtual axis of adjacent hyperbolas the secants cut a direct hyperbola in only one point;
- In conformity therewith, the magnitude of the abscissa, between a secant and a point of intersection of hyperbolas on the line  $Y=0.5$ , also changes;
- For the element Rhodium the secant becomes a tangent and also becomes the virtual axis of adjacent hyperbolas.

### §3.2 Mathematical motivation

On the basis of the presented facts, we have been led to calculations for 35 elements to establish the laws for the behavior of secants. The results are presented in Table 3.2 for the following parameters:

- Atomic numbers of elements and their masses;
- Calculated coordinates of peaks of elements (the square root of the atomic mass and coefficient of scaling 20.2895 are used);
- Abscissas of secants on the line  $Y = 0.5$  are deduced from the equation of a straight lines by two points

$$\frac{(X - X_1)}{(X_2 - X_1)} = \frac{(Y - Y_1)}{(Y_2 - Y_1)} \quad (\text{column 6}); \quad (3.1)$$

- Points of intersection of direct and adjacent hyperbolas (see column 7);
- Difference between the abscissas in columns 6 and 7 (column 8);
- Tangent of an inclination of a secant from calculations for column 6.

According to columns 6 and 7 of Table 3.2, Fig. 3.2 manifests dependences which essentially differ from each other are obtained. Abscissas of secants form a curve of complex form which can describe with high reliability (size of reliability of approximation  $R^2 = 1$ ) only a polynomial of the fifth degree. The second dependency has a strictly linear nature ( $Y = 2X$ ), and its straight line is a tangent to a curve at the point (102.9055, 205.811). For clarity the representation of a curve has been broken into two parts: increases in molecular mass (Fig. 3.3) and in return — upto Hydrogen, inclusive (Fig. 3.4). The strongly pronounced maximum for elements B, C, N, O, F, Ne is observed.

At the end of this curve there is a very important point at which the ordinate is equal to zero, where (the line of Rhodium in the table) the data of columns 6 and 7 coincide.

Thus it is unequivocally established that for Rhodium the secant, tangent and the virtual axis for an adjacent hyperbola are represented by just one line, providing for the first time a means to the necessary geometrical constructions on the basis of only its atomic mass (**the only one in the Periodic Table**), for the proof of the hyperbolic law.

Graphical representation of all reasoning is reflected in Fig. 3.5 from which it is plain that the point with coordinates (205.811, 0.5) is the peak of both hyperbolas, and the peaks of Ca and Ta are on both sides of it. Below are the detailed calculations for the basic lines of Rhodium on these data (see Page 44).

1	2	3	4	5	6	7	8	9
El.	No.	At. mass	X <sub>0</sub> peak	Y <sub>0</sub> peak	Abs. secant	Cross. hyperb.	$\Delta = 6 - 7$	tan a, secant
H	1	1.0079	20.3695	0.04948	10.715	2.0158	8.6992	-0.046664
He	2	4.0026	40.5992	0.0986	22.5163	8.0052	14.5111	-0.0222
Li	3	6.941	53.4543	0.12985	30.7155	13.882	16.8335	-0.01628
Be	4	9.0122	60.9097	0.14796	35.7434	18.0244	17.719	-0.014
B	5	10.811	66.712	0.162055	39.80692	21.622	18.18492	-0.01256
C	6	12.0107	70.3162	0.1708	42.4	24.0214	18.3786	-0.0117923
N	7	14.0067	75.9345	0.184458	46.5546	28.0134	18.5412	-0.01074
O	8	15.9994	81.1565	0.197143	50.5423	31.9988	18.5435	-0.009893
F	9	18.9984	88.4362	0.21483	56.3163	37.9968	18.3195	-0.008878
Ne	10	20.1797	91.1441	0.2214	58.5311	40.3594	18.1717	-0.0085425
Mg	12	24.305	100.0274	0.242983	66.0669	48.61	17.4569	-0.007568
S	16	32.065	114.89125	0.27909	79.6849	64.13	15.5549	-0.006273
Ca	20	40.078	128.4471	0.31202	93.3508	80.156	13.1948	-0.005356
Cr	24	51.9961	146.3042	0.3554	113.484	103.9922	9.4918	-0.004406
Zn	30	65.409	164.093	0.3986	136.428	130.818	5.61	-0.003665
Br	35	79.904	181.366	0.44057	162.0982	159.808	2.29	-0.003085
Zr	40	91.224	193.7876	0.47074	183.075	182.448	0.627	-0.002731
Mo	42	95.94	198.7336	0.482757	192.1085	191.88	0.2285	-0.002603
<b>Rh</b>	<b>45</b>	<b>102.906</b>	<b>205.82145</b>	<b>0.4999746</b>	<b>205.811</b>	<b>205.811</b>	<b>0</b>	<b>-0.00242941</b>
Cd	48	112.411	215.1175	0.52256	225.26	224.822	0.458	-0.00221946
Ba	56	137.327	237.7658	0.577573	281.428	274.654	6.774	-0.001777
Nd	60	144.242	243.6785	0.591936	298.5785	288.484	10.09455	-0.0016746
Sm	62	150.36	248.7926	0.60436	314.417	300.72	13.7	-0.00159

1	2	3	4	5	6	7	8	9
El.	No.	At. mass	$X_0$ peak	$Y_0$ peak	Abs. secant	Cross. hyperb.	$\Delta = 6 - 7$	tan a, secant
Dy	66	162.5	258.6414	0.628283	347.9	325	22.9	-0.001437
Yb	70	173.04	266.8976	0.64834	379.48	346.08	33.4	-0.0013176
Hf	72	178.49	271.068	0.65847	396.843	356.98	39.863	-0.00126
Ta	73	180.948	272.928	0.663	404.923	361.896	43.027	-0.0012348
Re	75	186.207	276.8658	0.67255	422.7646	372.414	50.35	-0.0011827
Ir	77	192.217	281.2984	0.68332	444.1376	384.434	59.704	-0.0011258
Hg	80	200.59	287.3598	0.698	475.8318	401.18	74.6518	-0.00105
At	85	210	294.0228	0.71423	514.44	420	94.44	-0.000972
Fr	87	223	302.9868	0.736	573.85	446	127.85	-0.00087
Th	90	232.038	309.0658	0.75077	620.0472	464.07612	155.971	-0.000806
Am	95	243	316.282	0.7683	682.53	486	196.53	-0.0007326
Es	99	252	322.0858	0.7824	740.0874	504	236.0874	-0.0006756

- a) Column 4 contains the square root of the respective atomic mass (column 3) multiplied by the scaling coefficient ( $M = 20.2895$ ). Column 5 contains the square root divided by the scaling coefficient  $M$ ;
- b) Column 6. We draw a straight line from the centre (0;1) to the point of crossing with the real axis at  $(X_0; Y_0)$ . With equation 3.1 we have, for example, for Mg:  $(X - 0)/(100.0274 - 0) = (Y - 1)/(0.242983 - 1)$ , so the equation of the straight line is  $Y = 1 - 0.007568 X$ . Thus, abscissa of the point of crossing of the line by the line  $Y = 0.5$  is 66.0669 (column 6);
- c) Column 7. These are abscissas of the points of crossing of the direct and adjacent hyperbolas, created for each element, by the straight line  $Y = 0.5$ . Abscissas of the crossing points decrease with the increase of atomic mass of elements, and reach zero at the meeting of the crossing line and the real axis of the adjacent hyperbolas.
- d) In column 9, the tangent of the corner of inclination of the secants is resulted; at the element Radium this line crosses the axis  $X$  in a point with abscissa 411.622, and its position meets the tangent at peak; 411.66 - 411.62 = 0.04 or nearly so 0.01% from atomic mass.

Table 3.1: Results of calculations for some elements of the Periodic Table.

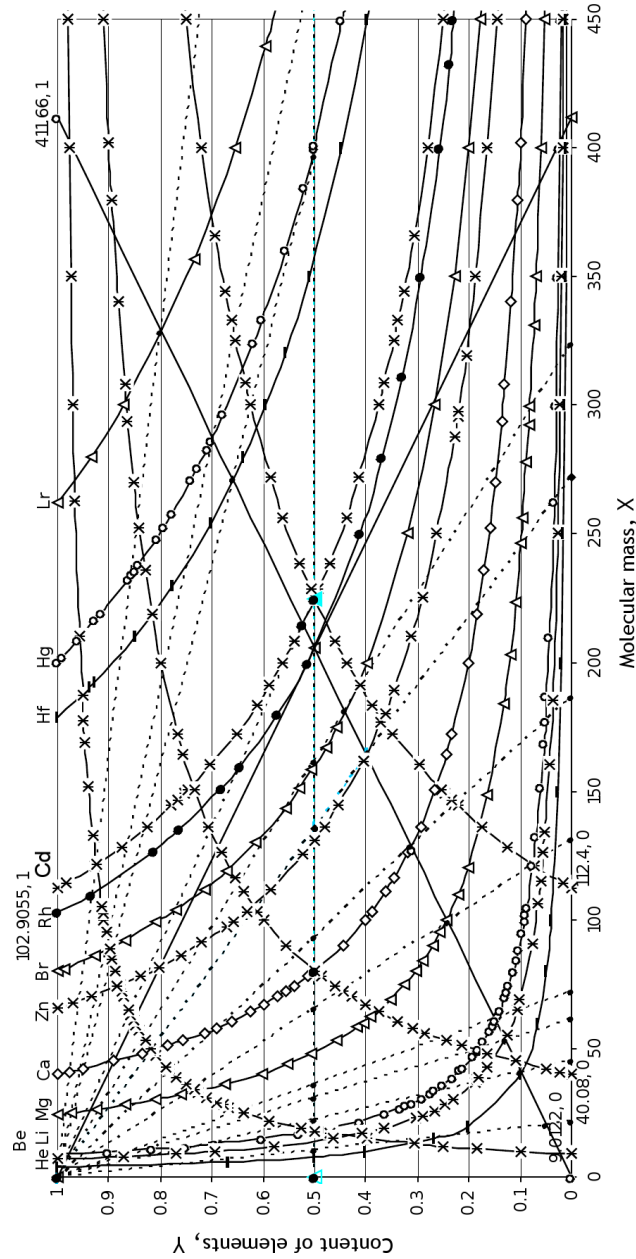


Fig. 3.1: Hyperboles created for some elements of the Periodic Table, and their peaks located in virtual axis. Position secants, dependent on molecular mass, are shown.

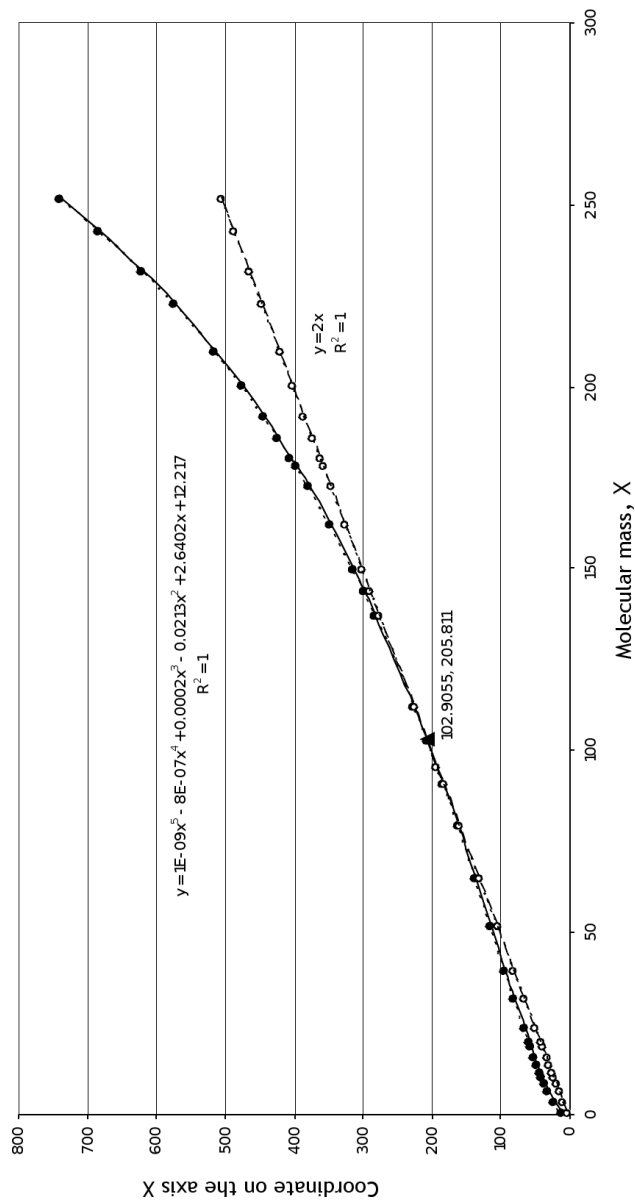


Fig. 3.2: Dependency of the coordinates of the axis  $X$  from molecular mass: secant (column 6) and cross-point of the hyperbolas (column 7) in line  $y=0.5$ .

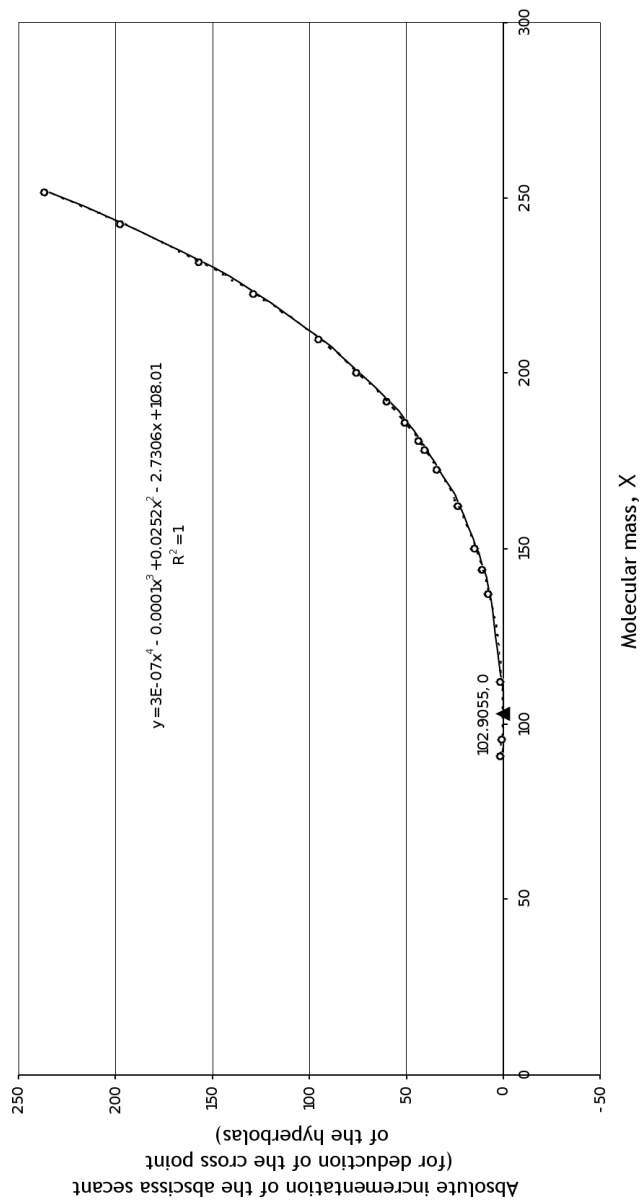


Fig. 3.3: Dependency of the absolute increment of the abscissa secant from the change of molecular mass (for calculation of the coordinate X of the cross-point of the hyperbolas).



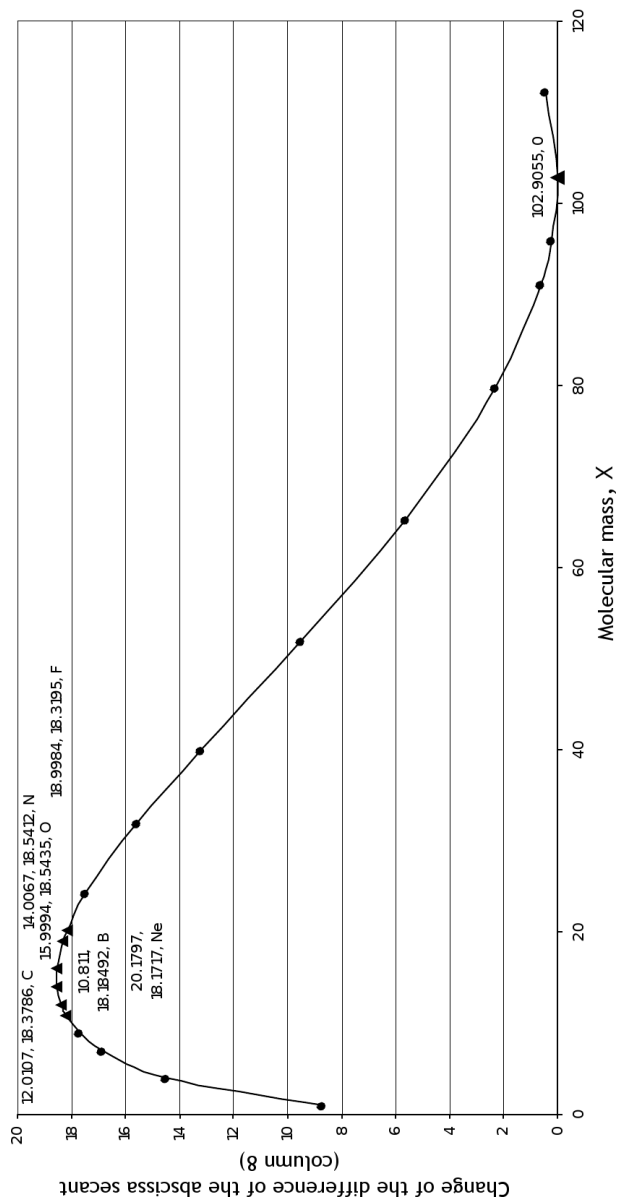


Fig. 3.4: Dependency of the abscissa secants from molecular mass (column 8) when crossing the hyperbolas in two points.

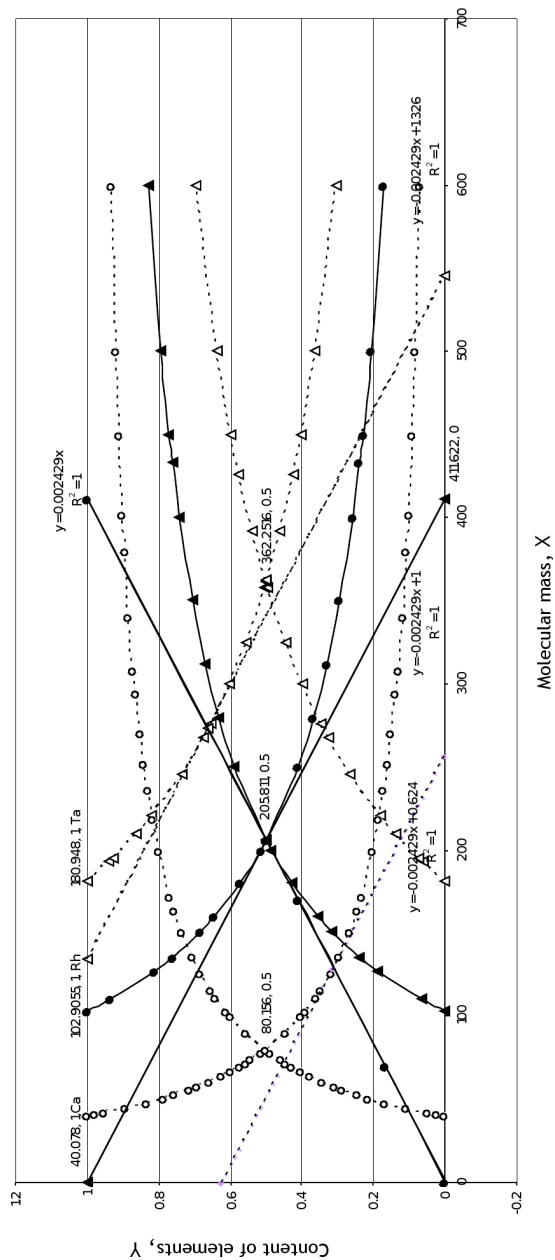


Fig. 3.5: Geometric composition for determination of the peaks of the hyperbolas in the virtual axis. The base of the calculation is the hyperbola of Rhodium (shown at the centre).

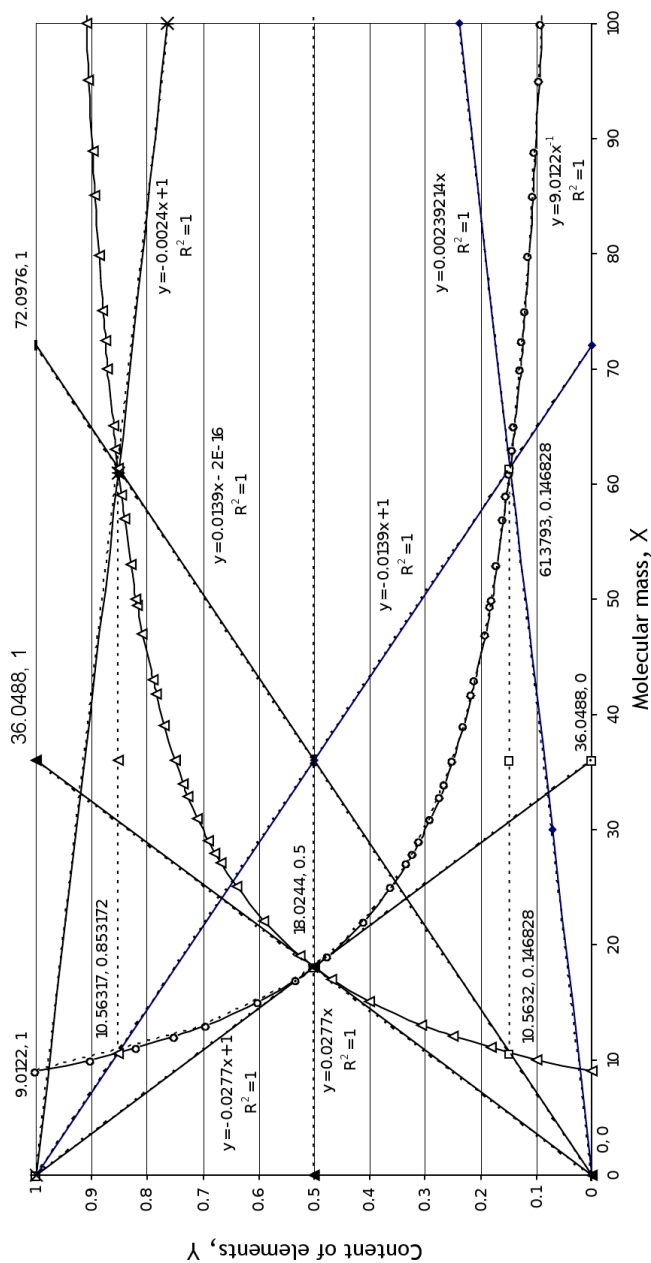


Fig. 3.6: Geometric composition for determination of the peak of the rectangular hyperbola of Beryllium. Secant passes arbitrarily through the point ( $x = 36.0488, y = 0.5$ ). Intersection of it with the hyperbola gives a wrong peak.

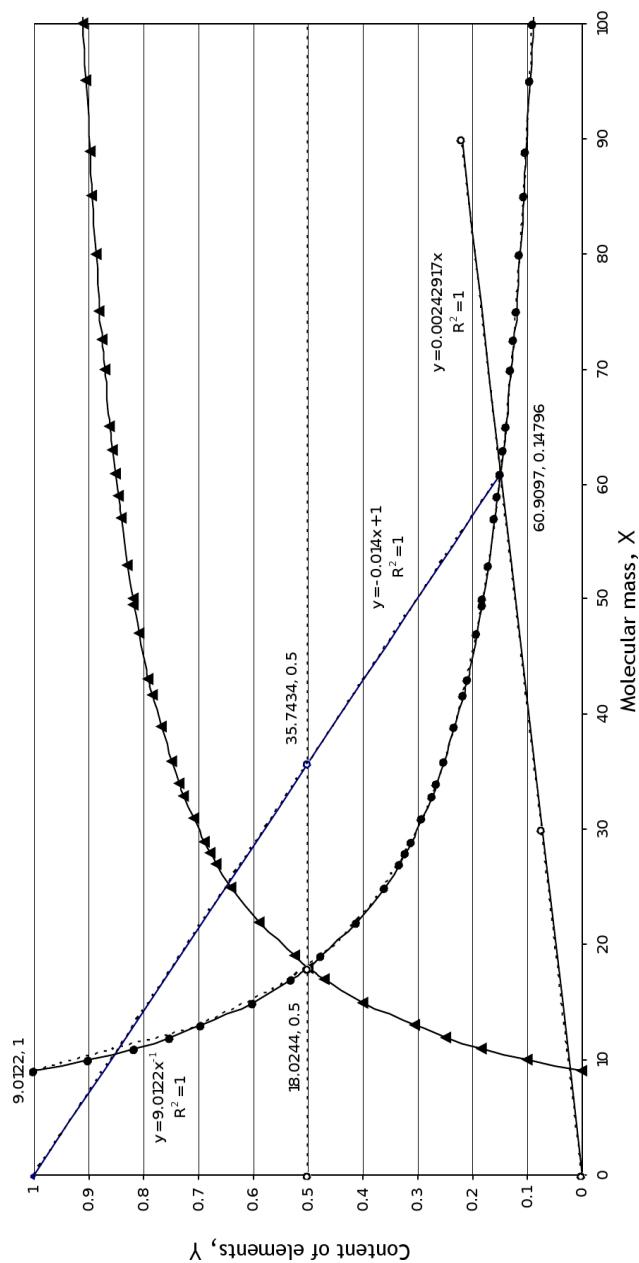


Fig. 3.7: Geometric composition for determination of the peak of the hyperbola of Beryllium. Scale of the hyperbola is  $x = 100$ . Abscissa of the secant is 35.7434.

1) A secant: —

$$\frac{(X - 0)}{(205.811 - 0)} = \frac{(Y - 1)}{(0.5 - 1)}, \quad (3.2)$$

whence

$$Y = -0.0024294134X + 1. \quad (3.3)$$

At  $Y=0$ ,  $X=411.622$ , in this case coordinates of peak will be:  
 $X=205.811$ ,  $Y=0.5$ .

2) A tangent: — the equation of a direct hyperbola,

$$Y = \frac{102.9055}{X}, \quad (3.4)$$

its derivative at  $X=205.811$ , so

$$Y' = -\frac{102.9055}{205.811^2} = -0.0024294134, \quad (3.5)$$

$$Y - 0.5 = -0.0024294134X + 0.5. \quad (3.6)$$

Finally,

$$Y = -0.0024294134X + 1 \quad (3.7)$$

at  $Y=0$ ,  $X=411.622$ .

3) A normal: — (the virtual axis),

$$Y = 0.0024294134X \quad (3.8)$$

at  $Y=1$ ,  $X=411.622$ .

Here are the same calculations for the tabulated data presented:

1) A secant: —

$$\frac{X}{205.82145} = \frac{(Y - 1)}{(0.4999746 - 1)}, \quad (3.9)$$

whence

$$Y = -0.0024294134X + 1; \quad (3.10)$$

$$Y = 1, \quad X = 411.622. \quad (3.11)$$

2) A tangent: —

$$Y = \frac{102.9055}{X}, \quad (3.12)$$

the fluxion at  $X=205.821454$ ,

$$Y' = -\frac{102.9055}{205.82145^2} = -0.0024291667, \quad (3.13)$$

so

$$Y - 0.4999746 = -0.0024291667(X - 205.82145), \quad (3.14)$$

whence

$$Y = -0.0024291667X + 0.99994928, \quad (3.15)$$

$$Y = 0, \quad X = 411.6429. \quad (3.16)$$

3) A normal: —

$$Y = 0.0024291667X; \quad (3.17)$$

$$Y = 1, \quad X = 411.6638. \quad (3.18)$$

### §3.3 Comparative analysis calculations

For a secant the results are identical with the first set of calculations above, whereas for a tangent and normal there are some deviations, close to last element calculated.

By the first set of calculations above its atomic mass is 411.622; hence the deviation is  $411.663243 - 411.622 = 0.041243$  (0.01%). By the second set the size of a tangent and a normal are close to one another (an average of 411.65335) and have a smaller deviation:  $411.663243 - 411.65335 = 0.009893$  (0.0024%). This is due to the tangent of inclination of the virtual axis of a direct hyperbola in the first set is a little high.

Using Rhodium (Fig. 3.5) we can check the propriety of a choice of coefficient of scaling. It is necessary to make the following calculations for this purpose:

- Take the square root of atomic mass of Rhodium (i.e.  $X = Y = 10.1442348$ );
- Divide  $X_0$  by  $X$  of the peak ( $205.811/10.1442348 = 20.2885$ );
- Divide  $Y = 10.1442348$  by  $Y_0$  of the peak (0.5): also gives 20.2885;
- The difference by  $X$  and  $Y$  with the coefficient obtained, 20.2895, yielding the same size at 0.001 or 0.005%.

Formulae for transition from one system of coordinates to another have been given in the first paper of this series.

Using data for peaks, from the table, we get the following results:

Coordinates of peak

$$X_0 = 205.8215, \quad Y_0 = 0.49997, \quad (3.19)$$

$$X = Y = 10.1442348, \quad (3.20)$$

then

$$\frac{X_0}{X} = 20.2895, \quad \frac{Y}{Y_0} = 20.2897, \quad (3.21)$$

i. e. absolute concurrence (maximum difference of 0.0009%).

### §3.4 The rôle of the element Rhodium

However, all these insignificant divergences do not belittle the most important conclusion: that the validity of the hyperbolic law is established because the data calculated above completely coincide with calculations for Rhodium is proved, based only on its atomic mass.

All the calculations for the table were necessary in order to find a zero point for Rhodium, for which it is possible to do so without calculating the secant, but using only its atomic mass, thereby verifying the hyperbolic law.

How to get the correct choice of abscissa of a secant is depicted in Fig. 3.6 (using Beryllium as an example) where instead of its tabulated value, 35.7434, the value equal to twice the point of intersection (36.0488) has been used. Here we tried to make a start from any fixed point not calculated (similar to the case for Rhodium). It has proved to be impossible and has led to a mistake in the definition of the peak. In Fig. 3.7 the geometrical constructions for Beryllium on the basis of correct settlement of data are given.

### §3.5 Conclusions

Previously we marked complexity of a choice of peak of a hyperbola of an element in the coordinates, satisfying the conditions  $Y \leq 1$ ,  $K \leq X$ , as on an axis of ordinates the maximum value being a unit whilst the abscissa can take values in the hundreds of units. The problem has been solved by means of the theorem of Lagrange and the coefficient of scaling deduced. On the basis thereof our further conclusions depended, so it was very important to find a method not dependent on our calculations and at the same time allowing unequivocally to estimate the results. Owing to properties of the virtual axis of a rectangular hyperbola on which peaks of all elements lie, it is enough to have one authentic point.

Analyzing the arrangement of the virtual axes of direct and adjacent hyperbolas, we have paid attention to their point of intersection (205.83, 0.5), the abscissa of which is exactly half of atomic mass of the last element. As secants from the centre  $X = 0$ ,  $Y = 1$  cut direct hyperbolas any way (Fig. 3.1), we have been led to necessary calculations and have obtained a zero point at which the secant coincides with a tangent and

the real axis. The divergence with tabular data is in the order of 0.004%–0.009%.

Thus Rhodium provides an independent verification of the method of rectangular hyperbolas for Mendeleev's Periodic Table of Elements.

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## Chapter 4

# Upper Limit of the Periodic Table and Synthesis of Superheavy Elements

### §4.1 Shell construction of a nucleus, magic numbers

The nucleus of an atom is the central part of the atom, consisting of positively charged protons ( $Z$ ) and electrically neutral neutrons ( $N$ ). They interact by means of the strong interaction.

If a nucleus of an atom is considered as a particle with a certain number of protons and neutrons it is called a nuclide. A nuclide is that version of an atom defined by its mass number ( $A = Z + N$ ), its atomic number ( $Z$ ) and a power condition of its nucleus. Nuclei with identical numbers of protons but different numbers of neutrons are isotopes. The majority of isotopes are unstable. They can turn into other isotopes or elements due to radioactive disintegration of the nucleus by one of the following means:  $\beta$ -decay (emission of electron or positron),  $\alpha$ -decay (emission of particles consisting of two protons and two neutrons) or spontaneous nuclear fission of an isotope. If the product of disintegration is also unstable, it too breaks up in due course, and so on, until a stable product is formed.

It has been shown experimentally that a set of these particles becomes particularly stable when the nuclei contain “magic” number of protons or neutrons. The stable structure can be considered as shells or spherical orbits which are completely filled by the particles of a nucleus, by analogy with the filled electronic shells of the noble gases. The numbers of particles forming such a shell are called “magic” numbers. Nuclei with magic number of neutrons or protons are unusually stable and in nuclei with one proton or other than a magic number, the neutron poorly binds the superfluous particle. The relevant values of these numbers are 2, 8, 20, 28, 50, 82, and 126, for which there exists more stable nuclei than for other numbers [8]. Calculations indicate existence of a nucleus with filled shell at  $Z = 114$  and  $N = 184$  ( $^{298}114$ ) which would be rather stable in relation to spontaneous division. There is experimental data for the connexion of magic numbers to a nucleus with  $Z = 164$ . Y. Oganessian [9, 10] has alluded to a Rutherford-model atom

which assumes existence of heavy nuclei with atomic numbers within the limits of  $Z \sim 170$ . At the same time there is a point of view holding that superheavy elements (SHEs) cannot have  $Z > 125$  [11]. In October 2006, it was reported that element 118 had been synthesized in Dubna (Russia), with atomic mass 293 [12]. (It is known however, that this atomic mass is understated, owing to technical difficulties associated with the experiments.)

#### §4.2 The $N$ - $Z$ diagram of nuclei, islands of stability

The search for superheavy nuclei, both in the Nature and by synthesis as products of nuclear reactions, has intensified. In the 1970's 1200 artificially produced nuclei were known [13]. Currently the number is  $\sim 3000$ , and it is estimated that this will increase to  $\sim 6500$  [14].

In Fig. 4.1 the neutron-proton diagram of nuclei of stable and artificial isotopes [15–17] is presented.

Light stable or long-lived nuclei which arrangement can be arranged in a valley of stability as shown by small circles. The top set of border points represents a line of proton stability and bottom a line of neutron stability. Beyond these limits begins the so-called, “sea of instability”. There is apparently only a narrow strip of stability for which there exists a quite definite parity,  $N/Z$ . For nuclei with atomic mass below 40, the numbers of protons and neutrons are approximately identical. With increase in the quantity of neutrons the ratio increases, and in the field of  $A = (N + Z) = 250$  it reaches 1.6. The growth in the number of neutrons advances the quantity of protons in heavy nuclei, which in this case become energetically more stable. To the left of the stable nuclei are proton excess nuclei, and on the right neutron excess nuclei. These and others are called exotic nuclei.

The diagram terminates in the last element from the table IUPAC at No. 114, with mass number 289, while scientists suspect nucleus No. 114–298. Such isotopes should possess the increased stability and lifetime of superheavy elements.

This diagram is specially constructed, only on the basis of tabulated data, but augmented by the theoretical upper limit of the Periodic Table. Up to the  $Z \sim 60$  the line of trend approaches the middle of a valley of stability, with  $N/Z \sim 1.33$ . Furthermore,  $N/Z$  increases steadily to  $\sim 1.5$  upto  $Z \sim 100$ . The equation of the line of trend represents a polynomial of the fourth degree. It is noteworthy that this implies rejection of the upper magic number for neutrons heretofore theoretically supposed.

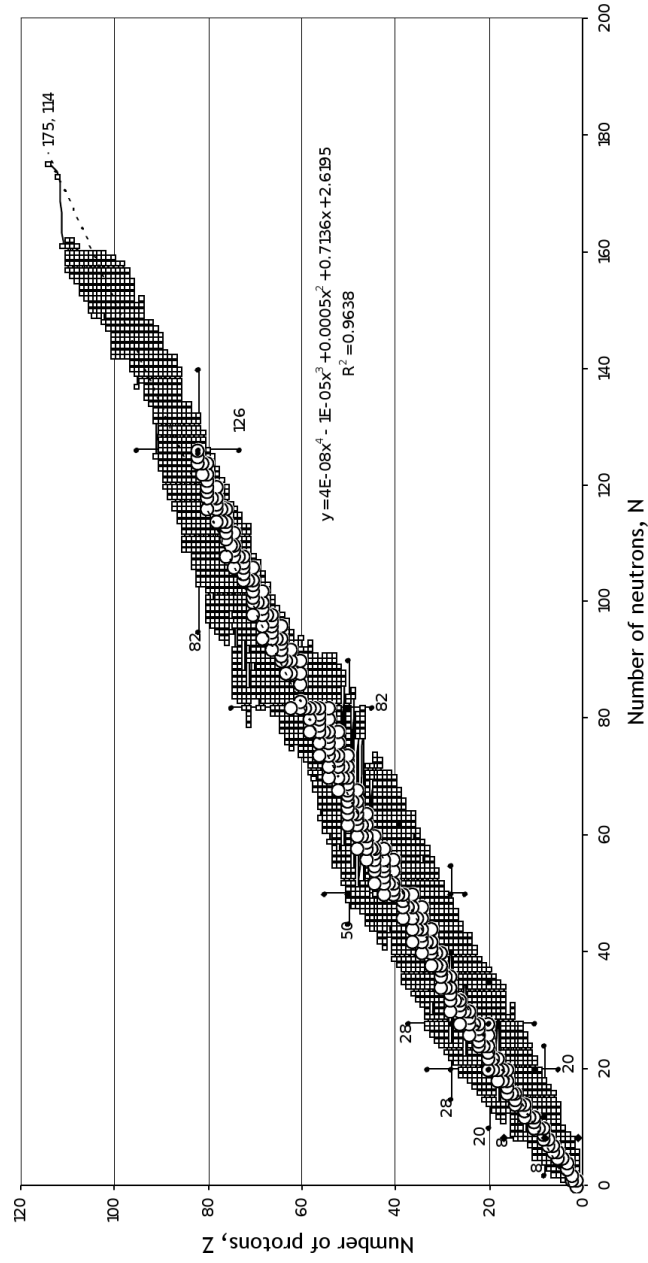


Fig. 4.1: N-Z diagram of nuclides.

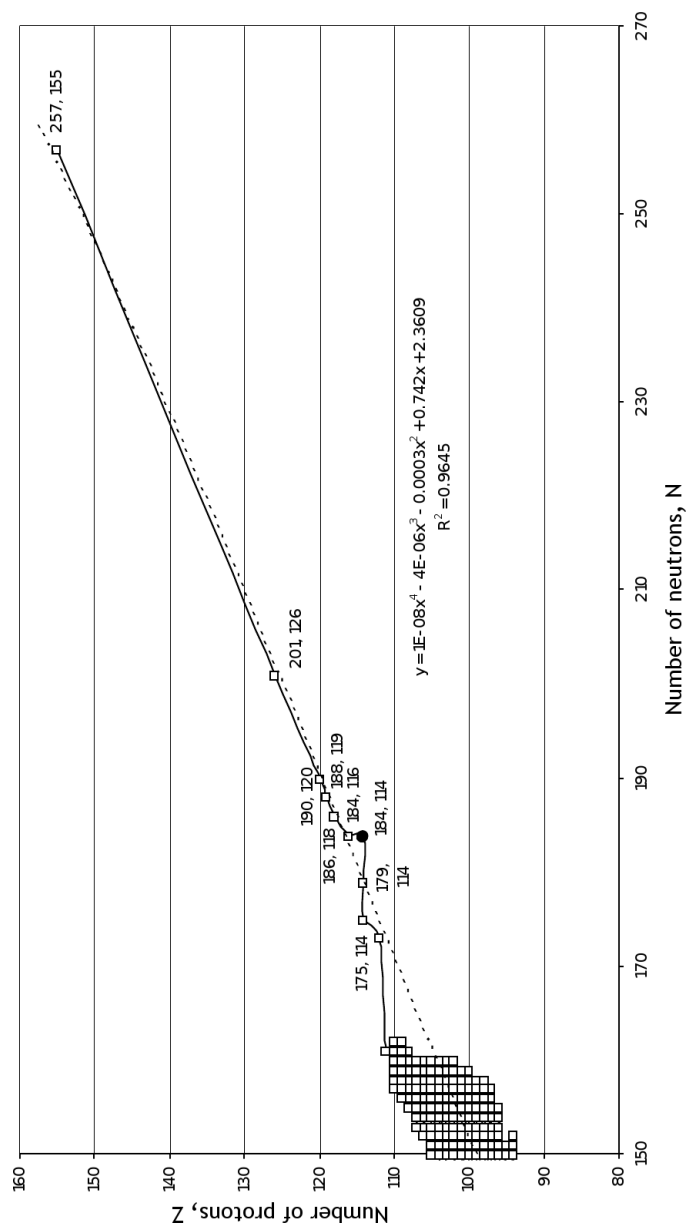


Fig. 4.2: N-Z diagram of nuclides. For increase in scale the diagram is reduced after carrying out of a line of a trend.

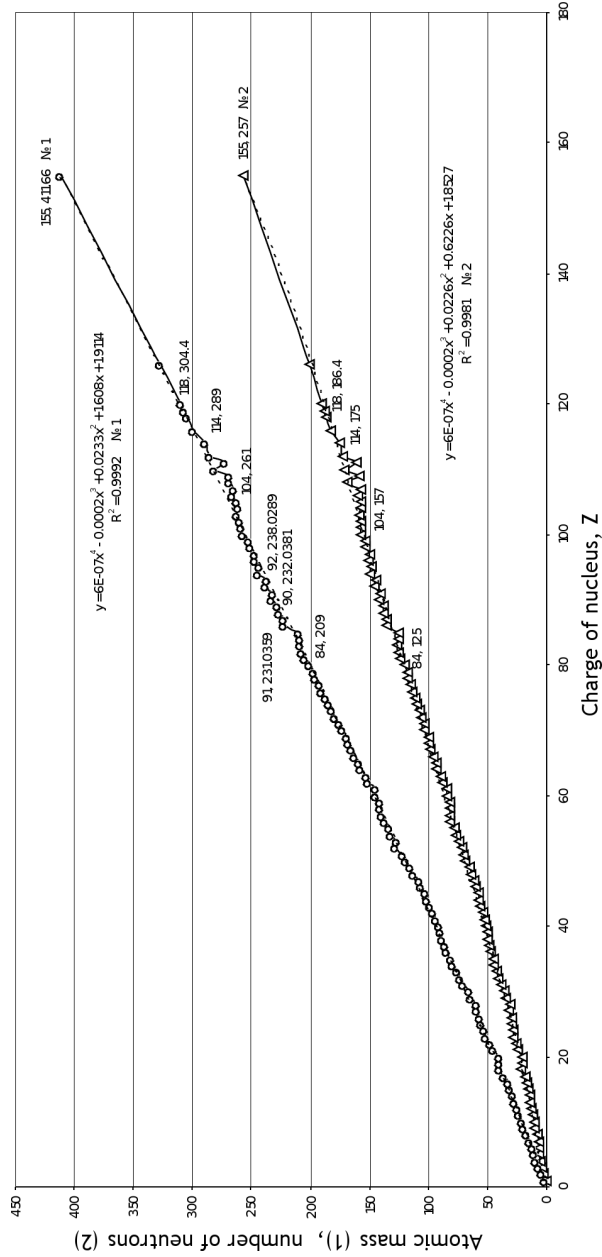


Fig. 4.3: Dependence of element mass number (1) and corresponding numbers of neutrons (2) on the atomic number in the Periodic Table.

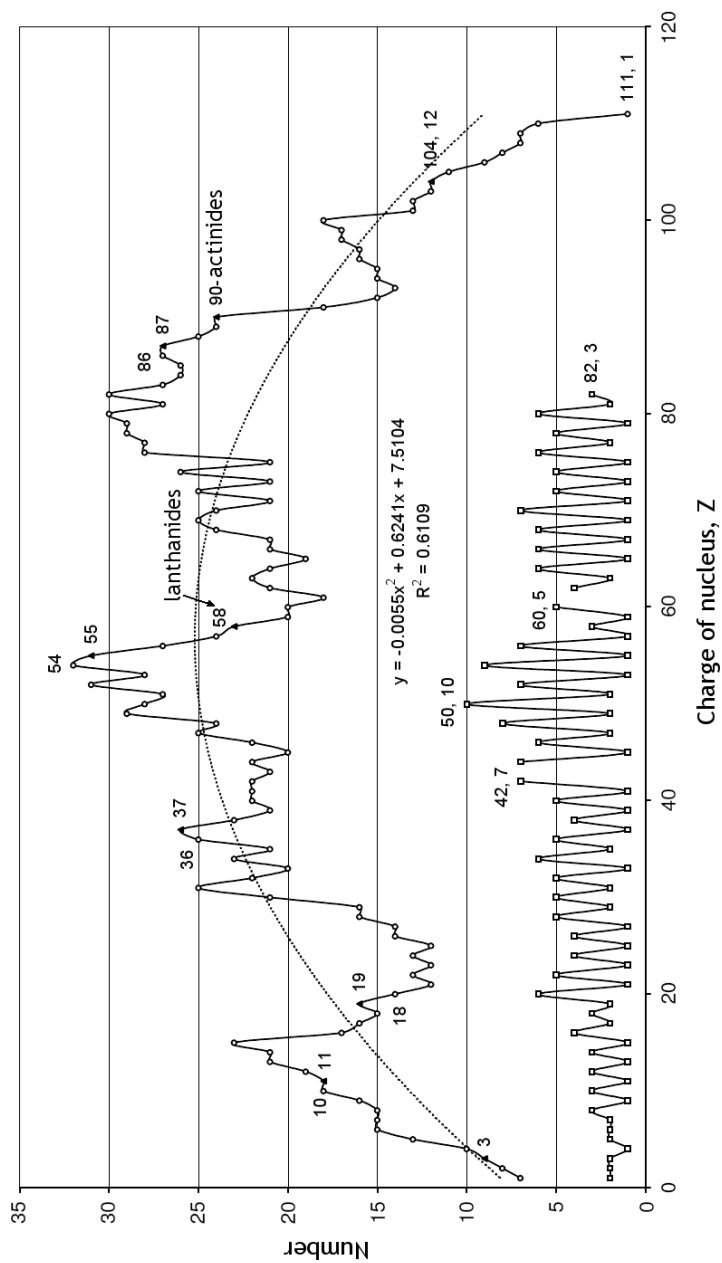


Fig. 4.4: Dependence of total isotopes (circle) and stable elements (square) on atomic number. The triangle designates the beginning of the periods.

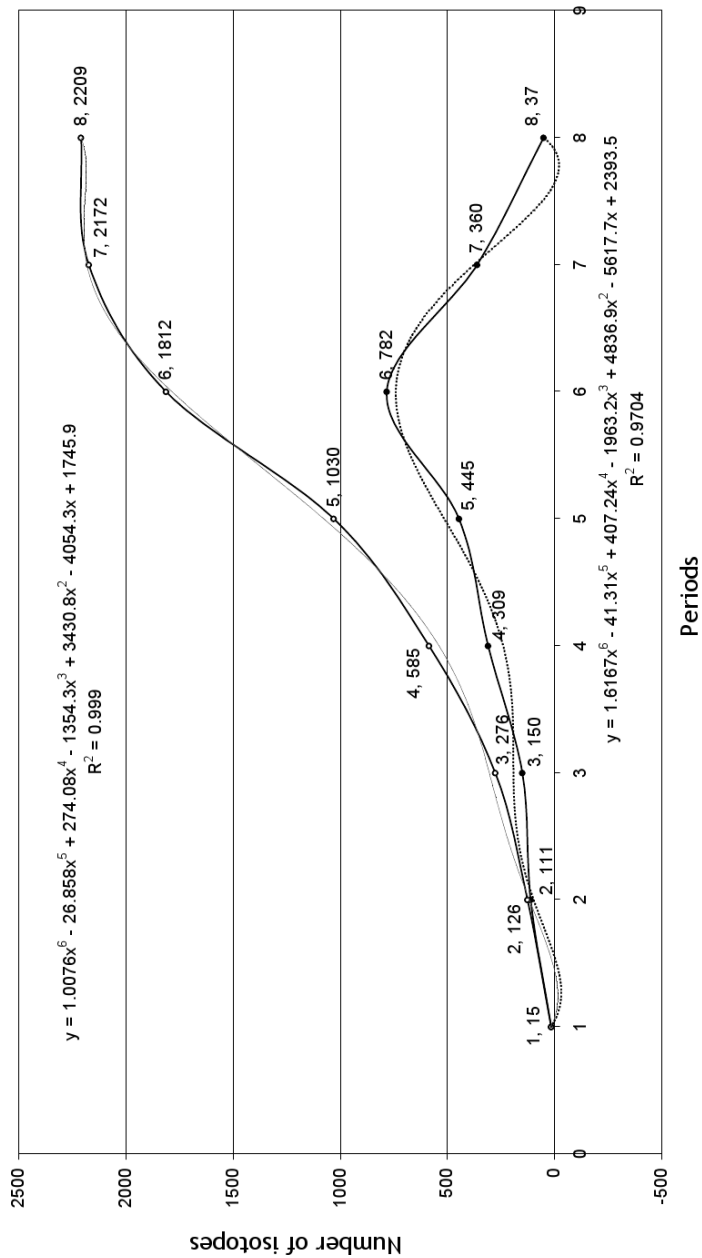


Fig. 4.5: Distribution of isotopes on the periods: an S-shaped summarizing curve, lower-quantity at each point.





122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139
140	141	142	143	144	145	146	147	148	149	150	151	152	153				

Table 4.2: The 8th period — a table of super-actinides (18g and 14f elements) as suggested by G. T. Seaborg and V. I. Goldanskii [1, 2].

119	120	121	154	<b>155</b> <b>Kh</b>
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Table 4.3: An add-on to the 8th period suggested by the Author — s-elements (No. 119, 120), d-elements (No. 121), d-elements (No. 154, 155). Must element No. 155 (Khazanium) be analogous to Ta, as Db?

119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136
137	138	139	154	<b>155</b>													

140	141	142	143	144	145	146	147	148	149	150	151	152	153
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Table 4.4: Fragments of the 8th period, according to the literature [18], with the end (No. 155) as suggested by the Author (in the literature [18] it is continuing over No. 155).

Comment: As seen from the suggested versions of the 8th period, there was no clear views on the position of the element No. 155 in the Periodic Table of Elements, before as we calculated an exact address to it. According to G. T. Seaborg and V. I. Goldanskii, the elements should be positioned in one row, in a pyramidal table: by 50 elements of the 8th and 9th periods. In this case, No. 155 would be in the 5th Group of the standard Mendeleev Table. I suggested 18 elements per row. This, in common with the principle of symmetry, which is specific to the Periodic Table of Elements, positions the last element (No. 155) in the 1st Group of the Periodic Table.

It is particularly evident from Fig. 4.2, in which small fragment of the  $N$ - $Z$  diagram is amplified and augmented with some theoretically determined nuclei, including the heaviest element  $Z = 155$ , that the equations of lines of trend and the values of  $R^2$  are practically identical in both Figures. When the line of trend for Fig. 4.1, without element 155, is extrapolated beyond  $Z = 114$ , it passes through the same point in Fig. 4.2 for  $Z = 155$ , indicating that element 155 is correctly placed by theory.

The predicted element No. 114–184 is displaced from the line of a trend. With a nuclear charge of 114 it should have 179 neutrons ( $A = 293$ ) whereas 184 neutrons has atomic number 116. In the first case there is a surplus 5 neutrons, in the second a deficit of 2 protons. For an element 126 (on hypothesis) the mass number should be 310, but by our data it is 327. The data for mass number 310 corresponds to  $Z = 120$ .

It is important to note that there is a close relation between the mass number and the atomic mass. The Author's formulation of the Periodic Law of D.I. Mendeleev stipulates that the properties of elements (and of simple compounds) depend upon periodicity in mass number. It was established in 1913, in full conformity with the hypothesis of Van den Brook, that the atomic numbers of the chemical elements directly reflect the nuclear charge of their atoms. This law now has the following formulation:

“Properties of elements and simple substances have a periodic dependence on the nuclear charge of the atoms of elements”.

In the Periodic Table the last, practically stable element is Bismuth,  $Z = 83$ . The six following elements (No.'s 84 to 89) are radioactive and exist in Nature in insignificant quantities, and are followed by the significant radioactive elements Thorium, Protactinium and Uranium ( $Z = 90, 91,$  and  $92$  respectively). The search for synthetic elements (No.'s 93 to 114) continues. In the IUPAC table, mass numbers for elements which do not have stable nuclides, are contained within square brackets, owing to their ambiguity.

It is clear in Fig. 4.3 that the reliability ( $R^2$ ) of approximation for both lines of trend is close to 1. However, in the field of elements No. 104 to No. 114, fluctuations of mass number, and especially the number of neutrons, are apparent.

According to the table, the most long-lived isotope of an element violates the strict law of increase in mass number with increase in atomic number. To check the validity of element No. 155 in the general line of trend of elements for all known and theoretical elements, the two following schedules are adduced:

- 1) For element numbers 1 to 114,  $Y = 1.6102 X^{1.099}$  at  $R^2 = 0.9965$ ;
- 2) For element numbers 1 to 155,  $Y = 1.6103 X^{1.099}$  at  $R^2 = 0.9967$ .

Upon superposition there is a full overlapping line of trend that testifies to a uniform relation of dependences. Therefore, in analyzing products of nuclear reactions and in statement of experiment it is necessary to consider an element No. 155 for clarification of results.

### §4.3 The 8th period of the Periodic Table of Elements

Our theoretical determination of the heaviest element at  $Z = 155$  allows for the first time in science a presentation of Mendeleev's Table with an 8th period. Without going into details, we shall note that at the transuranium elements, electrons are located in seven shells (the shells from 1 to 7 included), which in turn contain the subshells s, p, d, f. In the 8th period there is an 8th environment and a subshell g.

G. T. Seaborg and V. I. Goldanskii, on the basis of the quantum theory, have calculated in the 8th period internal transitive superactinoid a series containing 5g-subshells for elements No. 121 to No. 138 and 6f subshells for No. 139 to No. 152. By analogy with the seventh period, No. 119 should be alkaline, No. 120 should be an alkaline earth metal, No. 121 — similar to Actinium and Lanthanium, No. 153 to No. 162 contain a 7d subshell, and No. 163 to No. 168 an 8p subshell. The latter class resulted because these scientists assumed the presence not only of an 8th, but also a 9th periods, with 50 elements in each.

However, distribution of isotopes depending on a atomic number of the elements (Fig. 4.4) looks like a parabola, in which branch  $Y$  sharply decreases, reaching the value 1 at the end of the seventh period. It is therefore, hardly possible to speak about the probability of 100 additional new elements when in the seventh period there is a set of unresolved problems.

Our problem consisted not so much in development of methods for prediction of additional elements, but in an explanation as to why their number should terminate No. 155. Considering the complexities of synthesis of heavy elements, we have hypothesized that their quantity will not be more than one for each atom. Then, from Fig. 4.5 it can be seen that the  $S$ -figurative summarizing curve already in the seventh period starts to leave at a horizontal, and the 8th reaches a limit. The bottom curve shows that after a maximum in the sixth period the quantity of isotopes starts to decrease sharply. This provides even more support for our theoretical determination of the heaviest possible element at  $Z = 155$ .

In July 2003 at International Conference in Canada, resulting in publication [19], it was asked “Has the Periodic Table a limit?”

The head of research on synthesis of elements in Dubna (Russia), Y. Oganessian, has remarked that the question of the number of chemical elements concerns fundamental problems of science, and therefore the question, what is the atomic number of the heaviest element?

Despite the fact that hundreds of versions of the Periodic Table have been offered of the years, none have designated the identity of the heaviest element. The heaviest element is offered in Table 4.3 shown in Page 56.

#### §4.4 Conclusions

With this Chapter in a series on the upper limit of the Periodic Table of the Elements, the following are concluded:

1. As the fact of the establishment of the upper limit in Periodic Table of Elements until now is incontestable (on October 25, 2005, appeared the first publication on the Internet), it is obviously necessary to make some correction to quantum-mechanical calculations for electronic configurations in the 8th period.
  2. In modern nuclear physics and work on the synthesis of superheavy elements it is necessary to consider the existence of a heaviest element at  $Z = 155$  with the certain mass number that follows from the neutron-proton diagram.
  3. For discussion of the number of the periods and elements in them it is necessary to carry out further research into the seventh period.
  4. From the schedules for distribution of isotopes, it is apparent that the end of the seventh period of elements is accounted for in units because of technical difficulties: No. 94 to No. 103 have been known for 20 years, and No. 104 to No. 116 for 40. Hence, to speak about construction of the Table of Elements with the 8th and ninth periods (100 elements), even for this reason, is not meaningful.
  5. The variants of Mendeleev’s Periodic Table constructed herein with inclusion of the heaviest element No. 155 opens a creative path for theoretical physicists and other scientists for further development of the Table.
-

## Chapter 5

# Introducing the Table of the Elements of Anti-Substance, and the Theoretical Grounds to It

### §5.1 Introduction

As can be seen in [20,21], our method has produced hyperbolas located in the first quadrant. At the same time, their second branches have not been investigated from the point of view of the hyperbolic law in the Periodic Table of Elements.

Its essence is reflected in the fact that in any chemical compound with molecular mass  $X$  referred to one gram-atom of a defined element  $K$ , its maintenance  $Y$  represents the equilateral hyperbola  $Y = K/X$  whose top is located on the real axis located in a corner at  $45^\circ$  with respect to the abscissa in the positive direction.

### §5.2 Mathematical grounds. A principle of symmetry

For any element  $K > 0$  there is only one hyperbola consisting of two branches (in the first and the third quadrants). Hyperbolas with various values  $K$  cannot be imposed against each other. At each point of a hyperbola, there are coordinates according to the equation  $X \cdot Y = K$  where  $X$  and  $Y$  can have not only positive values, but also negative values. If we identify the set of hyperbolas at various values  $K$ , they can wholly fill the area of the rectangular corner  $XOY$  (the first quadrant). In mathematics, the two branches of an equilateral hyperbola are symmetric with respect to each other. The real axis passes through the tops located in the first and third quadrants, and also through the center of symmetry. The normal to it is an imaginary axis, and also an axis of symmetry around which it is possible to combine both quadrants.

### §5.3 The comparative analysis of equilateral hyperbolas in the first and third quadrants

Let's consider the hyperbolas of Beryllium, Chromium, Mercury, and the last element identified by us, which we shall call 155 and which is

represented in Fig. 5.1. Apparently, the ordinate of the curves is equal to unity, while the abscissa is 600. The tops of the curves are on the real axis which is perpendicular to the imaginary axis, while their curvature decreases with the growth of molecular mass. These properties have been considered in detail, above in this book, for the first quadrant, in which  $Y = K/X$  (where  $X > 0, Y > 0$ ).

If these hyperbolas are constructed in the coordinates  $X < 0, Y < 0$ , (at  $K > 0$ ), they will take the place of the second branches and settle down in the third quadrant. Hence, the properties of these equilateral hyperbolas, proceeding from mathematical concepts, except for one, can be completely found. It is impossible to combine these curves in two quadrants as the axes  $X$  and  $Y$  have different names and, accordingly, we see that the scales are caused by chemical conditions.

This discrepancy can be excluded if we take advantage of the factor of scaling  $M = 20.2895$ . In a graph shown in Fig. 5.2 the same hyperbolas in the coordinates transformed by means of  $M$  are shown:  $X' = X/M, Y' = YM$ . Apparently, the form and properties of the hyperbolas after transformation remain unchanged and prove the mathematical principles.

If now around an imaginary axis we make the third and the first quadrants overlap, it is possible to see that there is nearly full concurrence among the curves and real axes (Fig. 5.3). However, there is some increase in the ordinates because the abscissa in Fig. 5.2 possesses a slightly higher value than that of the ordinate, which is easy to notice from the position of circles designating the second branches. It has no basic value since the initial scales of the coordinate axes are naturally various upon their schematic construction. Therefore, the corner of the real axis seems to be less than  $45^\circ$  though its equation is given by the equality  $Y = X$ . This fact is due to the scale of coordinate axes only. At identical values of  $X$  and  $Y$ , the tangent of the corner of an inclination of the real axis of an equilateral hyperbola is equal to 1, while, at the same time, its top is defined as a root square of  $K$  and corresponds to the equality  $X_0 = Y_0$ .

It is necessary to note also that all the established laws apply extensively to adjacent hyperbolas of the kind given by  $Y = 1 - KX$ .

#### §5.4 Discussion of results

On the basis of our results, it is possible to draw a conclusion that the properties of hyperbolas described by  $K = XY$ , which is in first quadrant, prove to be true. The same holds for those in the third quadrant,

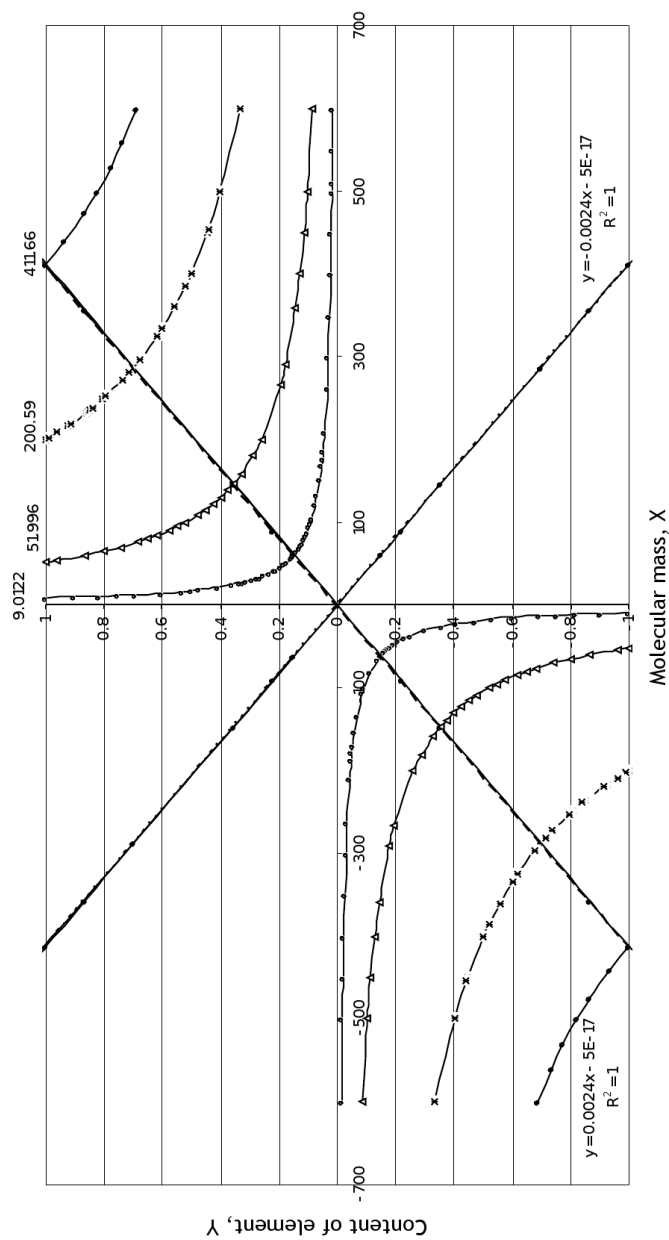


Fig. 5.1: Dependence of the contents of Be, Cr, Hg, No. 155 from molecular mass of the compounds.

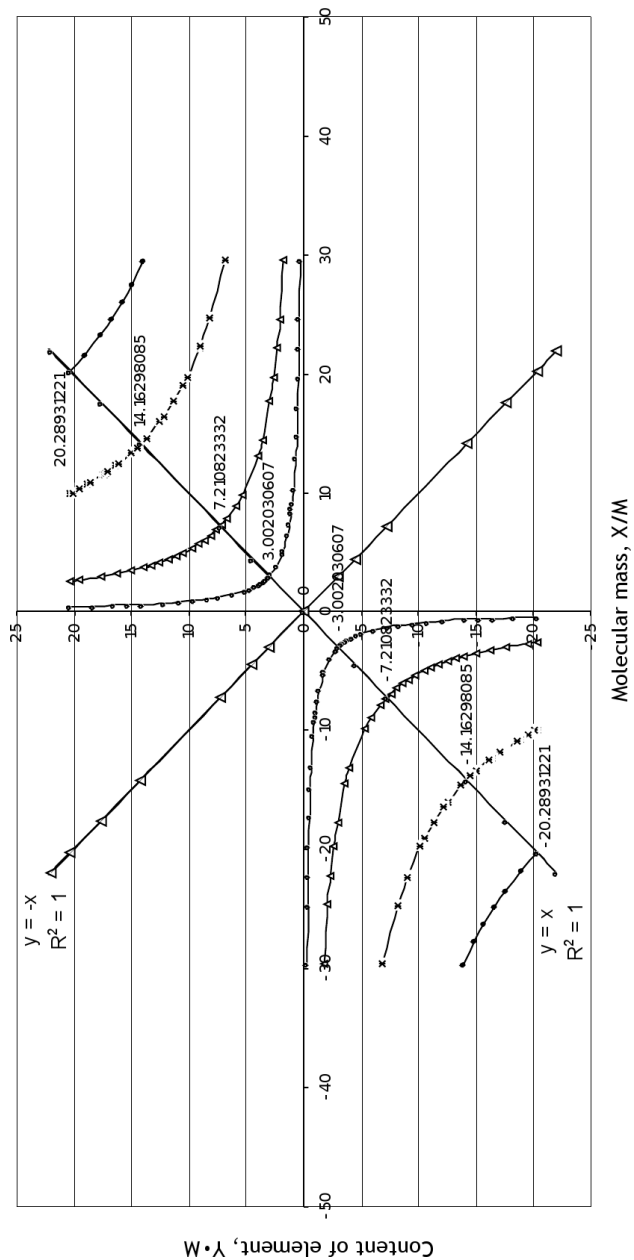


Fig. 5.2: Dependence of the contents of Be, Cr, Hg, No. 155 from molecular mass of the compounds, using the scaling coefficient  $M$ .



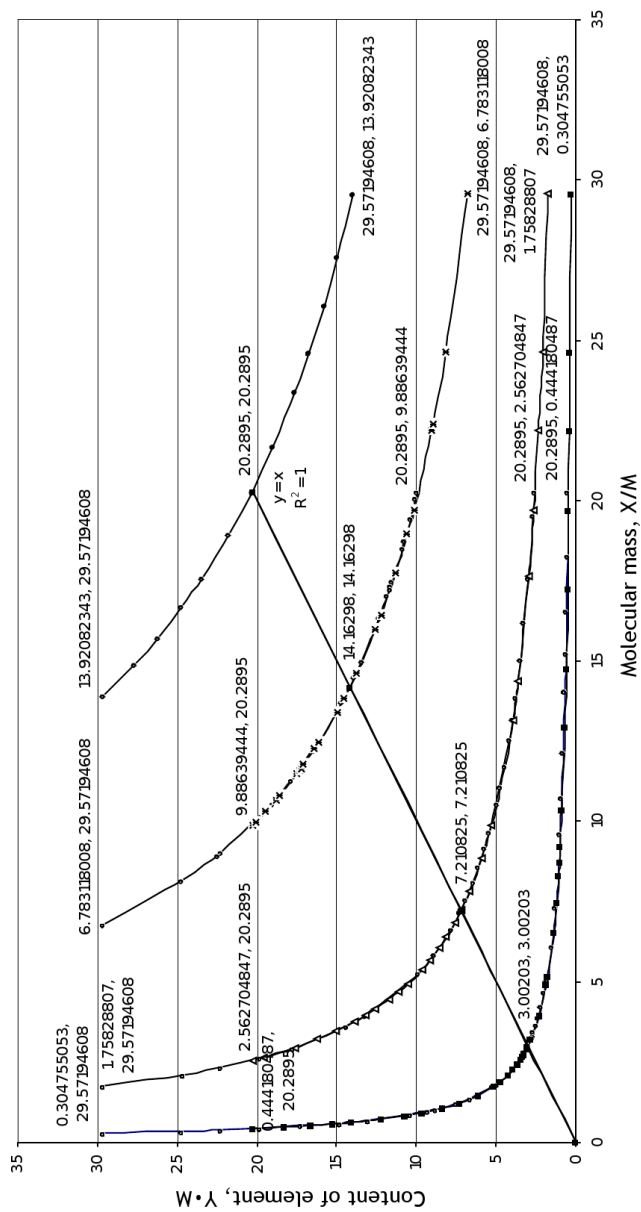


Fig. 5.3: The scale of the axes  $X$  and  $Y$  are numerically like each other, while the divisions of the scales are different. So, if a division is 3.075 in the axis  $X$ , while it is 1.75 in the axis  $Y$ . Under 60, the corner of the real axis gives  $45^\circ$ .

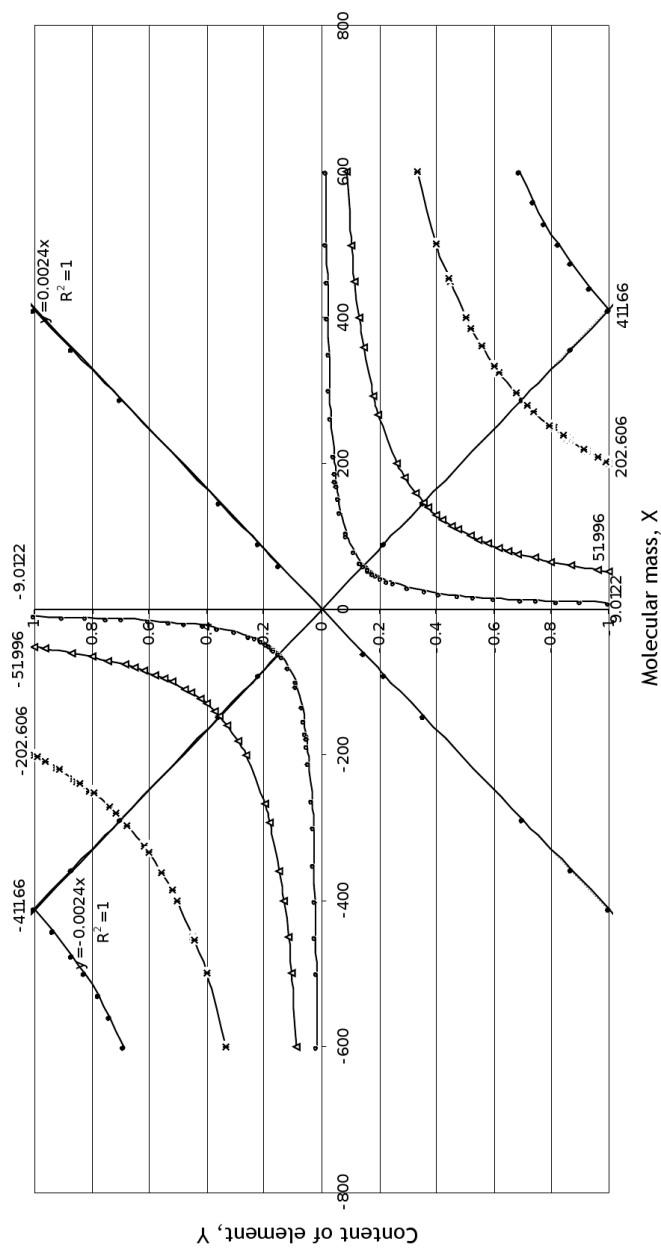


Fig. 5.4: Dependence of the contents of Be, Cr, Hg, No, 155 from molecular mass of the compounds in the 2nd and 4th quadrants.

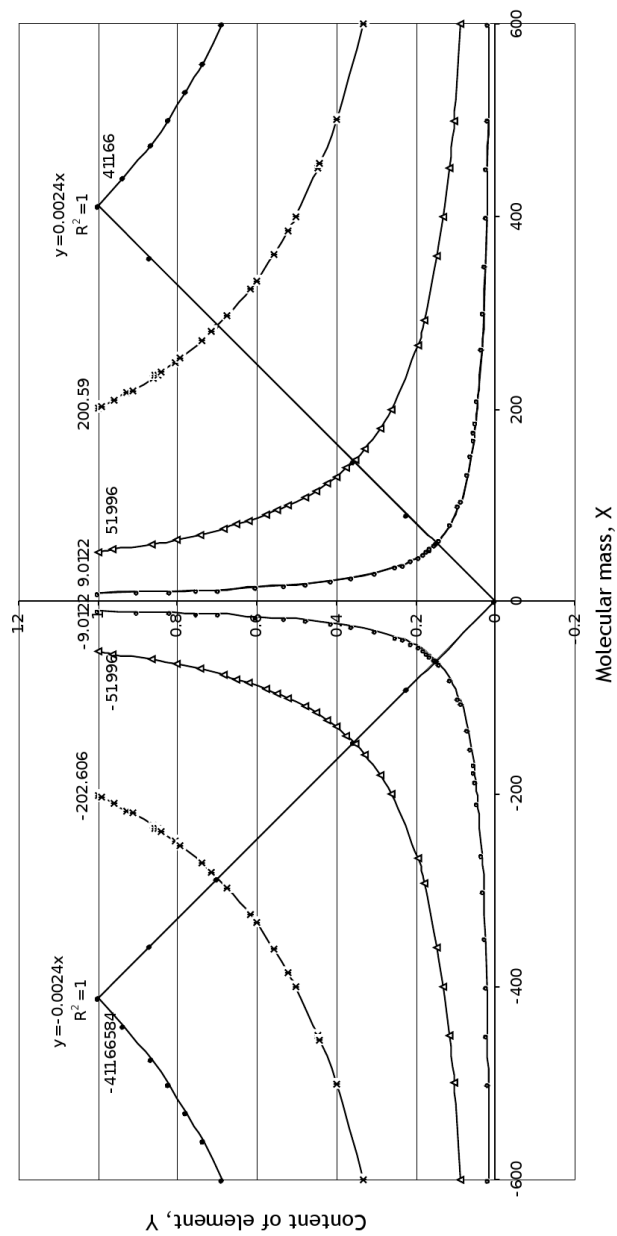


Fig. 5.5: Dependence of the contents of Be, Cr, Hg, No. 155 from molecular mass of the compounds in the 1st and 2nd quadrants.



57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

Lanthanides (first row) and actinides (second row).

119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136
137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
<b>155</b>																	

The 8th period of the Periodic Table.

Table 5.1 (shown in Pages 67–68): The Periodic Table of Elements and Anti-Elements, with the 8th period. Long dash is signed for anti-elements.

where  $K = (-X) \cdot (-Y)$ . Hence, the action of the hyperbolic law covers also an area of negative values of coordinate axes covering 155.

We recall the construction of hyperbolas at  $K < 0$  (Fig. 5.4). Therefore, it has been established that in the second and the fourth quadrants of the hyperbolas, the same laws hold, which have also been established by us for the first and the third quadrants. It is caused by the fact that the equilateral hyperbolas have equal parameters on the module, but opposite in sign, namely, they are mutually interfaced and so possess identical properties. Therefore, proceeding from the chemical concepts, they can be symmetric only after changing the scale of the axes  $X$ ,  $Y$ . Thus, referring to their congruence, unlike other mathematical conditions: curves coincide in the field of action of the factor  $M$ . Outside, its one hyperbola is generated as the abscissa increases, while the second corresponds to the increase in ordinate, not changing the direction of a curve. As it has appeared, absolute symmetry is available only on the axes  $X$  and  $Y$ .

Because in the third and fourth quadrants, a negative ordinate (a degree of transformation of a substance) cannot occur in Nature, we shall consider only quadrants 1 and 2.

From Fig. 5.5 it is seen that for  $K > 0$  and  $K < 0$  the congruence of hyperbolas and their real axes are imposed against each other.

Corresponding to such symmetry, there is a question about the observation of chemical conditions. In the first quadrant, they have been considered in detail and do not cause doubts. In the second case (at  $K < 0$ ) the abscissa is negative, and the ordinate is positive. Here the degree of transformation  $Y$  defined as the mass of an element (of one gram-atom), with respect to the corresponding molecular mass, is given by  $Y = K/(-X)$ , or, in other words,  $K = (-X)Y$ . From the point of view of mathematics, this result is fair. At the same time, physicists are in need of further necessary elaboration from the point of view of chemistry.

### §5.5 Substances and anti-substances

It is known that a *substance* consists of atoms containing protons, neutrons, and electrons. An *anti-substance* differs only by the prefix “anti”. In terms of chemical condition, all substances are divided into simple and complex (chemical compounds). They can be both organic and inorganic.

As the hyperbolic law in the Periodic Table has been proved for hyperbolas of the first quadrant, there arises an idea to apply it also

to the second quadrant. As the basis for this purpose, the quadrants are symmetric and the maintenance of elements in connexion ( $Y$ ) has a positive value. The difference consists only in those abscissas with opposite signs. But it is possible only when the molecular mass of a chemical compound has a minus sign. If, in the first quadrant, we arrange all possible hyperbolas around 155 inclusively, nothing prevents us from making the same apply to the second quadrant. Hence, in it there are substances with a minus sign, i.e., anti-substances constructed of anti-particles (similar to the substances in the first quadrant). With respect to mass, they are similar to a proton, neutron and, electron, only with an opposite (minus) sign.

From this it follows that it is possible to construct a Periodic Table, which is common for the elements of substances and for the elements of anti-substances. Such a Periodic Table has been constructed by the Author [22, 23], and shown as Table 5.1 in Pages 67–68 (it is similar to Table 4.1 we suggested in Chapter 4, Page 55, for the elements of substances only). For example, the known synthesized elements (their hyperbolas are more exact): anti-Hydrogen, anti-Deuterium, and anti-Helium occupy symmetric places in both quadrants.

### §5.6 Conclusions

On the basis of symmetry with application of the hyperbolic law in the Periodic Table of Elements, the existence of anti-substances has been indirectly proved. As well, the construction of the various hyperbolas in the second quadrant and in the Table has been shown to be similar to that of the Periodic Table of Elements. It is clear that the third and fourth quadrants cannot be (directly) applied to calculation in the field of chemistry because the negative degree of transformation of substances does not exist.

Hence, it is now possible to draw a conclusion that the hyperbolic law established by us in the Periodic Table of Elements is generally true for the characteristics of not only substances, but also those of anti-substances [22, 23]. It also allows us to calculate all nuclear masses upto the last element (anti-element).

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## Chapter 6

# Using Element No. 155 to Prove the Systematic Errors of the Quantum Mechanical Calculations

### **§6.1 On the necessity of using element no. 155 in the chemical physical calculations**

#### **§6.1.1 Introduction**

At the present time, we know about 20 lists of chemical elements (representing their most important properties such as atomic mass and radius, density, temperatures of melting and boiling, energy of ionization, etc.), which were suggested by their authors as periodic tables of the elements. These data were however obtained for, mainly, stable isotopes and numerous other radioactive isotopes that makes further interpolation of these properties onto superheavy elements quite complicate.

This is most important for planning further experiments whose task is synthesis new superheavy elements which approach to the recently predicted heaviest element No. 155, whose atomic mass is 411.66 (the upper limit of elements in Mendeleev's Table of Elements behind which stable elements cannot exist). Thus, using the parameters of element 155 in the analysis of other elements, we will see in this paper how the properties of the elements behave with increasing their number in the Table.

#### **§6.1.2 Some peculiarities of the dependency between atomic mass of the elements and their numbers in the Table of Elements**

Consider the dependency between atomic mass of the elements and their number in the Table of Elements. This dependency is well known in science and industry and is presented as numerous lists and tables. As is seen in Fig. 6.1, this dependency is well described by the exponential equation of the line of the trend. However, if we take more attention to this figure, we find numerous areas which destroy the common picture. Approximately smooth line continues from the origin of coordinates to almost the end of Period 6 (No. 83, 208.98, Bismuth). This is the last



stable isotope, after whom all elements of the Table have an artificial (radioactive) origin, except of Thorium (No. 90, 232.038), Protactinium (No. 91, 231.036) and Uranium (No. 92, 238.029). This is their order in the family of actinides. Period of half-decay of these natural elements consists many thousand years. It is easy to find in the figure that valuable deviations from the line of the trend are present in the region from Bismuth to element 104, then to element 119 where the deviations from the line of the trend are high (especially — in the region of the already synthesized superheavy elements 104–118).

This is seen more obvious in Fig. 6.2, where the absolute deviations of the atomic masses are presented. These are deviations between the data of the Table of elements and the result obtained after the equation

$$y = 1.6143 x^{1.0981}, \quad R^2 = 0.9969, \quad (6.1)$$

where  $y$  is the atomic mass, while  $x$  is the number in the Table of Elements.

It should be noted that mass number is an integer equal to the common number of nucleons in the nucleus. Mass number of an isotope is equal to the numerical value of its mass, measured in atomic mass units (a.m.u.) and approximated to a near integer. A difference between the mass numbers of different isotopes of the same element is due to the different number of neutrons in their nuclei.

It is seen in the figure that this difference does not exceed 4 a.m.u. in the first five periods and in lanthanides. This tendency still remain upto Bismuth after whom the deviations of actinides experience a positive shift: this means that the numerical values of the atomic masses presented in the Periodic Table are overstated for the region.

Then, after actinides, a region of the atomic masses of the elements of Period 7 (elements 104–118) is located. These elements were obtained as a result of nuclear reactions. As is seen, all deviations in this region are negative: this can mean a large deficiency of the numerical values of the atomic masses obtained in the nuclear synthesis producing these elements, incorrect calculations, or a lack of neutrons in the nuclei. All these in common resulted large deviations of the atomic masses upto 10–12 a.m.u.

Look at Fig. 6.1 and Fig. 6.2 again. Section of the line of the trend in the interval No. 119–155 is manifested in Fig. 6.1 as a very straight line without any deviation, while the same section in Fig. 6.2 manifests deviations from 0.63 to 1.28. Once we get a ratio of the difference between the table and calculated numerical values of the atomic masses to the

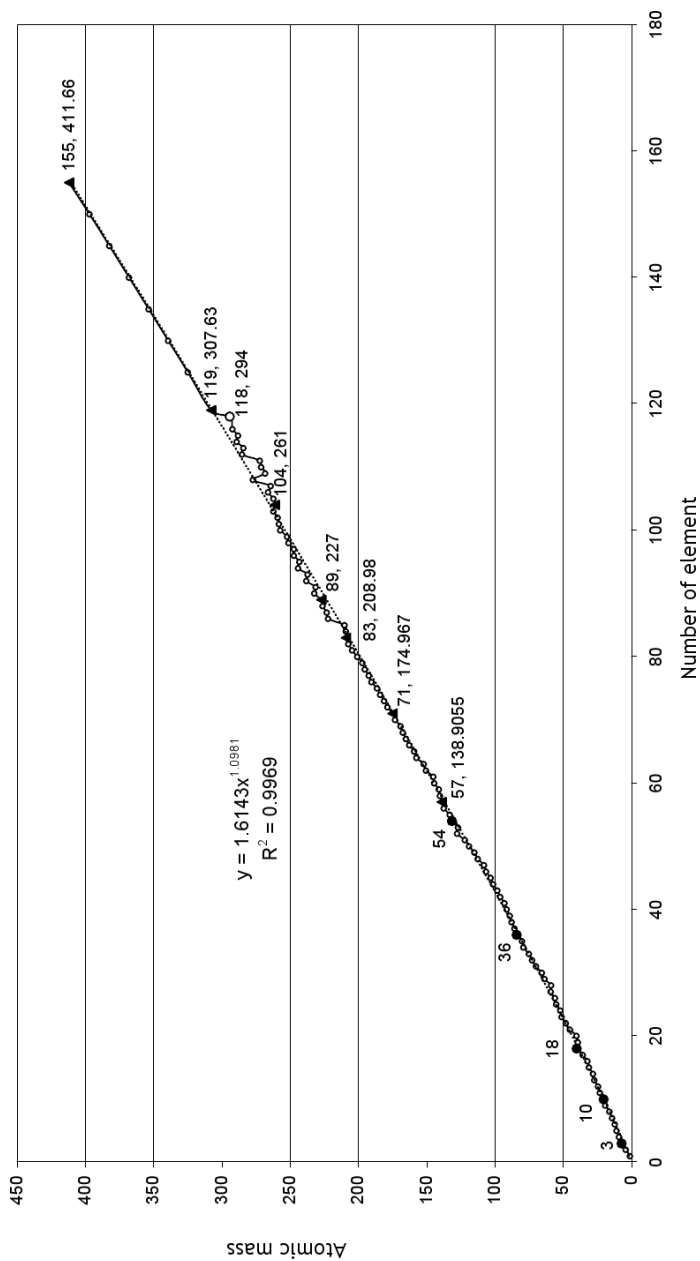


Fig. 6.1: Dependency between the atomic mass of the elements and their number in the Table of Elements (including element 155).

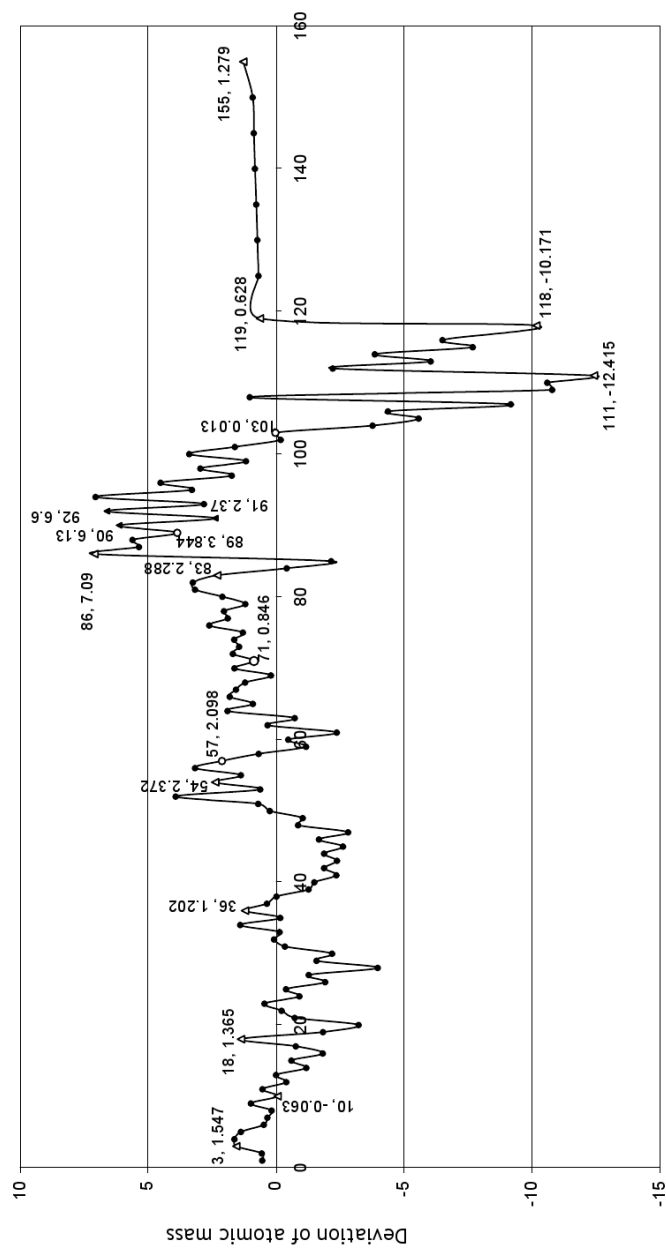


Fig. 6.2: Absolute deviations of atomic masses of the elements from the line of trend (including element 155).

respective a.m.u., we obtain Fig. 6.3 which shows the respective deviations in percents. As is seen in the figure, most valuable deviations are located in the left side (up to the first 20 numbers). This is because the respective elements of the Table of Elements bear small atomic masses under high difference of a.m.u., i.e. the larger numerator results the larger ratio. It is necessary to note that the results presented in this figure are within 3–5%. Most lower results are located in the scale from element 104 to element 118: according to our calculation, the deviations are only 0.2–0.3% there.

In order to exclude any influence of our calculations onto the creation of the line of the trend, we study the dependency “atomic mass — number in the Table” in the scale from element 1 to element 118 according to the equation

$$y = 1.6153 x^{1.0979}, \quad R^2 = 0.9966. \quad (6.2)$$

As a result we obtain that the general shape of the deviations and their numerical values are actually the same as the results obtained due to equation (6.1). So forth, the next particular equations were taken under analysis:

$$\text{elements 1–54:} \quad y = 1.6255 x^{1.0948}, \quad R^2 = 0.9922, \quad (6.3)$$

$$\text{elements 55–118:} \quad y = 1.8793 x^{1.0643}, \quad R^2 = 0.9954, \quad (6.4)$$

$$\text{elements 119–155:} \quad y = 1.5962 x^{1.1009}, \quad R^2 = 1.0. \quad (6.5)$$

These sections gave no any substantial change to the previous: the ultimate high difference of the deviations taken in 3 points of 120 was 0.7% for element 111, 0.95% for element 118, and 1.5% for element 57.

### §6.1.3 Why one third of the elements of the Table of Elements is taken into square brackets?

94 chemical elements of 118 already known elements are natural substances (contents of several of them consists, however, of only traces). Rest 24 superheavy elements were obtained artificially as a result of nuclear reactions. Atomic mass of an element in Table of Elements is presented by the average atomic mass of all stable isotopes of the element with taking their content in the lithosphere. This average mass is presented in each cell of the Table, and is used in calculations.

If an elements has not stable isotopes, it is taken into square brackets that means the atomic mass of most long living isotope or the specific isotope contents. There are 35 such elements. Of those 35, elements

from 93 to 118 are actinides and artificially synthesized superheavy elements. Hence, one third of 118 elements (known in science at the present time) bears undetermined atomic masses.

Fig. 6.4 shows common number of isotopes of all elements of the Table of Elements. Location of all elements can be described by the equation of parabola with a high coefficient of real approximation. As is seen, the descending branch of the parabola manifest that fact that the heavier element in the Table (the larger is its number) the lesser number of its isotopes. This tendency lads to decreasing the number of isotopes upto 1 at element 118.

#### §6.1.4 Synthesis of superheavy elements and the upper limit of the Periodic Table

Because number of the isotopes reduces to 1 in the end of Period 7, the possibility of Period 8 and Period 9 (each consisting of 50 elements) in the Table of Elements suggested earlier by Seaborg and Goldanskii [1, 2] seems non-real. At the same time, Seaborg suggested a possibility of the synthesis of a “magic nucleus” consisting of 114 protons and 184 neutrons: according to his suggestion, this nucleus should be the centre of a large “island of stability” in the sea of spontaneous decay. Goldanskii told that the “isthmus of stability” may be a region where isotopes of the elements bearing nuclear charges 114, 126, and even 164 may be located. Flerov [24], when analysed studies on the synthesis of superheavy elements, claimed that the elements should give us a possibility for answering the question: are the elements bearing nuclear charges 100–110 located at the real end of the Table of Elements, or more heavy nuclei exist in the Nature? There are many studies of the conditions of nuclear reactions. For instance, in already 1966, Strutinski [25] theoretically predicted a valuable increase of stability of nuclei near the “magic numbers”  $Z = 114$  and  $N = 184$ . His calculation was based on the shell model of nucleus (this model won Nobel Prize in physics in 1963 [8, 26, 27]).

In 1973, Oganessian in Dubna (Russia) and a group of German scientists in Darmstadt (Germany) first used cold synthesis, where the “magic nuclei” were used as both a target and bombing particles [10]. In 1973, Oganessian claimed that elements with atomic numbers 160 and, maybe, 170, are hypothetically possible. However only two years later, he claimed that the properties of an element with number 400 and bearing 900 neutrons in its nucleus were theoretically discussed [28].

In addition to the indeterminacy of atomic masses in the synthesis of superheavy elements, Oganessian also told, in his papers, that we do

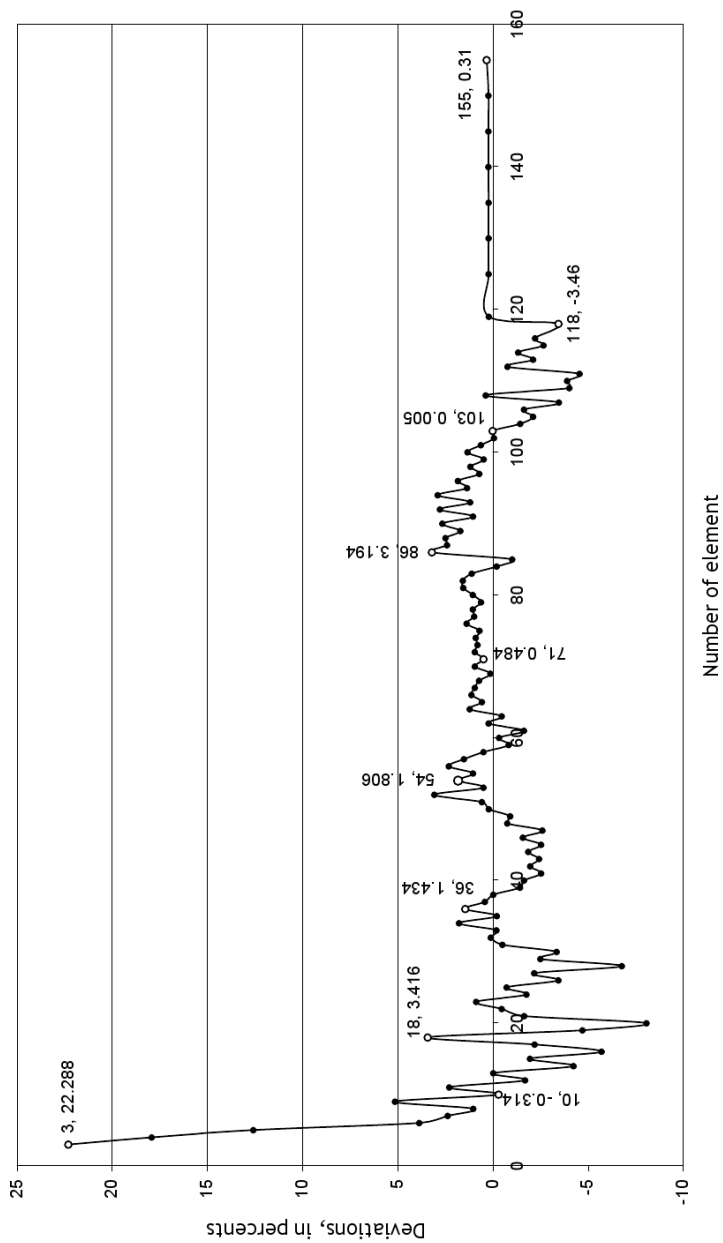


Fig. 6.3: Relative deviation of the atomic masses from the line of the trend, in percents.

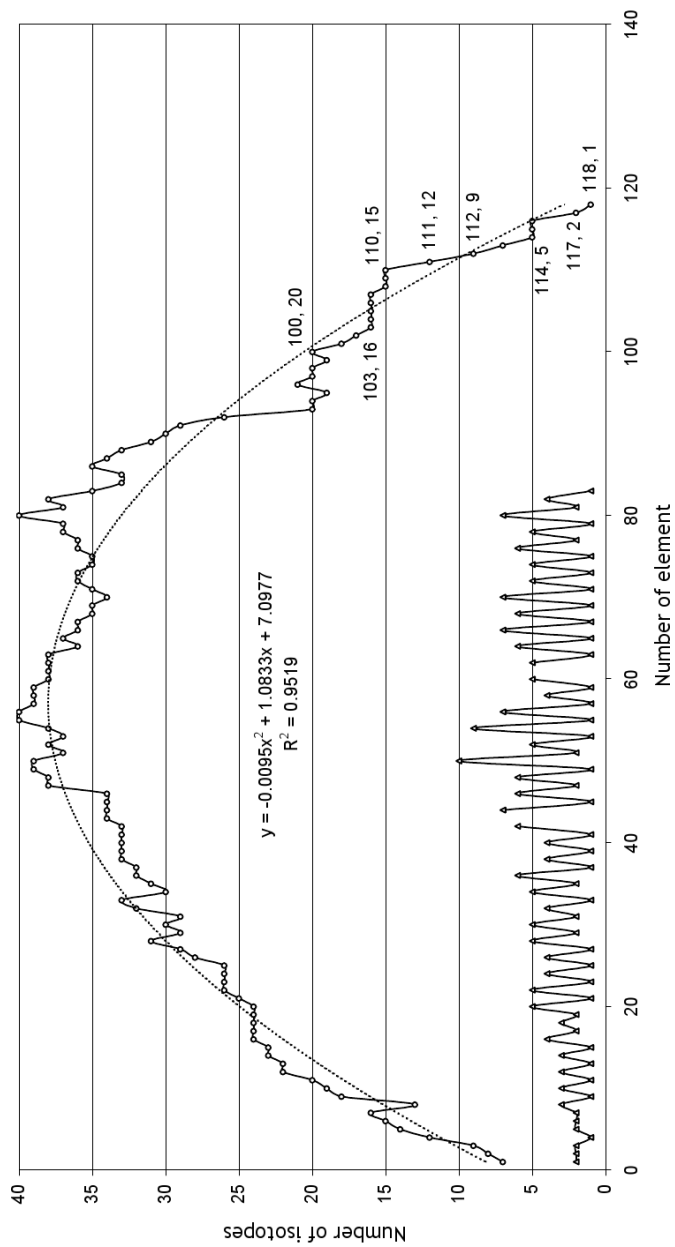


Fig. 6.4: Dependency between the number of the isotopes (3180) and the number of element in the Table of Elements. Location of the stable isotopes (256) is also shown. The data of Brookhaven National Laboratory, National Nuclear Data Center.

not know limits in the Table of Elements behind whom superheavy elements cannot exist. According to his own words, “the question about limits of the existence of the elements should be addressed to nuclear physics” [29]. A few years later, in 2005, Oganessian claimed “this question is still open: where is the limit of chemical elements?” [9]. In 2006, in his interview to *Moscow News*, he set up the questions again: “is a limit there?” and “how many elements can exist?”. So forth, he tells in the interview: “We use modelling instead a theory. Each models approaches this system in a form of those known to us in analogy to the macroscopic world. However we still do not understand what is nuclear substance. Thus the question asked about a limit of the Periodic System is still open for discussion” [30].

In January 20–21, 2009, in Dubna, the international symposium celebrating the 175th birthday of Dmitri Mendeleev set up the question about limits of the Table of Elements, and the complete number of elements in it again. Someone suggested even a possibility of the synthesis of elements with numbers 150–200 [31]. However a few weeks later, in February 09, at a press-conference in Moscow, the participants claimed that “at present the scientists discuss a theoretical possibility of extending Mendeleev’s Periodic Table upto **150 elements**” [32].

In April 07, 2010, the world press claimed about the end of an experiment in which element 117 was synthesized (this experiment continued from July 27, 2009, until February 28, 2010). During these seven months, the experimentalists registered six cases where nuclei of the new element were born. This experiment was also based on the supposition that there is an “island of stability” near an element bearing parameters  $Z = 114$  and  $N = 184$ . Lifespan of this island should be a few million years. However this target was not reached in the experiment. The research group of experimentalists in Dubna prepares next experiments which target synthesis of element 119 and element 120 [33].

In this connexion it is interesting those words said by Sigurd Hofman (the GSI Helmholtz Centre for Heavy Ion Research, Darmstadt), where he claimed about filling the Table of Elements upto its end in the close time. According to his opinion, atomic nuclei heavier than No. 126 cannot exist, because they should have not the shell effect [34].

### §6.1.5 Discussion of the results

1. The considered dependency of atomic masses of the elements on their numbers in the Table of Elements cannot answer the question “where is the upper limit of the Table”.



Despite the coefficient of the line of the trend is very close to unit, it is easy to see that there are large deviations of the data, especially starting from the numbers of actinides and then so forth. Because all actinides bear similar chemical properties, selecting a segregate element in this group is quite complicate task. Besides, the possibility of different isotopic content in samples of the elements leads to a large deviation of the calculated atomic masses from the atomic masses given by the Table of Elements. This is related to one third part of all elements of the Table.

2. Next elements to actinides, i.e. a group of elements 104–118, were synthesized as a result of nuclear reactions, in a very small portions (only segregate atoms were produced). The way how the elements were produced makes a problem in the identification of them, and the large deviations of the data of the Table of Elements from the line of the trend. Hence, atomic masses attributed to these numbers in the Table of Elements, are determined very approximate. The line of the trend, which includes element 155, gives a possibility to exclude the deviations of the atomic masses.

3. Section 6.1.4 gave a survey of opinions on the structure of the Table of Elements, its limits, superheavy elements (their synthesis and the products of the synthesis), the search for an “island of stability”, and the technical troubles with the nuclear reactions.

Many questions could be removed from discussion, if my recommendations suggested in [20], where I suggested the last (heaviest) element of the Table of Elements as a reference point in the nuclear reactions, would be taken into account. This survey manifests that the quantum mechanical approach does not answer the most important question: *where is the limit of the Periodic Table of Elements?* Only our theory gives a clear answer to this question, commencing in the *pioneering paper of 2005*, where the *hyperbolic law* — a new fundamental law discovered in the Table of Elements — was first claimed. This theory was never set up under a substantially criticism.

It should be noted that the word “discovery” is regularly used in the press when telling on the synthesis of a new element. This is incorrect in the core, because “discovery” should mean finding new dependencies, phenomena, or properties, while the synthesis of a new element is something like an invention in the field of industry, where new materials are under development.

4. Taking all that has been said above, I suggest to IUPAC that they should produce a legal decision about the use of element 155, bearing atomic mass 411.66, as a reference point in the synthesis of new super-

heavy elements, and as an instrument correcting their atomic masses determined according to the Table of Elements.

My theory I used in the calculations differs, in principle, from the calculations produced by the quantum mechanical methods, which were regularly used for calculations of the stability of elements. The theory was already approved with the element Rhodium that verified all theoretical conclusions produced in the framework of the theory with high precision to within thousandth doles of percent. Therefore there is no a reason for omitting the theory from scientific consideration.

### §6.1.6 Conclusions

Having all that has been said above as a base, I suggest an open discussion of the study “Upper Limit in Mendeleev’s Periodic Table — Element No.155” at scientific forums with participation of the following scientific organizations:

- International Union of Pure and Applied Chemistry (IUPAC);
- International Council for Science (ICSU);
- American Physical Society (APS).

This step should allow to give a correct identification to the chemical elements and substances, and also to plan new reactions of nuclear reactions with a well predicted result. In this deal, financial spends on the experimental research in nuclear reactions could be substantially truncated, because the result would be well predicted by the theory. The experimental studies of nuclear reactions could be continued as a verification of the theory, and aiming the increase of the experimental techniques. Thus, according to the last data of the List of Chemical Elements (on April 08, 2010), Ununseptium (No. 117) bears atomic mass [295], while atomic mass of Unuoctium (No. 118) is [294]. According to the calculation, produced in the framework of my theory, these quantities should be 301.95 and 304.79 respectively.

As was shown the theoretical studies according to the theory, and its comparing to the experimental data, the element bearing number 155 and atomic mass 411.66 a.m.u. answers all conditions necessary for including it into the Periodic Table of Elements.

## Appendix I

As was already noted above, we took much attention to the dependency between atomic mass of the elements and their number in the Table of Elements. It was shown that the line of the trend continued upto

No. 155 provides obtaining very correct results. In verification of this fact, additional dependencies concerning the last element No. 155 were studied [35].

Fig. 6.5 shows an empirical dependency between the radius of a nucleus and the number of nucleons in it (mass number). This graph manifests that this dependency is true upto element 155: the arc has the same shape without deviation along all its length.

Fig. 6.6 shows an arc, which manifests critical energies of the electrons for all elements of the Table of Elements, including No. 155. A critical is that energy with whom energy loss for ionization and radiation become equal to each other. Formula for the critical energy is  $T_{\text{crit}} = 800/Z$ , where  $Z$  is the charge the nucleus (in units of the charge of the electron). As is seen from the graph, this formula is applicable to all elements of the Table of Elements.

Fig. 6.7 gives calculations of the coupling energy in nuclei. This graph shows that minimally energy required for destruction of the nucleus into its nucleons. It is seen, from the graph, that this dependency is strictly straight along all Table of Elements, including element 155.

Dependency between the number of the neutrons and the charge of the nucleus is shown in Fig. 6.8. As is seen, equation of the line of the trend describes, with a high level of probability ( $R^2 = 0.9997$ ), the polynomial of the fourth order presented in the graph. This equation covers a large region along the axis  $x$ , from element 1 upto element 155 including. This dependency was also calculated, in order to compare it with the previous result, for a truncated region of the protons from element 1 upto element 104:

$$Y = 4E - 0.7x^4 + 2E - 0.5x^3 + 0.007x^2 + 1.0014x - 0.2176, \quad (6.6)$$

where  $R^2 = 0.999$ .

As is seen, certainty the level of the approximation differs only in 0.0007 from the previous. This manifests that fact that this dependency is as well true for the elements heavier than No. 104, including element 155.

## Appendix II

At the present time there are many versions of the periodic tables of elements, where each cell contains a property of a respective element (such as atomic radius, volume, density, first ionization potential, etc.). This information can also be obtained from the regular lists of the properties

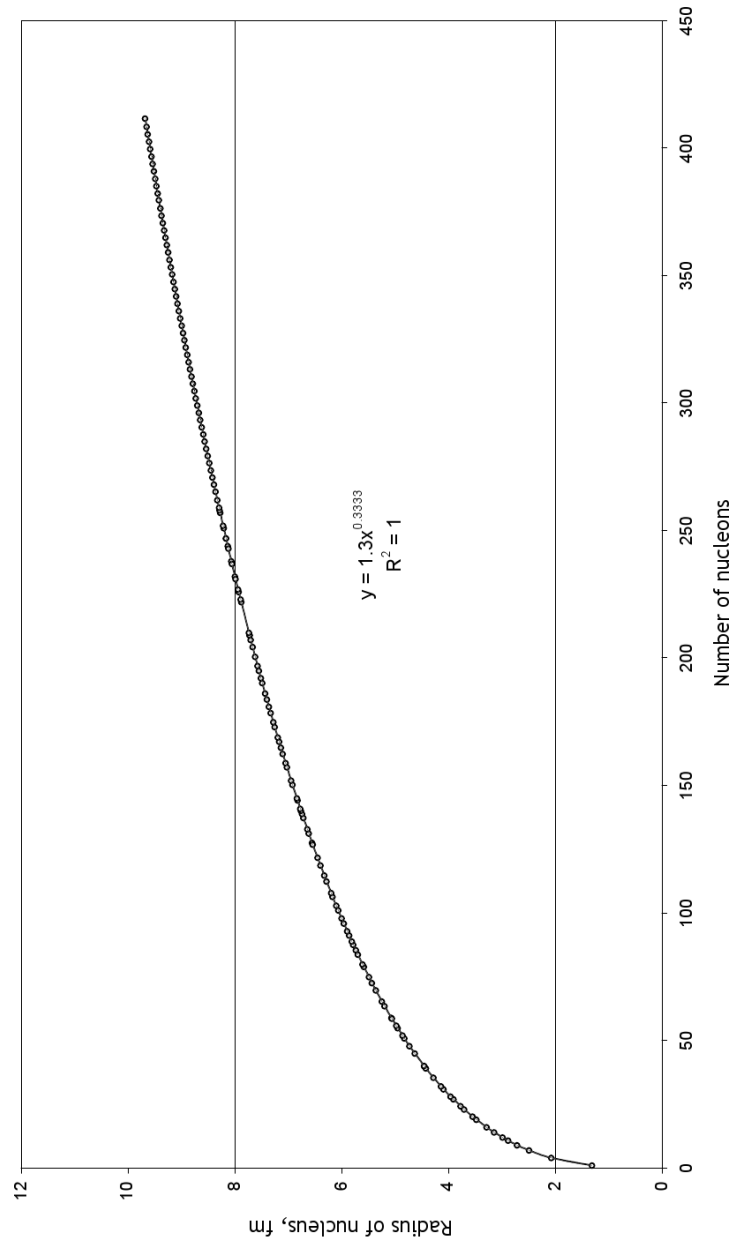


Fig. 6.5: Empirical dependency between the radius of the nucleus (fm) and the number of the nucleons.

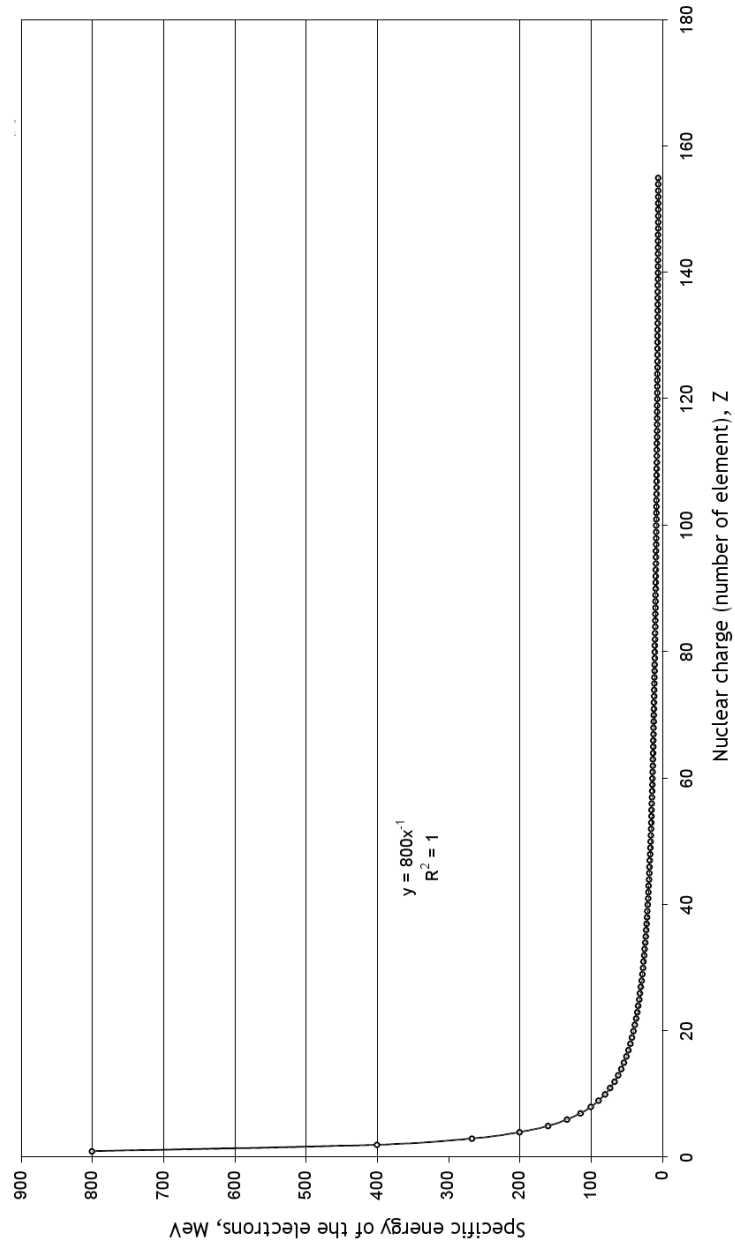


Fig. 6.6: Dependency between the critical energy of the electrons and the nuclear charge, according to formula  $T = 800/Z$ .

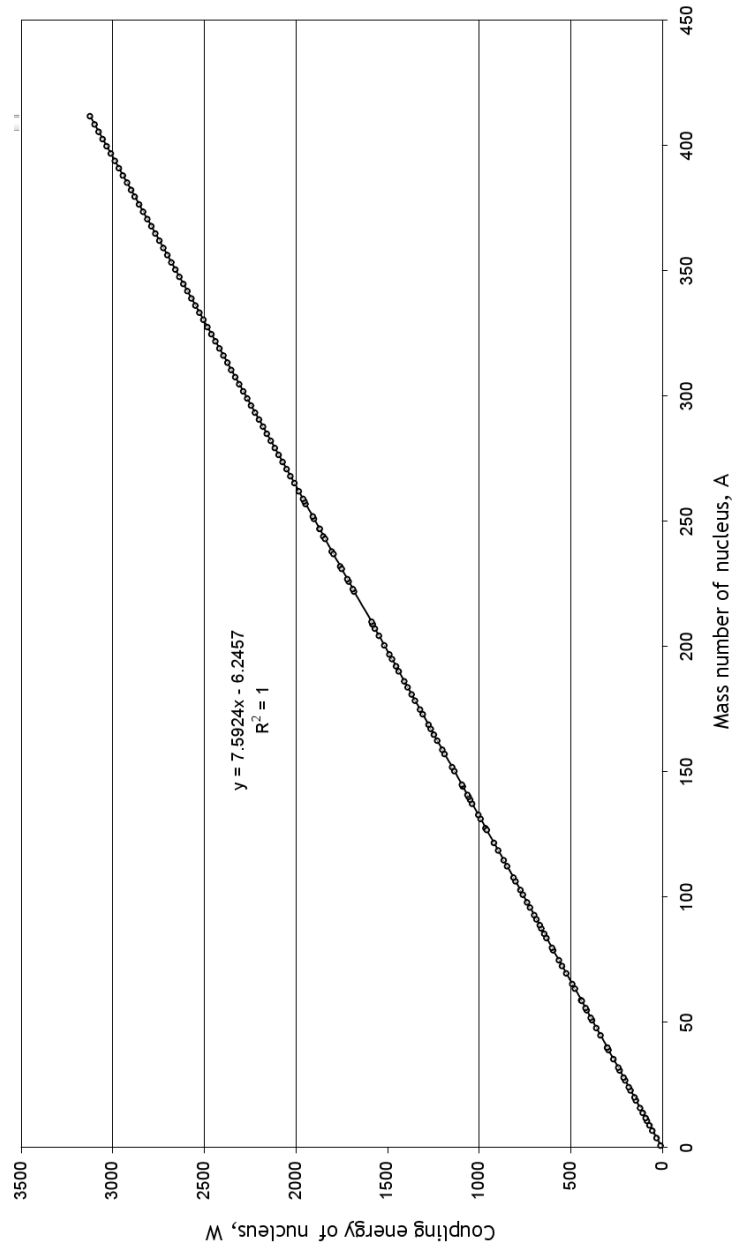


Fig. 6.7: Dependency between the coupling energy of the nuclei and the mass number (number of nucleons).

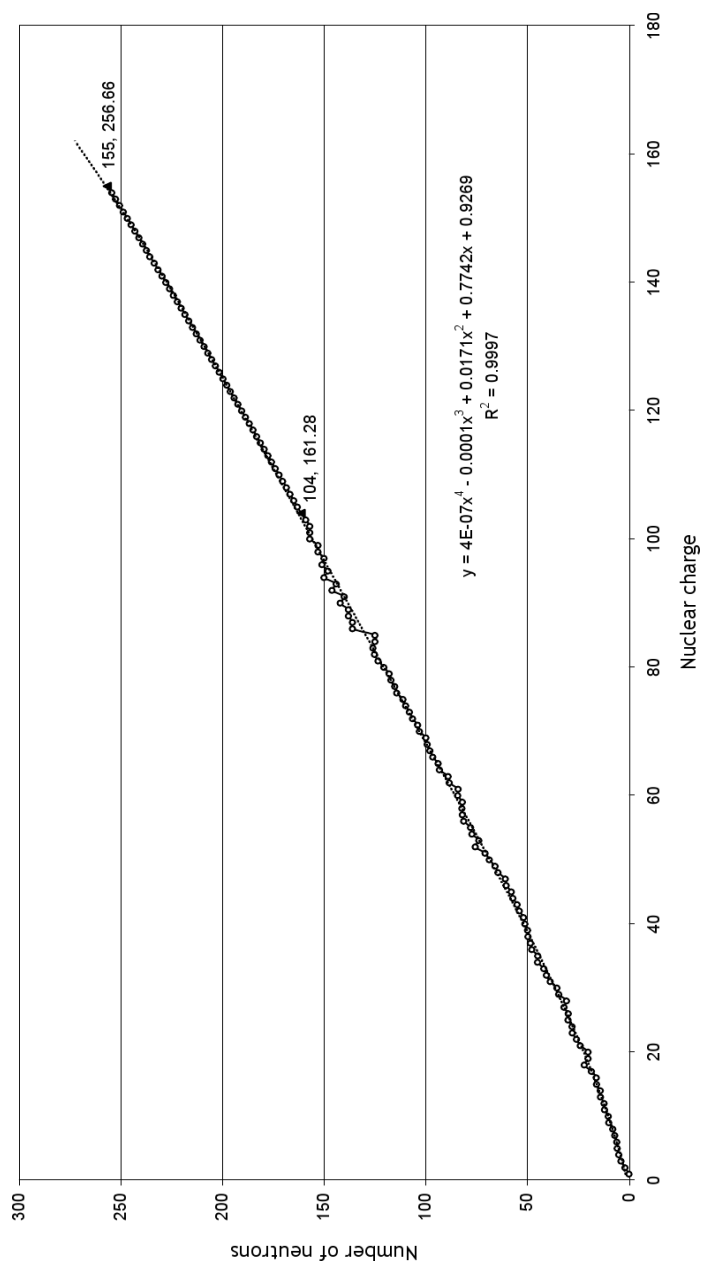


Fig. 6.8: Dependency between the number of neutrons and the number of protons in the atomic mass, for all elements of the Table of Elements. Our calculation data are given beginning from element 104.

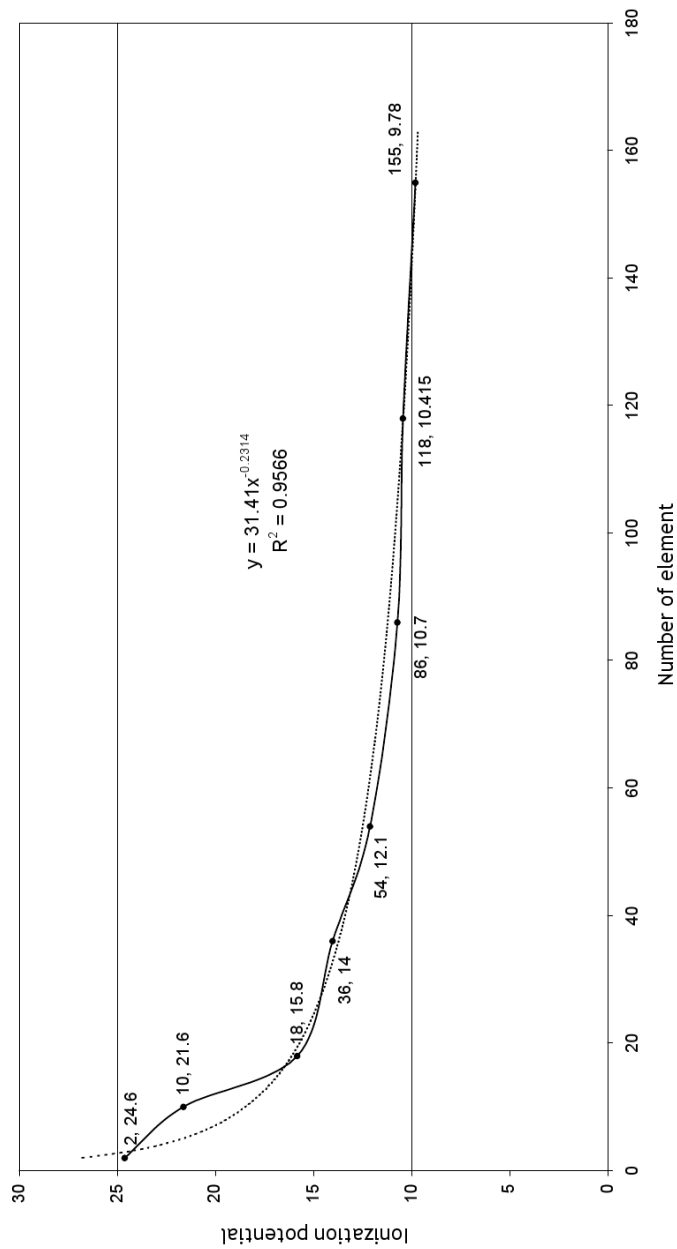


Fig. 6.9: Dependency between the ionization potential and the number of the elements (nuclear charge), for the neutral atoms of the elements ending the periods of the Table of Elements (including calculated element 118 and element 155).



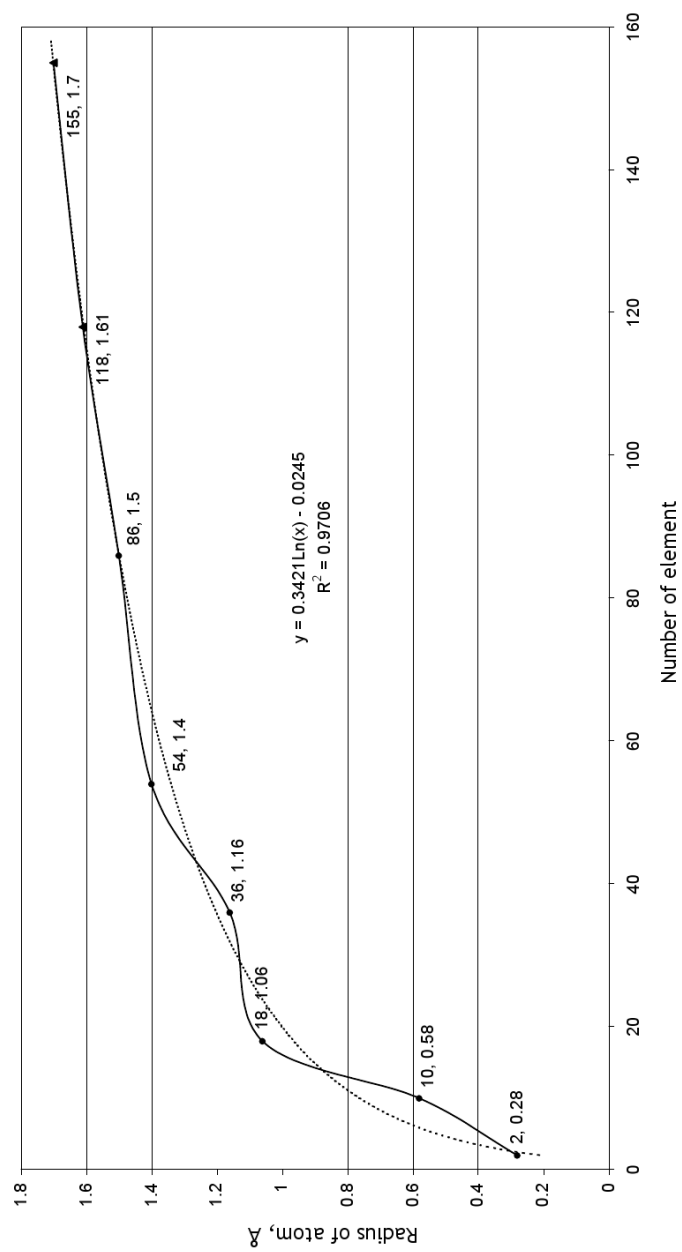


Fig. 6.10: Dependency between the atomic radius and the number of the elements in all periods of the Table of Elements, including the calculated elements No.188 in Period 7 and No.155 in Period 8.

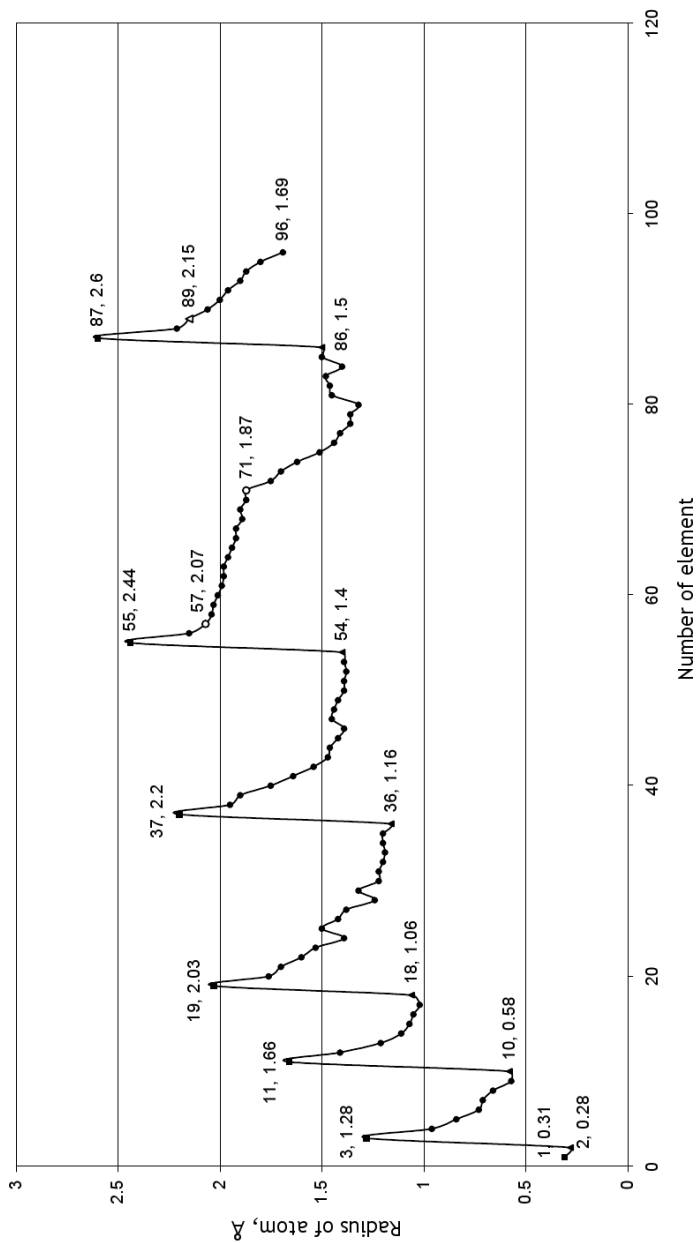


Fig. 6.11: Change of the numerical value of the atomic radius in each period with increasing number in the Table of Elements.

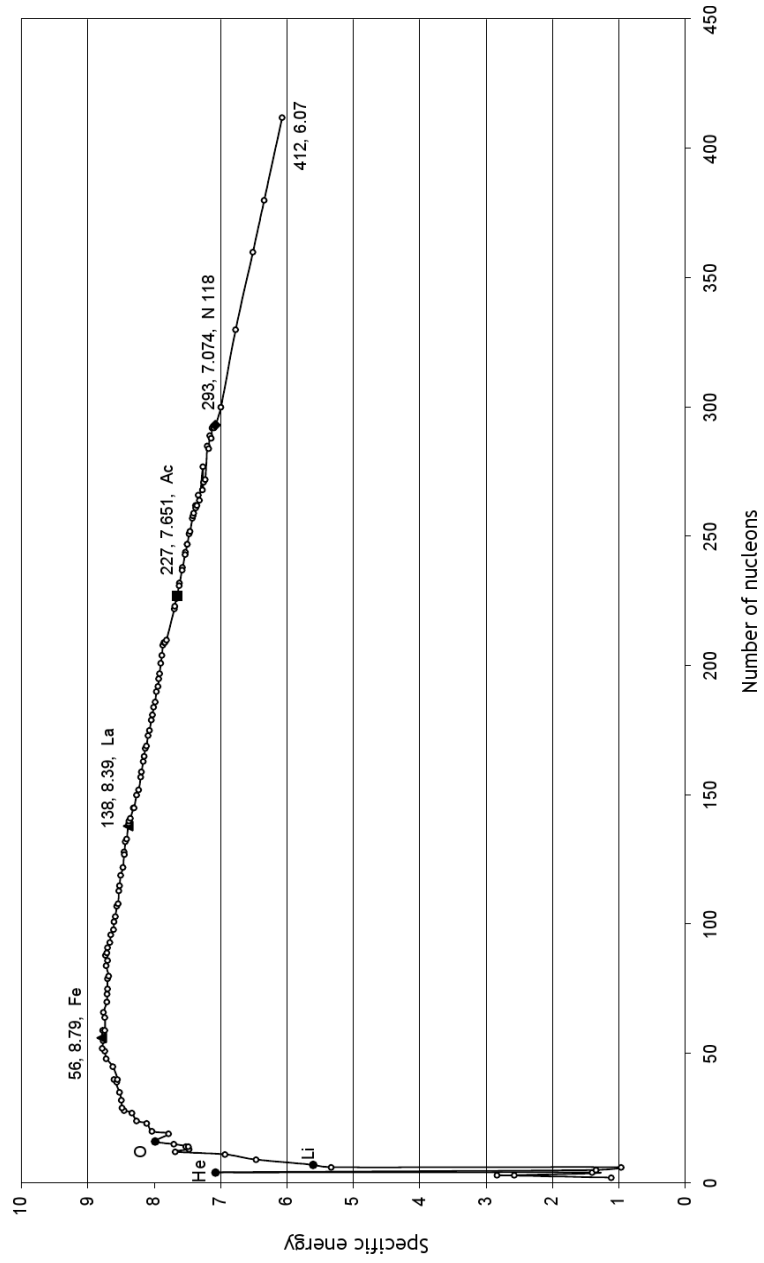


Fig. 6.12: Dependency between the specific energy of ther coupling in an atomic nuclei and the number of the nucleons in it.

of chemical elements. This information has, however, a substantially lack: most data end in the beginning or the middle of Period 7.

Here we target continuing the list of numerous properties of the elements upto element 155, and also the compatibility of the properties with the reference data.

Fig. 6.9 shows a dependency between the ionization potential of the neutral atoms of the elements and the change of their nuclei. Each point corresponds to the last element of the period, from Period 1 to Period 6. The end of Period 7 and that of Period 8 were calculated according to the equation of the trend. As is seen, the points corresponding element 118 and element 155 are completely correlated with the initially data.

An important characteristic of atomic nucleus is the numerical value of its radius (see Fig. 6.10). This graph was created on the basis of the reference data known at the present time. This dependency between the atomic radius and the number of the last element in the period was created for all periods of the Table of Elements where it was possible. Coordinates of the points for Period 7 and Period 8 were calculated according to the equation of the line of the trend. As is easy to see, even the point of Period 6 meets the calculated data in complete.

Fig. 6.11 shows how the atomic radii change from period to period and inside each period of the Table of Elements (i.e. in the columns of the Table from upto down, and along the horizontal line). The upper maxima represent the beginning of the periods, while the lower points represent their ends. It should be noted that in lanthanides, which are No. 57–No. 71, a linear dependency between the radius and the number is observed. Further study of the correlation shows that there is a change of the linearity upto No. 80 (Mercury). Another very interesting detail is that fact that, in the transfer from the alkaline to the alkaline earth elements, a valuable lowering the numerical values of the radii (for  $0.3\text{\AA}$  on the average) is observed in the periods.

In the calculations of nuclear reactions, the information about the stability of the nuclei as the systems consisting of protons and neutrons has a valuable meaning. The forces joining the particles altogether are known as nuclear forces; they exceed the forces of electrostatic and gravitational interactions in many orders.

The “resistance” of a nucleus can be bond by their coupling energy which shows the energy required for destroying the nucleus into its consisting nucleons (their number in the nucleus is equal to the mass number  $A$  expressed in atomic units of mass, a.m.u.). It is known that the sum of the masses of the free nucleons is already larger than the mass of the nucleus they consist. The difference of the masses is known

as the mass defect, according to which Einstein's formula  $E = \Delta mc^2$  gives a possibility for calculating the coupling energy of the nucleus, thus the specific energy in it per one nucleon.

Fig. 6.12 shows an arc, created according to the table data, which manifests the dependency between the specific energy of the coupling in a nucleus and the number of nucleons in it [36]. The left side of the graph shows several isotopes of Hydrogen and the nucleus of several light elements, which bear close numerical values of the specific energy of the coupling and, thus, a large deviation of the data. The arc become more smooth with increasing the number of the nucleons. The maximum is reached in a region of  $A = 50 - 60$ , then the falls slow down. The main advantage of this graph is that we produced the calculation beyond element 118 (at which the table data ended): we showed that the results of our calculation *completely meet* the table data known from the reference literature. Decreasing the specific energy of the coupling in the region of heavy nuclei is explained by increasing the number of protons that leads to increasing the Coulomb forces thus the need of additional neutrons appears.

This is well manifested in Fig. 6.13. The arc described by the quadratic three-term equation has the numerical value of real approximation  $R^2 = 1$ . In the region of the nuclei consisting about 120 nucleons, this dependency is actually linear. Then this dependency transforms into an arc of a very large curvature radius. Data before the point of the nuclear charge 118 (203, 2072.582) were taken from the previous Fig. 6.12, then the calculation was produced on the basis of the coordinates of the suggested last element No. 155. As is seen, the arc approaches the horizontal location, where the number of nucleons in a nucleus is not affected by its coupling energy. According to our calculation, this happens in a region of the coordinates (530, 2670) – (550, 2673) – (600, 2659). This is the ultimate high energy of the coupling of nuclei. If a nucleus has a higher coupling energy, is becomes instable: even a small external influence is needed in order to destroy it.

Therefore, Oganesyan's claim that the theoretical physicists discuss the properties of an element with number 400 and bearing 900 neutrons in its nucleus [28] has not any ground or reason.

## §6.2 On the geometry of the Periodic Table of Elements

Despite the spectacular versions of the periodic tables of elements were suggested by the scientists, no one person did not state the following problem: how the elements are geometrically connected among each other in the groups and periods? As is known, the element are located

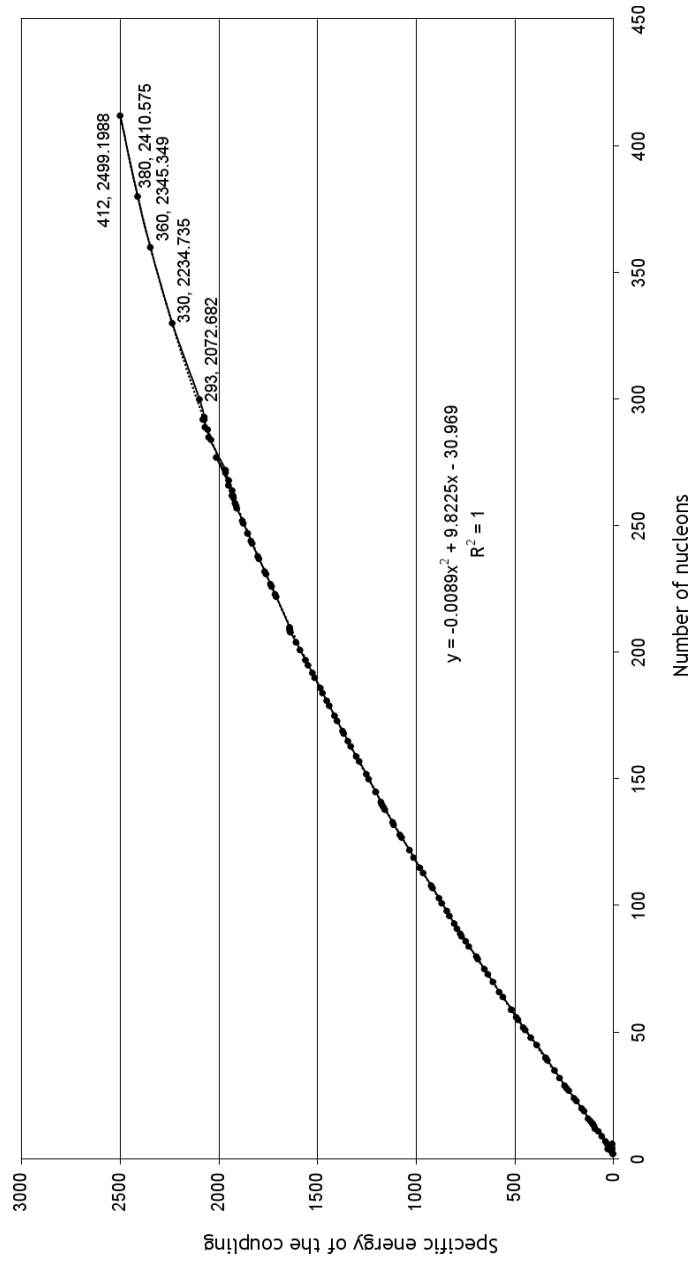


Fig. 6.13: Dependency between the specific energy of their coupling in an atomic nuclei and the number of the nucleons in it.

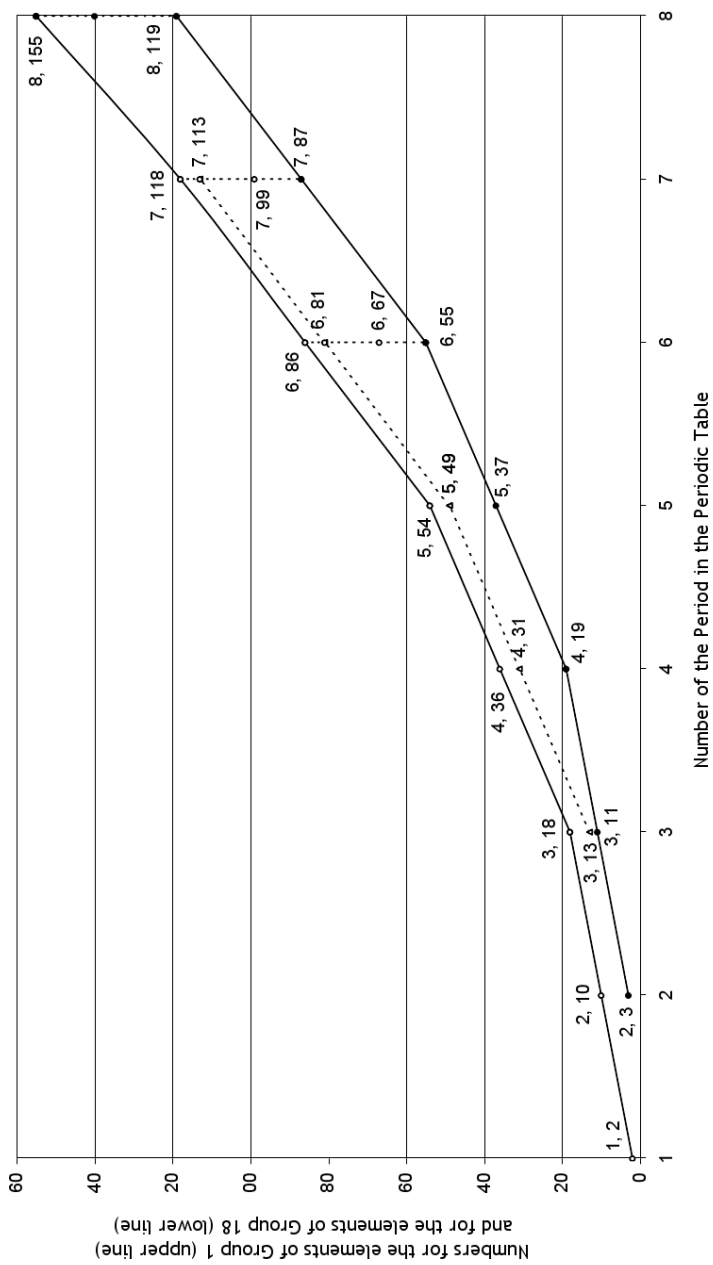


Fig. 6.14: Locations of the elements opening the Periods (the lower line) and those closing the Periods (the upper line).

in the cells, which are joined into 18 groups along the vertical axis in the Table of Elements, and into 7 periods (I suggested recently that 8 periods, see [37] and references therein) along the horizontal axis. Number of the elements rises from left to right in the periods, and from up to down in the groups. The periods begin with the elements of Group 1, and end with the elements of Group 18. Each column determines the main physical chemical properties of the elements, which change both from up to down and from left to right. For example, the elements of Group 1 are alkaline metals (the very active chemical elements), while Group 18 consists of inert gases which manifest a very low chemical activity under the regular physical conditions. In the end of the 20th century, IUPAC suggested a long period form of the Table of Elements, where Period 1 consists of 2 elements, Periods 2 and 3 consist of 8 elements in each, Periods 4 and 5 consist of 18 elements in each, while Periods 6 and 7 consist of 32 elements in each. Finally, Period 8 consisting of 37 elements was suggested on the basis of my theoretical studies [37].

This short study targets a search for the geometrical connexion among the elements of the Periodic Table.

Figure 6.14 in Page 94 shows that the elements of Group 18 are concentrated along the upper broken line, which is split into three straight lines joining three elements (four elements in the end) in each. The numbers indicate the periods and elements. Period 8, containing element No. 155, is also shown here. Each straight section of these can easily be described by a straight line equation.

The lower broken line presents Group 1 (as seen according to the numbers of the elements). The space between the upper and lower straight lines is filled with the straight line of Group 13. It consists of Periods 2–4, 4–6, and 6–8 (Period 1 was omitted from the graph for simplicity). Besides, the points 6,67; 6,81; and 7, 99 which are related to actinides and lanthanides are shown inside the boundaries. Hence, we can suppose that the plane bounded by the lines of Group 1 and Group 18, and also by the points 8,155 and 8,119 on right and the points 1,2; 1,1 on left (and 2,3 of course) contains all known and unknown elements of the Periodic Table. Thus, this figure obtained as a result of the purely geometrical constructions, allows us to make the following conclusions:

- The Periodic Table should necessary contain Period 8, which begins with No.119 and ends by No. 155;
- No elements can exists outside this figure;
- A strong geometrical connexion exists among the groups and periods.



Thus, this short study hints at a geometrical connexion among the elements of the Table of Elements, which exists in addition to the known physical chemical properties of the elements. Note that the geometrical connexion manifests itself per se in the study, without any additional suggestions or constructions. Therefore, this does not change the form of the Periodic Table of Elements, which remains the same.

### §6.3 On the source of the systematic errors in the quantum mechanical calculation of the superheavy elements

Most scientists who worked on the problems of the Periodic Table of Elements (G. T. Seaborg, J. T. Bloom, V. I. Goldanskii, F. W. Giacobbe, M. R. Kibler, J. A. Rihani et al.) attempted to construct new models of the Table with the use of quantum mechanical calculations. In this process, they used a complicate mathematical apparatus of Quantum Mechanics, and introduced additional conditions such as the periods, the number of the elements, and so on. In other word, they first set up a problem of introducing Periods 8 and 9 into the Table of Elements (50 elements in each), and predict the respective interior of the cells of the Table and the interior of the atoms. Only then, on the basis of the above data, they calculate the atomic mass and the number of the neutrons. However the main task — obtaining the exact numerical values of the atomic mass, corresponding to the numbers of the elements higher than period 8 — remains unsolved.

The core of my method for the calculation is the law of hyperbolas discovered in the Periodic Table [37]. Using the law, we first calculated the atomic mass of the upper (heaviest) element allowed in the Periodic Table (411.663243), then its number (155) was also calculated. According to the study [37], this element should be located in Group 1 of Period 8. The main parameters of the chemical elements were obtained in our study proceeding from the known data about the elements, not from the suggestions and the use of the laws specific to the microscale.

Figure 6.15 in Page 97 shows two dependencies. The first is based on the IUPAC 2007 data for elements 80–118 (line 1). The second continues upto element 224 (line 2). As is seen, there is a large deviation of the data in the section of the numbers 104–118. This is obviously due to the artificial synthesis of the elements, where the products of the nuclear reactions were not measured with necessary precision. Line 2 is strictly straight in all its length except those braking sections where it is shifted up along the ordinate axis. It is easy to see that at the end of line 1, in the numbers 116–118, the atomic mass experiences a

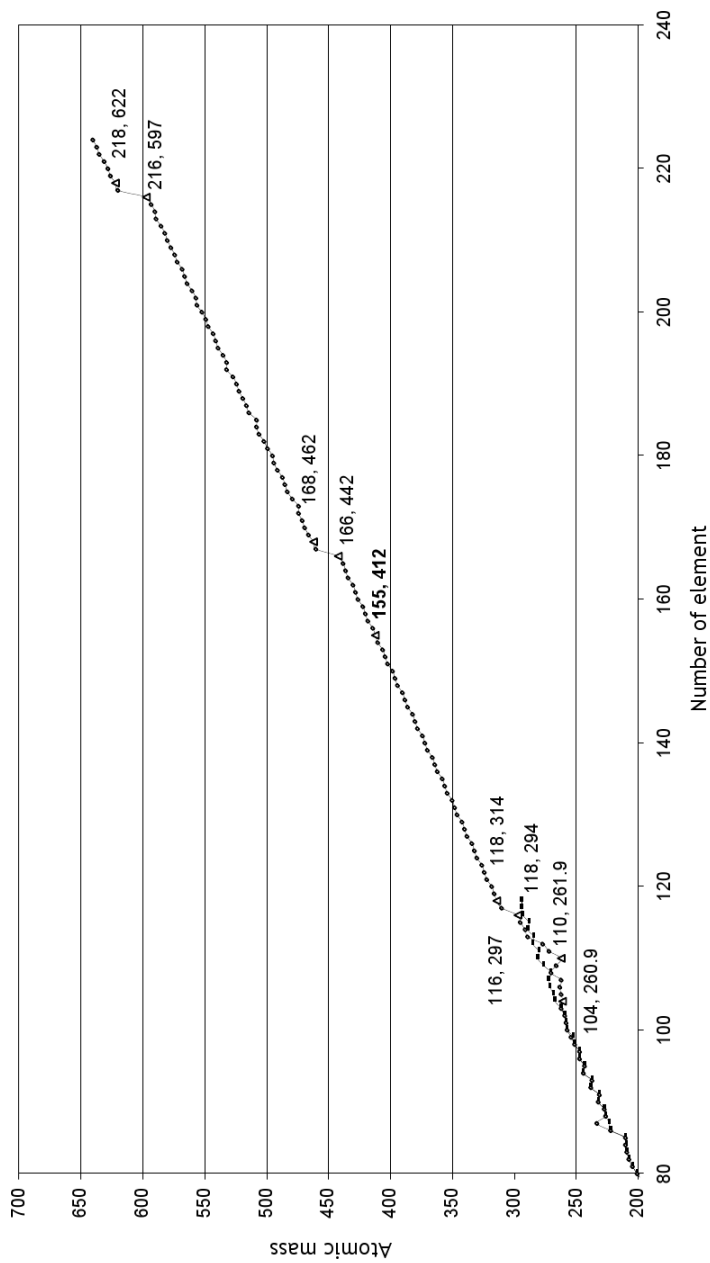


Fig. 6.15: Dependency between the atomic mass of the elements and their number in the Table of Elements. The IUPAC data and the FLW Inc. data begin from number 80, for more visibility of the dependency.

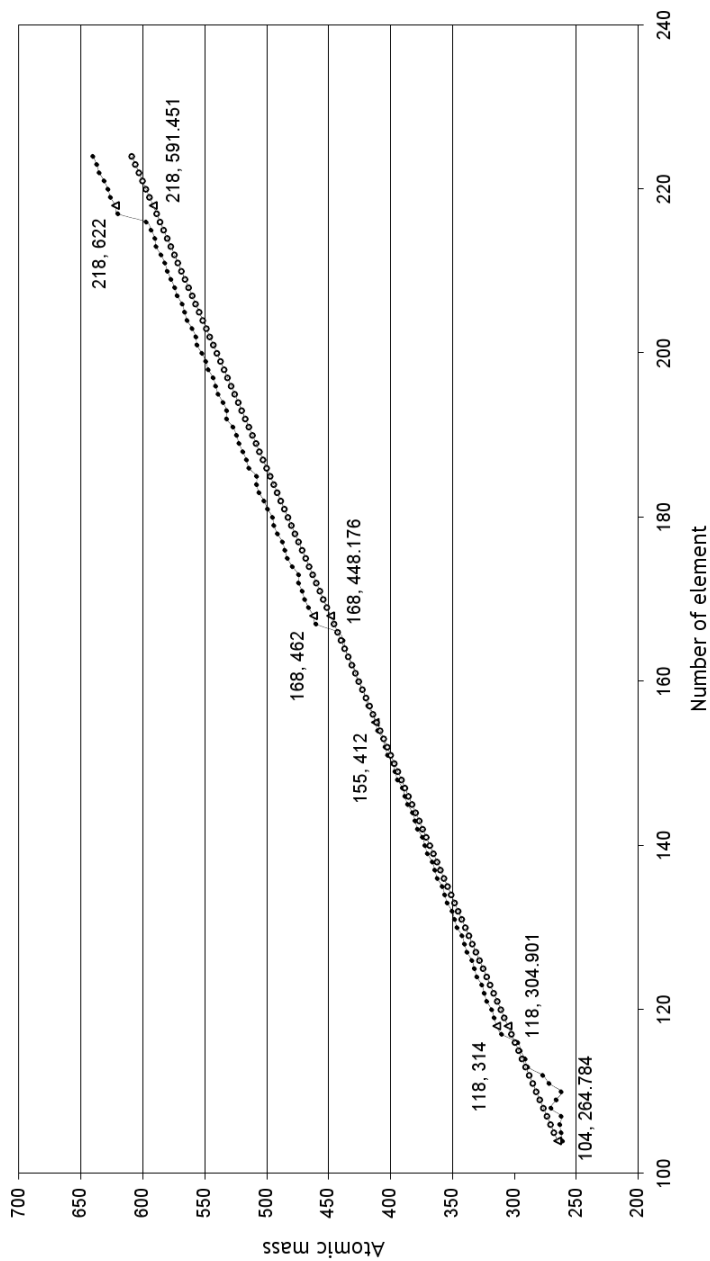


Fig. 6.16: Dependency between the atomic mass of the elements and their number in the Table of Elements. Black dots are the FLW Inc. data. Small circles — the averaged results according to the FLW Inc. data.

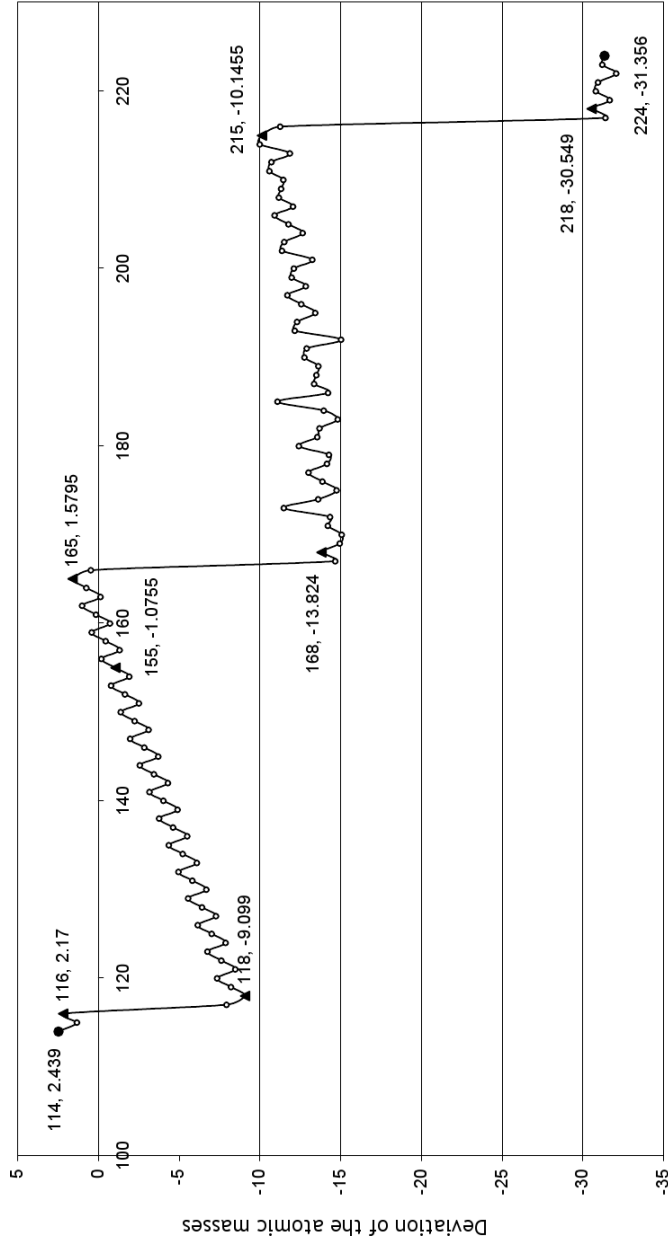


Fig. 6.17: Dependency between the atomic mass, calculated according to our theory and the FLW Inc. data, and their number in the Table of Elements.

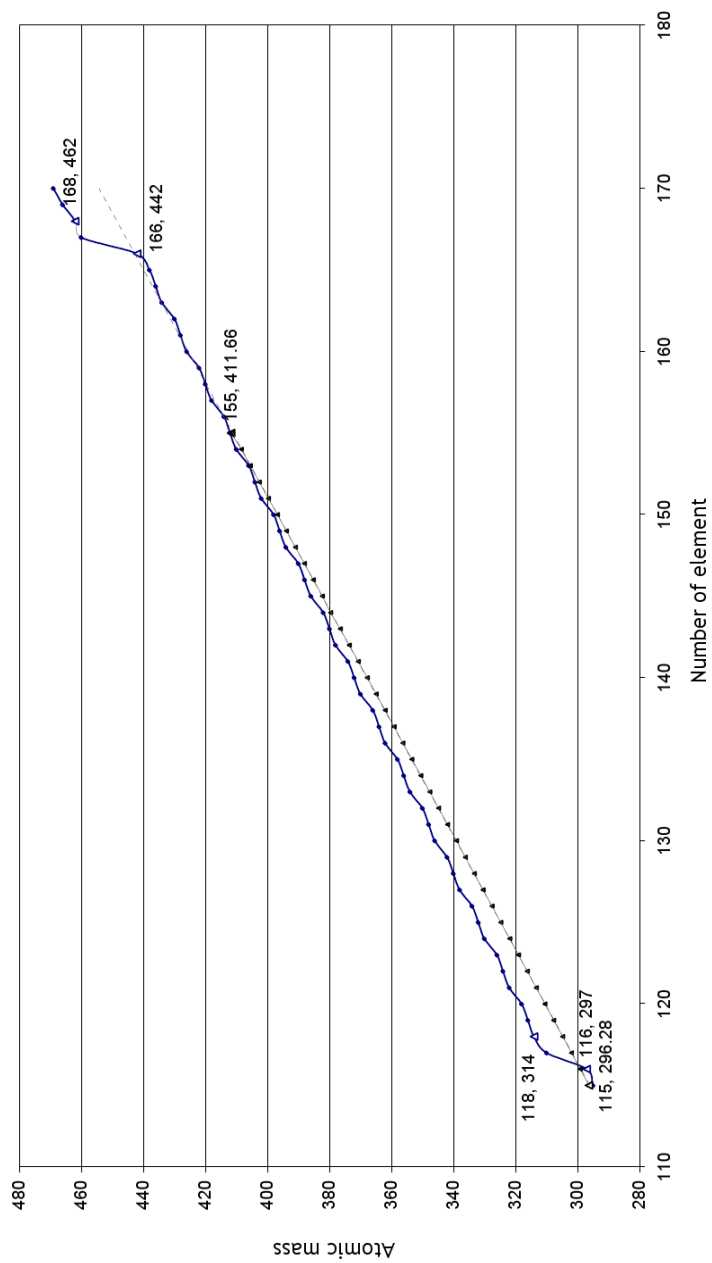


Fig. 6.18: Dependency between the atomic mass of the elements and their number in the Table of Elements, shown for Period 8. Black dots are the FLW Inc. data. Small triangles — the data according to our calculations.

shift for 17 units. These shifts increase their value with the number of the elements: the next shift rises the line up for 20 units, and the last shift — for 25 units. In order to find the numerical values of the shifts more precisely, Figure 6.16 was created (see Page 98): this is the same broken line (the initially data) compared to itself being averaged by the equation of the line of trend (whose data were compared to the initial data). Hence, the difference between these lines should give the truly deviation of the numerical values of the atomic masses between the FLW Inc. data and our data (our data deviate from the equation of the line of trend for nothing but only one hundredth of 1 atomic mass unit). Figure 6.17 in Page 99 shows a shift of the atomic mass just element 104, before Period 8: in element 118 the atomic mass is shifted for 11 units; in Period 9 the shift exceeds 15 units, and then it increases upto 21 units. The respective data for Period 8 are shown in Figure 6.18.

These data lead to only a single conclusion. Any software application, which targets the quantum mechanical calculation for the atomic mass of the elements, and is constructed according to the suggested law specific to the microscale, not the known data about the chemical elements, will make errors in the calculation. The theory [37] referred herein manifested its correctness in many publications, and met no one negative review.

#### **§6.4 Applying adjacent hyperbolas to calculation of the upper limit of the Periodic Table, with use of Rhodium**

##### **§6.4.1 Introduction**

In the theoretical deduction of the hyperbolic law of the Periodic Table of Elements [37], the main attention was focused onto the following subjects: the equilateral hyperbola with the central point at the coordinates  $(0; 0)$ , its top, the real axis, and the line tangential to the normal of the hyperbola. All these were created for each element having the known or arbitrary characteristics. We chose the top of the hyperbolas, in order to describe a chemical process with use of Lagrange's theorem; reducing them to the equation  $Y = K/X$  was made through the scaling coefficient 20.2895, as we have deduced.

The upper limit of the Table of Elements, which is the heaviest (last) element of the Table, is determined within the precision we determine the top of its hyperbola [37]. Therefore hyperbolas which are related to fraction linear functions were deduced. These hyperbolas are equilateral as well, but differ in the coordinates of their centre:  $x = 0, y = 1$ . To avoid possible mistakes in the future, the following terminology has been

assumed: hyperbolas of the kind  $y = k/x$  are referred to as *straight*; equilateral hyperbolas of the kind  $y = (ax + b)/(cx + d)$  are referred to as *adjacent*. The latter ones bear the following properties: such a hyperbola intersects with the respective straight hyperbola at the ordinate  $y = 0.5$  and the abscissa equal to the double mass of the element; the line  $y = 0.5$  is the axis of symmetry for the arcs; the real and tangential lines of such hyperbolas meet each other; the normal of such a hyperbola is the real axis and the tangential line of another hyperbola of this kind.

The found common properties of the hyperbolas provided a possibility to use them for determination of the heaviest (last) element in another way than earlier.

#### §6.4.2 Method of calculation

Once drawing straight hyperbolas for a wide range of the elements, according to their number from 1 to 99 in the Table of Elements, where the atomic masses occupy the scale from Hydrogen (1.00794) to Einsteinium (252), one can see that the real axis of each straight hyperbola is orthogonal to the real axis of the respective adjacent hyperbola, and they cross each other at the point  $y = 0.5$ .

Then we draw the intersecting lines from the origin of the adjacent hyperbolas (0; 1). The lines intersect the straight hyperbolas at two points, and also intersect the real axis and the abscissa axis where they intercept different lengths.

Connexion to molecular mass of an element (expressed in the Atomic Units of Mass) differs between the abscissas of the lengths selected by the intersecting lines and the abscissas of transection of the straight and adjacent hyperbolas. Therefore, the line which is tangent to the straight in the sole point (102.9055; 205.811) is quite complicated. These coordinates mean the atomic mass of Rhodium and the half of the atomic mass of the heaviest (last) element of the Periodic Table.

The right side of the line can easily be described by the 4th grade polynomial equation. However the left side has a complicate form, where the maximum is observed at the light elements (Nitrogen, Oxygen) when lowered to (102.9055; 0) with the increase in atomic mass.

According to our calculation, the straight and adjacent hyperbolas were determined for Rhodium. The real axes go through the transecting points of the hyperbolas to the axis  $X$  and the line  $Y = 1$ , where they intercept the same lengths 411.622. This number differs for 0.009% from 411.66.

Thus, this calculation verified the atomic mass 411.66 of the heaviest element (upper limit) of the Periodic Table of Elements, which was determined in another way in our previous study [37].

### §6.4.3 Algorithm of calculation

The algorithm and results of the calculation without use of Rhodium were given in detail in Table 3.1 of the book [37]. The calculation is produced in six steps.

Step 1. The data, according to the Table of Elements, are written in columns 1, 2, 3.

Step 2. Square root is taken from the atomic mass of each element. Then the result transforms, through the scaling coefficient 20.2895, into the coordinates of the tops of straight hyperbolas along the real axis. To do it, the square root of the data of column 3 is multiplied by 20.2895 (column 4), then is divided by it (column 3).

Step 3. We draw transecting lines from the centre (0; 1) to the transections with the line  $y = 0.5$ , with the real axis at the point  $(X_0; Y_0)$ , and so forth upto the axis  $X$ . To determine the abscissa of the intersection points, we calculate the equation of a straight line of each element. This line goes through two points: the centre (0; 1) and a point located in the line  $y = 0.5$  or in the axis  $X$ :  $(X - 0)/(X_0 - 0) = (Y - 1)/(Y_0 - 1)$ . For instance, consider Magnesium. After its characteristics substituted, we obtain the equation  $(X - 0)/(100.0274 - 0) = (Y - 1)/(0.242983 - 1)$ , wherefrom the straight line equation is obtained:  $Y = 1 - 0.007568 X$ . Thus, the abscissa of the transecting line, in the line  $y = 0.5$ , is 66.0669 (column 6).

Step 4. We write, in column 7, the abscissas of the points of transection of the straight and adjacent hyperbolas. The abscissas are equal to the double atomic mass of the element under study.

Step 5. We look for the region, where the segment created by a hyperbola and its transecting line is as small as a point (of the hyperbola and its transecting line). To find the coordinates, we subtract the data of column 7 from the respective data of column 6. Then we watch where the transecting line meets the real axis. The result is given by column 8. Here we see that the numerical value of the segments increases, then falls down to zero, then increases again but according to another law.

Step 6. Column 9 gives tangent of the inclination angle of the straights determined by the equations, constructed for two coordinate points of each element:  $Y = -KX + 1$ , where  $K$  is the tangent of the inclination angle.



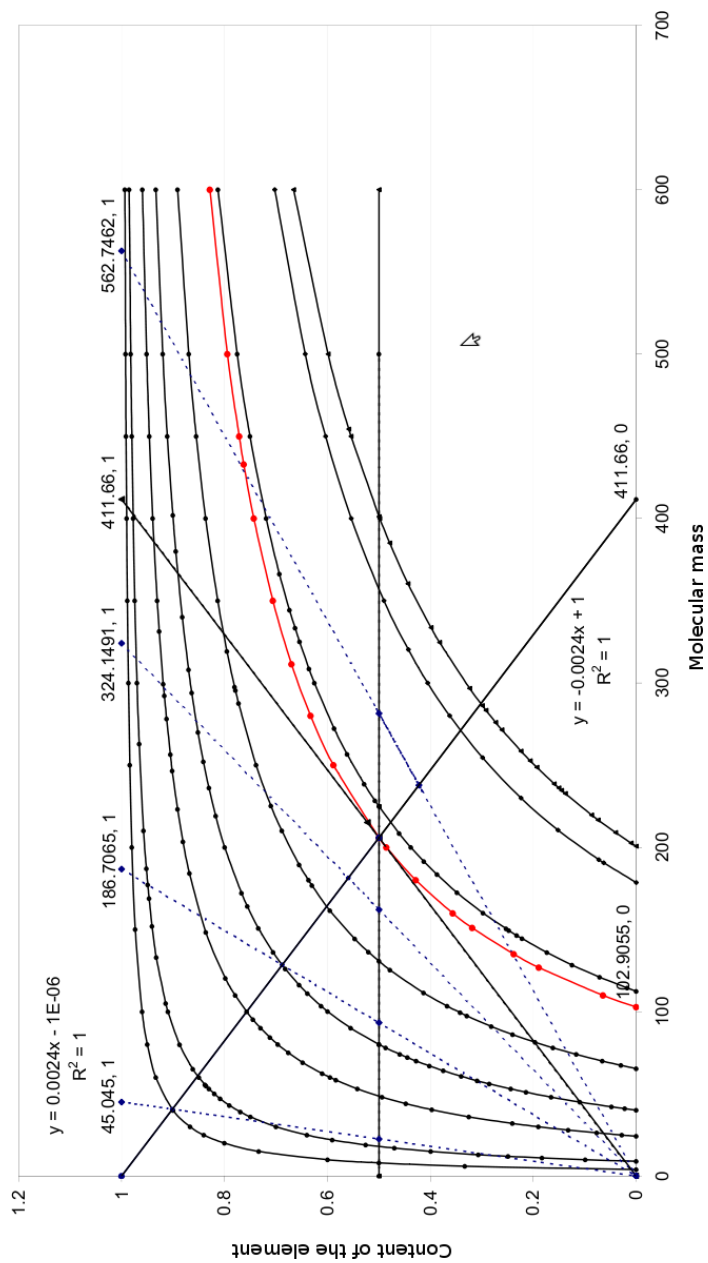


Fig. 6.19: Calculation with the centre at the point (0;0).

#### §6.4.4 Using adjacent hyperbolas in the calculation

Because straight and adjacent hyperbolas are equilateral, we use this fact for analogous calculations with another centre, located in the point  $(0; 0)$ . The result has been shown in Fig.6.19. In this case  $X_0$  remains the same, while the ordinate is obtained as difference between 1 and  $Y_0$ . The straight line equation is obtained between two points with use of the data of column 9, where tangent should be taken with the opposite sign. As a result, we obtain an adjacent hyperbola of Rhodium. For example, consider Calcium. We obtain  $X_0 = 128.4471$ ,  $Y_0 = 0.31202$  (the ordinate for the straight hyperbola of Calcium), and  $Y_0 = 1 - 0.31202 = 0.68798$  (for the adjacent hyperbola). The straight line equation between these two points is  $Y = 0.005356 X$ . Thus, we obtain  $x = 186.7065$  under  $y = 1$ , and  $x = 93.3508$  under  $y = 0.5$ .

The new calculations presented here manifest that determining the heaviest (last) element of the Periodic Table of Elements is *correct for both ways of calculation*: the way with use of Lagrange's theorem and the scaling coefficient [37], and also the current method of the hyperbolas adjacent to that of Rhodium (method of adjacent hyperbolas). As one can see, the calculation results obtained via these two methods differ only in thousand doles of percent.

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## Chapter 7

# Electron Configuration of the Elements, Their Blocks, and the Isotopes, with Taking the Upper Limit of the Periodic Table into Account

### §7.1 Electron configuration and element no. 155

#### §7.1.1 Introduction

As is known, even the simplest atoms are very complicated systems. In the centre of such a system, a massive nucleus is located. It consists of protons, the positively charged particles, and neutrons, which are charge-free. Masses of protons and neutrons are almost the same. Such a particle is almost two thousand times heavier than the electron. Charges of the proton and the electron are opposite, but the same in the absolute value. The proton and the neutron differ from the viewpoint on electromagnetic interactions. However in the scale of atomic nuclei they do not differ. The electron, the proton, and the neutron are subatomic particles. The theoretical physicists still cannot solve Schrödinger's equation for the atoms containing two and more electrons. Therefore, they process the calculations for only the single-electron atom of hydrogen, with use of the dualistic property of the electron, according to which it can be represented, equally, as a particle and a wave. At the same time, the conclusions provided after the quantum theory cannot be considered as the finally true result.

To make the further text simpler, we assume the following brief notations: the Periodic Table of Elements containing 118, 168, and 218 elements will be referred to as T.118, T.168, and T.218 respectively.

#### §7.1.2 Calculation of the electron shell for element No.155

Electron shells of the atoms (known also as the *levels*) are regularly denoted as K, L, M, N, O, or as plain numbers from 1 to 5. Each level consists of numerous sub-levels, which are split into atomic orbitals. For instance, the 1st level K consists of a single sub-level 1s. The second level L consists of two sub-levels 2s and 2p. The third level M consists

	K	L	M	N	O	Sum	Content in the shells
s	2					2	in each shell
p	2	6				8	in each, commencing in the 2nd shell
d	2	6	10			18	in each, commencing in the 3rd shell
f	2	6	10	14		32	in each, commencing in the 4th shell
g	2	6	10	14	18	50	in each, commencing in the 5th shell

Table 7.1: Number of electrons in each level.

of the 3s, 3p, and 3d sub-levels. The fourth level N consists of the 4s, 4p, 4d, and 4f sub-levels. At the same distance from the atomic nucleus, only the following orbitales can exist: one -s-, three -p-, five -d-, seven -f-, while no more than two electrons can be located in each single orbital (according to Pauli's principle). Hence, the number of electrons in each level can be calculated according to the formula  $2N^2$ . Results of the calculation are given in Table 7.1.

As is seen from this Table, the complete external electron level is the configuration  $s^2+p^6$ , known as octet.

The elements, whose electrons occupy the respective sub-levels, have one of the denotations: s-, p-, d-, f-, or g-elements (in analogy to electrons).

### a) Electron configuration in the other elements

In the regular form of the Periodic Table of Elements, each cell of the Table bears a large information about the element, including the electron constitution of the atom. The cells containing the same sub-levels are often the same-coloured in the Table, and are joined into the following blocks (T.118):

s-elements, the 1st and the 2nd groups, 7 periods;

p-elements, 6 groups  $\times$  6 periods (periods 5–10, 13–18, 31–36, 49–54, 81–86, 113–118);

d-elements, 10 groups  $\times$  4 periods, between s- and p-elements;

f-elements, 2 lines of 14 elements each (lantanides and actinides).

Fig. 7.1 shows distribution of the blocks of T.118, with the assumption of that all last elements are known (the lower arc) [38]. The tabular data of the blocks are easy-to-convert into a graph, if using the known number of the elements. It should be noted that the abscissa axis means number of the blocks (not number of the periods). The form of this arc

Number of the elements	Number of the blocks				
	s	p	d	f	g
T.218	18	48	60	56	36
T.168	16	42	50	42	18
T.118	14	36	40	28	—
T.155	16	36	46	42	15

Table 7.2: Blocks of the electron configuration.

is close to parabola, and is easy-to-describe by the cubic equation with the value of true approximation  $R^2 = 1$ .

One can find, in the scientific press, suggestions about the possibility of introducing, into the version T.118 of the Periodic Table, two additional periods of 50 elements in each thus making it T.218. Therefore, we checked this variant as well (the upper arc), for clarity of the experiments [1, 2]. According to the reference data [39], we assumed five blocks which join all elements of the Periodic Table as follows:

$$\text{s-elements} = 18,$$

$$\text{p-elements} = 48,$$

$$\text{d-elements} = 60,$$

$$\text{f-elements} = 56,$$

$$\text{g-elements} = 36.$$

As is seen, the upper arc in Fig. 7.1 is absolutely similar to that of T.118 (the lower arc). The larger size of the upper arc (T.218) are due to the larger number of elements.

Having these two examples considered, we clearly understand that the aforeapplied method we suggested can as well be applied to the version of the Periodic Table which ends at element No. 155.

In order to check this supposition, we created Table 7.2 wherein we present the respective data for Fig. 7.1 and Fig. 7.2.

The upper arc of Fig. 7.2 shows distribution of the blocks of the electron configuration, calculated according to the reference data of T.168. Lower, another arc is presented. It is created according to our calculation for T.155 (i.e. for the Table of Elements, whose upper limit is element No. 155). As is seen, the left branches of the arcs differ from each other for a little, while the right branches actually met each other. The absence of any bends or breaks, and also smooth form of both arcs, and their complete satisfying the approximation equation  $R^2 \approx 1$ ,

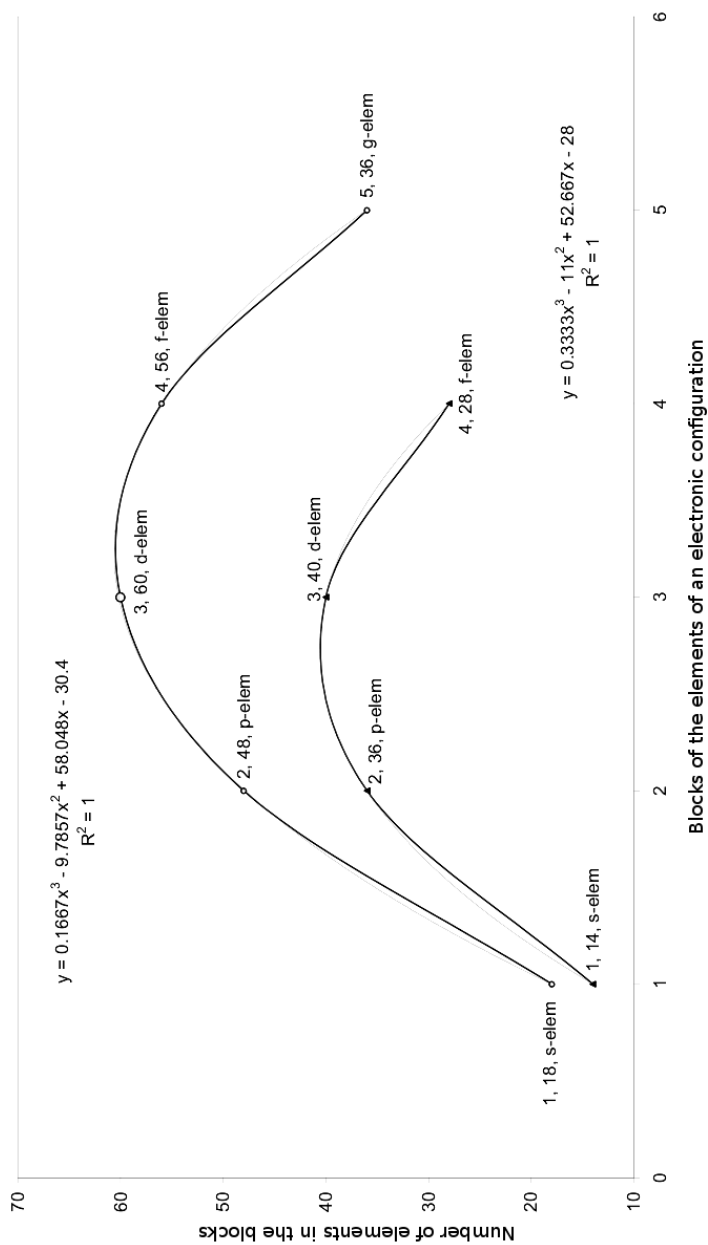


Fig. 7.1: Location of the blocks of the electron configuration in the Periodic Table of Elements, containing different number of the elements. The upper arc — the Table of 218 elements. The lower arc — the Table of 118 elements.

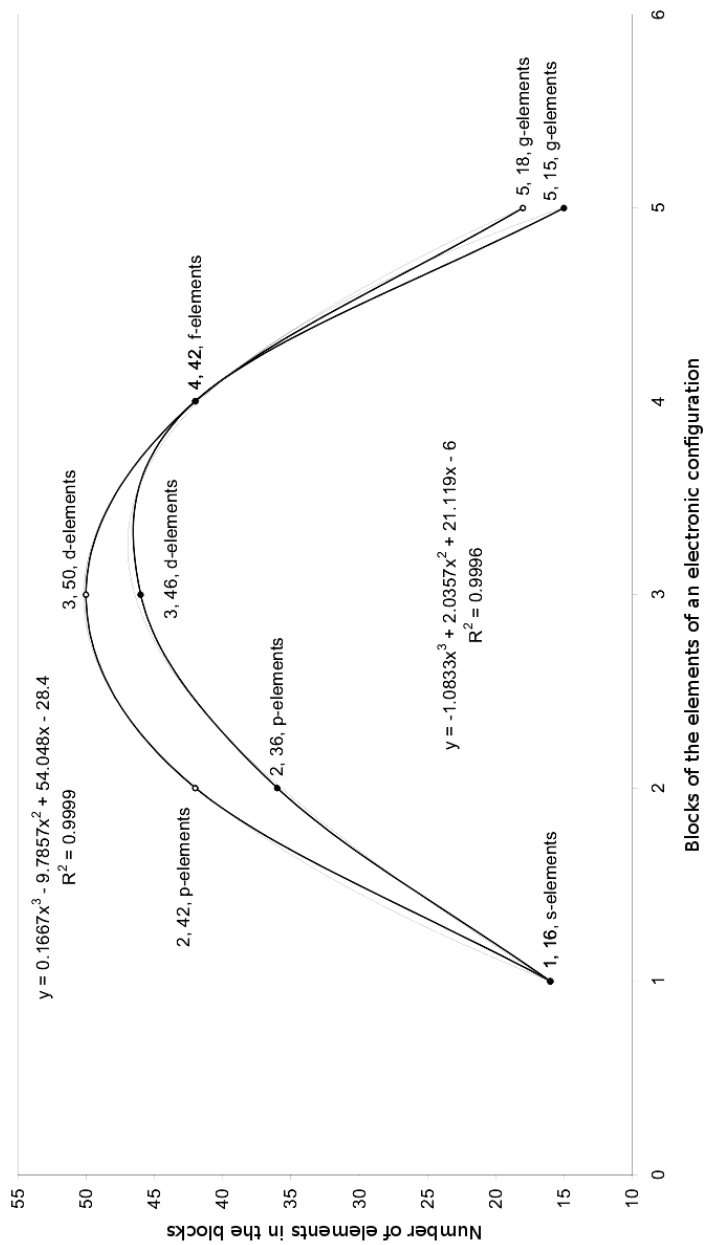


Fig. 7.2: Dependency, in the blocks, between the number of the elements and the electron configuration. The upper arc — the Table of 168 elements. The lower arc — the Table of 155 elements.

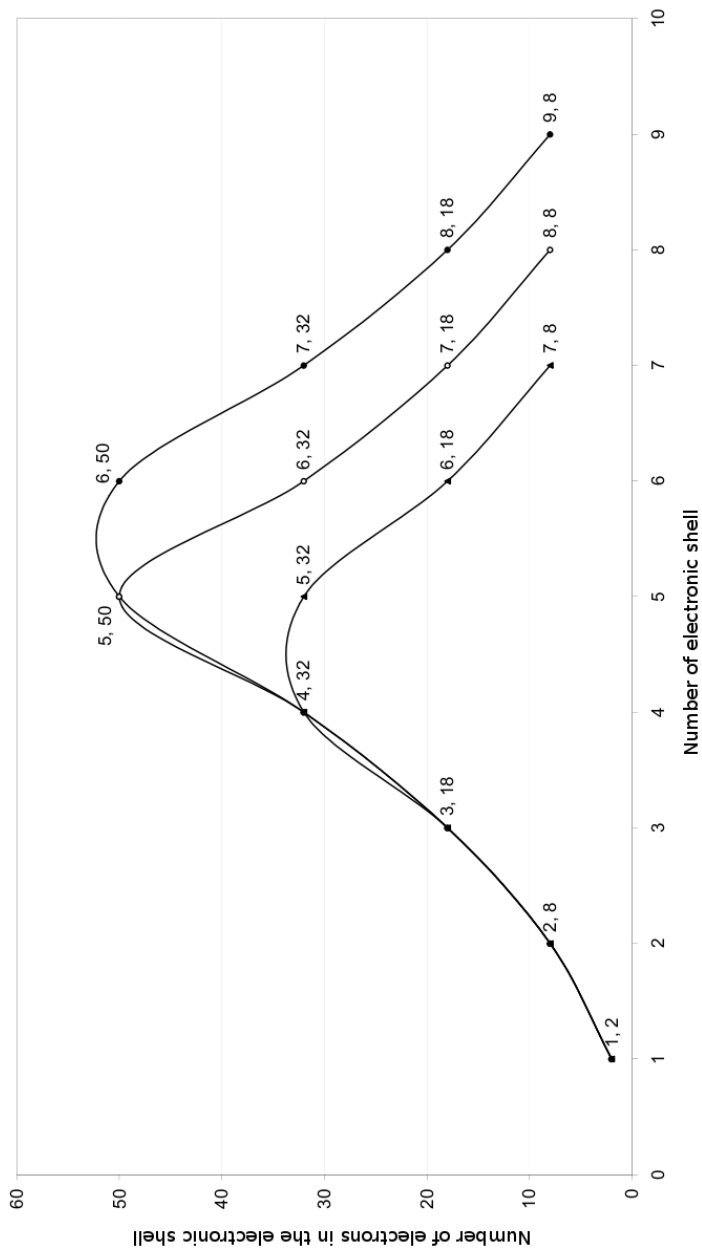


Fig. 7.3: Dependency of the number of electrons in the electron shells from the shell number, for three versions of the Periodic Table of Elements — T.118, T.168, T.218 (from upto down).



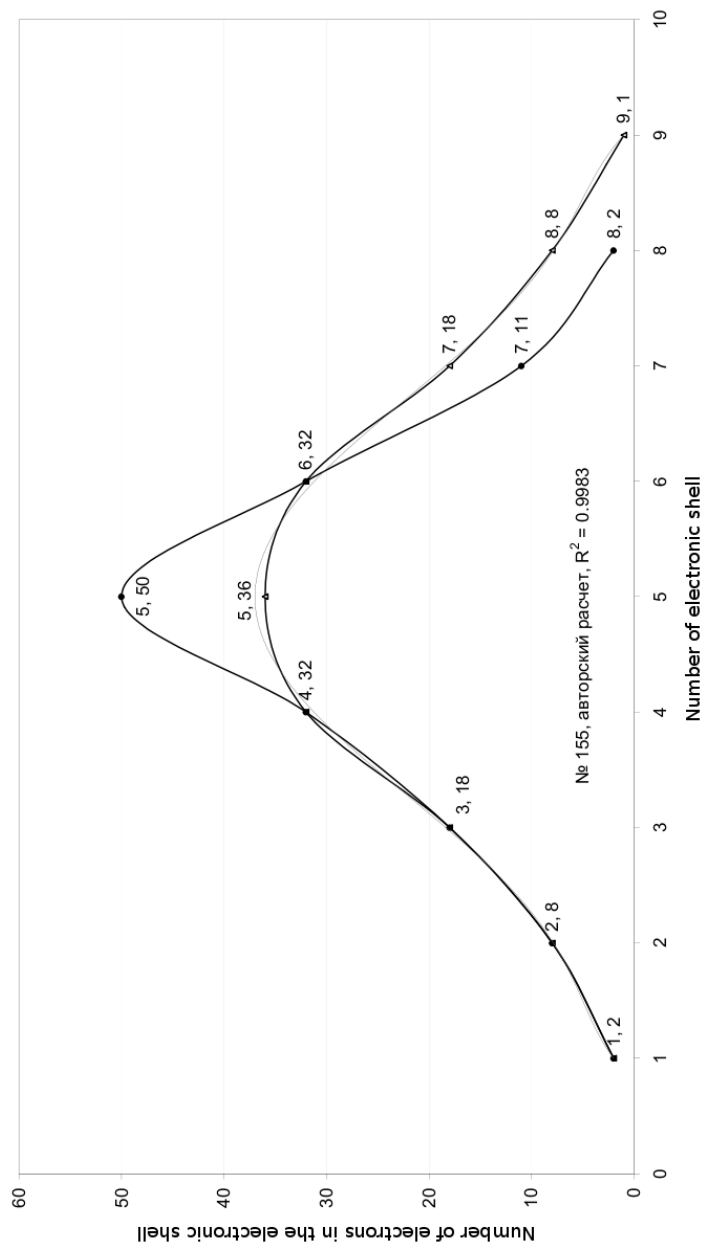


Fig. 7.4: Dependency of the number of electrons in the electron shells from the shell number, for element No.155 according to the tabular data (the upper arc) and the author's calculation (the lower arc).

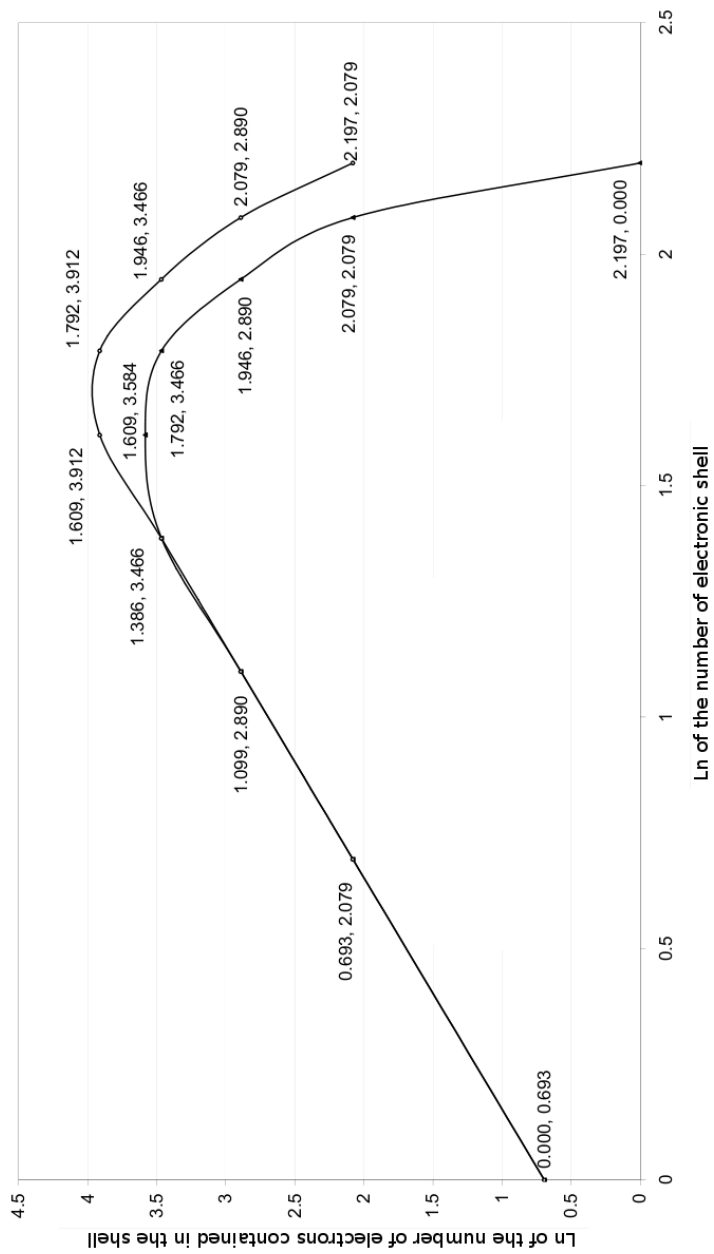


Fig. 7.5: Dependency of the number of electrons in the electron shells from the shell number (presented in the logarithmic coordinates), for T.218 (the upper arc) and for T.155 according to the author's calculation (the lower arc).

Number of the elements	Number of the electrons in the shells								
T.218	2	8	18	32	50	50	32	18	8
T.168	2	8	18	32	50	32	18	8	—
T.118	2	8	18	32	32	18	8	—	—
T.155 Table	2	8	18	32	50	32	11	2	—
T.155 Author	2	8	18	32	36	32	18	8	1

Table 7.3: Electron shells of the atoms.

manifests the presence of the same law in the basis of these data. Therefore, we now can claim that element No. 155 is included into the blocks of the electron configuration as the last element of the Periodic Table of Elements.

#### b) Electron shells of the atoms

Because our method of comparing the electron configuration of the elements was successful for element No. 155, we are going to apply it to theoretical constructing the electron shells. Here we should take into account that: the electrons of the external shells bear more powerful energy, they are more distantly located from the nucleus, and determine the chemical properties of reactions due to the fact that their connexion with the nucleus is weaker thus easier to break. All data, we collected in order to check the aforementioned suggestion, are presented in Table 7.3. Line 4 of the Table contains the data for the version of element No. 155 as that continuing the Table of Elements, while Line 5 contains the respective data suggested by me according to [40].

As is seen, from Fig. 7.3, all the arcs have the form which is very close to parabola, with a clearly observed maximum and the joined left branches. The difference in their ordinates is due to the difference in the number of the electrons (column 5 of Table 7.3). The right branches are parallel to each other, and are shifted with respect to each other for the shell number. The main result means here the presence of a qualitative connexion between the electron shells and their graphical representation. For only this reason, we had the possibility to compare the data of the last lines of Table 7.3.

Fig. 7.4 manifests that the upper arc is similar to the previous of Fig. 7.3, while the lower arc (T.155 Author) very differs from all them. According to its form, this is a differential function of normal distribution (the Gauss arc). The difference between the ends of the left

and right branches is 0.645%. The branches are very symmetric to each other with respect to the vertical axis coming through the top with coordinates (5, 36). Hence, here is also a strong dependency between the regular method of description of the electron shells and its graphical representation.

This fact is most illustrative manifested in Fig. 7.5. The left straight covers four electron shells (2, 8, 18, 32), which are the same for all versions of Table 7.3 (as follows from the equation of the straight line  $Y = 2X + 0.6931$ ). As is seen, once the arcs reach their maximum, they come down very fast (this is because the number of electrons decreases very fast in the shells).

### §7.1.3 Conclusion

Thus, element No. 155 has really lawful to be positioned in the Periodic Table of Elements. This element points out not only the upper limit of the Table, found in my earlier study on the basis of the hyperbolic law [7, 37], but also can be presented as a graphical sequel of the calculations produced according to Quantum Mechanics (they have a high precision).

## §7.2 Isotopes and the electron configuration of the block in the Periodic Table, upto the last element no. 155

### §7.2.1 Introduction

It is known that elements of the Periodic Table of Elements have fractional numerical values of atomic masses. This is because the elements consists of, as regularly, a mix of inborn (native) isotopes. For this reason we conclude that the average weighted atomic mass of all stable isotopes of any element (taking their distribution in the Earth crust) is that atomic mass which is used in all calculations. Because it is equal to the sum of the electric charge of an atomic nucleus and the number of neutrons in it, the isotopes are determined by the condition  $A = Z + N$ , where  $A$  is the atomic mass,  $Z$  is the charge,  $N$  is the number of neutrons of the nucleus. With all these, it is necessary to keep in mind that, having the same number of protons in a nucleus, the nucleus may contain different number of neutrons which do not change the chemical properties of the atoms: all isotopes of the same element bear the same electric charge of its nucleus, but change only with the number of neutrons in it.

### §7.2.2 Calculation according to the table of isotopes

According to the data provided by *Nuclear Periodic Table* [41], all spectacularity of the data was split into blocks, wherein the number of isotopes was determined, namely: 431 (s), 1277 (p), 1612 (d), 1147 (f). As is seen in Fig. 7.6, the obtained results form a smooth arc with  $R^2 = 1$ . Because all the isotopes are grouped into clocks of the electron configuration alike elements of the Periodic Table, we are lawful to conclude that the *same law* lies in the ground of the geometric configurations. It is necessary to note that, with reaching the top of the arc, the number of the isotopes very lowers, that was as well observed in the case of elements of the Periodic Table [42].

### §7.2.3 Version of the Periodic Table of Elements, which limits by element No. 155

It is known that the “blocks” of the Periodic Table of Elements are sets of adjacent groups [43, 44]. The names of the blocks originate in the number of the spectroscopic lines of the atomic orbitales in each of them: **sharp**, **principal**, **diffuse**, **fundamental**. During the last decades, one suggested to extend the Periodic Table upto 218 elements, with appearance a **g**-block in it [37]. If, in the version of the Periodic Table consisting of only 118 elements, the blocks draw a smooth arc with  $R^2 = 1$  (see Fig. 7.7), the appearance of additional elements in the Table requires new construction of the blocks, which should be set up in another configuration.

Earlier [37], we suggested a version of the Periodic Table which contained Period 8 with 37 elements (two lines with 18 and 1 elements in Group 1). In this form, the Periodic Table satisfies the common structure of the location of the elements. However, once lanthanides and actinides have been extended into a common scheme, the heaviest element No.155 (which ends the Table in this its version) became shifted for 4 positions to right. Therefore, a question rose: how to locate these 37 elements in the new version of the Table so that they would completely satisfy all the rules of the electron configuration of the blocks?

First, we added 2 elements to block **s** upto the beginning of Period 8. Then we added 6, 10, and 14 elements (respectively) to blocks **p**, **d**, **f**. Concerning the rest 4 elements, we created a new block **g**. All these changes are shown in Fig. 7.7 (the upper arc). As is seen, the arc has the same form as the lower arc, and shows that fact that the number of elements of the last block reaches the actual limit.

On the basis of that has been said above, a long-period form of

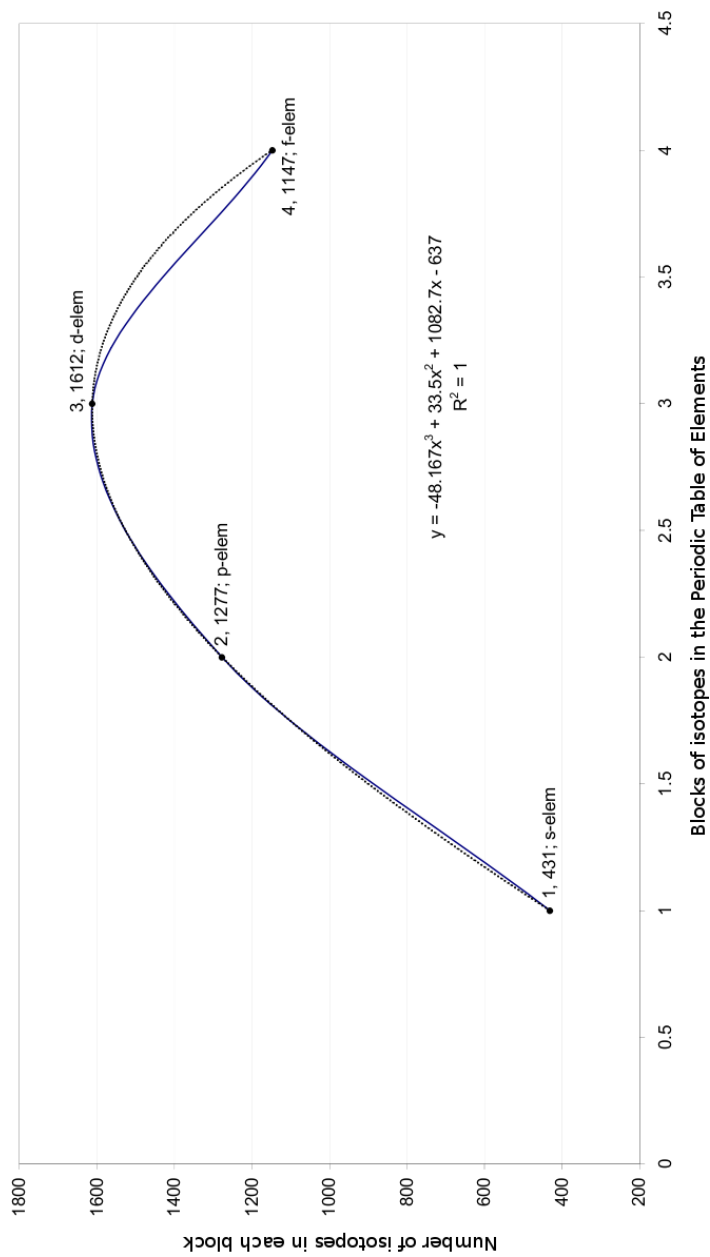


Fig. 7.6: Dependency of the number of the isotopes in the blocks from their names according to the elements of the electron configuration.

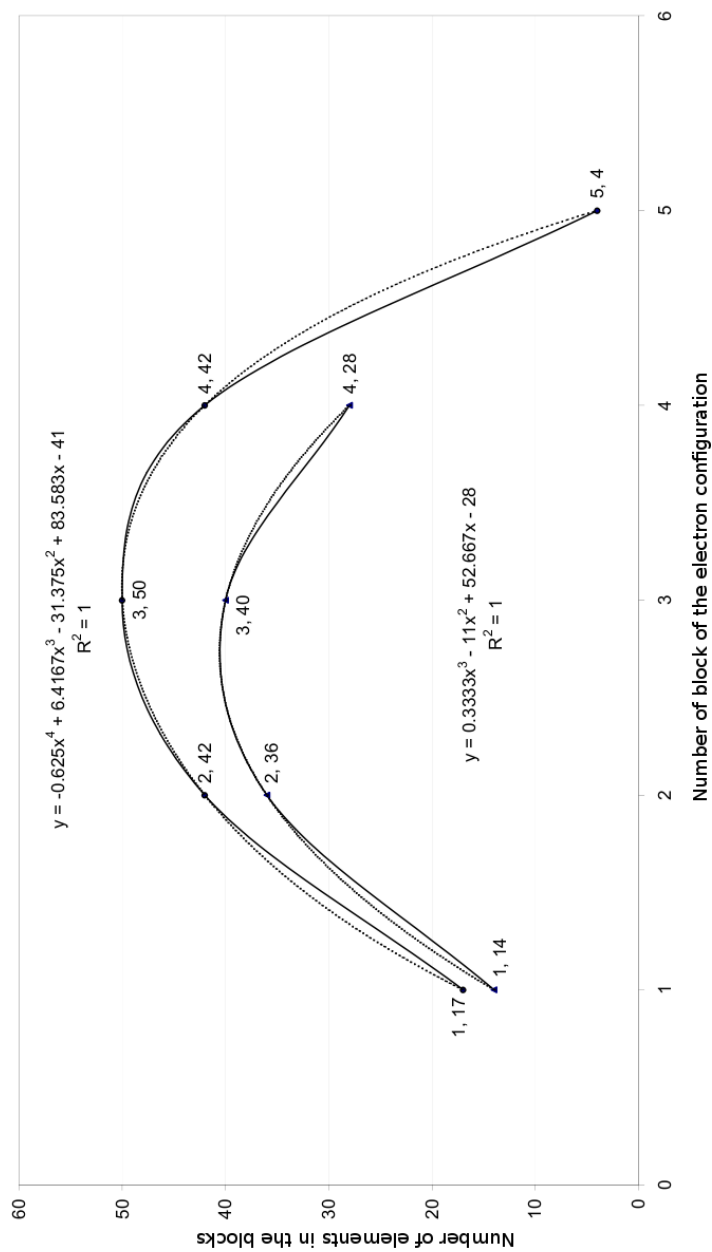


Fig. 7.7: Results of calculation of the electron configuration of the elements. The lower arc has been calculated for the version of the Periodic Table containing 118 elements. The upper arc has been calculated for the version of the Periodic Table containing 155 elements (suggested by the Author [37]).

the Periodic Table of Elements was constructed by the Author (see Table 7.4). It differs from the hypothetical forms of the Periodic Table by the real data consisting our Table. Element No. 155 is the last (heaviest) in our version of the Table, thus this element “closes” the Table. Element No. 155 also opens and closes Period 9, being located in Group 1 of this Period.

This scheme of calculation is applicable to all Tables of Elements containing more than 118 elements. The necessity of our study, presented herein, and the suggested version of the Table which limits by element No. 155, is due to that fact the law of hyperbolas we used previously in the Periodic Table [37] provided not only the possibility to calculate the upper limit of the Table (element No. 155 and its parameters such as atomic mass 411.66), but also allowed to determine its location in the extended version of the Table of Elements.

If earlier the theoretical physical chemists discussed the possibility to add a number of elements over 118 to the Table of Elements (they suggested to do it as new blocks they referred to as superactinide series, eka-superactinide, Ubb-series, Usb-series), we now obviously see that this step is nonsense. Despite the bulky mathematical apparatus of Quantum Mechanics was applied to calculation of stability of the elements, it never led to a result about a limit of the Periodic Table of Elements. This was never claimed in the basis of the quantum mechanical calculations. This is because that the conditions of micro-scales, where the laws of Quantum Mechanics work, do not provide the necessary data for the calculation. Only common consideration of the conditions of micro-world and macro-world, as the author did in the recent study [37], allowed to develop the fundamental law of hyperbolas in the Periodic Table of Elements, which starts from the positions of macro-scale then continues upto the electron configuration of the elements (wherein it works properly as well, as we seen in this paper) that led to that final version of the Periodic Table of Elements, which has been presented in this paper.

### **§7.3 The upper limit of the Periodic Table points out to the “long” version of the Table**

#### **§7.3.1 Introduction**

Many research papers have been written about the discovery of the Periodic Law of Elements. Many spectacular versions of this law have likewise been suggested. However the main representation of this law is still now a two-dimensional table consisting of cells (each single cell



1	2																		
3	4																		
11	12																		
19	20																		
37	38																		
55	56					57	58	59	60	61	62	63	64	65	66	67	68		
87	88					89	90	91	92	93	94	95	96	97	98	99	100		
119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	030		
155																			

s-block	g-block	f-block
---------	---------	---------

Table 7.4: Periodic Table of Elements, which is limited by element No. 155

manifests a single element). The cells are joined into periods along the horizontal axis (each row represents a single period), while the cells are joined into groups along the vertical axis (each column represents a single group). The resulting system is represented in three different forms: the “short version” (short-period version); the “long version” (long-period version); and the “super-long version” (extended version), wherein each single period occupies a whole row.

Our task in this paper is the consideration of the first two versions of the Periodic System.

There are hundreds of papers discussing the different versions of the Periodic Table, most of whom have been suggested by Mark R. Leach [45].

To avoid any form of misunderstanding of the terminology, we should keep in mind that, in each individual case, the Periodic Law sets up the fundamental dependence between the numerical value of the atomic nucleus and the properties of the element, while the Periodic System shows how we should use this law in particular conditions. The Periodic Table is a graphical manifestation of this system.

On March 1, 1869, Dmitri Mendeleev suggested the first “long” version of his Table of Elements. Later, in December of 1970, he published another, “short” version of the Table. His theory was based on atomic masses of the elements. Therefore, he formulated the Periodic Law as

												5	6	7	8	9	10
												13	14	15	16	17	18
		21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
		39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118
137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154

	d-block										p-block						
--	---------	--	--	--	--	--	--	--	--	--	---------	--	--	--	--	--	--

(suggested by the Author).

follows:

*“Properties of plain bodies, and also forms and properties of compounds of the elements, have a periodic dependence on the numerical values of the atomic masses of the elements”.*

After the internal constitution of each individual atom had been discovered, this formulation was changed to:

*“Properties of plain substances, and also forms and properties of compounds of the elements, have a periodic dependence from the numerical value of the electric charge of the respective nucleus”.*

All elements in the Periodic Table have been numbered, beginning with number one. These are the so-called atomic numbers. Further, we will use our data about the upper limit of the Periodic Table [5,37,46], when continuing both the short and long versions of the Table upto their natural end, which is manifested by element No. 155.

### §7.3.2 The short version of the Periodic Table

#### a) The Periods

The Periodic System of Elements is presented with the Periodic Table (see Table 7.5), wherein the horizontal rows are known as Periods. The first three Periods are referred to as “short ones”, while the last five — “long ones”. The elements are distributed in the Periods as follows: Period 1 — by 2 elements, Periods 2 and 3 — by 8 elements in each,

Periods 4 and 5 — by 18 elements in each, Periods 6 and 7 — by 32 elements in each, Period 8 — by 37 elements. Herein we mean that Period 7 is full upto its end, while Period 8 has been introduced according to our calculation. Each single Period (except for Hydrogen) starts with an alkaline metal and then ends with a noble gas. In Periods 6 and 7, within the numbers 58–71 and 90–103, families of Lanthanoids and Actinides are located, respectively. They are placed on the bottom of the Table, and are marked by stars. Chemical properties of Lanthanides are similar to each other: for instance, they all are “reaction-possible” metals — they react with water, while producing Hydroxide and Hydrogen. Proceeding from this fact we conclude that Lanthanides have a very manifested horizontal analogy in the Table. Actinides, in their compounds, manifest more different orders of oxidation. For instance, Actinium has the oxidation order +3, while Uranium — only +3, +4, +5, and +6. Experimentally studying chemical properties of Actinides is a very complicate task due to very high instability of their nuclei. Elements of the same Period have very close numerical values of their atomic masses, but different physical and chemical properties. With these, and depending on the length of the particular Period — each small one consists of one row, while each long one consists of two rows (the upper even row, and the lower odd row), — the rate of change of the properties is smoother and slower in the second case. In the even rows of the long Periods (the rows 4, 6, 8, and 10 of the Table), only metals are located. In the odd rows of the long Periods (these are the rows 5, 7, and 9), properties of the elements change from left to right in the same row as well as those of the typical elements of the Table.

The main sign according to which the elements of the long Periods are split into two rows is their oxidation order: the same numerical values of it are repeated in the same Period with increase of atomic mass of the elements. For instance, in Period 4, the oxidation order of the elements from K to Mn changes from +1 to +7, then a triad of Fe, Co, Ni follows (they are elements of an odd row), after whom the same increase of the oxidation order is observed in the elements from Cu to Br (these are elements of an odd row). Such distribution of the elements is also repeated in the other long Periods. Forms of compounds of the elements are twice repeated in them as well. As is known, the number of each single Period of the Table is determined by the number of electronic shells (energetic levels) of the elements. The energetic levels are then split into sub-levels, which differ from each one by the coupling energy with the nucleus. According to the modern reference data, the number of the sub-levels is  $n$ , but not bigger than 4. However, if taking

Seaborg's suggestion about two additional Periods of 50 elements in each into account, then the ultimate high number of the electrons at an energetic level, according to the formula  $N = 2n^2$ , should be 50 (under  $n = 5$ ). Hence, the quantum mechanical calculations require correction.

### b) The Groups

The Periodic Table of Elements contains 8 Groups of the elements. The Groups are numbered by Roman numbers. They are located along the vertical axis of the Table. Number of each single Group is connected with the oxidation order of the elements consisting it (the oxidation number is manifested in the compounds of the elements). As a rule, the positive highest oxidation order of the elements is equal to the number of that Group which covers them. An exception is Fluorine: its oxidation number is  $-1$ . Of the elements of Group VIII, the oxidation order  $+8$  is only known for Osmium, Ruthenium, and Xenon. Number of each single Group depends on the number of the valence electrons in the external shell of the atom. However it is equally possible to Hydrogen, due to the possibility of its atom to loose or catch the electron, to be equally located in Group I or Group VII. Rest elements in their Groups are split into the *main* and *auxiliary* sub-groups. Groups I, II, II include the elements of the left side of all Periods, while Groups V, VI, VII — the elements located in the right side. The elements which occupy the middle side of the long Periods are known as the transferring elements. They have properties which differ from the properties of the elements of the short Periods. They are considered, separately, as Groups IVa, Va, VIa, VIII, which include by three elements of each respective long Period Ib, IIb, IIIb, IVb. The main sub-groups consist of the typical elements (the elements of Periods 2 and 3) and those elements of the long Periods which are similar to them according to their chemical properties. The auxiliary sub-groups consist of only metals — the elements of the long Periods. Group VIII differs from the others. Aside for the main sub-group of Helium (noble gases), it contains three shell sub-groups of Fe, Co, and Ni. Chemical properties of the elements of the main and auxiliary sub-groups differ very much. For instance, in Group VII, the main sub-group consists of non-metals F, Cl, Br, I, At, while the auxiliary subgroup consists of metals Mn, Tc, Re. Thus, the sub-groups join most similar elements of the Table altogether. Properties of the elements in the sub-groups change, respectively: from up to down, the metallic properties strengthen, while the non-metallic properties become weak. It is obvious that the metallic properties are most expressed on

Group →	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Period ↓	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	H	He																
	Li	Be																
	Na	Mg																
	K	Ca																
	Rb	Sr																
	Cs	Ba	*															
	Fr	Ra	**															
	Uue	Ubn	***															
	155																	

<b>Lanthanides *</b>	57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
<b>Actinides **</b>	89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr
<b>g-elements ***</b>	121 Ubu	122 Ubb	123 Ubt	124 Ubbq											
<b>f-elements</b>	125	126	127	128	129	130	131	132	133	134	135	136	137	139	
<b>Ubb-series</b>	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154

Table 7.5: The standard (long) version of the Periodic Table of Elements.

Fr then on Cs, while the non-metallic properties are most expressed on F then on O [47].

### c) Electron configuration of the atoms, and the Periodic Table

The periodic change of the properties of the elements by increase of the ordinal number is explained as the periodic change of their atoms' structure, namely by a number of electrons at their outer energetic levels. Elements are divided into *seven periods* (*eight according to our dates*) in accordance with energetic levels in electron shells. The electron shell of Period 1 contains one energetic level, Period 2 contains two energetic levels, Period 3 — three, Period 4 — 4, and so on. Every Period of the Periodic System of Elements begins with elements whose atoms, each, have one electron at the outer level, and ends with elements whose atoms, each, have at the outer shell 2 (for Period 1) or 8 electrons (for all subsequent Periods). Outer shells of elements (Li, Na, Ka, Rb, Cs); (Be, Mg, Ca, Sr); (F, Cl, Br, I); (He, Ne, Ar, Kr, Xe) have a similar structure. The number of the *main sub-Groups* is determined by the maximal number of elements at the energetic level which equals 8. The number of common elements (elements of auxiliary sub-Groups) is determined by maximal electrons at d-sub-level, and it equals 10 for every large Period (see Table 7.6).

As far as one of auxiliary sub-Groups of the Periodic Table of Elements contains at once three common elements with similar chemical properties (so called triads Fe-Co-Ni, Ru-Rh-Pd, Os-Ir-Pt), then the number, as of common sub-Groups as main ones, equals 8. The number of Lanthanoids and Actinides placed at the foot of the Periodic Table as independent rows equals the maximum number of electrons at the f-Sub-level in analogy with common elements, i.e. it equals 14.

A Period begins with an element the atom of which contains one s-electron at the outer level: this is hydrogen in Period 1, and alkaline metals in the others. A Period ends with precious gas: helium ( $1s^2$ ) in Period 1.

Detailed studies of the structure of an atom are not the aim of our paper, therefore we draw common conclusions concerning the corresponding locations of *elements in blocks*:

1. **s-elements**: electrons fill s-sub-shells of the outer level; two first elements of every Period are related to them;
2. **p-elements**: electrons fill p-sub-shells of the outer level; six last elements of every Period are related to them;

3. **d-elements:** electrons fill s-sub-shells of the outer level; they are elements of inserted decades of big Periods placed between s- and p-elements (they are called also common elements);
4. **f-elements:** electrons fill f-sub-shells; they are Lanthanoids and Actinides.

### §7.3.3 Drawbacks of the short version and advantages of the long version of the Periodic Table

The “short” form of the Table was cancelled officially by IUPAC in 1989. But it is still used in Russian information and educational literature, must probably, according to a tradition. But it follows by detailed consideration that it contains some moot points.

In particular, Group VIII contains in the common Group, together with precious gases (the main sub-Group), triads of elements, which have precisely expressed the properties of metals. The contradiction here is that the triad Fe, Co, Ni is near families of platinum metals although their properties differ from the properties of Groups of iron. Group I contains alkaline metals having very strong chemical activity, but simultaneously the sub-Group contains copper, silver and gold which have not these properties but possess excellent electric conductivity. Besides gold, silver and platinum, metals have very weak chemical activity.

Group VII, where nearby halogens such metals as manganese, technetium and rhenium are placed, is also incorrect, because in the same Group two sub-Groups of elements possessing absolutely different properties are collected.

The “short” Table is sufficiently informative but it is difficult in terms of use due to the presence of the “long” and the “short” Groups, i.e. the small and big Periods divided by even and odd lines. It is very difficult to place f-elements inside eight Groups.

The “long” form of the Table consisting of 18 Groups was confirmed by IUPAC in 1989. Defect characteristics of the “short” Table were removed here: the sub-Groups are excepted, Periods consist of one stitch, elements are composed of blocks, the families of iron and platinum metals have disappeared, and so on.

The known Periodic Table consisting of 118 elements and 7 Periods where our dates for Period 8 are added must contain: 17 s-elements, 42 p-elements, 50 d-elements, 42 f-elements, and 4 g-elements.

The number 17 for s-elements follows from the fact that two of them are in Group I and Group II of Period 8, while element No. 155 (the last s-element, 17-th) is in Period 9 and Group I (the sole) closes the Table.





Lanthanides (the upper row) and Actinides (the lower row)

Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
58	59	60	61	62	63	64	65	66	67	68	69	70	71
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr
90	91	92	93	94	95	96	97	98	99	100	101	102	103

Period 8

<b>8</b>	12	119	120	121	122	123	124	125	126	127	128
		Uue	Ubn	Ubu	Ubb	Ubt	Ubc	Ubp	Ubh	Ubs	Ubo
	13	129	130	131	132	133	134	135	136		
		Ube	Utn	Utu	Utb	Utt	Utc	Utp	Uth		
	14	137	138	139	140	141	142	143	144	145	146
		Uts	Uto	Ute	Uqn	Uqu	Uqb	Uqt	Uqq	Uqp	Uqh
15	147	148	149	150	151	152	153	154			
	Uqs	Uqo	Uqe	Upn	Upu	Upb	Upt	Upq			
16	<b>155</b>										

121–124 — g-elements

125–138 — f-elements

155 — Upp (Unpententium) — Last element

Table 7.6: The suggested (short) version of the Periodic Table of Elements, upto No. 155.

The extended Table consisting of blocks containing the number of elements calculated by us is published in [46].

### §7.3.4 From the Periodic Law to the Hyperbolic Law and the upper limit of the Periodic System

A note by Mendeleev, in March of 1869, was published and sent in Russian and French to scientists, titled “Experience of Systems of Elements Founded on Their Atomic Weights and Chemical Similarity” (with “atomic weight” to be understood as “atomic mass” here and in the future). This date is considered as the discovery date of the periodic law of chemical elements. The author dedicated the next two years to the work in this direction, which was a correction of atomic masses, an elaboration of studies about the periodical properties of elements, about the rôle of Groups, of big and small Periods, as well as about the places of chemical combinations in the Table. As a result, “Mendeleev’s Natural System of Elements” which was the first periodic table of chemical elements was published in the first edition of his book “The Foundations of Chemistry”, in 1871.

It is necessary to note that the dates published in the table of “Experience of Systems of Elements Founded on Their Atomic Weights and Chemical Similarity” permits us to use them in order to prove the correctness of Mendeleev’s work.

The comprehensive table based the book “Experience of System of Element Found on Their Atomic Weight and Chemical Similarity”, in terms of the dependence of each atomic mass on the number of the corresponding element, has been built by us and showed on Fig. 7.8. Because then it was not known yet that the ordinal number of each element characterizes its charge, it was simply the case that an element possessing a minimal mass was allowed to be designed as No. 1, and this order is conserved in the future: the next, in terms of mass, element will be designated as No. 2, the third as No. 3, and so on. Thus the ordinal number, which was attributed to the element after the theory of the atom was constructed has here another numerical value — symbolizing order of priority. The Table on Fig. 7.8 is the same as the one composed by Mendeleev, and the elements and the numbers are placed as the points on the arc where the triangles designate the beginning of the Periods. As is clear, the arc goes smoothly, preceding the elements and the atomic mass  $\sim 100$ , and after that it deviates preceding Ba. The trend line equation can be easily described by the multinomial of the third degree, i.e. by  $R^2 = 0.9847$ , in spite of a strong jump in the region of Lantanides. It should be noted that the part of the

arc preceding Ba has  $R^2 = 0.999$ . It means that the direction of the trend line after Ba reflects correctly the further course of our dependence, which allows us to calculate easily the atomic weights of other elements.

It should be noted that the trend line of the curve constructed according to contemporary dates has  $R^2 = 0.9868$ . In order that compare the dependence of the atomic mass from the ordinal number according to contemporary dates and the dates of Mendeleev the graph of was constructed (see Fig. 7.9). As is clear, the maximal deviations (3–4%) are observed for 6 cases, (1–1.5%) — for 8 cases, the others are placed lower. Because the common number of elements is 60, this spread is negligible for the those time.

As follows from the indicated dates, Mendeleev showed by means of his works concerning the Periodic Law that it is true for 60–70 elements, opening the way for the extension of the Table upto No. 118.

But our studies of the Periodic Table distinctly show that a hyperbolic law takes place in it. The law determines the upper limit of the Table through element No. 155. This fact is indisputable and it is justified by numerous publications.

### §7.3.5 Conclusion

If it was allowed in the 1950s that a maximum value of an ordinal number in Periodic Table could not exceed the value  $Z = 110$  due to a spontaneous division of the nucleus, then in the 1960s theoreticians proposed the hypothesis that the atomic nucleus could have anomalously high stability. Seaborg called these regions “islands of stability” in a “sea of instability”. He hoped for a possible synthesis of super-elements inside these regions,

“... but until [now] the problem of the upper bound of the Periodic System [remains] unsolved...”

(and so: at that time)!

Since in order to solve any problem it is necessary to know a final goal and to define its bounds, we have realized experimental studies and constructed a mathematical apparatus for the determination of the upper bound of the Periodic Table. According to our calculations, the last element is estimated and its location is determined: Period 9, Group I, with atomic mass of 411.66 (approximately), for which  $Z = 155$ . The earlier-proposed extended tables by Seaborg for 168 and 216 elements simply cannot be realized, because *only 155 elements can be in the Table, in its entirety.*

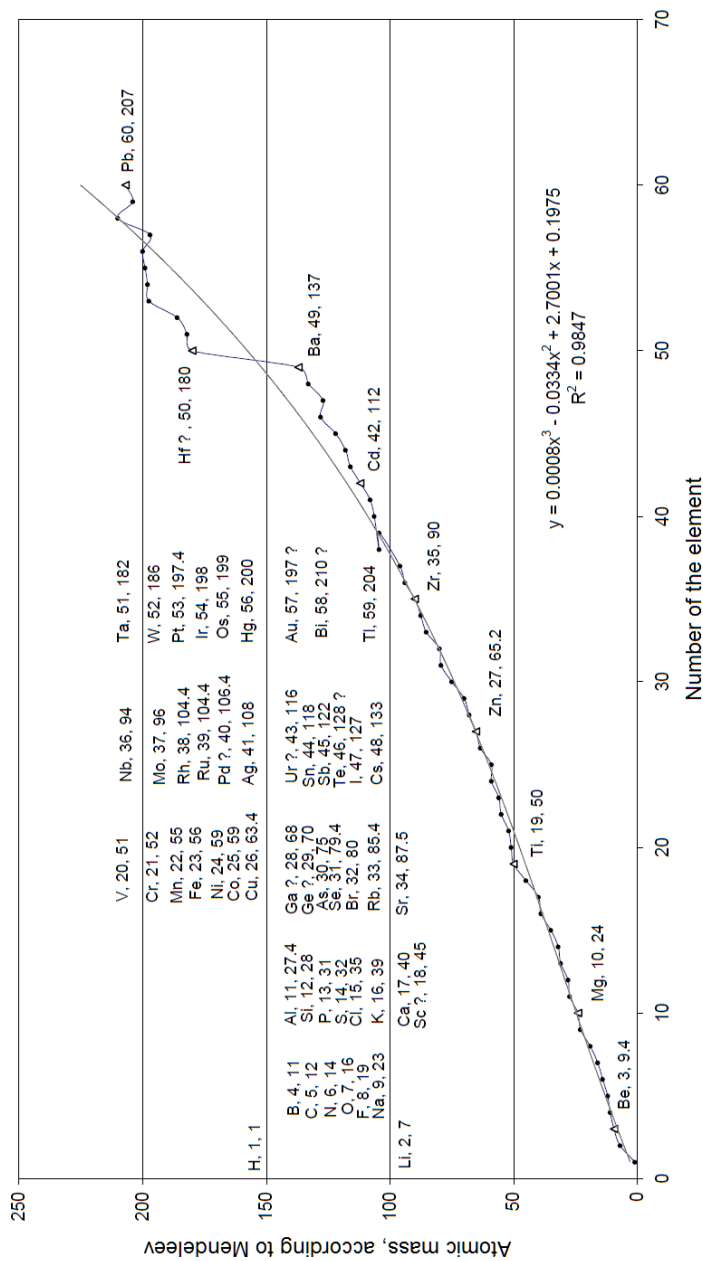


Fig. 7.8: Experience of the System of the Elements, based on their atomic mass (the table, according to Mendeleev). Dependence of the atomic mass from the number of the elements (the graphs, according to the suggested formulation). The triangles mean the beginning of each Period.

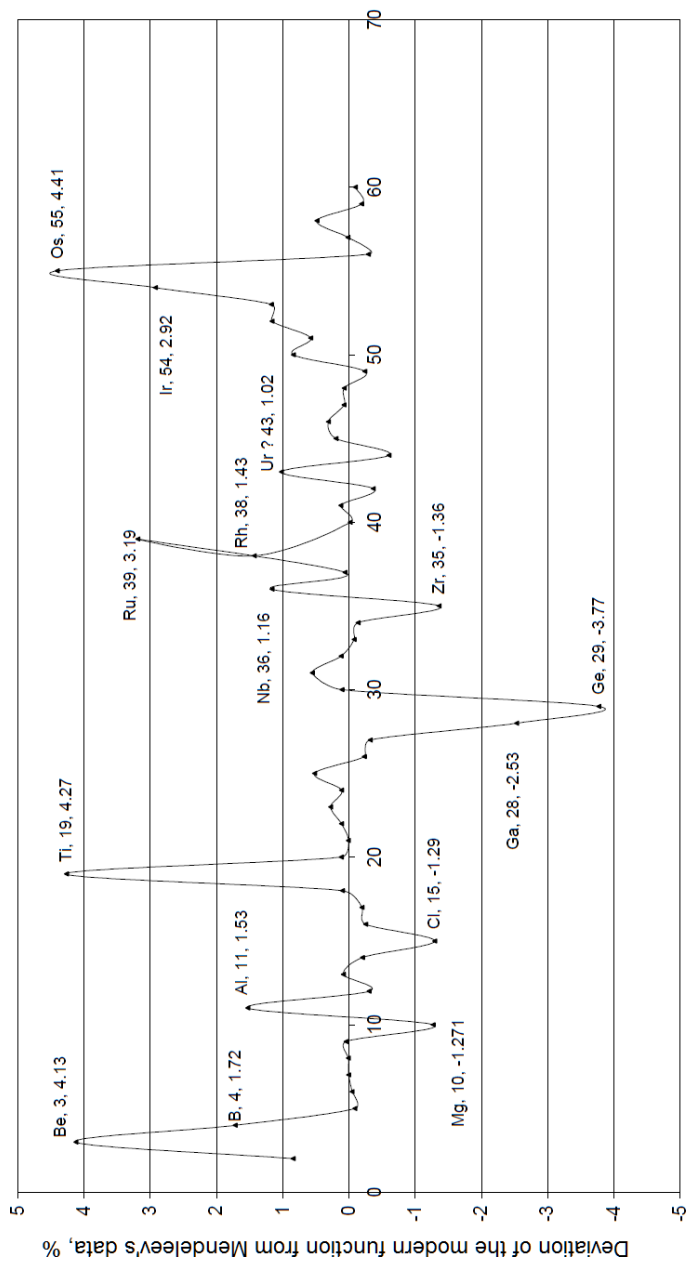


Fig. 7.9: Deviation of the modern (suggested) dependence of the atomic mass from the number of the elements from Mendeleev's data.

## §7.4 From the chloride of Tungsten to the upper limit of the Periodic Table of Elements

### §7.4.1 Introduction

In the early 1960's, I and my research group worked in the Department of Rare, Radioactive Metals and Powder Metallurgy at Moscow Institute of Steel and Alloys, Russia. We looked for a better technology of manufacturing the chemically clean hexachlorid of tungsten ( $WCl_6$ ) through chlorination of ferrotungsten. Then, in the 1970's, I continued this experimental research study at the Baikov Institute of Metallurgy, Russian Academy of Sciences.

Our main task in this experimental search was to obtain a purely oxygen-free product. Because the raw material we worked with was resented as a many-component gaseous mix, we studied behaviour of the vaporous medleys during filtering them by saline method, distillation, and rectification. As a result, the percent of mass of the metal we have obtained in vaporous medley was 99.9% for W, 20.0% for Mo, 2.0% for Fe [48–50].

After cleaning the obtained condensate with the aforementioned methods, we have found a small inclusion of the chloride compound of tungsten in it. This chloride compound of tungsten differs from the hexachloride of tungsten in colour and the boiling temperature, which was  $348^\circ\text{C}$  for  $WCl_6$ ,  $286^\circ\text{C}$  for  $WCl_5$ , and  $224^\circ\text{C}$  for  $WOCl_4$  [51]. The cleaned hexachloride of tungsten recovers to the powder metallic state by hydrogen in the boiling layer, in plasma, precipitates as a thin cover on a base in use. It is used for manufacturing alloys with other metals through metalthermic method, etc. [52].

### §7.4.2 Results

In development of this technology, it was found that the theoretical (expected) results of the chemical analysis of the vaporous medleys do not match the experimental results for a little. This occurred due to some quantity of  $WO_2Cl_2$  and  $WOCl_4$  obtained in the process, which were used further for manufacturing a high clean  $WO_3$  [53]. In order to keep control on the product of the chemical reactions, we have drawn dependencies of the content of tungsten, chlorine, and oxygen in the compounds (per one gram-atom of each element).

This is necessary because, for example, the common quantity of the chloride of tungsten in chlorides is presented with a broken line (see Fig. 7.10) whose mathematical equation is impossible. As was found, after our Fig. 7.10, the arc of the content of tungsten is presented with

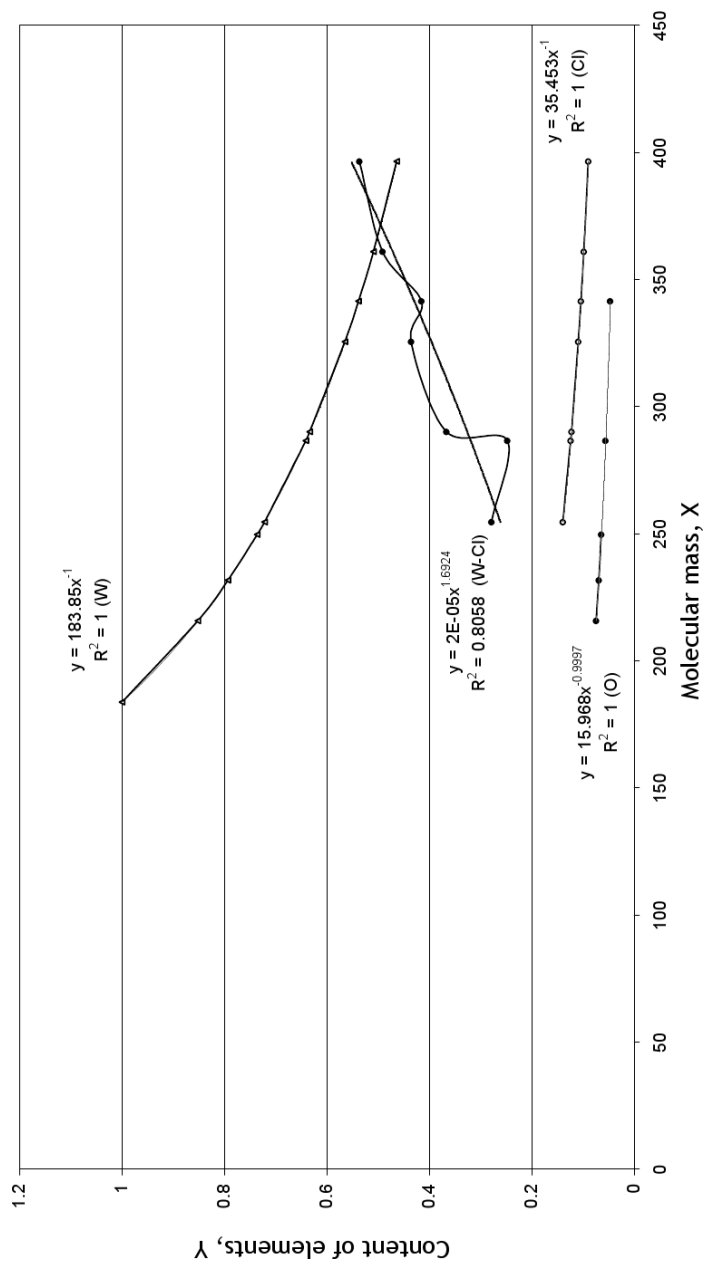


Fig. 7.10: The common quantity of the chloride of tungsten in chlorides.



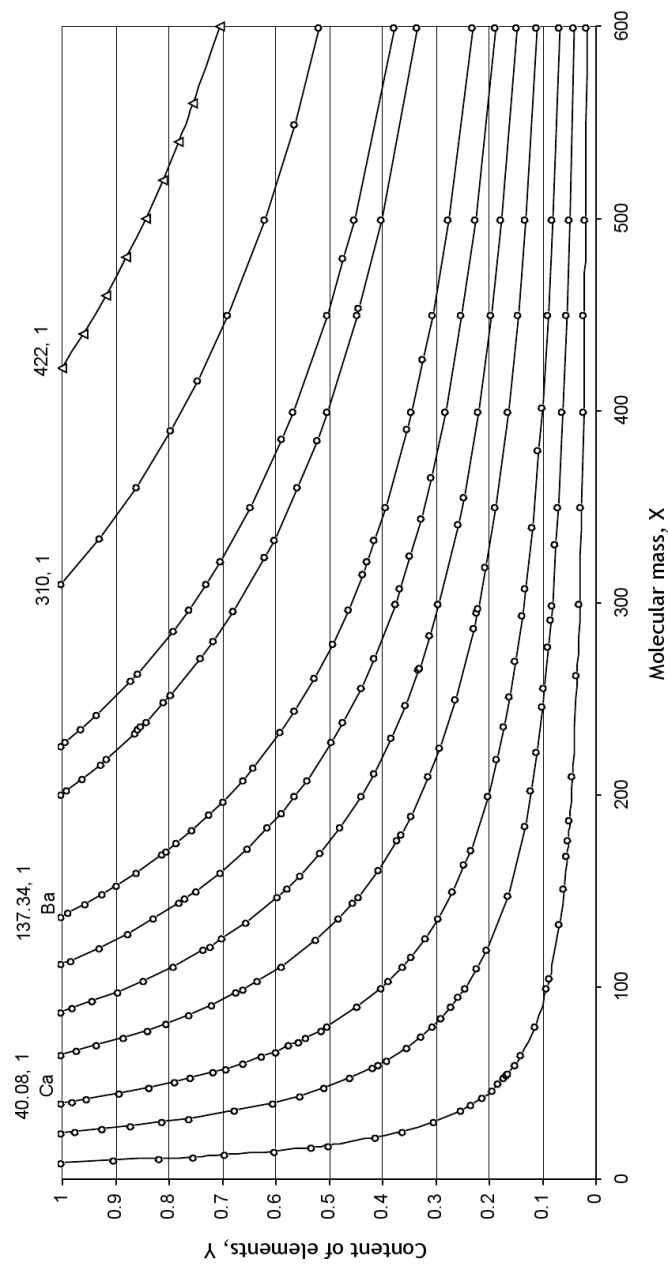


Fig. 7.11: The hyperbolas created for the elements of Group 2, including the hypothetical elements No.126 and No.164.

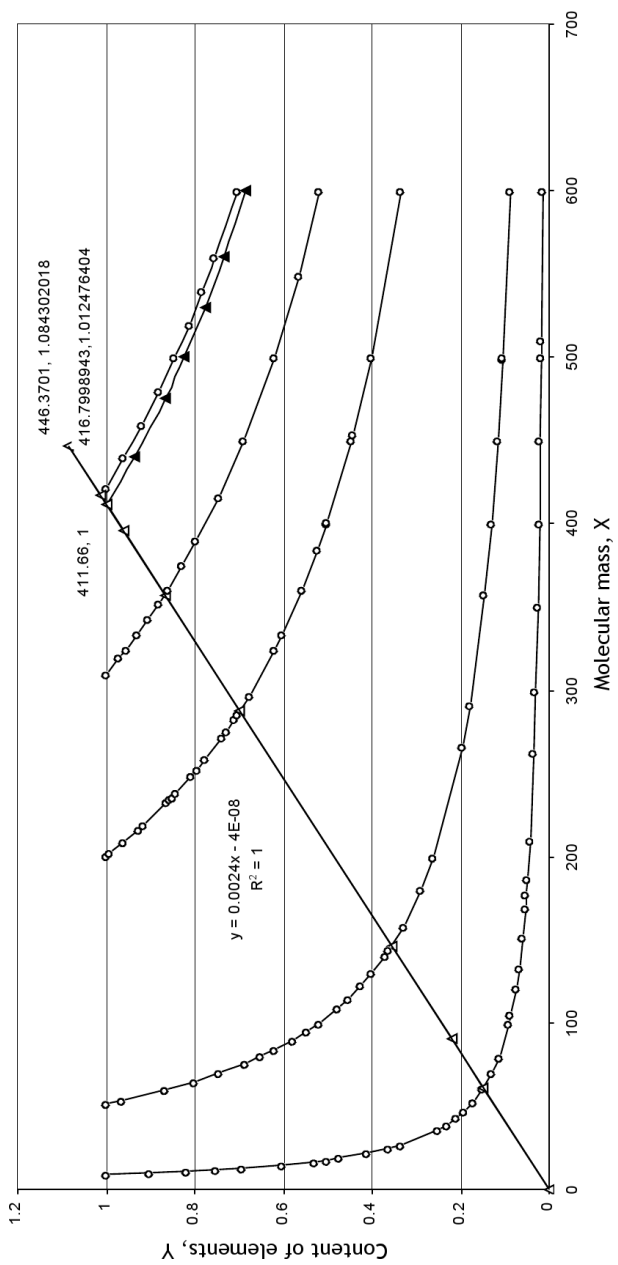


Fig. 7.12: The upper limit of the Periodic Table of Elements.

an equilateral hyperbola  $Y = K/X$  wherein its different compounds (in particular  $\text{WO}_3$ ) are located. In analogy to this graph, the respective arcs were obtained for chlorine and oxygen, which appeared as hyperbolas as well.

Further checking for the possibility of creating similar functions for the other chemical elements manifested the fact that each element of the Periodic Table of Elements has its own hyperbola, which differs from the others according to the atomic mass of the element. As an example, Fig. 7.11 shows the hyperbolas created for the elements of Group 2, including the hypothetical elements No. 126 and No. 164. As is known, an equilateral hyperbola is symmetric with respect to the bisector of the angle  $XOY$  in the first quarter. Besides, the bisector coincides with the real axis, while the point of intersection of it with the hyperbola (the top point) is determined as the square root from  $K(X_0 = Y_0)$ . Respectively, for instance, the top point of the hyperbola of beryllium (atomic mass 9.0122) is located at  $X_0 = Y_0 = 3.00203$ .

In chemistry, it is commonly assumed to calculate the quantity of a reacted element in the parts of unit. Therefore, the hyperbola of each element begins from the mass of the element and  $Y = 1$ . From here, through Lagrange's theorem, we calculate the top of the hyperbola of beryllium:  $X = 60.9097$ ,  $Y = 0.14796$ . Comparing the obtained coordinates, it is easy to see that  $X/X_0 = 20.2895$  and  $Y_0/Y = 20.2895$ , which is the inverse proportionality with a respective scaling coefficient. Tangent of the angle of inclination of the real axis in the other (scaled) coordinates is  $Y/X = 0.14796/60.9097 = 0.00242917$ . The scaling coefficient allowed us to create a line joining the tops of the hyperbolas, located in the real axis (see Fig. 7.12). This is a straight crossing the line  $Y = 1$ , where the atomic and molecular masses of an element described by the hyperbolas are equal to each other ( $K = X$ ). This is only possible if the origin of the hyperbola and its top meet each other at a single point where the content  $Y$  takes maximal numerical value (according to the equation  $Y = K/X$ ). Atomic mass of this "ultimate" element, determined by the crossing point, was calculated with use of the scaling coefficient and the tangent of inclination of the real axis:  $X = Y/\tan \alpha = 1/0.00242917 = 411.663243$ . This calculated element is the last (heaviest of all theoretically possible elements) in the Periodic Table of Elements because  $Y$  cannot exceed 1. The second important characteristic of the element — its atomic number — was calculated through the equation of the exponent  $Y = 1.6089 \exp^{1.0993x}$  ( $R^2 = 0.9966$ ). The calculated number of the last element is 155. With use of these equations, the respective parameters of all other elements

of the Periodic Table can be calculated, including in the interval of super-heavy elements No. 114–No. 155 [5, 37].

### §7.4.3 Discussion

We see that on the basis of the initially experimental studies of the chloride of tungsten, a new law was found in the Periodic Table of Elements. This is the hyperbolic law, according to which the content  $Y$  of any element (per 1 gram-atom) in any chemical compound of a molecular mass  $X$  can be described by the equation of the positive branches of an equilateral hyperbola of the kind  $Y = K/X$  (where  $Y \leq 1$  and  $K \leq X$ ). The hyperbolas of the respective chemical elements lie in the order of the increasing nuclear charge, and have a common real axis which meets their tops. The tops, with distance from the origin of the coordinates, approach the location  $Y = 1$  and  $K = X$  wherein atomic mass takes its maximally possible numerical value, which indicates the last (heaviest) element of the Periodic Table.

It should be noted that the new dependencies we pointed out here have provided not only better conditions of applied research, but also a possibility for re-considering our views on the conditions of synthesis of super-heavy elements. If already in 2003 theoretical physicists discussed properties of elements with number near 400 whose nuclei contain until 900 neutrons each [28], in February 2009, after primary publication of our studies, they discuss the elements with numbers not higher than 150–200 [31].

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## Chapter 8

### Concluding Remarks

#### §8.1 Element No. 155 — the upper limit (heaviest element) in the Periodic Table of Elements

In the Periodic Table, elements are in a static condition, which until now has not allowed us to reveal the dynamics of their contents in various chemical compounds. The regularity established by us represents equilateral hyperbolas  $Y = K/X$ , where  $Y$  is the content of any element  $K$  and  $X$  is the molecular mass of compounds taken according to one gram-atom of the defined element. The extreme conditions of the equation are attained when  $Y \leq 1$ ,  $K \leq X$ . Mathematically speaking, if, for such hyperbolas, the peak is defined as  $\sqrt{K}$ , according to the theorem of Lagrange, on the basis of which the calculated factor of scaling ( $M = 20.2895$ ) is applied, it shall allow us to pass from one system of coordinates to another. The square of this number (411.66) is equal to the maximal atomic mass of the last element, which is the crossing point of the real axis of all hyperbolas whose ordinate is given by  $Y = 1$ . Its serial number is 155.

Calculations of adjacent hyperbolas of the kind  $Y = (X - K)/X$  whose center is the point 0; 1 have a simultaneous effect. Both versions of hyperbolas serve as additions with respect to each other. When in one curve  $Y$  decreases, in the second it increases. Each pair of hyperbolas of one element is crossed at the point ( $X = 2K$ ,  $Y = 0.5$ ) through which passes the axis of symmetry. Direct and adjacent hyperbolas of all elements are crossed among themselves. The hyperbolas of the last element are the right boundaries of existence for the compounds, and, at the left, they are bounded by the coordinate axes.

As a result of graphical constructions and voluminous calculations, it has been found that in the Periodic Table there is the element Rhodium (Rh) to which it is not required to apply theorem Lagrange and the factor of scaling. On the basis of direct tabular data and adjacent hyperbolas, at a point of their crossing (205.811; 0.5), the real axes which, on the  $X$  axis and along the line  $Y = 1$ , cut apiece with abscissa 411.622, are under construction. The divergence from the data described above

is a several thousandths shares of the percent. This fact manifests the validity of our theory.

It is thereby proved that the Top Limit of the Periodic Table is the element No.155 with atomic mass 411.66. At present it is known that No.118-th has been synthesized — last element of the seventh period (No.117 is not discovered for yet). And, the above the serial number suggests that it is somehow difficult for the Table to receive a new element. So, accordingly, in nuclear reactions involving the synthesis of elements nos.114, 115, 116, and 118, events 60, 24, 9 and 3 have been registered. In the known neutron-proton diagram of the nucleus (nearby 2500) which finishes with the element No. 114, it is seen that, in the end, its quantity of artificial isotopes sharply decreases. To the number of the element with atomic mass 298, scientists have assigned special hopes as here isotopes should possess raised stability. However, with the addition of the nucleus No. 155 to the diagram, a general line of new trends shows that the predicted element No.114 should have 179 neutrons, instead of 175. Also expected by scientists are the twice-magic nucleus with a charge number 114 and atomic mass 298, which, according to our data, has a lack of 2 protons or, in other words, a surplus of 5 neutrons. The existing disorder in the parameters of the elements is caused by the fact that there enters a more long-living isotope into the table. Therefore the element No. 155 should be a reference point in nuclear reactions. It is necessary to consider it in new quantum theory calculations for the sake of filling the Periodic Table. There are different points of view on the quantity of elements in it: from 120 upto 218 and more. For example, G. T. Seaborg and V. I. Goldanskii have suggested adding 8-th and 9-th periods to 50 elements. But in constructing the total dependence of isotopes (more than 2500) on the charge of a nucleus, it is possible to see that it has the parabolic form, and, in the end, its account goes by the units of the seventh period. It is also necessary to acknowledge that elements with numbers 94–103 have been discovered over the last 20 years, and 104–113—for 40.

In the world, hundreds of variants of the Periodic Table have been created, but no one never has been able to answer the question, whether it has a limit. We, for the first time, have given the parameters of the last element as belonging to the 8th period, the first group, having No. 155 and atomic mass 411.66.

## §8.2 Periodic Table of Anti-Elements

It is necessary to note that while our theory has been considered with reference to the first quadrant, the position of the second branches of

equilateral hyperbolas in the third quadrant (where  $K > 0$ ) has not been analyzed. However, it has appeared that they possess similar properties (similar to those in the first quadrant). Here too it is necessary to enter the factor for reduction of coordinate axes by one scale. If now around an imaginary axis we allow the overlapping of the third and the first quadrants, it is possible to see practically the full concurrence of curves, coordinates, and real axes. However, it concerns only the central part of the hyperbolas, and their edges, observing a direction, fall outside the limits. Hence, here the principle of symmetry does not work. At  $K < 0$  it is established, in the second and the fourth quadrants of the hyperbolas, that there is similar regularity which has been established by us for the first and the third quadrants. It is caused by equilateral hyperbolas having equal parameters with respect to the module, but with an opposite sign; namely, being mutually interfaced, they possess identical properties. Therefore, proceeding from the chemical concepts, they can be symmetric only after the change of scale of the  $X$  and  $Y$  axes. As in the third and fourth quadrants a negative ordinate (a degree of transformation of substance) is not allowable in Nature, we shall analyze only quadrants 1 and 2, in which  $K > 0$  and  $K < 0$ . Here there is a full symmetry: the hyperbolas are congruent and all axes coincide. Hence, the hyperbolic law in the Periodic Table shall be applied to the second quadrant. At a positive value of  $Y$ , a negative value  $X$ , and  $K < 0$ , it is possible to assert that in it there are substances with a minus sign, i.e., Anti-Elements. Furnished with the analysis above, there arises the opportunity of constructing the Periodic Table of Anti-Elements similar to the one considered above [22, 23].

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## Postface: Additional Explanations to Element No. 155

True number of elements in Mendeleev's Periodic Table is the most important problem to the scientists working on the theory of the Periodic Table. The theory is based in the core on our views about the properties of the electron shells and sub-shells in atoms, which obviously change with increasing nuclear charge (the nuclei themselves remains unchanged in chemical reactions). The electron shells change due to redistribution of electrons among the interacting atoms. Therefore, it is important that we know the limits of stability of the electron shells in the heavy elements (high numbers in the Periodic Table); the stability limits are the subjects of calculation in the modern quantum theory which takes into account the wave properties of electron and nucleons. To do it, the scientists employ a bulky mathematical technique, which gives calculations for the 8th and 9th periods of the Table (a hundred new elements are joined there).

Already 40 years ago the physicists proved that no chemical elements with number higher than 110 cannot exist. Now, 118th element is known (117th element, previous to it, is still non-discovered). In the last time, the scientists of Joint Institute for Nuclear Research, Dubna, talked that the Periodic Table ends with maybe 150th element, but they did not provide any theoretical reason to this claim. As is probable, the regular method of calculation, based on the quantum theory, gives no exact answer to the question about upper limit of the Table.

It should be noted that 10 new elements were synthesized during the last 25 years: 5 elements were synthesized in GSI\*, 4 elements were synthesized in JINR<sup>†</sup> (2 of these — in common with LLNL<sup>‡</sup>), and 1 element was synthesized in LBNL<sup>§</sup>. All the laboratories produced new elements as a result of nuclear reactions in accelerators: new elements were found after analysis of the products of the reactions. This is a very simplified explanation, however the essence of the process is so: problem statement, then components for the nuclear reaction and the necessary

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\*Gesellschaft für Schwerionenforschung — Helmholtz Centre for Heavy Ion Research, Darmstadt, Germany.

<sup>†</sup>JINR — Joint Institute for Nuclear Research, Dubna, Russia.

<sup>‡</sup>LLNL — Lawrence Livermore National Laboratory, USA.

<sup>§</sup>LBNL — Lawrence Berkeley National Laboratory, USA.



physics condition, then — identification of the obtained products after the reaction. This method gives new elements, of course, but it gives no answer to the question about their total number in the Periodic Table.

In contrast to this approach, when I tackled this problem, I used neither calculation for the limits of stability of the electron shells in atoms, nor experiments on synthesis of new elements, but absolutely another theoretical approach which allowed me for formulation of a new law in the Periodic Table and, as a result, the upper limit in it. Here I explain how, in short.

First. Contents  $Y$  of every single element (say, of a  $K$ -th element in the Table) in a chemical compound of a molecular mass  $X$  can be given by the equation of an equilateral hyperbola  $Y = K/X$ , according to which  $Y$  (in parts of unit) decreases with increasing  $X$ .

Second. After as I created the hyperbolic curves for not only all known elements, but also for the hypothetical elements, expected by the aforementioned experimentalists, I looked how the hyperbolas change with molecular mass. To do it, I determined the tops of the hyperbolas, then paved a line connecting the tops.

Third. The line comes from the origin of the coordinates, then crosses the line  $Y = 1$  in a point, where the top of one of the hyperbolas meets atomic mass of element,  $K = X$ , that is the boundary condition in the calculation. The calculated coordinates of the special point are  $X = 411.663243$  and  $Y = 1$ . Because no elements can be above the point (contents  $Y$  of an element in a chemical compound is taken in parts of unit), the element with mass  $X = 411.663243$  is the heaviest in the Periodic Table, so the Table ends with this element.

Fourth. In the next stage of this research, I was focused on the functions of atomic mass of element from its number along the Periodic Table. As a result, I have deduced the number of the last (heaviest) element in the Table. It is No. 155.

Thus, the last (heaviest) element in the Periodic Table was proved and its parameters were calculated without calculation of the stability of the electron shells in atoms on the basis of the quantum theory, but proceeding only from the general considerations of theoretical chemistry.

Of course, the methods of theoretical chemistry I applied in this research do not cancel the regular methods of the quantum theory; both methods are also not in competition to each other. Meanwhile calculations for the stability of the electronic shells of super-heavy elements can be resultative only in the case where the last element is known. Also, the experimentalists may get a new super-heavy element in practice, but, in the absence of theory, it is unnecessary that the element is the

last in the Periodic Table. Only the aforementioned theory, created on the basis of the hyperbolic law in the Periodic Table, provides proper calculation for the upper limit in the Periodic Table, for characteristics of the last (heaviest) element, and hence sets a lighthouse for all further experimental search for super-heavy elements.

This short postface was written due to the readers who, after reading my papers and the first edition of my book, asked me about the rôle of the calculations for the stability of the electron shells in my theory.

New York, January, 2010

*Albert Khazan*

## Appendix A: Theses Presented at Meetings of the American Physical Society

2008 ANNUAL MEETING OF THE DIVISION OF NUCLEAR PHYSICS  
October 23–26, 2008, Oakland, California

THE UPPER LIMIT IN THE PERIODIC TABLE — *by Albert Khazan* — Many scientists believe in the idea that the Periodic Table of Elements may be expanded to the period 8, 9, and so forth. Offered atomic nucleuses on 114, 126, 164 protons and 184, 258 neutrons. However no one claim was made yet on the upper limit of the Table. The standard methods of nucleosynthesis of super-heavy elements include recognition of the products came from nuclear reactions, where new elements may be discovered as well. This fact however gives no information about a possible limit in the up of the Table (a last element). To fill this gap a new theoretical approach is proposed, an essence of which is the idea that on any chemical composition of a molecular mass  $X$  the content  $Y$  of the recognized element  $K$  which should be related to one gram-atom, for unification. In such a case, meaning  $K$  the atomic mass, the equation  $Y = K/X$  manifests an equal-side hyperbola which lies in the 1st quadrant ( $K > 0$ ), while the top of the hyperbola should be located in a real axis directed with 45 deg to the positive direction of the abscissa axis with the boundary conditions  $Y \leq 1$ ,  $K \leq X$ . The equation allows calculation for the content of any element in any chemical composition.

2008 ANNUAL MEETING OF THE DIVISION OF NUCLEAR PHYSICS  
October 23–26, 2008, Oakland, California

PARAMETERS OF THE HEAVIEST ELEMENT — *by Albert Khazan* — The theory of equilateral hyperbola, which looks for the heaviest element of the Periodical Table of Elements, manifests the fact that, according to the boundary conditions, the arc along the ordinate axis is limited by the line  $Y = 1$ , while the arc can be continued upto any value of  $X$  along the abscissa axis. Calculation shows: to draw the hyperbolae in the same scale the value  $X = 600$  is necessary and sufficient. The top of each hyperbola, found through Lagrange's theorem, should be located in the real axis. Beryllium: the ratio  $Y = K/X$  gives the coordinates  $X = 60.9097$ ,  $Y = 0.14796$ . On the other hand, the formal properties of equilateral hyperbolae give  $X_0 = Y_0 = 3.00203$  (these are the sq. root of the atomic mass of the element, 9.0122). This shows that there is the reciprocal law for coming from one reference in the case to another:  $X/X_0 = Y_0/Y = 20.2895$ . We call this number the scaling coefficient. As seen

the tangent of the angle of the real axis is  $Y/X = 0.00242917$ , while this line intersects the line  $Y=1$  in the point where  $K=X=411.663243$ . Assuming this  $X$  into our equation we deduced, we arrive at the number 155. These two values are attributed to the heaviest element of the Table.

#### 75TH ANNUAL MEETING OF THE SOUTHEASTERN SECTION OF APS

October 30 — November 1, 2008, Raleigh, North Carolina

THE HYPERBOLIC LAW IN THE PERIODIC TABLE — *by Albert Khazan* — My recent presentations at the APS Meetings gave a theory which gave the heaviest (last) element of the Periodic Table of Elements. The basis of the theory is the equilateral hyperbolae  $Y=K/X$ . These arcs taken in the logarithm coordinates  $(\ln X_0, \ln Y_0)$  draw straight lines in the 4th quadrant right of Hydrogen, and parallel to it. The real axis  $(\ln Y_0 = \ln X_0 - 6.0202)$  transects them at the points which present the tops of the elements of the Periodic Table. The number of the heaviest (last) element was calculated through the exponential function of the atomic mass on the element's number and a logarithm of it. A new hyperbolic fundamental law of the Periodic Table has been conducted: the element content  $Y$  per gram-atom in any chemical composition of the molecular mass  $X$  can be given by the equations of the positive branches of the equilateral hyperbolae  $Y=K/X$  ( $Y \leq 1, K \leq X$ ), which are located according to the increase of the nuclear change, and are a real axis common with their tops: with distance from the origin of the coordinates they approach to the positions  $Y=1$  or  $K=X$  where the atomic mass is ultimate high — the last element of the Table.

#### FALL 2008 MEETING OF THE OHIO SECTION OF APS

October 10–11, 2008, Dayton, Ohio

THE FRACTIONAL-LINEAR FUNCTION IN THE HYPERBOLIC LAW — *by Albert Khazan* — The maintenance of any element in a chemical compound decreases with increase of the molecular weight under the equipotential hyperbolic law  $Y=K/X$  (1). However the size  $(1-Y)$  increases according to the equation  $1-Y=K/X$  or  $Y=(X-K)/X$  (2). This function refers to as fractional linear one, and after transformations turns to the equation of an equipotential hyperbola whose center is displaced from the beginning of the coordinates about  $(0; 0)$  in a point with  $(0; 1)$ . Hence, the real axis on which there tops of new hyperbolas are, pass perpendicularly to the axes of the equation (1). We shall enter names for hyperbolas: (1) "straight one", (2) "adjacent one". Their directions are mutually opposite in the point  $Y=0.5$  of crossing of each pair; this line is an axis of symmetry for all the hyperbolas; the abscissa is equal to the double nuclear weight of any element  $(2K)$ . Coordinates of other crossing points of the hyperbolas have following parameters:  $X=(K_1+K_2)$ ,  $Y_1=[K_1/(K_1+K_2)]$ ,  $Y_2=[K_2/(K_1+K_2)]$ . At the last element the curves designate the borders of the existence of possible chemical compounds.

## 2008 MEETING OF THE APS OHIO-REGION SECTION

October 10–11, 2008, Dayton, Ohio

THE LAW OF HYPERBOLES FOR CHEMICAL COMPOUNDS — *by Albert Khazan*

— The essence of the law of the hyperbolas is that the contents of substance of a specific chemical element should take the quantity of one gram-atom. Earlier, there in the equation  $Y = K/X$  any element of the Periodic Table was considered at the numerator. Now we expand the law: we enter the groups OH, CO<sub>3</sub>, SO<sub>4</sub> and the others into the numerator. In this case the direct and adjacent hyperbolas exchange their places, but their shape remains unchanged. Besides, the position of one gram-mole with the number of the group cannot be more than the unit should be carried out. Then the hyperbolas have smooth shape without breaks. It confirms that fact, that the hyperbolas with various values  $K$  are similar against each other, but they are not congruent. At the same time through a point with the coordinates  $X, Y$  it is possible to describe only one hyperbola, for which  $K = XY$  [for adjacent  $K = X(1 - y)$ ]. The opportunity of application of groups of elements testifies the universality of the law of the hyperbolas, and it expands the mathematical base of chemical research.

## 2008 FALL MEETING OF THE TEXAS AND FOUR CORNERS SECTIONS OF APS

October 17–18, 2008, El Paso, Texas

## THE LAST/HEAVIEST ELEMENT OF THE PERIODIC TABLE AND THE NEUTRON-

PROTON DIAGRAM — *by Albert Khazan* — The raised stability of the atomic nucleus containing 2, 8, 20, 28, 50, 82 and 126 protons and neutrons, is caused by that growth of number of neutrons advances quantity of protons in heavy nucleus. As a result they become energetically steadier. The nucleus we have calculated, including an element 155, is located in the line of a trend whose size of reliability makes 0.9966. The element predicted by some scientists, with nucleus  $Z = 114, N = 184$ , is far distant in the party. Thus it was found out, that with  $Z = 114$  the  $N$  should be 179, and also  $N = 184$  results  $Z = 116$ . In the field of the numbers 104–114 there are essential fluctuations of the nuclear masses and the numbers of neutrons. It is due to the fact that, in the Periodic Table, the nuclear mass of the most long-living isotopes of an element is a result of that fact that the breaking of the strict law of increase in the mass with the growing up of the charge of a nucleus. Independence of the line of a trend of the position of the last element has been verified by calculation. Therefore it is offered to consider No.155 for diagnosing products of nuclear reactions.

## 2008 FALL MEETING OF THE NEW ENGLAND SECTIONS OF APS

October 10–11, 2008, Boston, Massachusetts

THE LAST ELEMENT IN A NEW PERIODIC TABLE — *by Albert Khazan* —

Among scientists there is no common opinion about possible number of the elements in the Periodic Table. The existing points of view lay within the

limits from 120 upto 218 and more. However if to arrange the number of isotopes depending on the charge of a nuclei of atoms the broken curve in the form of the average parabola will turn out, in descending which branch the number of the isotopes sharply decreases, reaching units at all upto the end of the 7th period. After achievement of the maximum in the 6th period, the number of the isotopes sharply decreases. Hardly it is necessary to tell about prospective new 100 elements when are unsolved all of the problem upto No.119. As a result of the establishment of the top border of the Periodic Table there is a question about the location of the last element. From the views on the symmetry, it should be close to the 1st group. On the electronic configuration calculated for 218 elements, its place in the 5th group: 2, 8, 18, 32, 50, 32, 11, 2. Considering that fact, that in the 8th period has not 50 elements, we offer a following version to discuss: 2, 8, 18, 32, 36, 32, 18, 8, 1.

#### 2009 APS MARCH MEETING

March 16–20, 2009, Pittsburgh, Pennsylvania

THE RÔLE OF THE ELEMENT RHODIUM IN THE HYPERBOLIC LAW OF THE PERIODIC TABLE OF ELEMENTS — *by Albert Khazan* — The method of equilateral hyperbolas assumes that their tops should be certain with high accuracy by means of Lagrange's theorem. On this basis the scaling factor for transition from the coordinate system usual to mathematicians to that which is to be used in chemistry is calculated. Such an approach has allowed calculating parameters of the last element. The calculation can be checked by means of the first sequel from the hyperbolic law, proceeding only from the atomic mass of the element Rhodium. As it has appeared, the direct and adjacent hyperbolas are crossed in a point with the coordinates 205.811; 0.5, which abscissa makes a half of the last element's atomic mass (the deviation is about 0.01%). The real axes of the hyperbolas coincide with the tangents and normals, and the scaling factor differs from the first calculation as 0.001%. However these insignificant divergences are so small to the most important conclusion that the validity of the hyperbolic law, as calculation on Rhodium our data consists of (Progr. Physics, 2007, v. 1, 38; v. 2, 83; v. 2, 104; 2008, v. 3, 56).

#### 2009 SPRING MEETING OF THE APS OHIO-REGION SECTION

April 24–25, 2009, Ada, Ohio

UPPER LIMIT OF MENDELEEV PERIODIC TABLE OF ELEMENTS — ELEMENT NO.155 — *by Albert Khazan* — The most important problem for the scientists, who are working on the theory of Mendeleevs Periodic Table, is how to determine the real number of elements in it. One of the mainstream methods applied to resolving this problem suggests a calculation for the stability limits of the electronic shells of atoms. In this way, one sets up a number of elements for a period of the Table, and then calculates (as a sequence) the respective atomic masses for the elements. A second mainstream way

is synthesis of new elements in nuclear reactions, with identification of the obtained products among which a new element may be found (meanwhile the element may unnecessary be the last). 10 new elements were obtained in this way during the last 25 years. In contrast, the basis of my calculation were neither calculations for the stability limits of the atomic shells nor synthesis of new elements, but a study of chemical processes which allowed, through the mathematical apparatus, to formulate a new law of Hyperbolas in the Periodic Table, and led to the last element No.155 whose atomic mass is 411.66 (details in: Khazan A. Progress in Physics, 2007, v. 1, 38; v. 2, 83, 104; 2008, v. 3, 56; 2009, v. 2, 19, L12).

#### 2009 APS APRIL MEETING

May 2–5, 2009, Denver, Colorado

THEORETICAL GROUNDS TO THE TABLE OF THE ELEMENTS OF ANTI-SUBSTANCE — *by Albert Khazan* — If equilateral hyperbolas were created with  $X < 0$ ,  $Y < 0$  ( $K > 0$ ), they build the second branches in the 3rd quadrant. In contrast to hyperbolas in mathematics, the conditions  $Y \leq 1$  and  $K \leq X$  don't give congruency (this is because the different scales and dimensions of the axes). This inadequacy vanishes if using the coefficient  $M$  (20.2895). With it the properties of the hyperbolas in the 1st quadrant are verified in the 3rd quadrant. The 2nd and 4th quadrants show the same on the hyperbolas. Reducing the axes to the joint scale doesn't lead to congruency in full. The ordinate (the rate of transformation of matter) is negative in the 3rd and 4th quadrant that is unseen in nature. Thus, we consider the 1st and 2nd quadrants (there is  $K > 0$ ,  $K < 0$ ). In the quadrants, the curves meet each other around the ordinate. Thus, the hyperbolic law is true in the 2nd quadrant as well (it is "inhabited" by "negative matter", i.e. anti-matter consisting antiparticles). This allowed me to create the Periodic Table of the elements of anti-matter (see Progr. Phys., 2007, v. 1, 38; v. 2, 83; v. 2, 104; 2008, v. 3, 56).

#### 2010 APS MARCH MEETING

March 15–19, 2010, Portland, Oregon

A METHOD FOR CALCULATION OF THE UPPER LIMIT OF MENDELEEV'S PERIODIC TABLE — *by Albert Khazan* — 40 years ago some scientists claimed that elements heaviest than No.110 are impossible. The technics got much progress in the last years: element 118 has already been registered. Now, the researchers of Joint Inst. for Nuclear Research (Dubna, Russia) claim that the Periodic Table will end with element 150. However they do not provide theoretical proofs to this claim, because the stability limits of electronic shells they calculated by means of Quantum Mechanics do not answer this question in exact. In contrast, I focused onto the contents of chemical compounds along the Table. The used method is as follows. First, it was found that, given any

chemical compound, the contents of any element in it (per 1 gram-atom) is described by the equation of a equilateral hyperbola  $Y = K/X$ . Then the scaling coefficient was deduced for the hyperbolas, thus the atomic mass of the last (heaviest) element, 411.66, was found as the abscissa of the ultimate point of the arc drawn by the tops of the hyperbolas. With it, the number of the last element, 155, was found as a consequence. See: Khazan A. Upper Limit in Mendeleev's Periodic Table — Element No.155. Svenska fysikarkivet, 2009.

#### 2010 APS APRIL MEETING

February 13–16, 2010, Washington, DC

THE LAST ELEMENT OF MENDELEEV'S PERIODIC TABLE — *by Albert Khazan* — Despite much achievements of the synthesis for super-heavy elements (10 new elements were obtained during the last 25 years), the experts in Mendeleev's Periodic Table have not answered the most fundamental question: where the Table ends? The calculations produced on the basis of Quantum Mechanics (the physical conditions in micro-scales) do not answer this question till now. In my study of chemical compounds, I focused onto the physical conditions observed in macro-scales (the subjects of the regular physics and chemistry). Thus, the Law of Hyperboles was discovered in the Periodic Table: given any chemical compound, the contents of any element in it (per 1 gram-atom), including the contents of unknown elements, whose atomic masses can be set up arbitrarily, is described by the equation of a equilateral hyperbola  $Y = K/X$ . The tops of all the arcs are distributed along a real axis crossing the line  $Y = 1$  in the point of abscissa 411.66, which manifests the actual atomic mass of the last (heaviest) element of the Periodic Table: its location is Period 8, Group 1; its atomic mass is 411.66, its number is 155 (Khazan A. Upper Limit in Mendeleev's Periodic Table — Element No.155. Svenska fysikarkivet, 2009).

#### JOINT SPRING 2011 MEETING OF THE NEW ENGLAND SECTIONS OF THE APS AND THE AAPT

April 8–9, 2011, Lowell, Massachusetts

GEOMETRIC LAWS IN THE PERIODIC TABLE OF ELEMENTS — *by Albert Khazan* — Despite many versions of the Periodic table of Elements were suggested, no one discussed the problem how the elements are connected to each other inside the Groups and Periods of the Table. As is known, the Groups are joined along the vertical (18 Groups in total), while the Periods are joined along the horizontal (7 Periods; we also suggest Period 8). Period 1 consists of 2 elements, Periods 2 and 3: 8 elements each, Periods 4 and 5: 18 elements each, Periods 6 and 7: 32 elements each, and Period 8: 37 elements. Dependency of the number of elements in each Period on its number is expressed with a broken line, described by equations of the respective linear intervals. It is shown that, according to the dependency of the common number of elements in each Period on its number, all Periods are joined into three sections,



for the elements of all 18 Groups: Periods 1–3 ( $y = 8x - 6$ ), Periods 3–5 ( $y = 18x - 36$ ), Periods 5–7 ( $y = 32x - 106$ ), Periods 7–8 ( $y = 37x - 141$ ). For the elements of Group 1, we obtain a respective line. The region created by these two lines includes all elements of the Periodic Table (Khazan A. Progress in Physics, v.4, 2010, 64).

42ND ANNUAL MEETING OF THE APS DIVISION OF ATOMIC, MOLECULAR AND OPTICAL PHYSICS

June 13–17, 2011, Atlanta, Georgia

ON THE SYSTEMATIC ERROR IN THE QUANTUM MECHANICAL CALCULATIONS TO THE PERIODIC TABLE OF ELEMENTS — *by Albert Khazan* — The scientists working on the problems of the Periodic Table of Elements regularly attempt to create models of the elements on the basis of the laws of Quantum Mechanics. One even attempted to use the calculation of the dependency “atomic mass — element’s number” on this basis, in order to extend the Table by introducing two new Periods containing 50 elements each. The hyperbolic law we have found in the Periodic Table allows to find, first, the atomic mass of the last (heaviest stable) element (411.66), then — the number of the protons in it (155). Two functions were compared: the IUPAC 2007 function (elements 80–118) and another one created according the other data (elements 80–224). Both functions have a large deviation of data in No. 104–118. Commencing in Period 8, there are three “shifts” of atomic mass for 17, 20, and 25 AMU. Also, our analysis manifests that there in all the aforementioned data is a single point with atomic mass 412 and number 155, where the parameters meet each other. This fact verifies our theory (Khazan A. Upper Limit in Mendeleev’s Periodic Table — Element No. 155. 2nd ed., Svenska fysikarkivet, Stockholm, 2010).

2011 APS APRIL MEETING

April 30–May 3, 2011, Anaheim, California

ELEMENT NO.155 - AN EQUAL MEMBER OF THE PERIODIC TABLE OF ELEMENTS — *by Albert Khazan* — Properties of the elements of the Periodic Table of Elements were studied on the basis of experimental and theoretical data with use of the parameters of a suggested element No.155. The dependency “atomic mass — number in the Table” showed that the calculated equations of the intervals of elements No. 1–54, No. 55–118, and No. 119–155 have a very high probability of 0.99-1.0, as well as the calculated line of the trend in No. 1–118. Additionally, the other dependencies were studied for the intervals No. 1–155 and No. 1–104 ( $R^2 = 0.9997; 0.999$ ): the nucleus’ radius — the number of the nucleons; the electrons’ critical energy — the number of the protons; the nucleus’ coupling energy — the mass number; the number of the neutrons — the nucleus’ charge; the ionization potential of the atom — the nucleus’ charge. The region of the ultimate high coupling energy of the nuclei in the Table (behind which the nuclei become instable)

was calculated with use of the parameters of element No. 155. The obtained results manifest: element No. 155 should be considered as an equal member of the Periodic Table (Khazan A. Upper Limit in Mendeleev's Periodic Table — Element No. 155. Svenska fysikarkivet, Stockholm, 2010).

2011 APS MARCH MEETING 2011

March 21–25, 2011, Dallas, Texas

WHERE THE PERIODIC TABLE OF ELEMENTS ENDS? ADDITIONAL EXPLANATIONS — *by Albert Khazan* — Already 40 years ago, physicists claimed that the elements with number higher than 110 cannot exist. However at this day, Period 7 has been complete. Experimentalists synthesized 10 new superheavy elements during only the last because. The method of synthesis is so finely developed that the experimentalists of Dubna tell about element No. 150 as the higher limit of the Table of Elements (they do not provide a ground to the calculation). In contrast, our calculation are based neither on calculation of the stability of the electronic shells of the atoms, nor synthesis of the superheavy elements. Our calculation is based on study of the chemical processes, which give a new law of the Periodic Table (Albert Khazan. Upper Limit in Mendeleev's Periodic Table — Element No. 155. Svenska fysikarkivet, Stockholm, 2009). The core of the delusion of numerous scientists was that they, in their calculations based on Quantum Mechanics, initially set up the number of the elements (number of the protons) then calculated the atomic mass proceeding from the data. According to our theory, the atomic mass of the last element (411.66) should be calculated first, only then its number (155)!

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## **Appendix B: Calculation for Atomic Masses of the Elements of the Periodic Table, According to Our Formula**

The equation we have deduced in this book (it gives atomic masses of elements depending from their numbers) gave the advantage that the atomic masses of the elements from No. 104 to No. 155 included we calculated. These data will be useful to researches in many fields of science, including researchers in Quantum Mechanics, for further studies of Mendellev's Periodic Table with taking its upper limit into account. These data will also be needed to theoretical physicists, experts in nuclear reactions, physical chemists, and chemists. The calculations cover 15 elements of the 7th period, and 37 elements of the 8th period. These data are given in Table B-1. Table B-2 compares our theoretical calculation to the data, obtained by FLW Inc. and also IUPAC (for the years 2001 and 2005).

Even short view on Table B-1 manifests that the atomic mass of an element increases, with its number, for three units on the average. In connexion to this finding, we studied this dependency in the scale of the numbers 1–83, 90, 92 (natural isotopes), 1–104, and 1–155. We have found that this dependency exists in all these cases. An evidence to it are the high values of approximation of the lines of trend, which cover each other (see Fig. B-2). Hence, we are lawful to create the aforementioned dependency upto No. 155.

As Mendeleev wrote, in already 1905, "As probable, the future does not threaten to the Periodic Law to be destroyed, but promises to it to be only updated and developed".

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No.	Element, its symbol		At. mass	No.	Element, its symbol		At. mass
104	Rutherfordium	Rf	265.28	131	Untriumium	Utu	341.89
105	Dubnium	Db	268.09	132	Untribium	Utb	344.76
106	Seaborgium	Sg	270.89	133	Untritrium	Utt	347.63
107	Bohrium	Bh	273.7	134	Untriquadium	Utq	350.51
108	Hassium	Hs	276.52	135	Untripentium	Utp	353.38
109	Meitnerium	Mt	279.33	136	Untrihexium	Uth	356.26
110	Darmstadtium	Ds	282.15	137	Untriseptium	Uts	359.14
111	Roentgenium	Rg	284.97	138	Untrioctium	Uto	362.02
112	Ununbium	Uub	287.8	139	Untriennium	Ute	364.91
113	Ununtrium	Uut	290.62	140	Unquadnilium	Uqn	367.8
114	Unuquadium	Uuq	293.45	141	Unquadunium	Uqu	370.68
115	Ununpentium	Uup	296.28	142	Unquadbium	Uqb	373.58
116	Ununhexium	Uuh	299.11	143	Unquadtrium	Uqt	376.47
117	Ununseptium	Uus	301.95	144	Unquadqadium	Uqq	379.63
118	Unuoctium	Uuo	304.79	145	Unquadpentium	Uqp	382.26
↓ 8th period starts herefrom				146	Unquadhexium	Uqh	385.16
119	Ununennium	Uue	307.63	147	Unquadseptium	Uqs	388.06
120	Unbinilium	Ubn	310.47	148	Unquadoctium	Uqo	390.96
121	Unbinium	Ubu	313.32	149	Unquadennium	Uqe	393.87
122	Unbibium	Ubb	316.16	150	Unpentnilium	Upn	396.77
123	Unbitrium	Ubt	319.01	151	Unpentunium	Upu	399.68
124	Unbiquadium	U bq	321.86	152	Unpentbium	Upb	402.59
125	Unbipentium	Ubp	324.72	153	Unpenttrium	Upt	405.5
126	Unbihexium	Ubh	327.57	154	Unpentqadium	Upq	408.42
127	Unbiseptium	Ubs	330.43	155	Unpentpentium	Upp	411.35
128	Unbioctium	Ubo	333.29	No.119 – No.155 create the 8th period of the Periodic Table of Elements			
129	Unbiennium	Ube	336.16				
130	Untrinilium	Utn	339.02				

Table B-1: Calculation for the atomic masses of the elements of Mendeleev's Periodic Table, from No.104 to No.155, according to the equation we have deduced in the book.

Atomic number	Symbol	Atomic masses, according to the data:				Number of neutrons
		FLW Inc.	Our calc.	IUPAC, 2001	IUPAC, 2005	
104	Rf	261*	<b>265</b> <sup>‡</sup>	261*	267 <sup>‡</sup>	157, <b>161</b> , 157, 163
105	Db	<u>262</u>	<b>268</b> *	<u>262</u>	268*	157, <b>163</b> , 157, 163
106	Sg	263 <sup>‡</sup>	<b>271</b> *	266 <sup>‡</sup>	271*	157, <b>165</b> , 160, 165
107	Bh	<u>262</u>	<b>274</b> <sup>‡</sup>	<u>264</u>	272 <sup>‡</sup>	155, <b>167</b> , 157, 165
108	Hs	—	<b>277</b> *	277*	270	—, <b>167</b> , 169, 162
109	Mt	<u>266</u>	<b>279</b> <sup>‡</sup>	<u>268</u>	276 <sup>‡</sup>	157, <b>170</b> , 159, 167
110	Ds	262	<b>282</b> <sup>‡</sup>	281*	281*	152, <b>172</b> , 171, 171
111	Rg	272*	<b>285</b>	272*	280	161, <b>174</b> , 161, 169
112	Uub	277	<b>288</b> <sup>‡</sup>	285*	285*	165, <b>176</b> , 173, 173
113	Uut	289 <sup>‡</sup>	<b>291</b> <sup>‡</sup>	—	284	176, <b>178</b> , —, 171
114	Uuq	291 <sup>‡</sup>	<b>293</b> <sup>‡</sup>	289*	289*	177, <b>179</b> , 175, 175
115	Uup	295 <sup>‡</sup>	<b>296</b> <sup>‡</sup>	—	288	180, <b>181</b> , —, 173
116	Uuh	297 <sup>‡</sup>	<b>299</b> <sup>‡</sup>	—	293	181, <b>183</b> , —, 177
117	Uus	310	<b>301</b>	—	—	193, <b>184</b> , —, —
118	Uuo	314	<b>305</b>	—	294	196, <b>186</b> , —, 176
119	Uue	316	<b>308</b>	—	—	197, <b>188</b> , —, —
120	Ubn	318	<b>310</b>	—	—	198, <b>190</b> , —, —
126	Ubh	334	<b>327</b>	—	—	208, <b>201</b> , —, —
155	Upp	412*	<b>411.66</b> *	—	—	257, <b>257</b> , —, —
168	Uho	462				
218	Buo	622				

Table B-2: The atomic masses of the elements. Column 3 gives atomic masses according to the calculation data of FLW Inc. Column 4 — atomic masses, according to our calculation. Column 5 — atomic masses, according to the IUPAC data for the year 2001. Column 5 — atomic masses, according to the IUPAC data for the year 2005.

\* Complete coincidence of the data.

<sup>‡</sup> The data, which meet each other within 1–3 units.

Boldshaped are the numbers given according to our calculation.

Underlined are the numbers, equal by pairs (can be broken in the rows).

Long dash is signed for undetermined values (in the cases where a parameter was unknown).

The IUPAC data of 2005 were published only in the end of 2006.

Our data first appeared, in the internet, in October 25, 2005.

Our calculations meet the IUPAC data of 2005, in complete, in 9 cases.

According to the FLW Inc. data, only No. 155 gives complete coincidence of the atomic mass with our calculation.

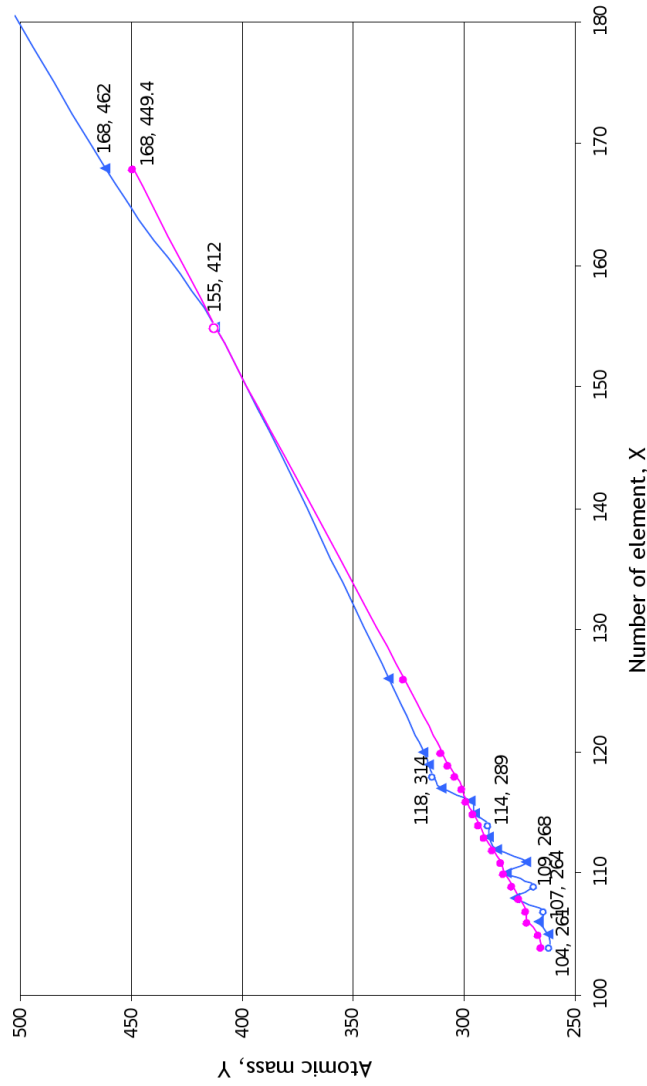


Fig. B-1: Dependence of the atomic mass of an element from its number in the Periodic Table. Lower line (circles) — our data. Upper line (triangles) — FLW Inc.

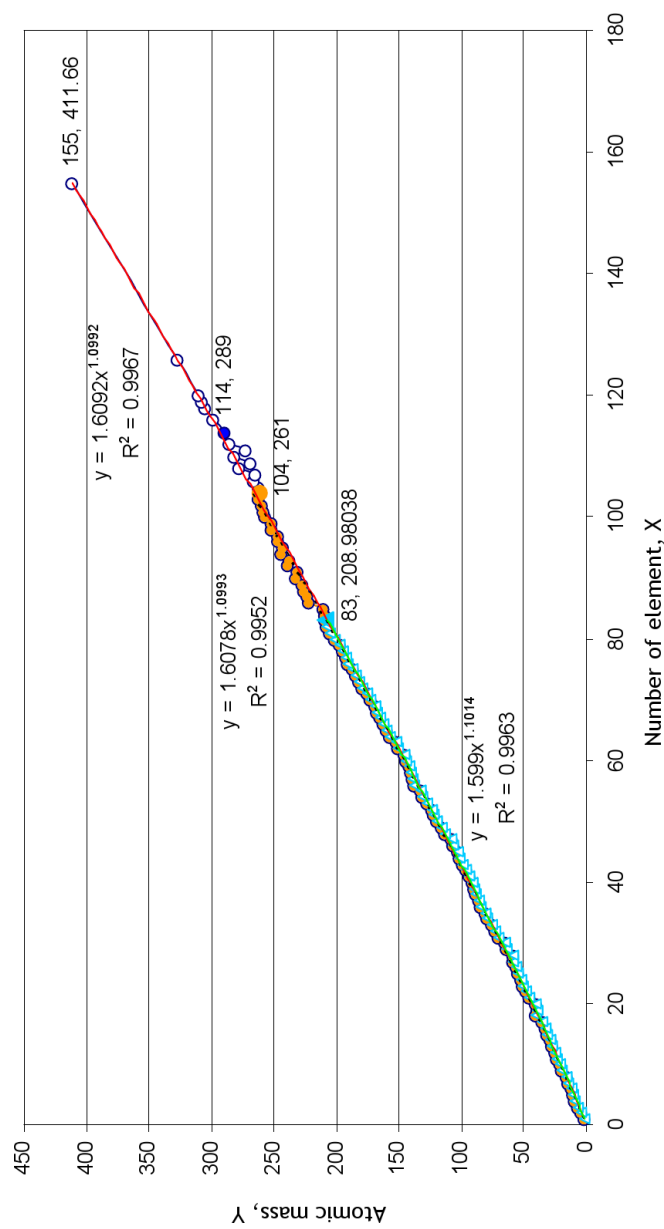


Fig. B-2: Dependence of the atomic mass of an element from its number in the Periodic Table. Triangle is given for No. 1-83, black circle — for No. 1-104, and circle — for 1-155. Lines of trend have been drawn to all three versions.

## Appendix C: The Hyperbolic Diagrams of All Elements of the Periodic Table, Including the Hypothetic Elements

Initially, the theory of the hyperboles of the Periodic Table of Elements, presented in this book, was a reply to the practical needs of the fine compounds of the refractory metals.

Just a few details. When analyzing the chlorides, in particular — the chloride of Wolfram, numerous admixtures in addition to the main contents were found. The admixtures distorted the measurement results. Therefore, in several cases, there was also Oxygen in addition to Wolfram and Chlorine.

Using the general purpose analysis, we already obtained the common content of the elements. Meanwhile, we were still unable to find the correlation among the elements due to the scattering of the data (see line W-Cl in Fig. C-1). In this case, we were should take into account the fact that, in the substances under study, the compounds containing 1 gram/mole of Wolfram were presented (according to our calculation, see Fig. C-1, line W). Therefore, we were should produce only a correction for Chlorine and Oxygen, reducing their contents to 1 gram/mole of the compound. As a result, we obtained three hyperboles. The hyperboles, being taken separately or commonly, characterize the contents of the compound we were looking for.

Checking this conclusion on the other metals, analogous to the previous, completely verified the obtained hyperbolic correlations. Thus, it was permitted to expand this research method (I refer to it as the method of hyperbolas, in short) onto the other chemical compounds.

Several parts of the obtained arcs deviated from the common hyperbolic shape. I therefore was enforced to add, into these parts of the arcs, the numerical values of the molecular masses related to the hypothetical compounds, constructed from the same elements. Because the arcs, according to the equation of hyperbola, did not change their meaning, this step did not produce any break of the general chemical laws.

As an illustration to the research process I followed with, here are the graphs, containing the hyperbolas (in the linear and logarithmic coordinates) created for all elements of the Periodic Table, including both already known elements and the hypothetical elements upto No. 155.

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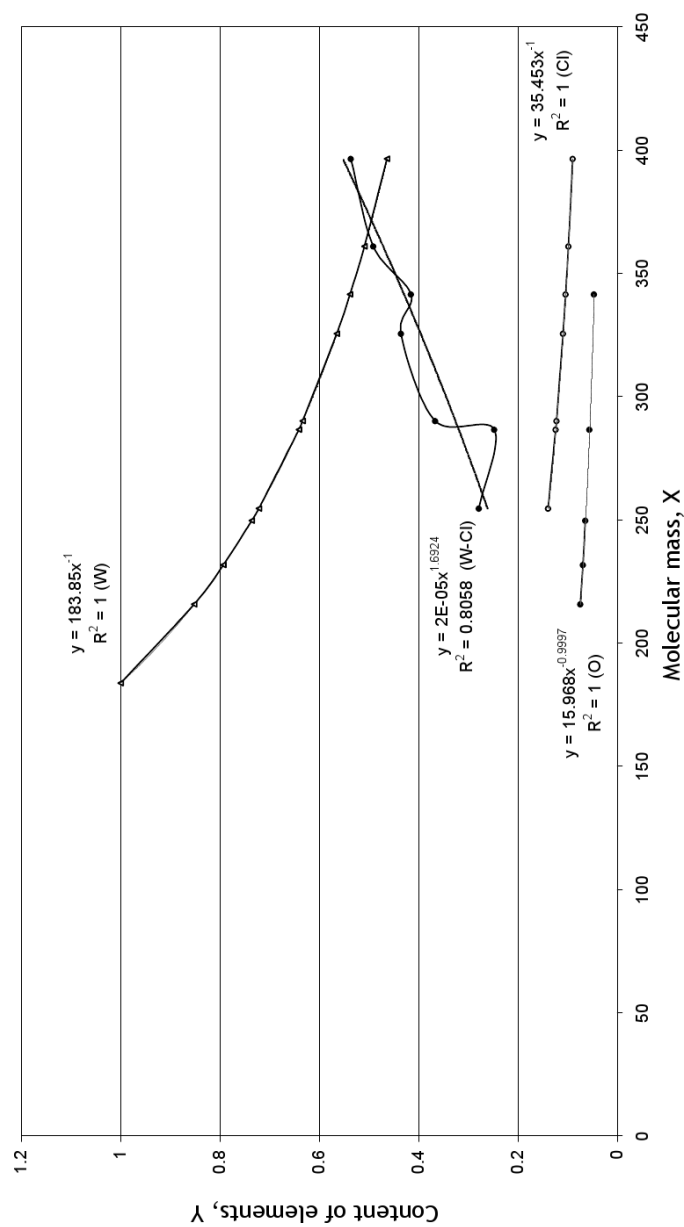


Fig. C-1: Content of Wolfram, Chlorine and Oxygen in 1 gram-mole of the compounds of Wolfram (W, Cl, O). Intersecting curve: (W-Cl).

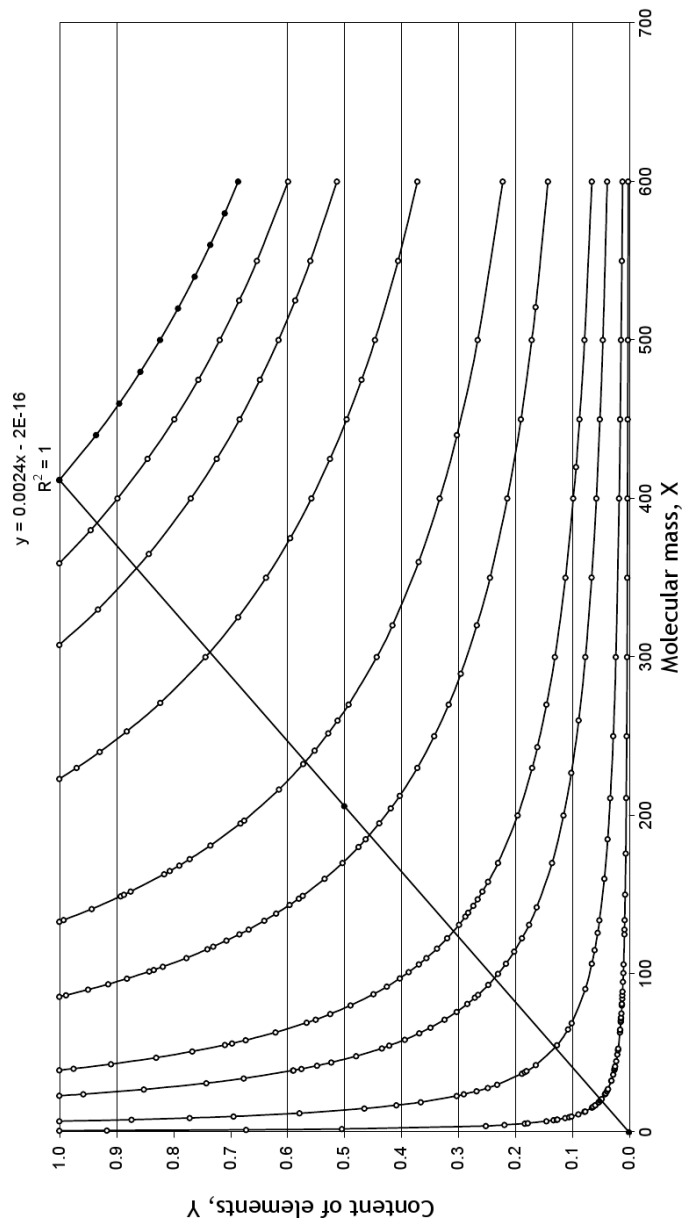


Fig. C-2: Contents of elements in the chemical compounds for Group 1 of the Periodic Table. From left to right: H, Li, Na, K, Rb, Cs, Fr, No. 119, No. 137, No. 155. The real axis, diagonally crossing the graph, and its equation are shown.

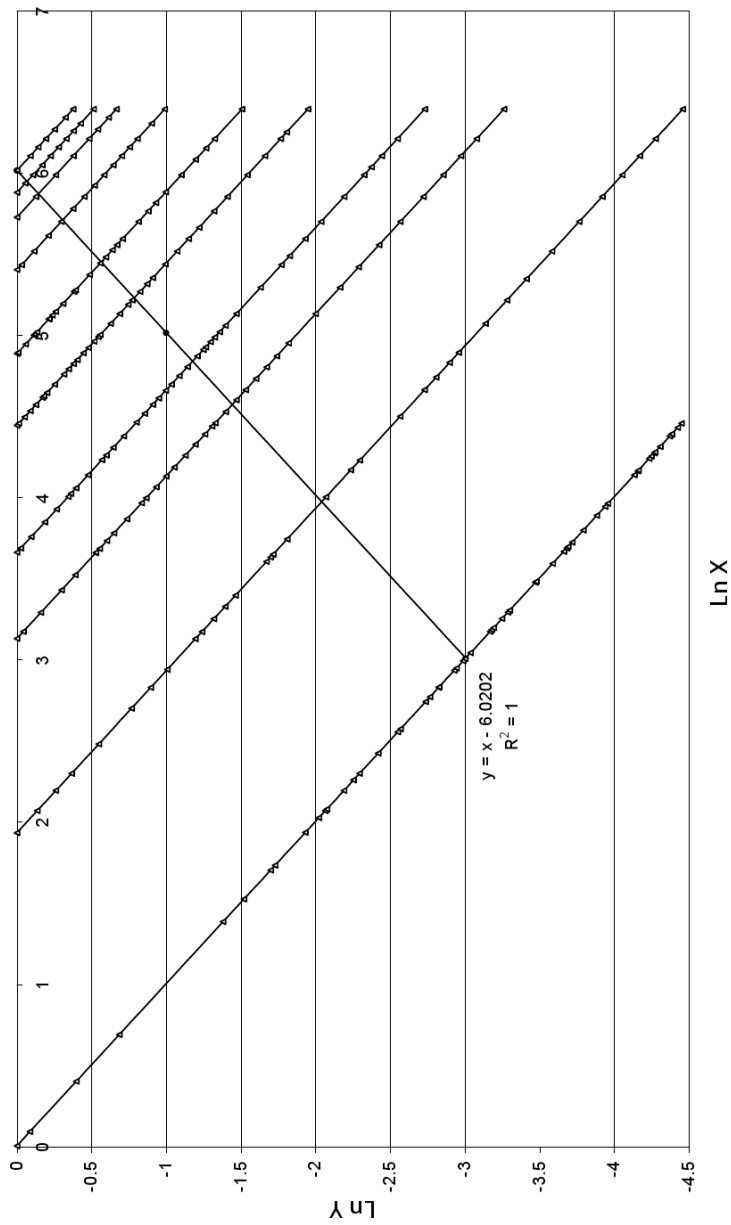


Fig. C-3: The same data of Group 1 of the Periodic Table, represented in the logarithmic coordinates. The real axis, diagonally crossing the lines, and its equation are shown.

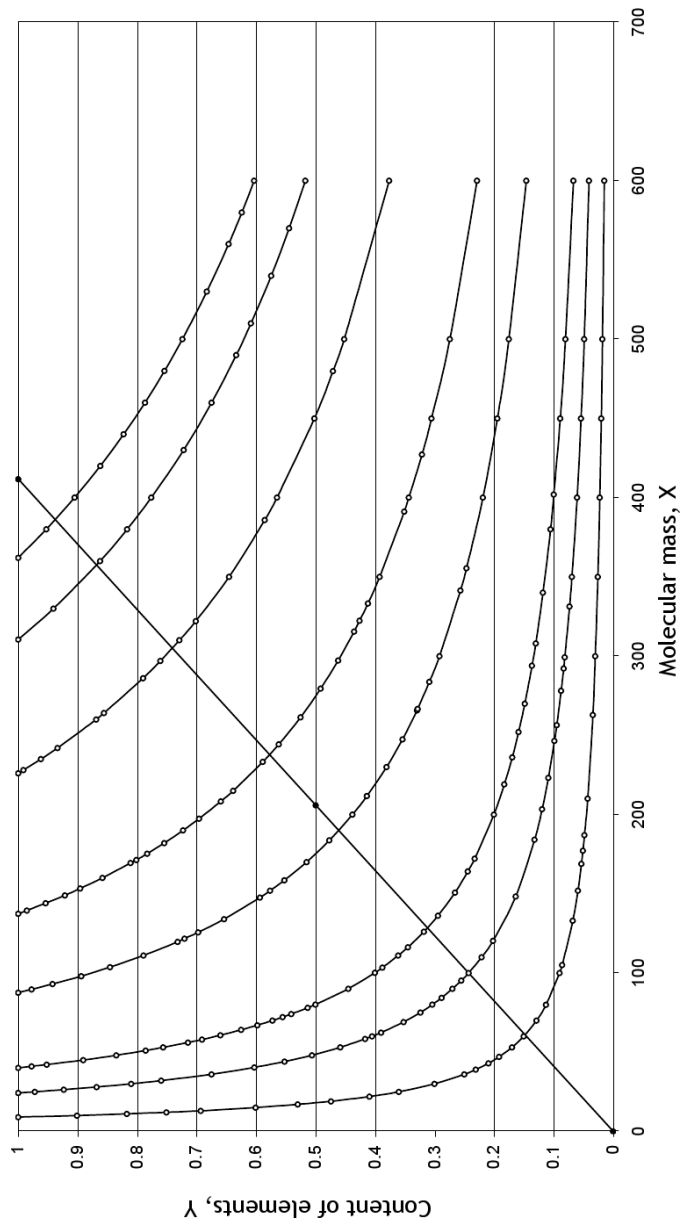


Fig. C-4: This is alike Fig. C-2. Hyperbolas created for the elements of Group 2 of the Periodic Table. From left to right: Be, Mg, Ca, Sr, Ba, Ra, No. 120, No. 138. The real axis and its equation are here the same as in Fig. C-2.

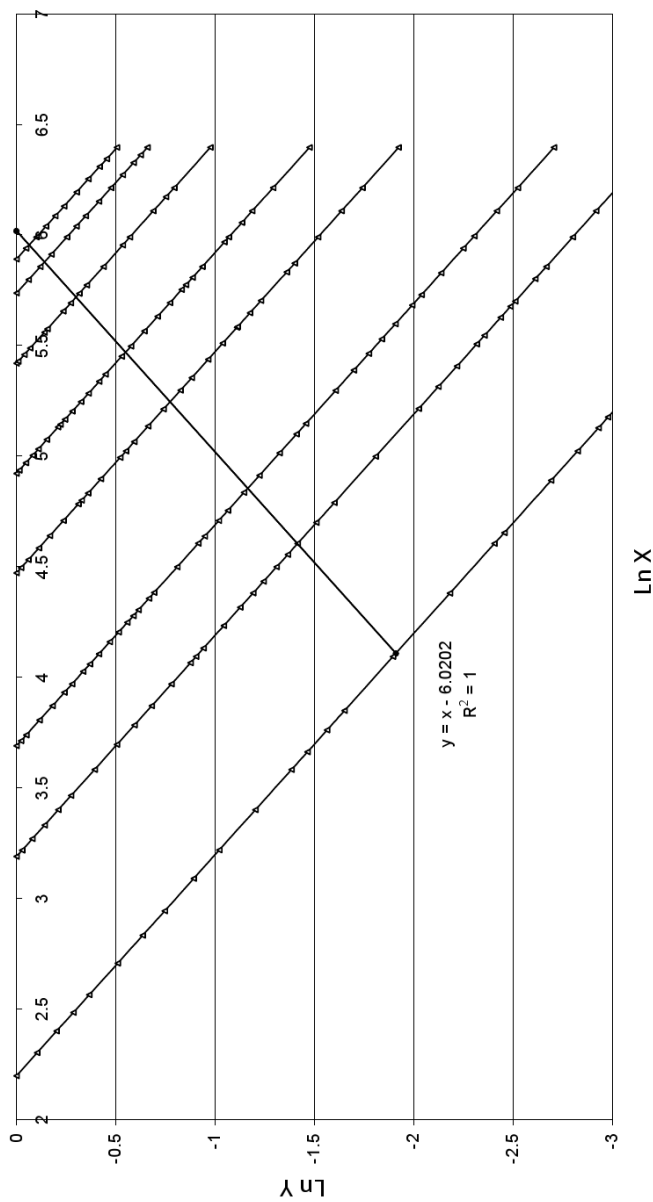


Fig. C-5: Elements of Group 2 of the Periodic Table, represented in the logarithmic coordinates. From left to right: Be, Mg, Ca, Sr, Ba, Ra, No. 120, No. 138. The real axis is diagonally crossing the lines.

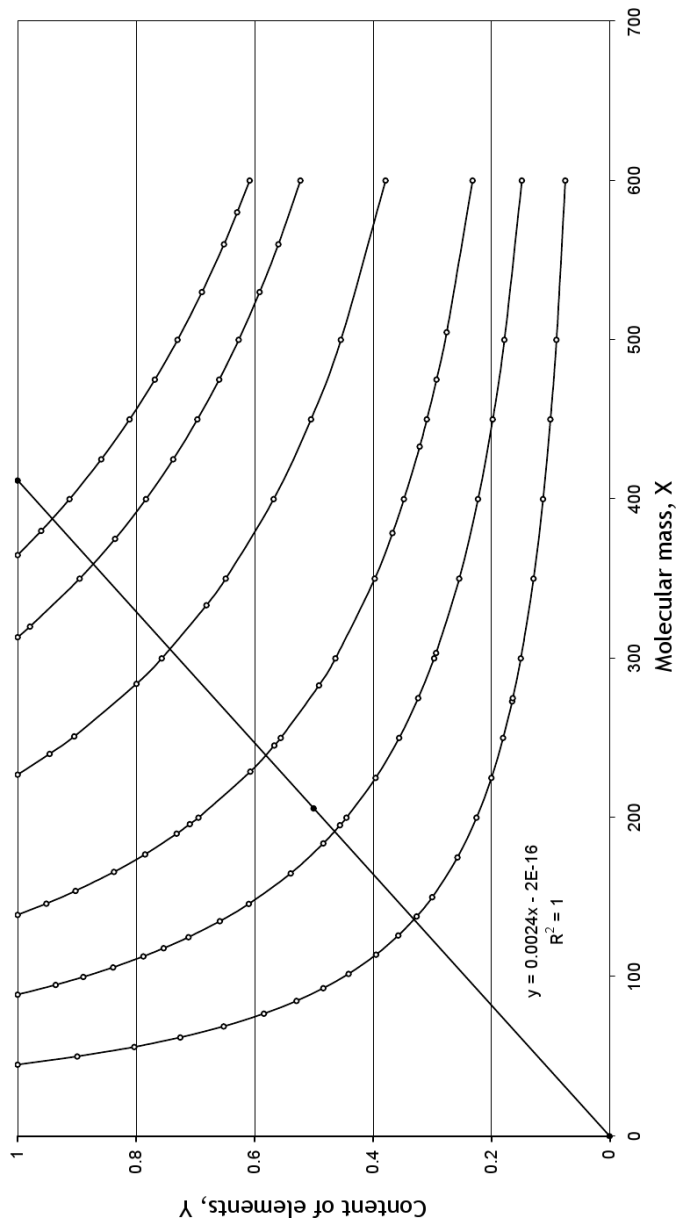


Fig. C-6: Hyperbolas created for the elements of Group 3 of the Periodic Table. From left to right: Sc, Y, La, Ac, No. 121, No. 139. The real axis is diagonally crossing the graph.

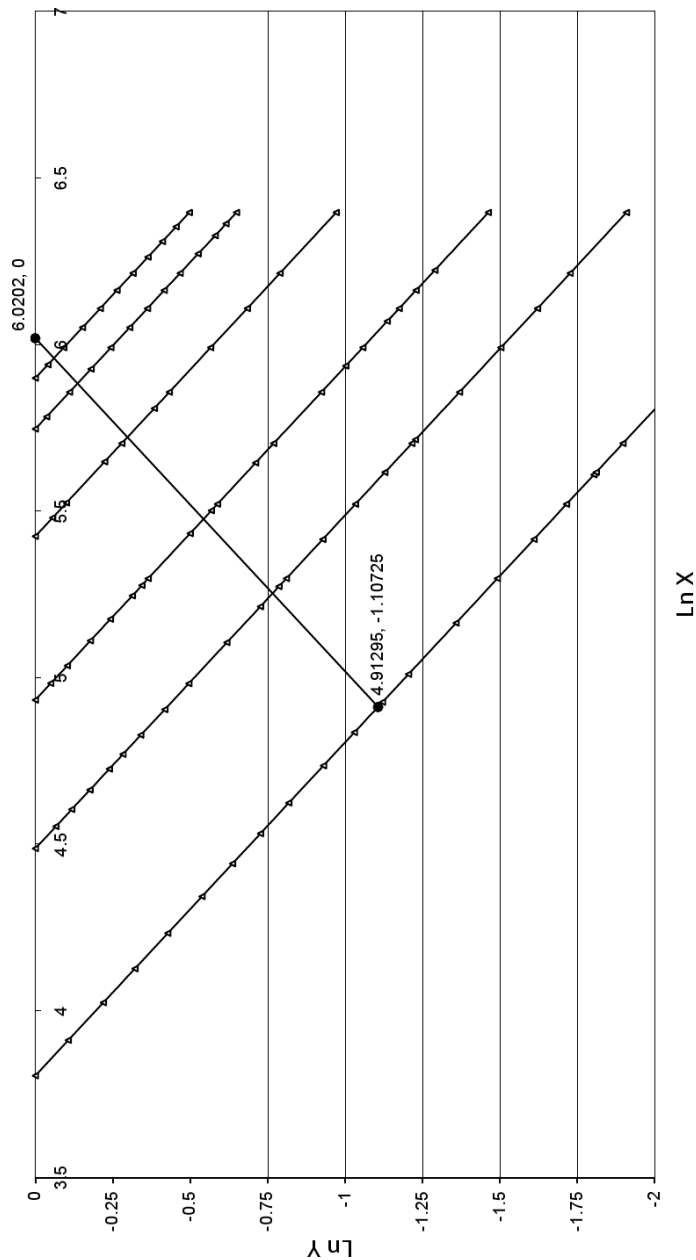


Fig. C-7: The same data of Group 3 of the Periodic Table, represented in the logarithmic coordinates. From left to right: Sc, Y, La, Ac, No. 121, No. 139. The real axis is diagonally crossing the lines.

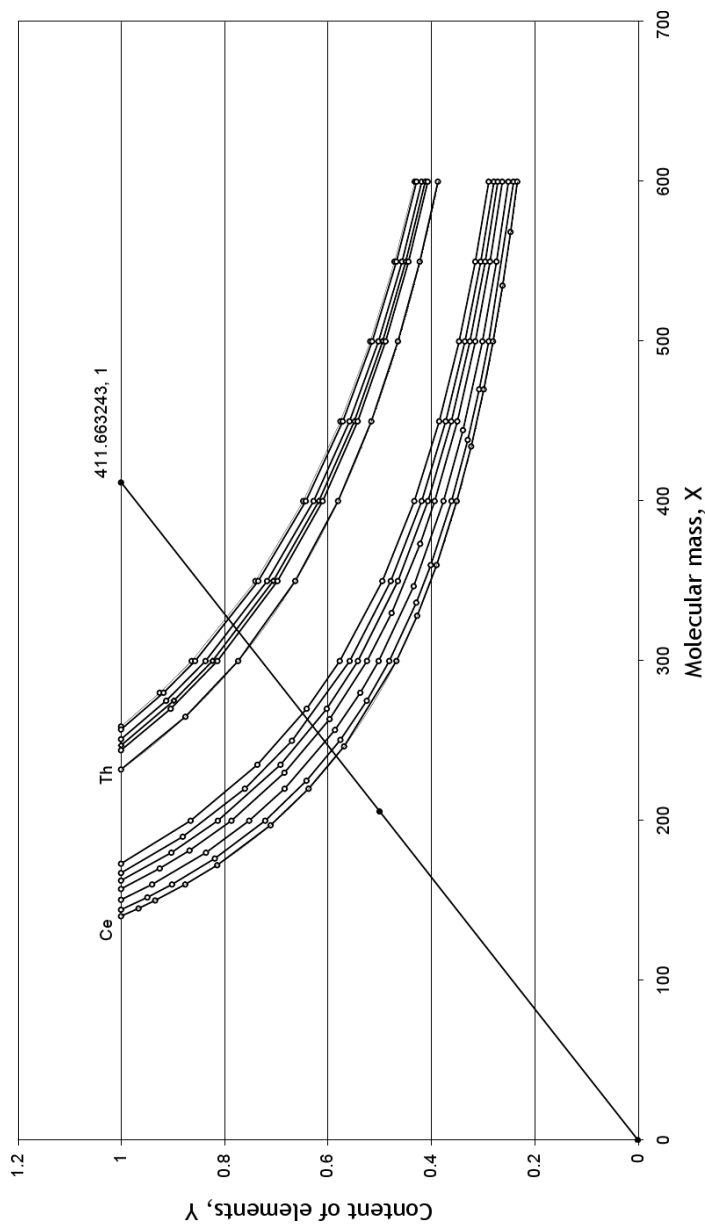


Fig. C-8: Function  $Y = K/X$  for the lanthanides (Ce, Nd, Sm, Gd, Dy, Er, Yb) and the actinides (Th, U, Pu, Cm, Cf, Fm, No), from left to right. The real axis is diagonally crossing the graph.



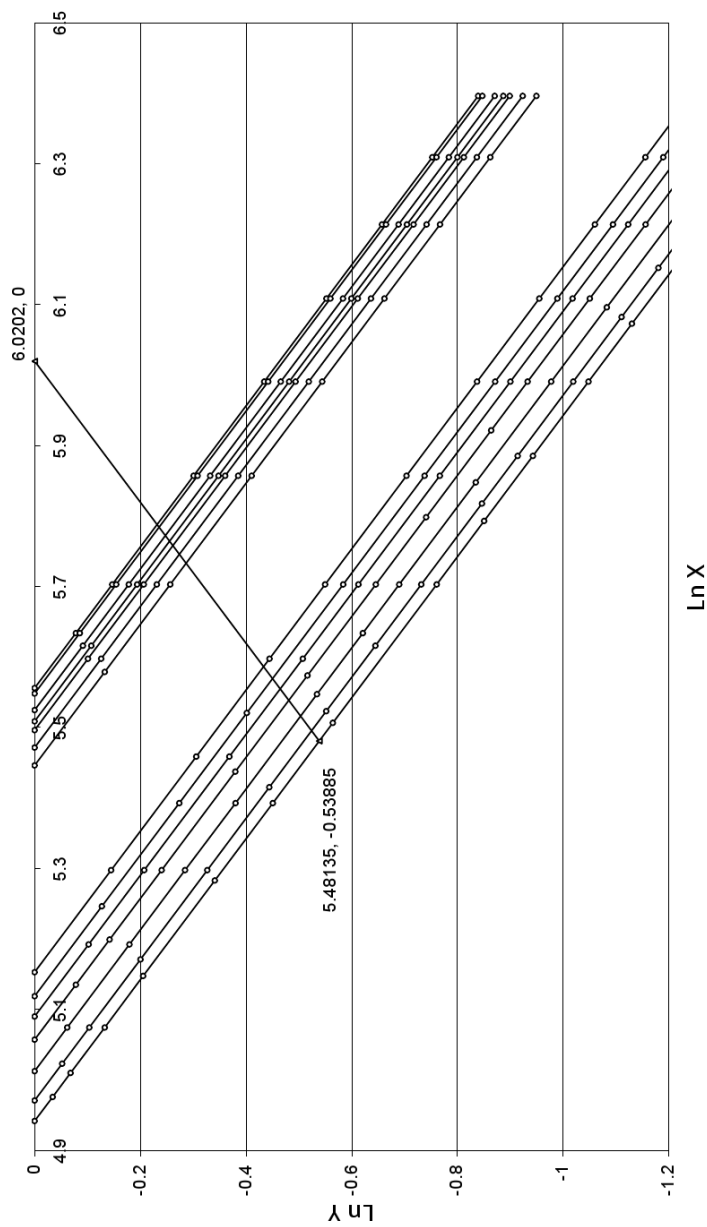


Fig. C-9: Function  $Y = K/X$  represented, in the logarithmic coordinates, for the lanthanides (Ce, Nd, Sm, Gd, Dy, Er, Yb), which are the straight lines at the left side, and the actinides (Th, U, Pu, Cm, Cf, Fm, No), which are the straight lines at the right side. The real axis is diagonally crossing the lines.

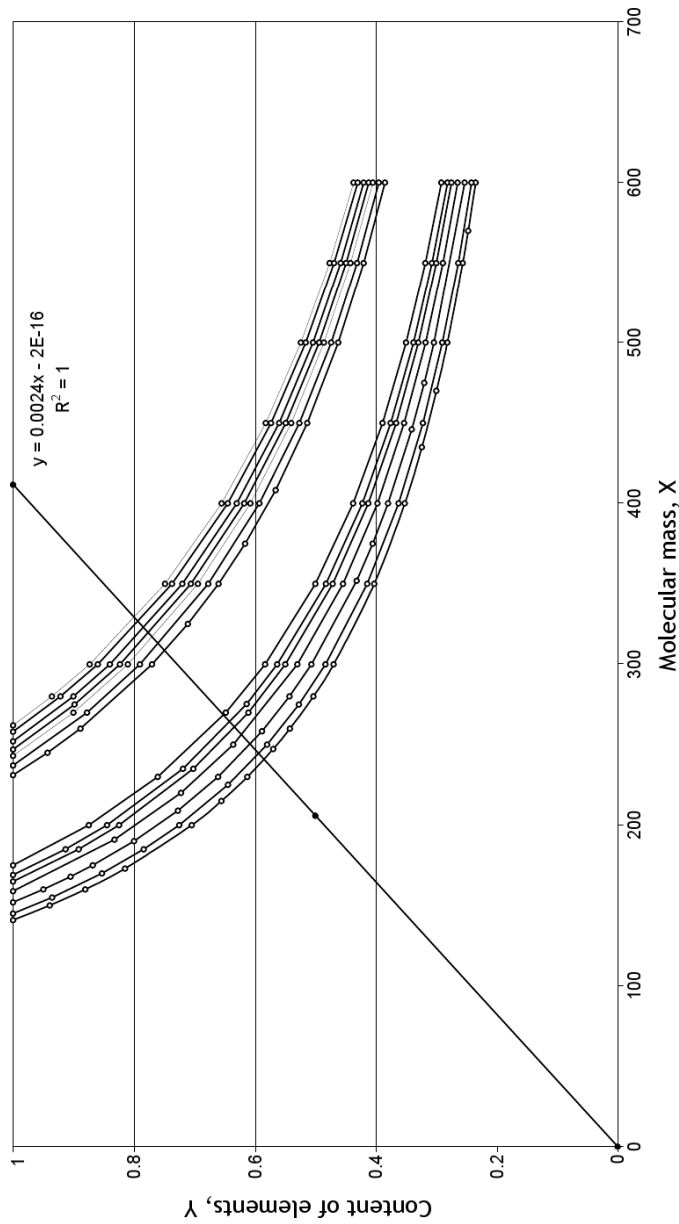


Fig. C-10: Function  $Y = K/X$  for the lanthanides (Pr, Pm, Eu, Tb, Ho, Tm, Lu), which are the arcs at the left side, and for the second group of the actinides (Pa, Np, Am, Bk, Es, Md, Lr), which are the arcs at the right side. The real axis is diagonally crossing the graph.

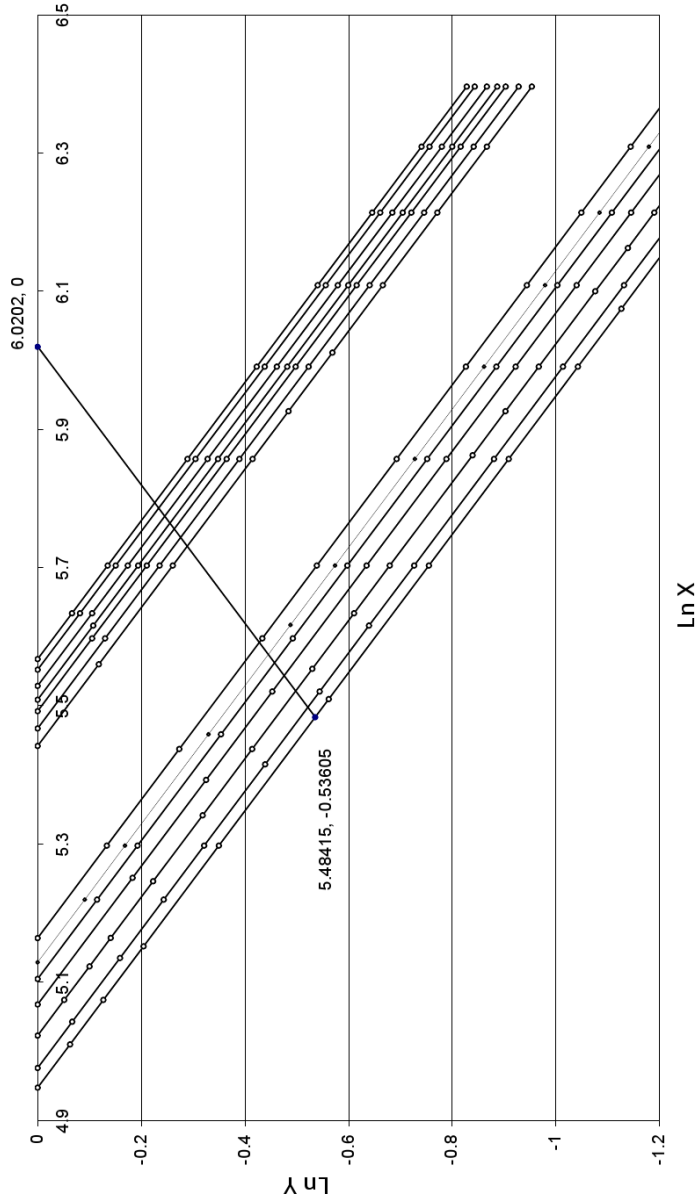


Fig. C-11: Function  $Y = K/X$  represented, in the logarithmic coordinates, for the lanthanides (Pr, Pm, Eu, Tb, Ho, Tm, Lu), which are the straight lines at the left side, and the actinides (Pa, Np, Am, Bk, Es, Md, Lr), which are the straight lines at the right side. The real axis is diagonally crossing the graph.

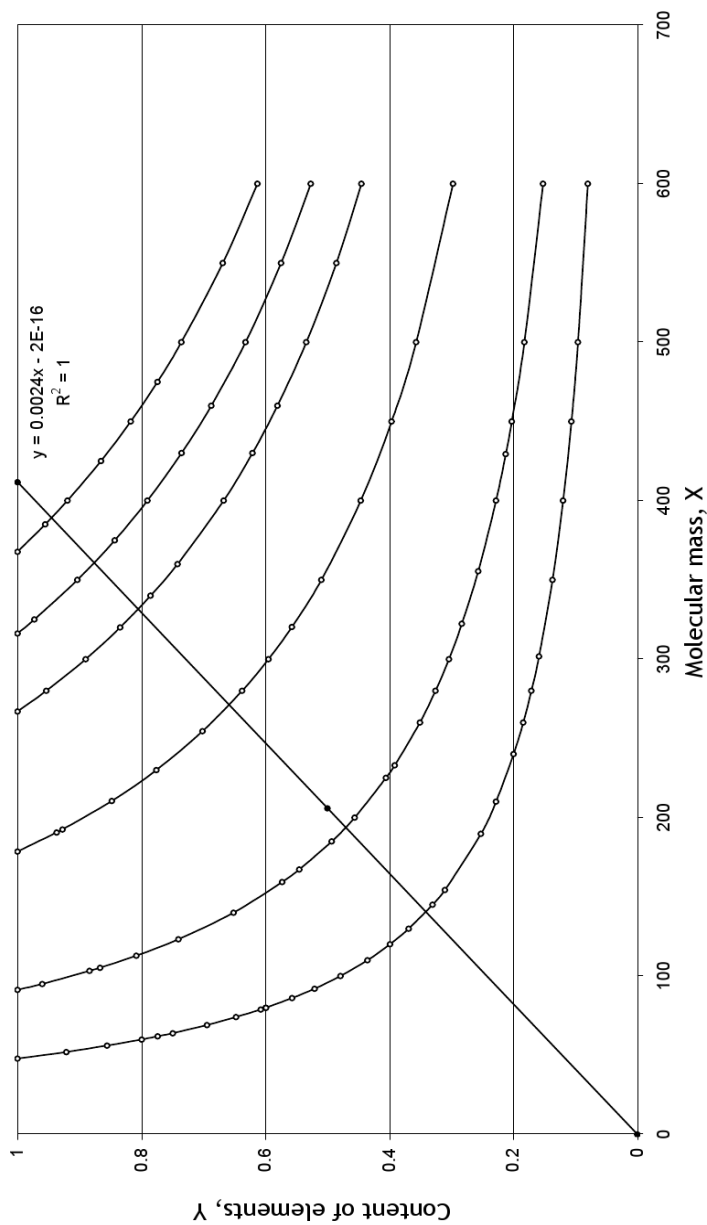


Fig. C-12: Hyperbolas created for the elements of Group 4 of the Periodic Table. From left to right: Ti, Zr, Hf, Rf, No. 122, No. 140. The real axis is diagonally crossing the graph.

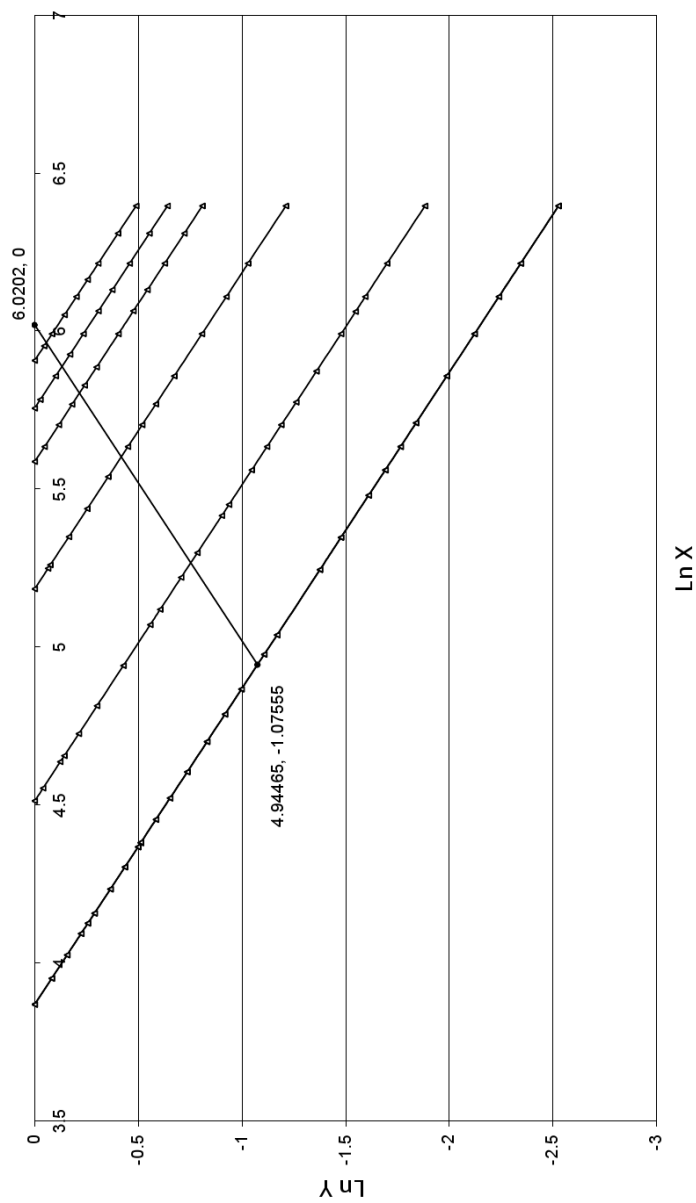


Fig. C-13: The same data of Group 4 of the Periodic Table, represented in the logarithmic coordinates. From left to right: Ti, Zr, Hf, Rf, No. 122, No. 140. The real axis is diagonally crossing the lines.

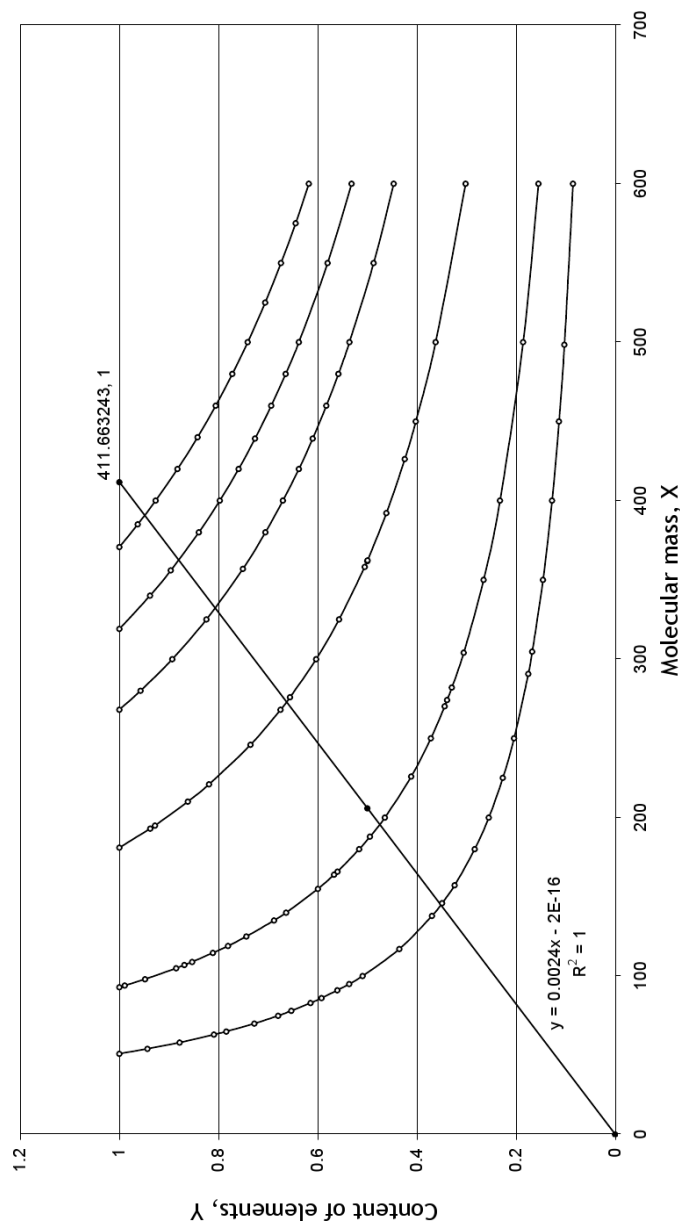


Fig. C-14: Hyperbolas created for the elements of Group 5 of the Periodic Table. From left to right: V, Nb, Ta, Db, No. 123, No. 141. The real axis is diagonally crossing the graph.

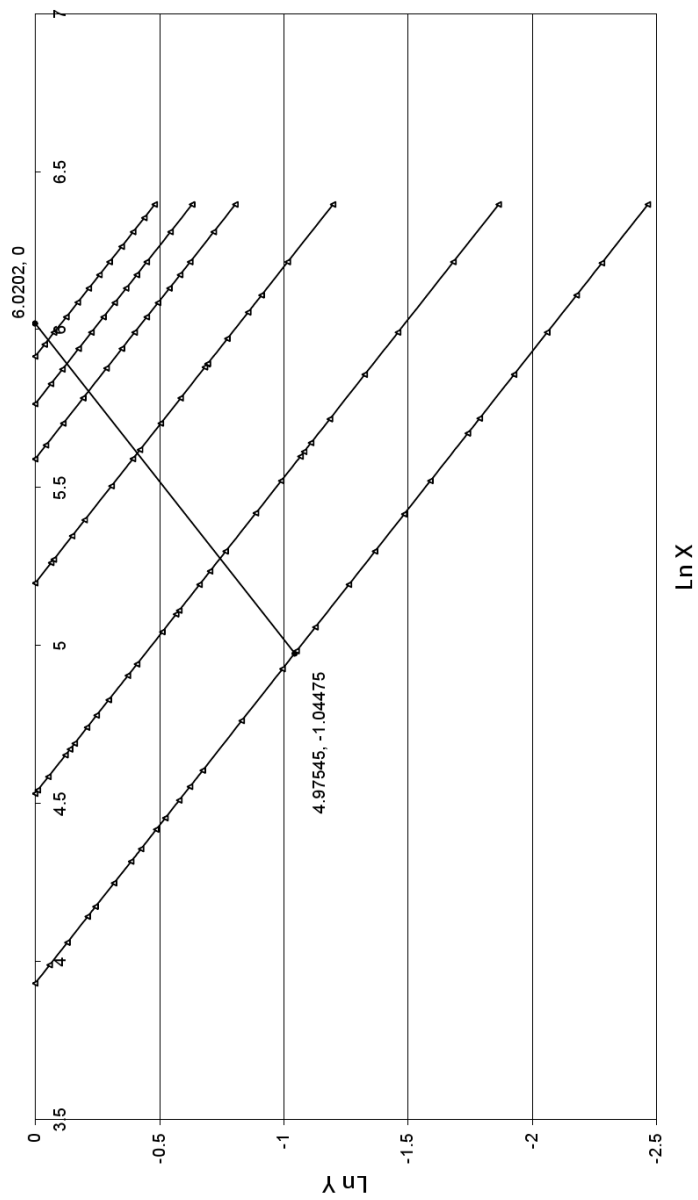


Fig. C-15: The same data of Group 5 of the Periodic Table, represented in the logarithmic coordinates. From left to right: V, Nb, Ta, Db, No. 123, No. 141. The real axis is diagonally crossing the lines.

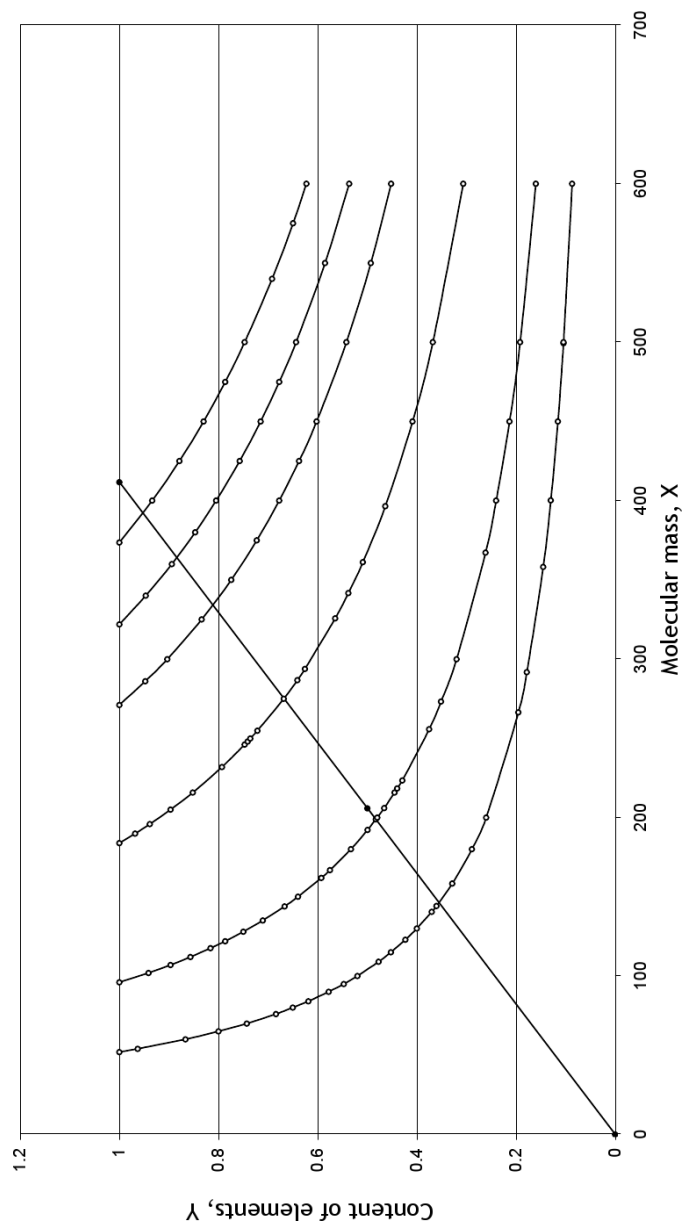


Fig. C-16: Hyperbolas created for the elements of Group 6 of the Periodic Table. From left to right: Cr, Mo, W, Sg, No. 124, No. 142. The real axis is diagonally crossing the graph.



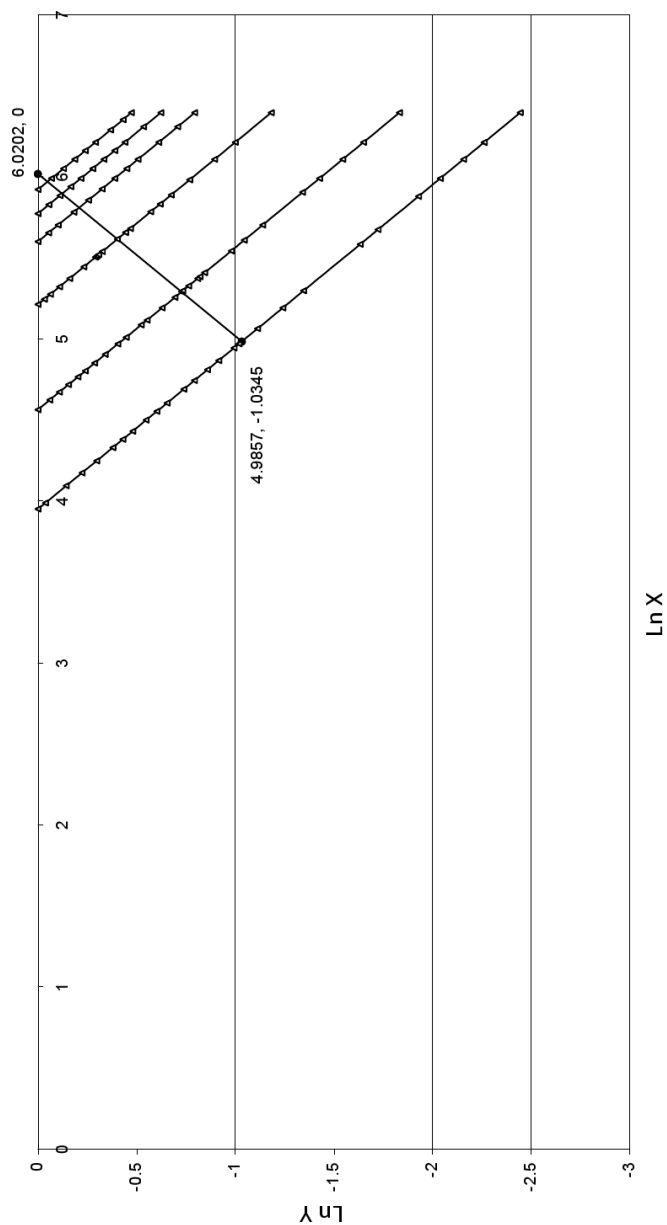


Fig. C-17a: The same data of Group 6 of the Periodic Table, represented in the logarithmic coordinates. From left to right: Cr, Mo, W, Sg, No.124, No.142. The data presented here are not shifted along the coordinate axes.

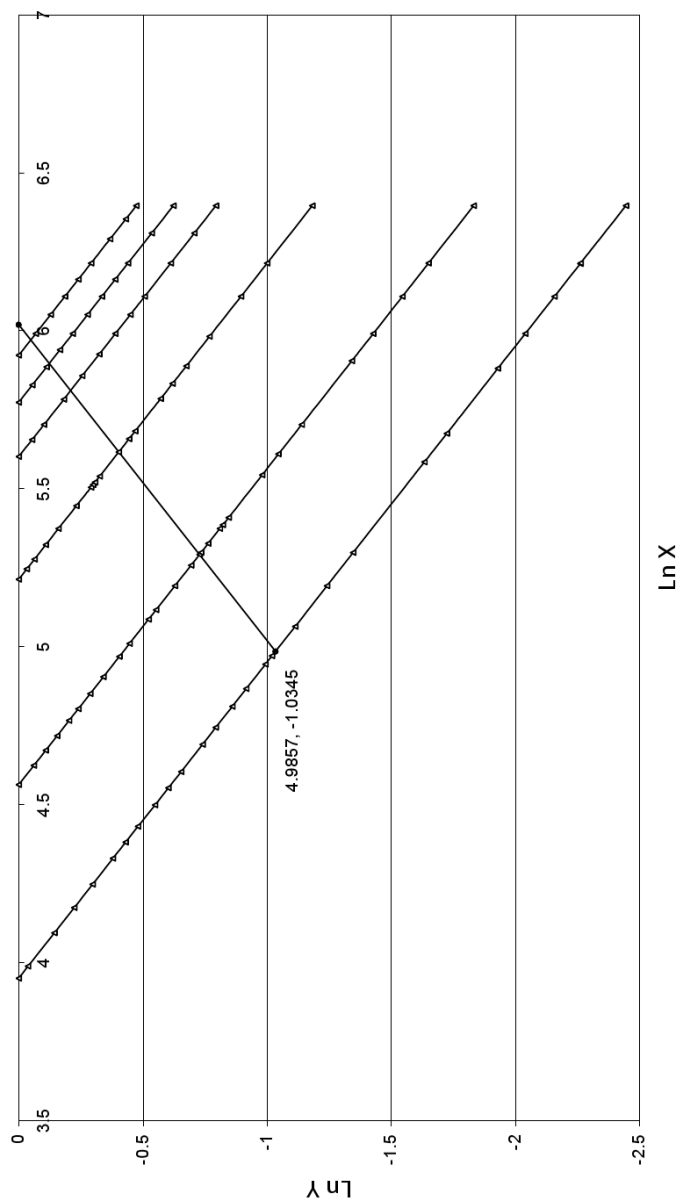


Fig. C-17b: The same data of Group 6 of the Periodic Table, represented in the logarithmic coordinates. From left to right: Cr, Mo, W, Sg, No. 124, No. 142. The data shifted along the coordinate axes. The real axis is diagonally crossing the lines.

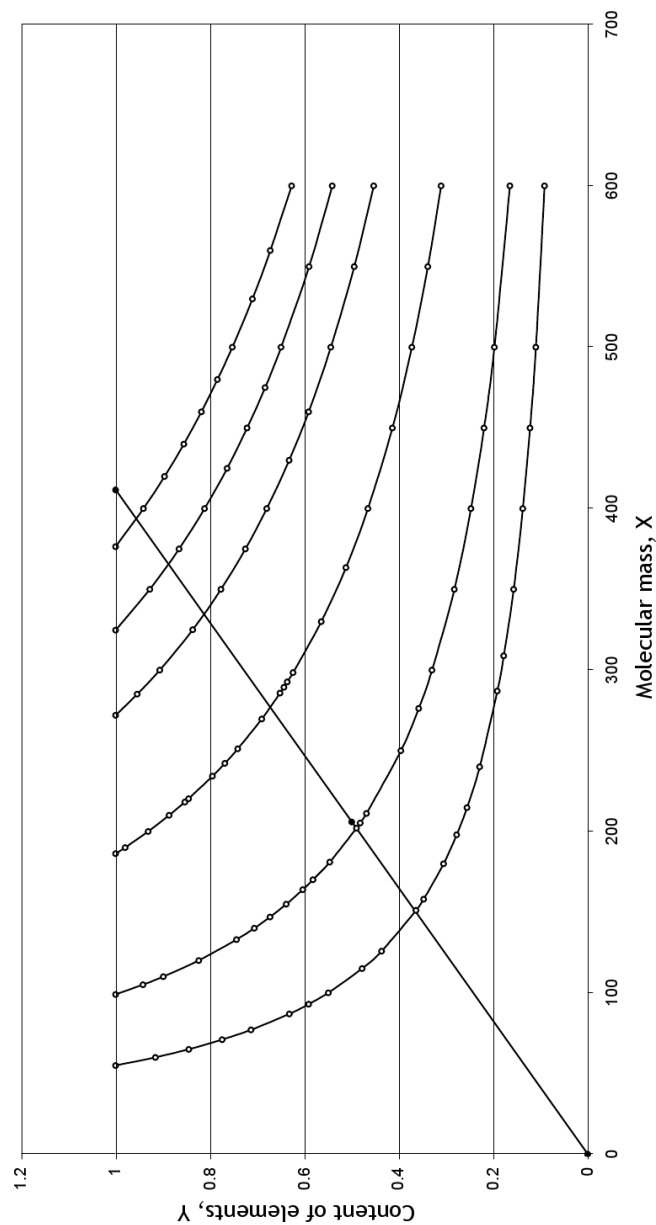


Fig. C-18: Hyperbolas created for the elements of Group 7 of the Periodic Table. From left to right: Mn, Tc, Re, Bh, No. 125, No. 143. The data presented here are not shifted along the coordinate axes. The real axis is diagonally crossing the graph.

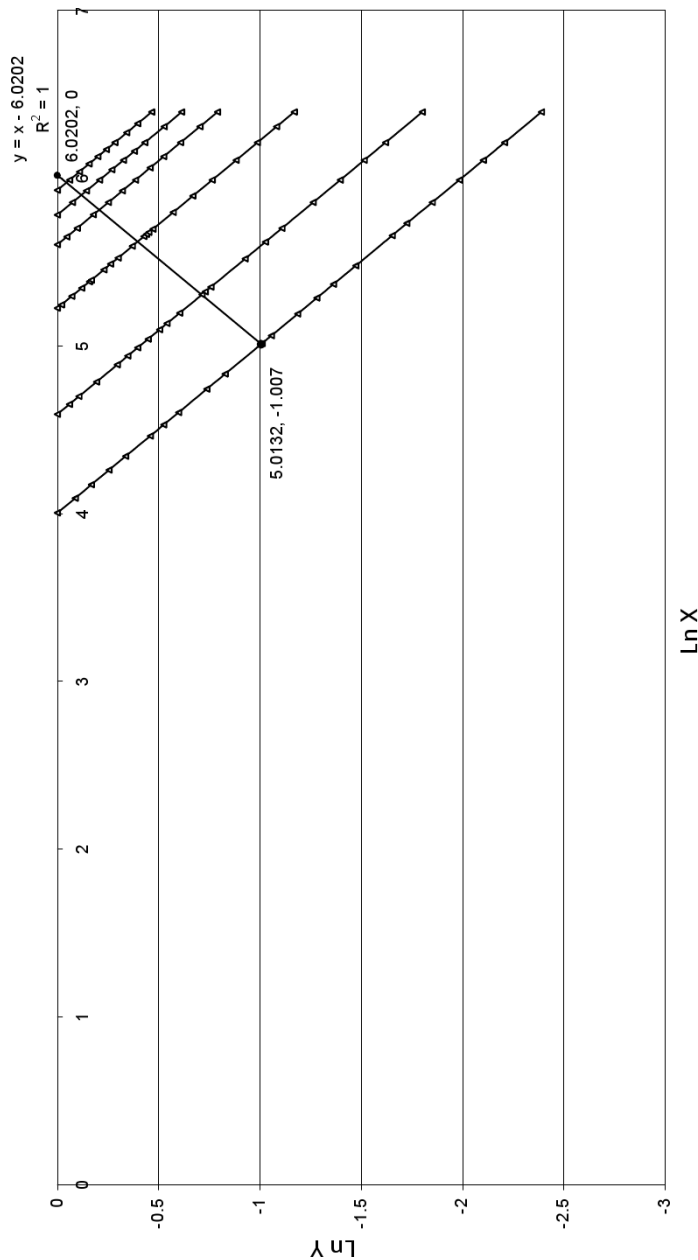


Fig. C-19: The same data of Group 7 of the Periodic Table, represented in the logarithmic coordinates. From left to right: Mn, Tc, Re, Bh, No. 125, No. 143. The data presented here are not shifted along the coordinate axes. The real axis is diagonally crossing the lines.

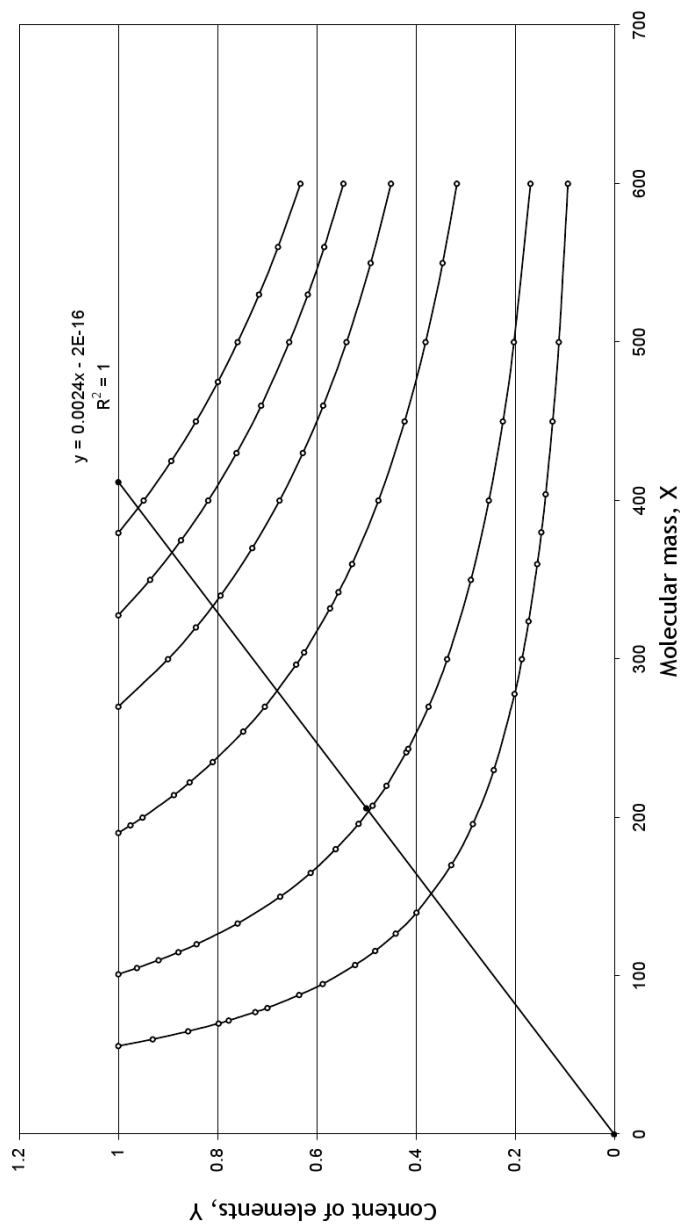


Fig. C-20: Hyperbolas created for the elements of Group 8 of the Periodic Table. From left to right: Fe, Ru, Os, Hs, No, Lr. The data presented here are not shifted along the coordinate axes. The real axis is diagonally crossing the graph.

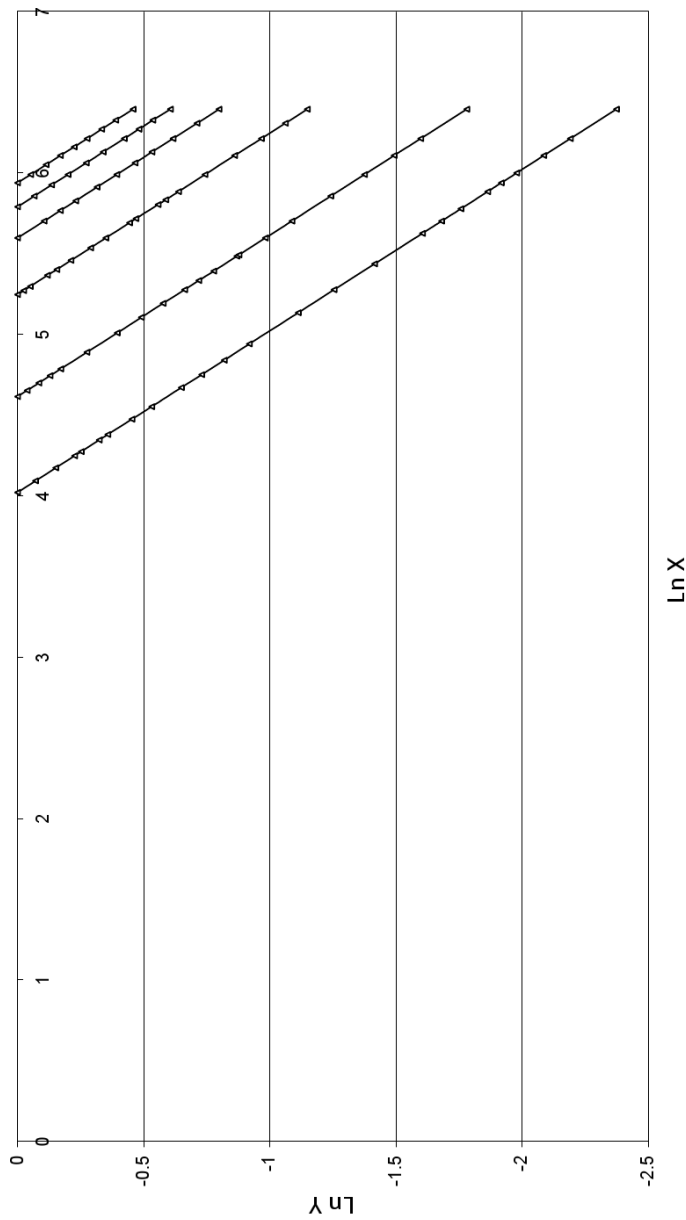


Fig. C-21: The same data of Group 8 of the Periodic Table, represented in the logarithmic coordinates. From left to right: Fe, Ru, Os, Hs, No, 144. The data presented here are not shifted along the coordinate axes. The real axis is diagonally crossing the lines.

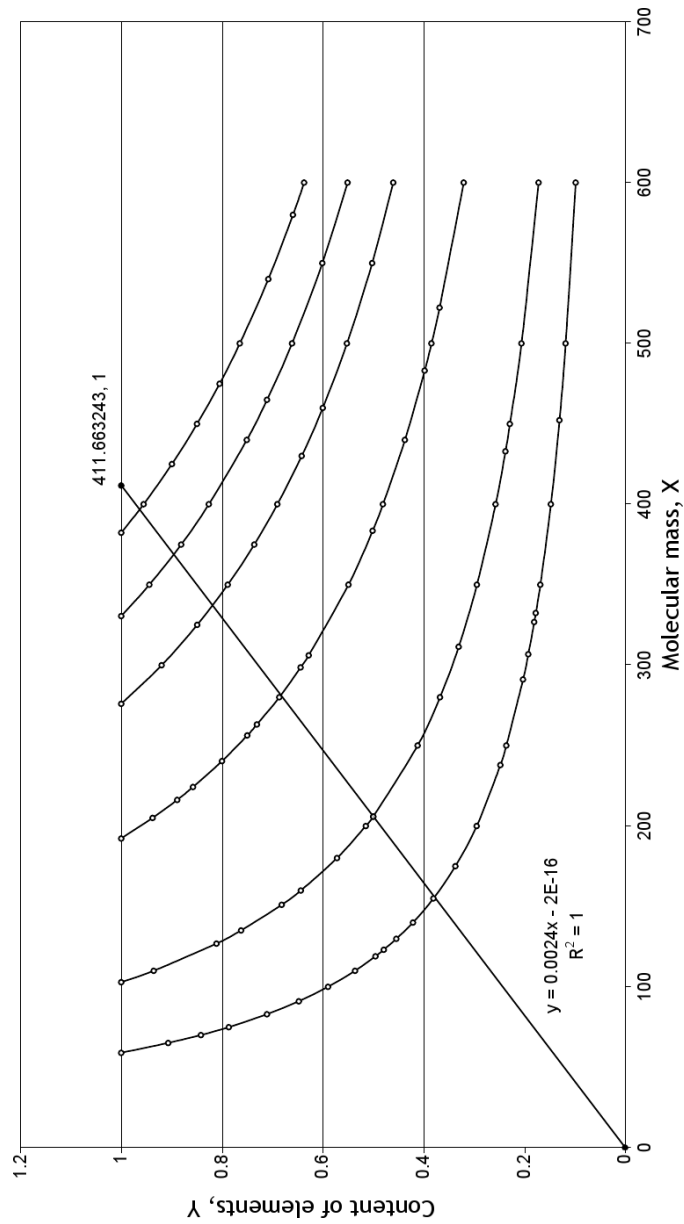


Fig. C-22: Hyperbolas created for the elements of Group 9 of the Periodic Table. From left to right: Co, Rh, Ir, Mt, No. 127, No. 145. The real axis is diagonally crossing the graph.

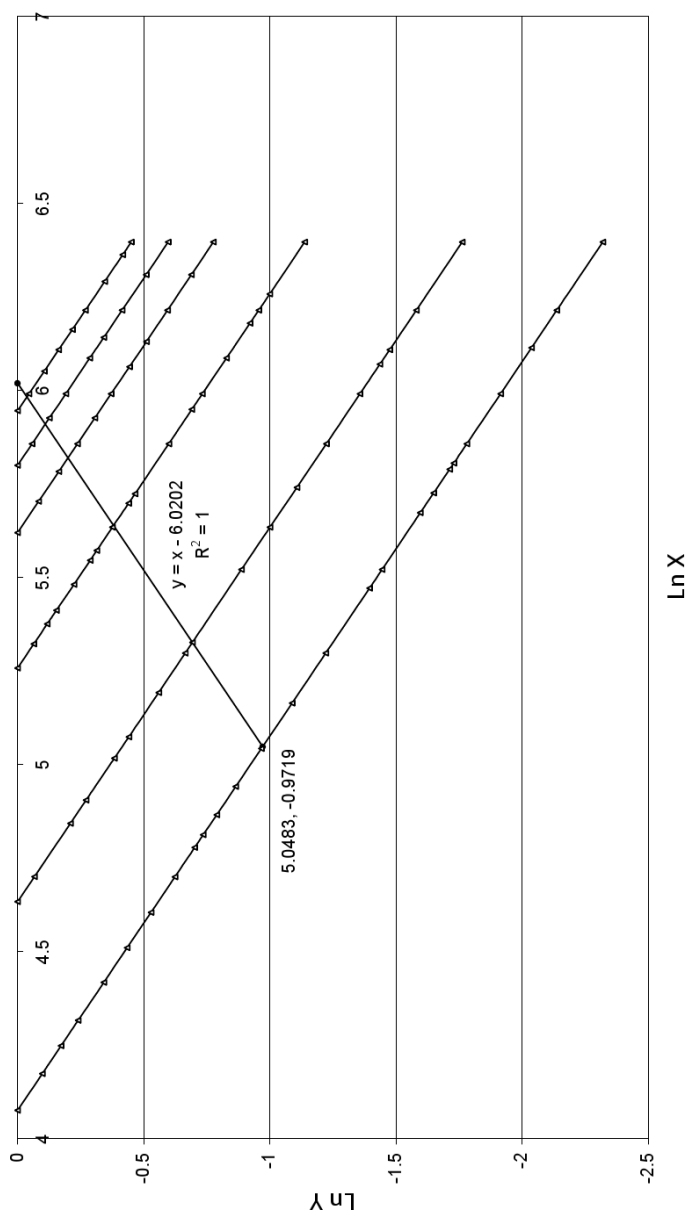


Fig. C-23: The same data of Group 9 of the Periodic Table, represented in the logarithmic coordinates. From left to right: Co, Rh, Ir, Mt, No. 127, No. 145. The data presented here are shifted along the coordinate axes. The real axis is diagonally crossing the lines.



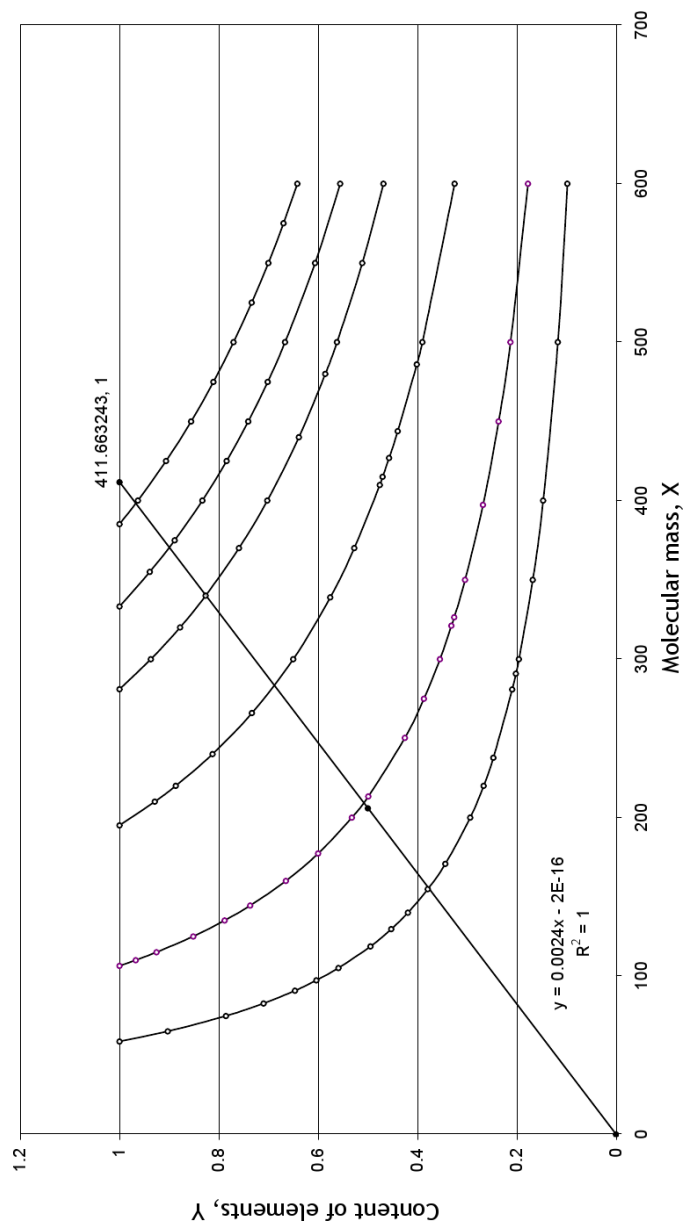


Fig. C-24: Hyperbolas created for the elements of Group 10 of the Periodic Table. From left to right: Ni, Pd, Pt, Ds, No. 128, No. 146. The real axis is diagonally crossing the graph.

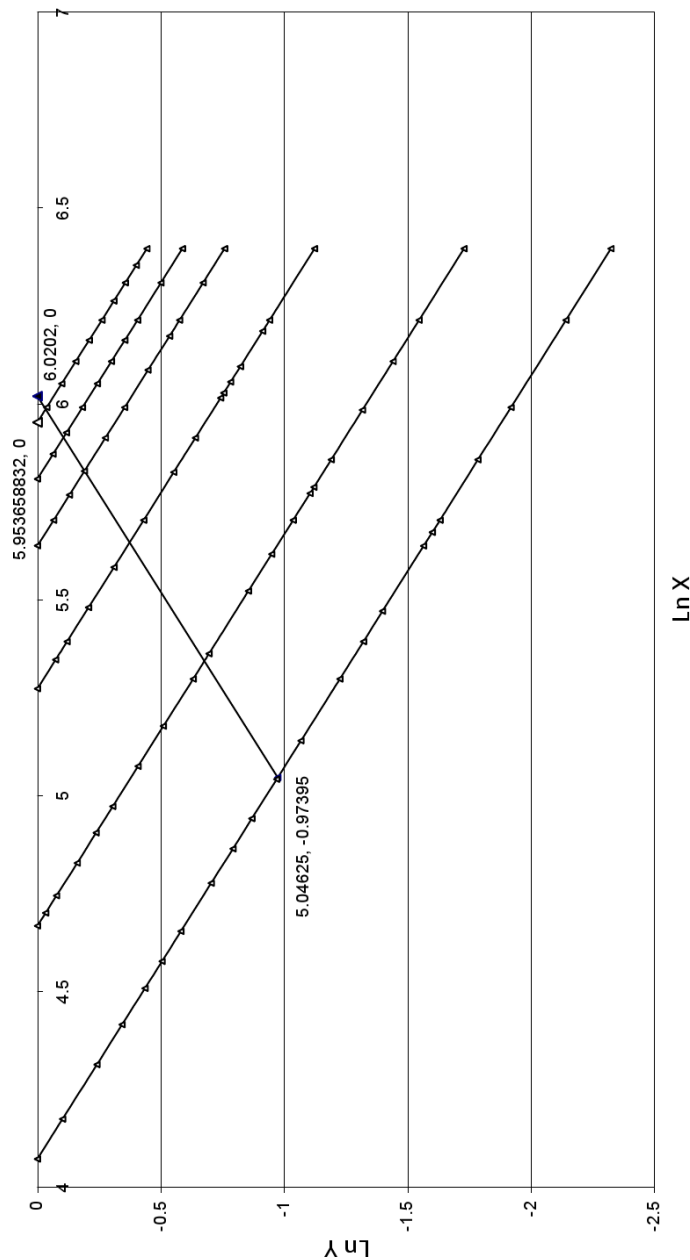


Fig. C-25: The same data of Group 10 of the Periodic Table, represented in the logarithmic coordinates. From left to right: Ni, Pd, Pt, Ds, No. 128, No. 146. The data presented here are shifted along the coordinate axes. The real axis is diagonally crossing the lines.

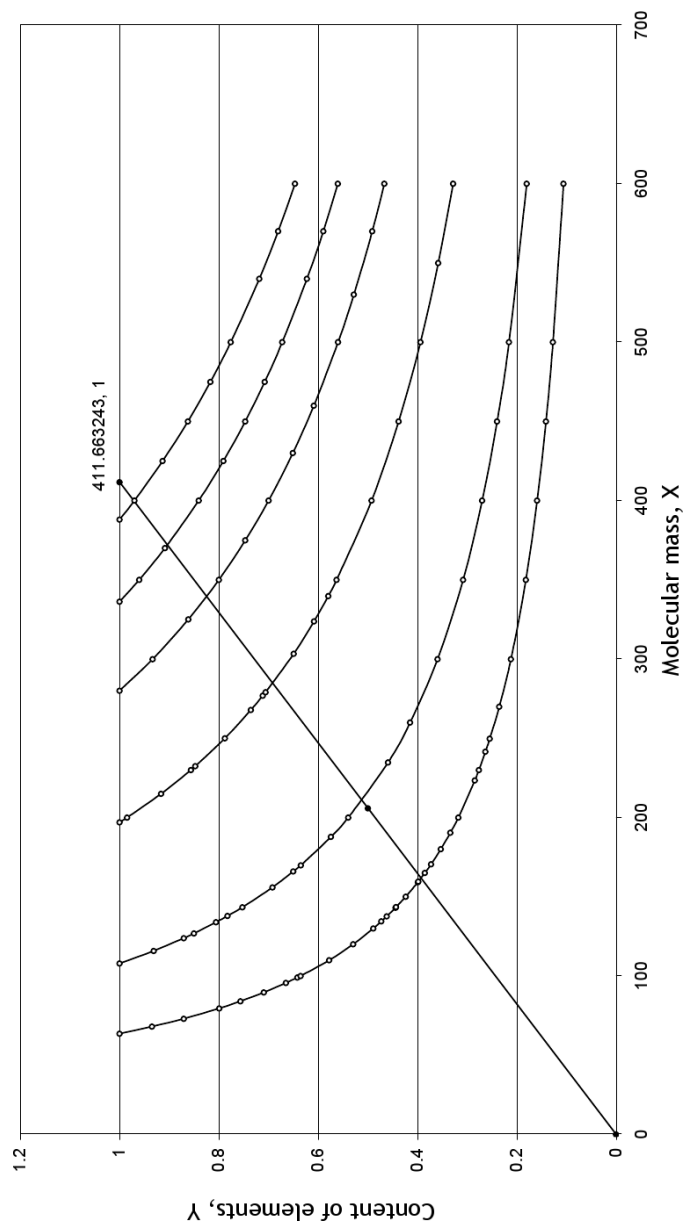


Fig. C-26: Hyperbolas created for the elements of Group 11 of the Periodic Table. From left to right: Cu, Ag, Au, Rg, No. 129, No. 147. The real axis is diagonally crossing the graph.

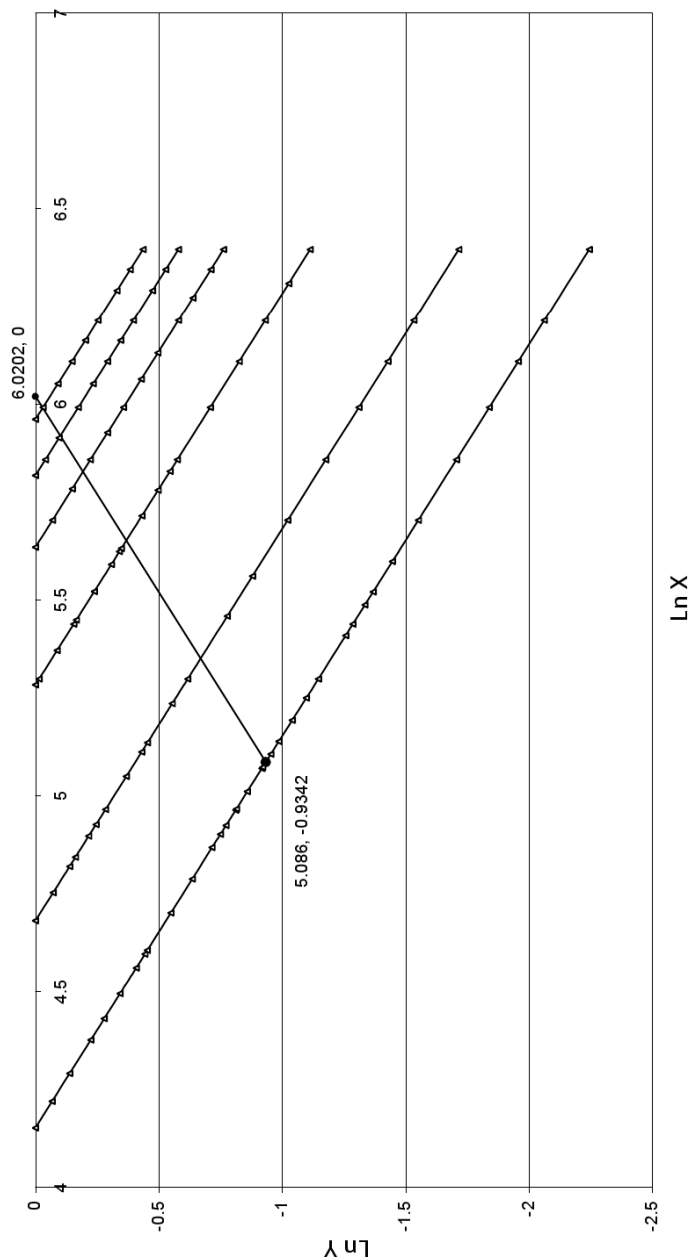


Fig. C-27: The same data of Group 11 of the Periodic Table, represented in the logarithmic coordinates. From left to right: Cu, Ag, Au, Rg, No. 129, No. 147. The data presented here are shifted along the coordinate axes. The real axis is diagonally crossing the lines.

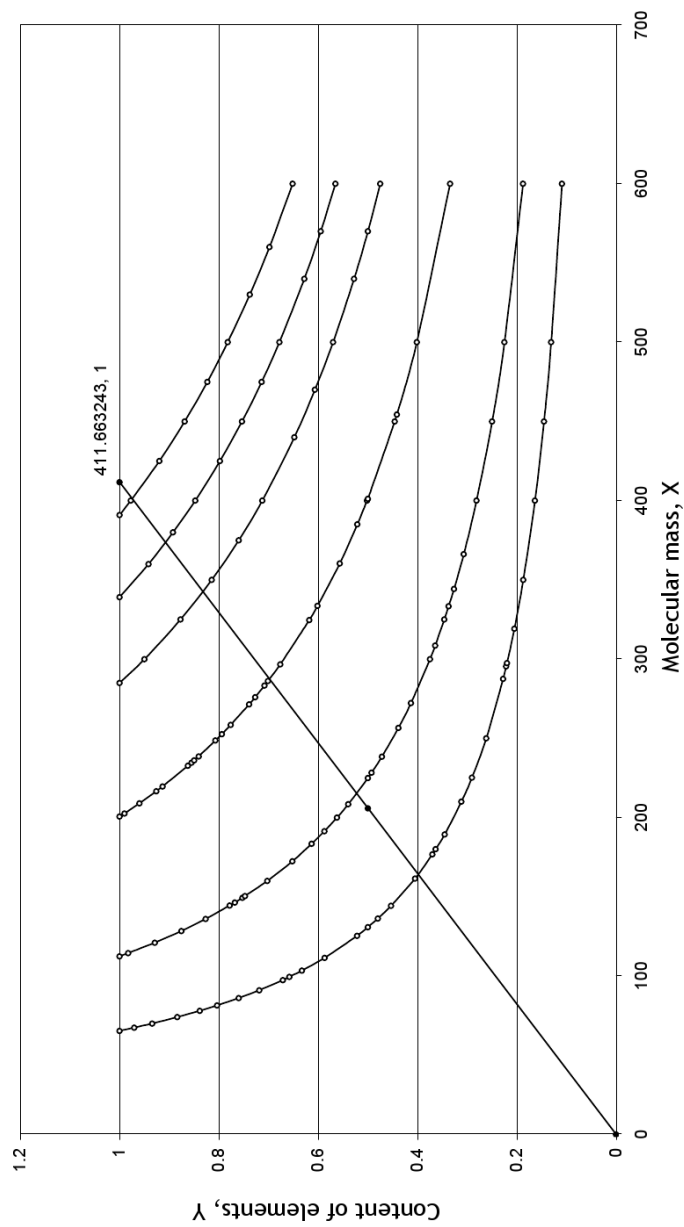


Fig. C-28: Hyperbolas created for the elements of Group 12 of the Periodic Table. From left to right: Zn, Cd, Hg, Cp, No. 130, No. 148. The real axis is diagonally crossing the graph.

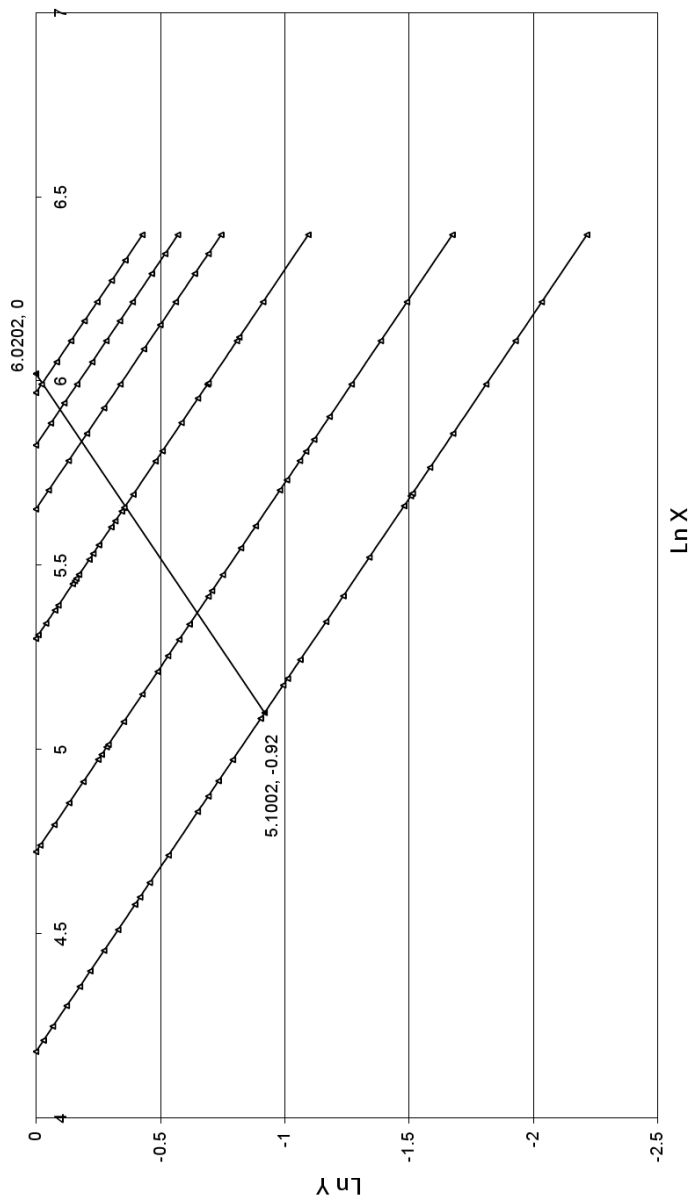


Fig. C-29: The same data of Group 12 of the Periodic Table, represented in the logarithmic coordinates. From left to right: Zn, Cd, Hg, Cp, No. 130, No. 148. The data presented here are shifted along the coordinate axes. The real axis is diagonally crossing the lines.

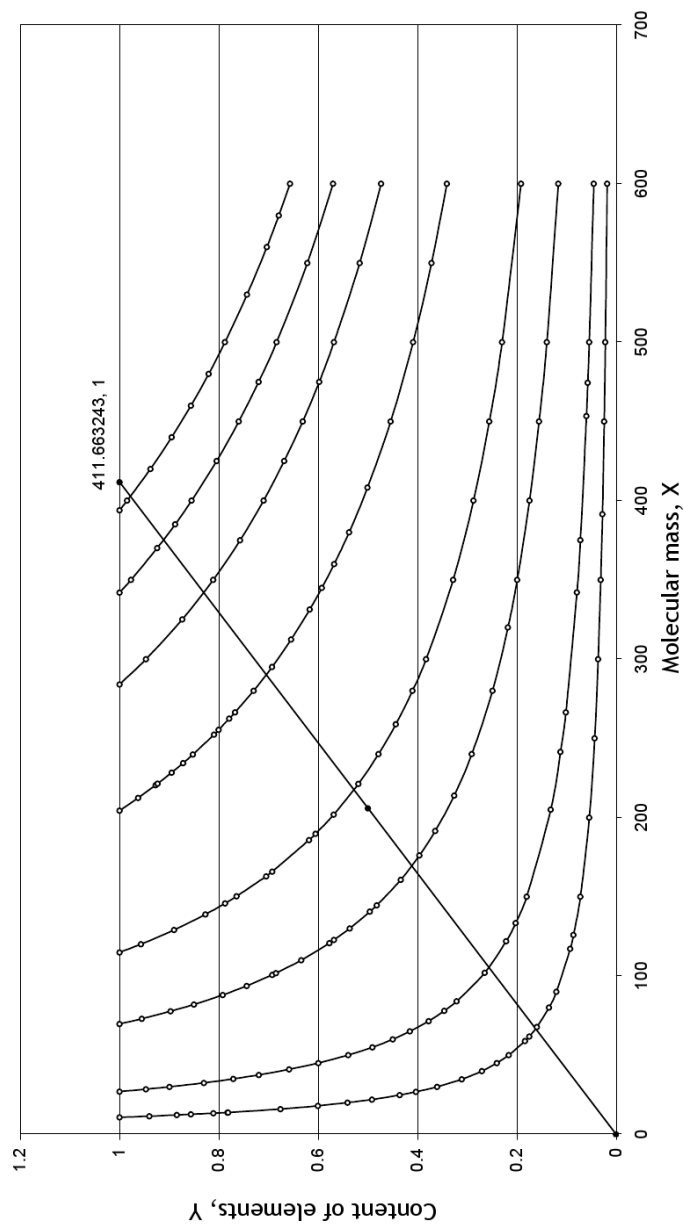


Fig. C-30: Hyperbolas created for the elements of Group 13 of the Periodic Table. From left to right: B, Al, Ga, In, Tl, Uut, No. 131, No. 149. The real axis is diagonally crossing the graph.

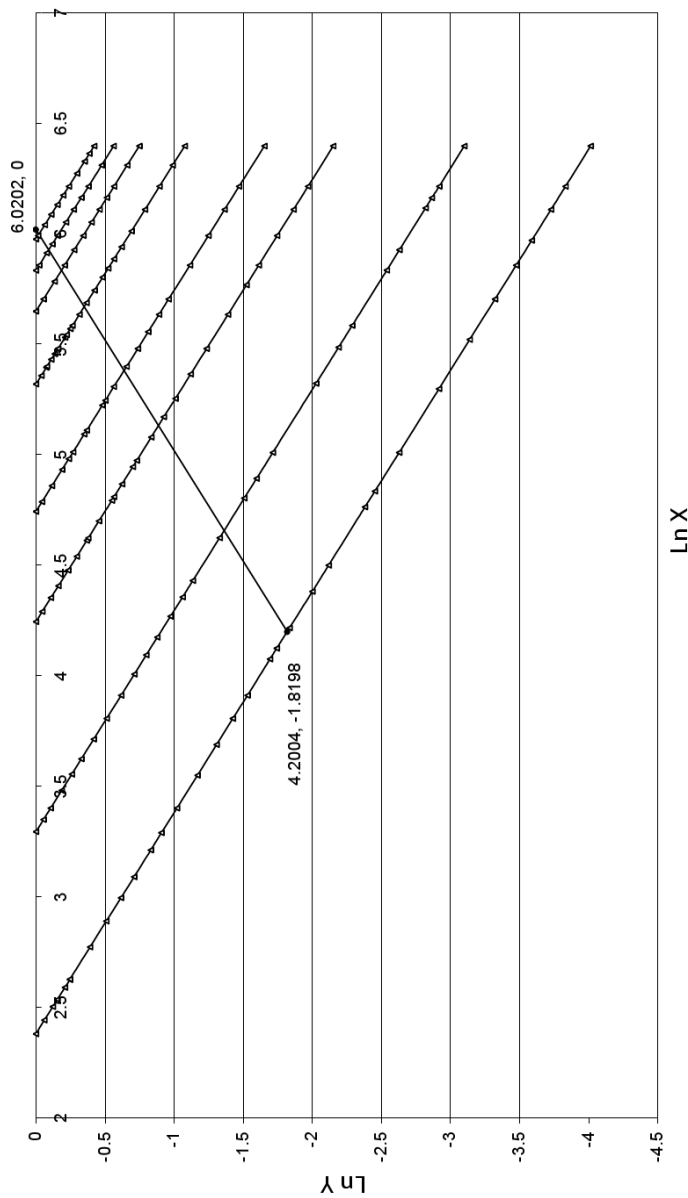


Fig. C-31: The same data of Group 13 of the Periodic Table, represented in the logarithmic coordinates. From left to right: B, Al, Ga, In, Tl, Uut, No. 131, No. 149. The data presented here are shifted along the coordinate axes. The real axis is diagonally crossing the lines.



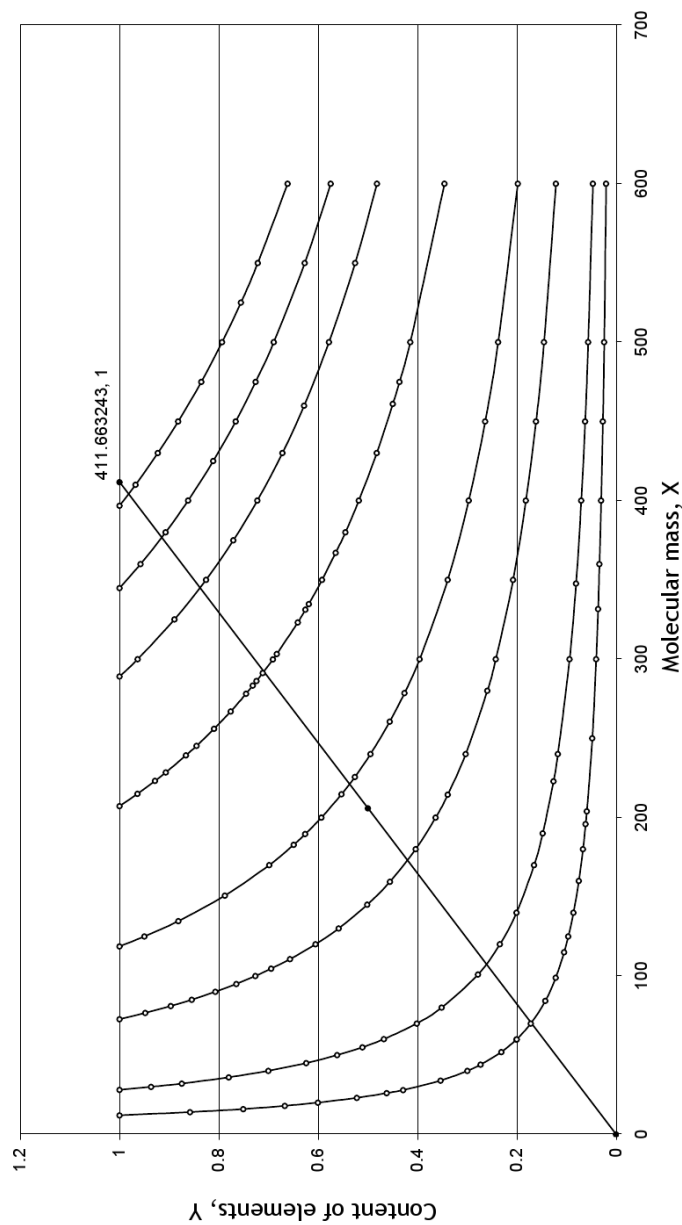


Fig. C-32: Hyperbolas created for the elements of Group 14 of the Periodic Table. From left to right: C, Si, Ge, Sn, Pb, Uuq, No.132, No.150. The real axis is diagonally crossing the graph.

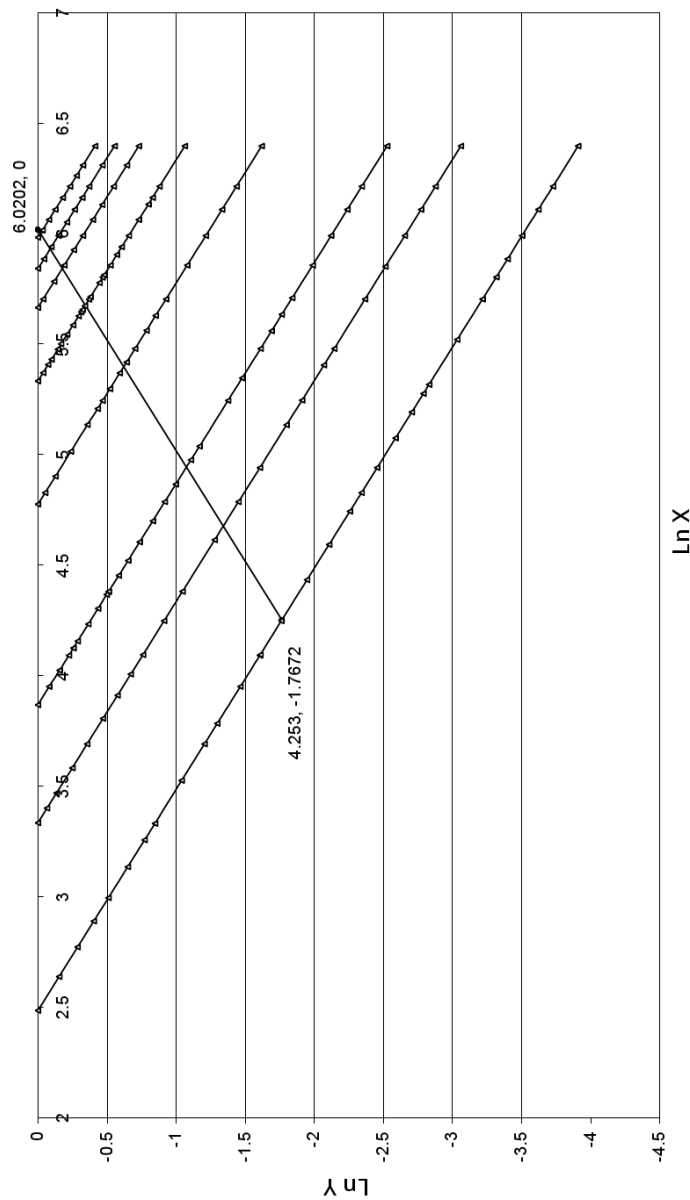


Fig. C-33: The same data of Group 14 of the Periodic Table, represented in the logarithmic coordinates. From left to right: C, Si, Ge, Sn, Pb, Uuq, No. 132, No. 150. The data presented here are shifted along the coordinate axes. The real axis is diagonally crossing the lines.

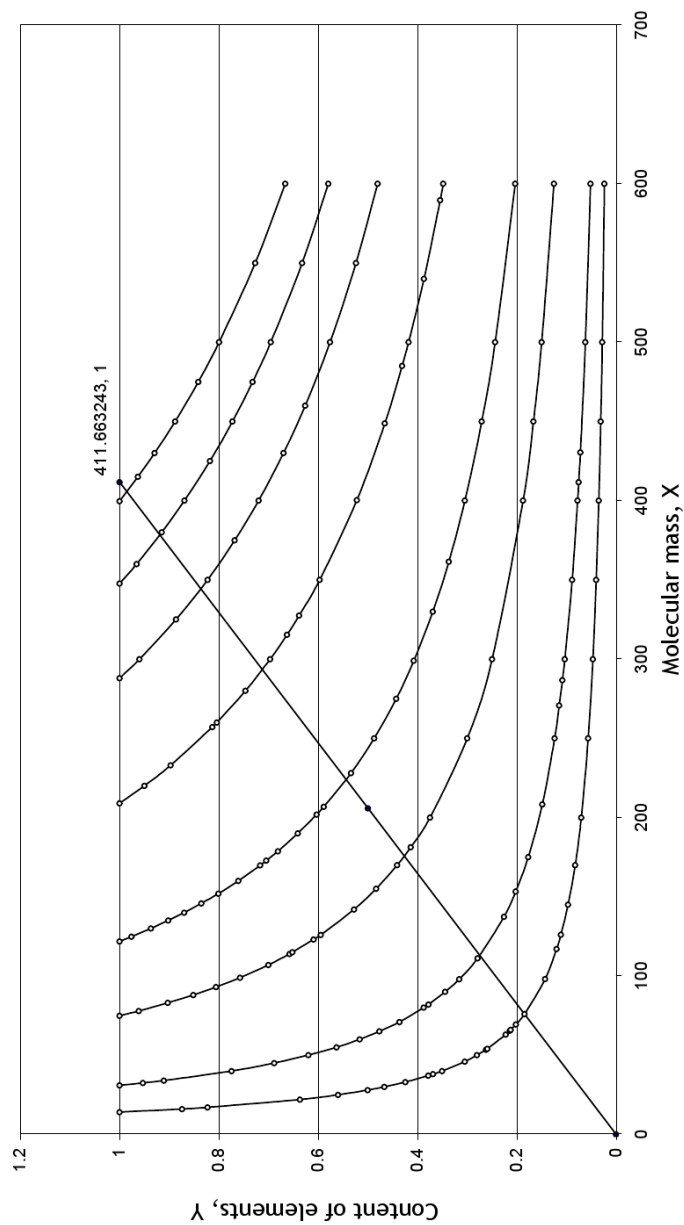


Fig. C-34: Hyperbolas created for the elements of Group 15 of the Periodic Table. From left to right: N, P, As, Sb, Bi, Uup, No. 133, No. 151. The real axis is diagonally crossing the graph.

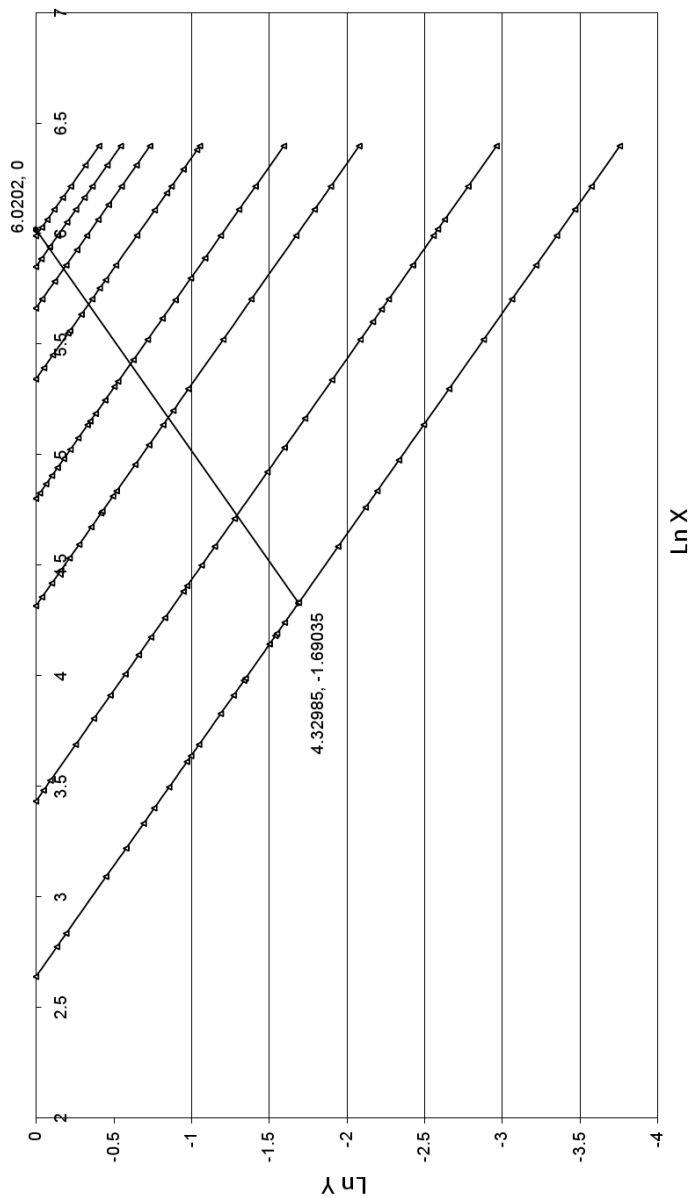


Fig. C-35: The same data of Group 15 of the Periodic Table, represented in the logarithmic coordinates. From left to right: N, P, As, Sb, Bi, Uup, No. 133, No. 151. The data presented here are shifted along the coordinate axes. The real axis is diagonally crossing the lines.

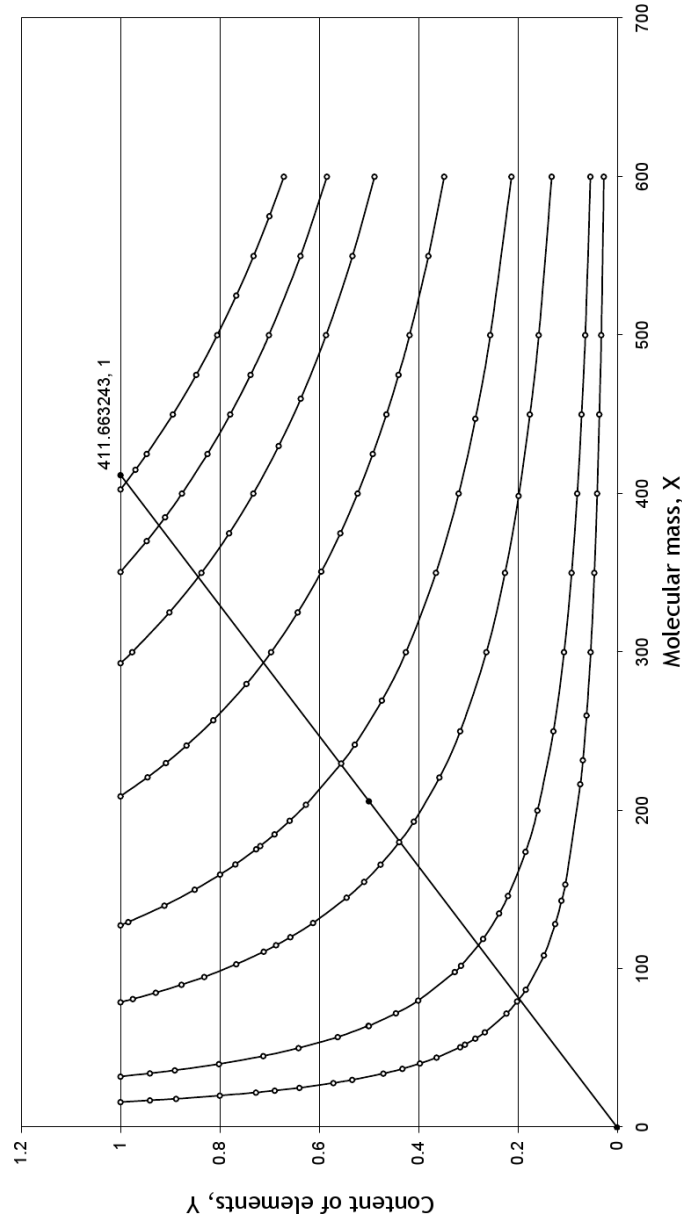


Fig. C-36: Hyperbolas created for the elements of Group 16 of the Periodic Table. From left to right: O, S, Se, Te, Po, Uuh, No. 134, No. 152. The real axis is diagonally crossing the graph.

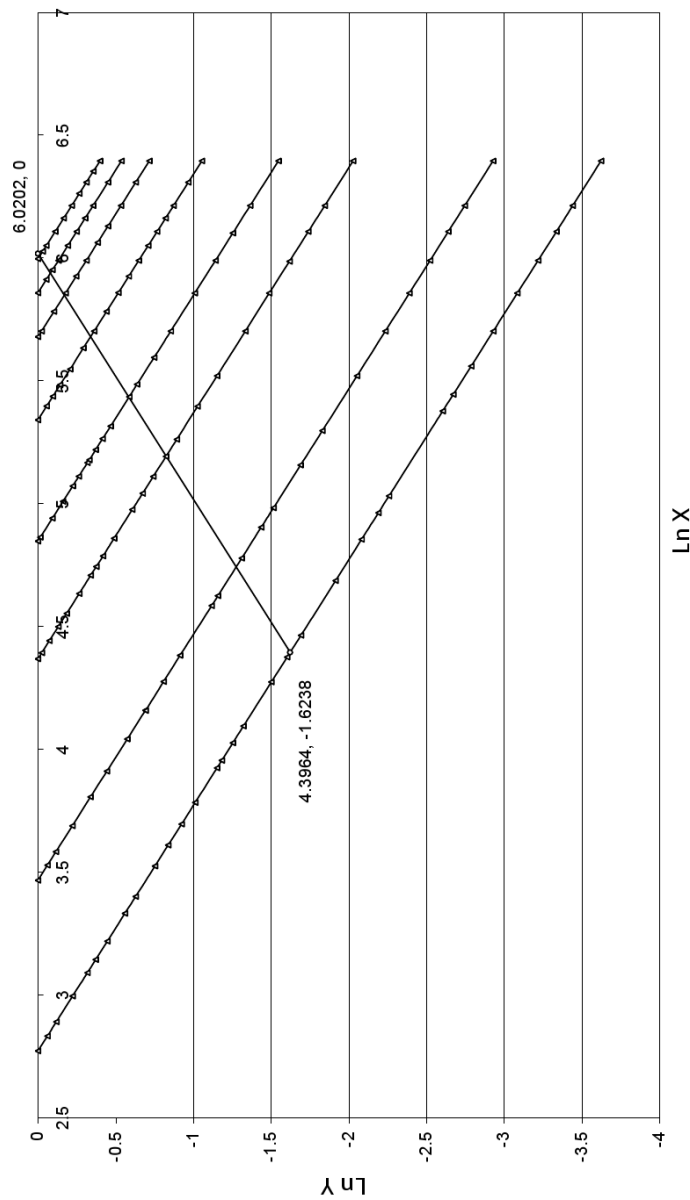


Fig. C-37: The same data of Group 16 of the Periodic Table, represented in the logarithmic coordinates. From left to right: O, S, Se, Te, Po, Uuh, No. 134, No. 152. The data presented here are shifted along the coordinate axes. The real axis is diagonally crossing the lines.

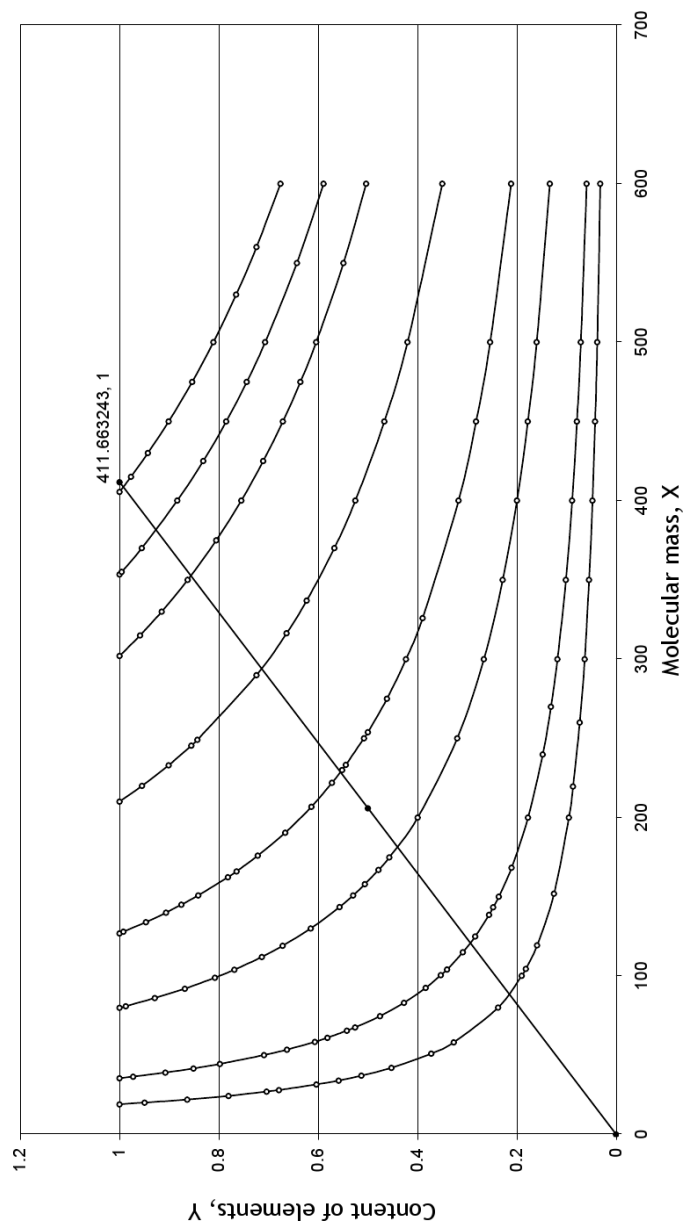


Fig. C-38: Hyperbolas created for the elements of Group 17 of the Periodic Table. From left to right: F, Cl, Br, I, At, Uus, No. 135, No. 153. The real axis is diagonally crossing the graph.

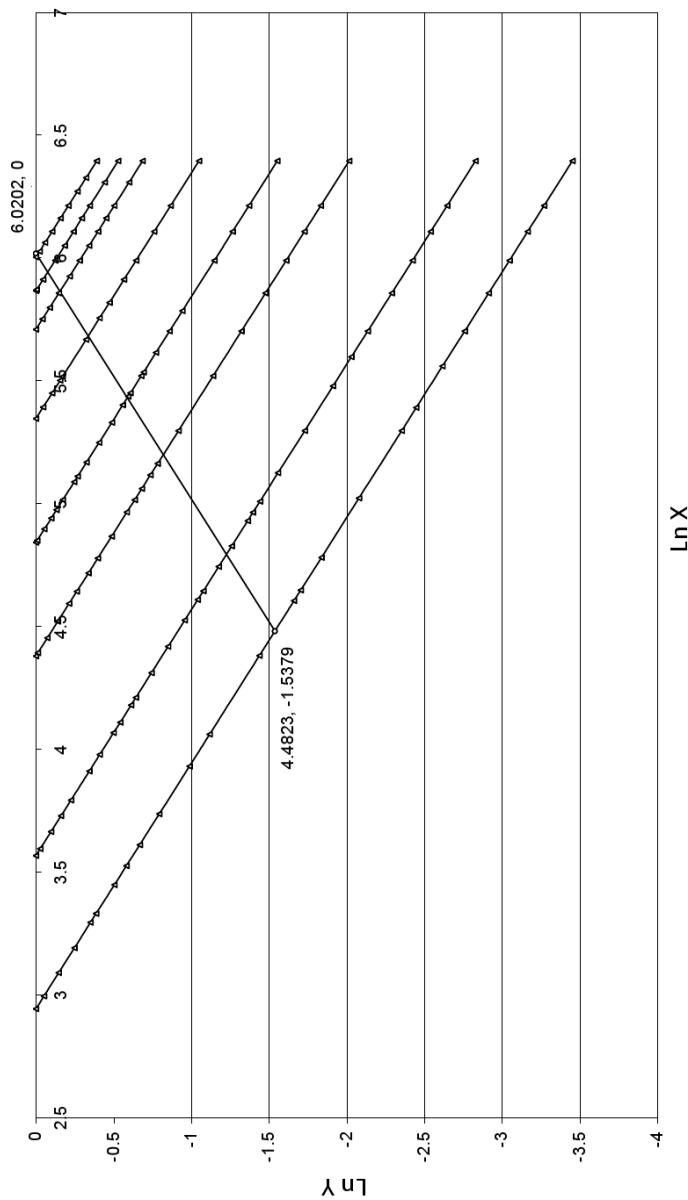


Fig. C-39: The same data of Group 17 of the Periodic Table, represented in the logarithmic coordinates. From left to right: F, Cl, Br, I, At, Uus, No. 135, No. 153. The data presented here are shifted along the coordinate axes. The real axis is diagonally crossing the lines.



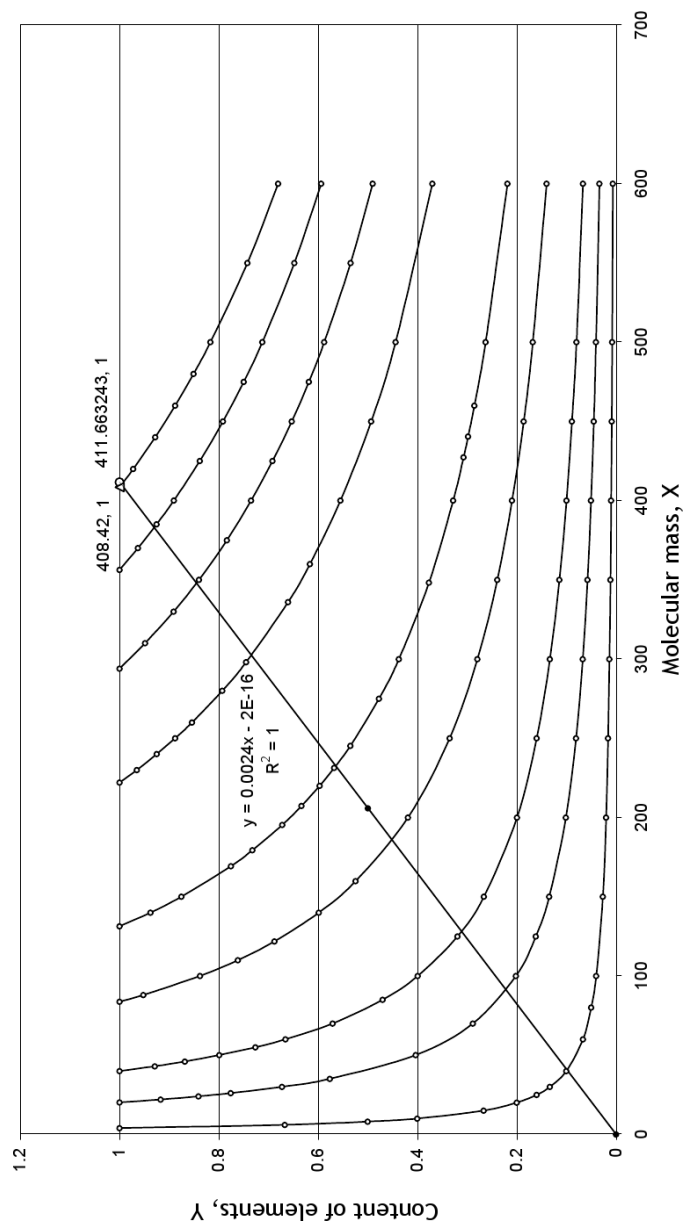


Fig. C-40: Hyperbolas created for the elements of Group 18 of the Periodic Table. From left to right: He, Ne, Ar, Kr, Xe, Rn, Uuo, No. 136, No. 154. The real axis is diagonally crossing the graph.

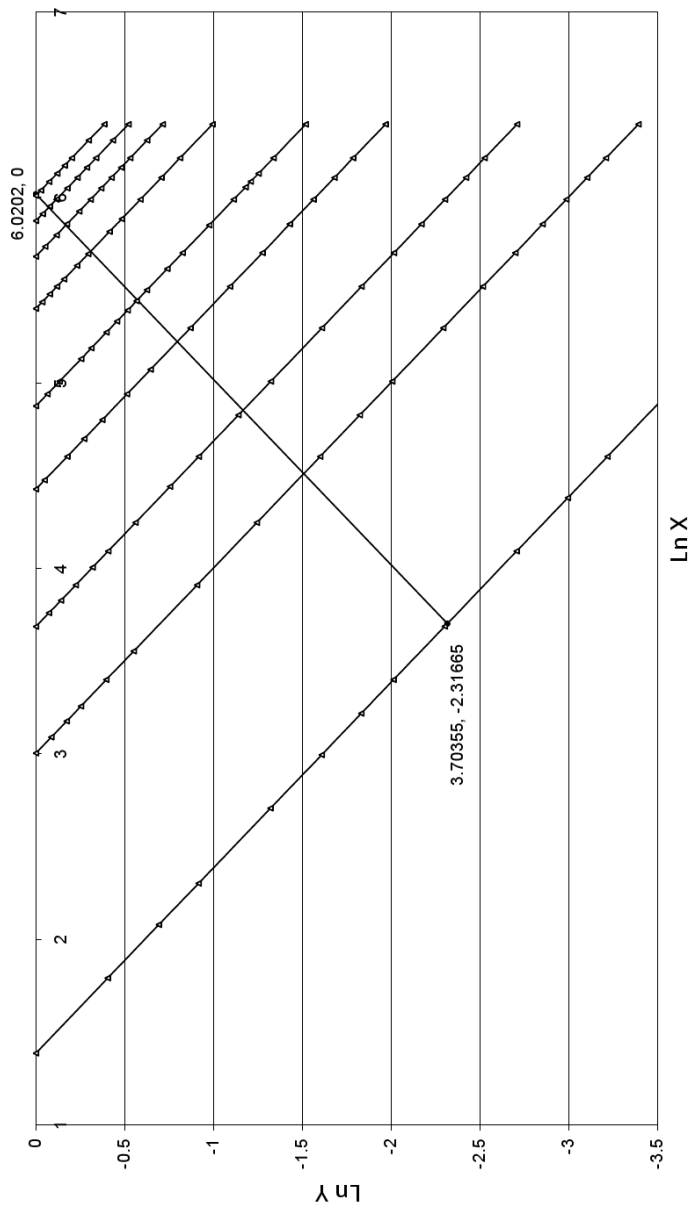


Fig. C-41: The same data of Group 18 of the Periodic Table, represented in the logarithmic coordinates. From left to right: He, Ne, Ar, Kr, Xe, Rn, Uuo, No. 136, No. 154. The data presented here are shifted along the coordinate axes. The real axis is diagonally crossing the lines.

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**About the author:** Albert Khazan was born in 1934, in Vologda, Russia. He was educated in the Institute of Steel and Alloys, Moscow, where he also continued post-educational studies on the chloride of Wolfram. From 1969 to 1996 he worked on the research staff of Baikov Institute of Metallurgy and Materials Science (IMET), Russian Academy of Sciences, and got a PhD degree in physical chemistry of the colour and refractory metals. Commencing in 1997, Albert Khazan lives in New York, the USA, where he continues his scientific research. He is a US citizen and a full member of the American Physical Society.

## Upper Limit in Mendeleev's Periodic Table — Element No.155 by Albert Khazan

This book represents a result of many-year theoretical research, which manifested hyperbolic law in Mendeleev's Periodic Table. According to the law, an upper limit (heaviest element) exists in Mendeleev's Table, whose atomic mass is 411.66 and No.155. It is shown that the heaviest element No.155 can be a reference point in nuclear reactions. Due to symmetry of the hyperbolic law, the necessity of the Table of Anti-Elements, consisting of anti-substance, has been predicted. This manifests that the found hyperbolic law is universal, and the Periodic Table is common for elements and anti-elements.

ISBN 978-1-59973-265-7



American Research Press, 2012, 205 pages  
Third edition with some recent amendments  
contained in new chapters  
Printed in the United States of America