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CONSIDERATIONS ON THE CONVERGENCE BETWEEN CHEMISTRY AND THEOLOGY THE PERIODIC TABLE OF ELEMENTS

Iulian Rusu*

Technical University "Gh. Asachi', Faculty of Chemical Engineering and Environmental Protection, Bd. D. Mangeron 71, OP10 CP2014, Iasi 700050, Romania

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Abstract

The paper deals with the theological implications of the discovery and further developments of the periodic system of the elements. The use of expert systems, based on Mendeleev's law, on the design of new materials is also taken into account. The resulting conclusions are compared with the patristic writings of Clement the Alexandrine, Saint Basil the Great and Saint Gregory of Nyssa.

Keywords: prophecy, prediction, transcending order, revelation

1. Introduction

The periodic system of elements is in the very heart of the Philosophy of Chemistry, which, among other things, tries to clarify the picture concerning the nature of this science. It is probably the most powerful and informative icon of Chemistry, because it seems to contain the entire subject on a single graphic representation and none of those who have studied it remained unimpressed by its beauty and simplicity [1]. Remarkably, the periodic table is important both for its historic roots and for its modern relevance.

It is a fact known for long time that the periodic system cannot be included in the traditional categories with which are used to work the science philosophers. He is not a theory, or a model, not even a law of the nature. Despite all these, the periodic system is able to rationalise vast quantities of information and with its aid successful predictions can be made.

Before the recent development of the Philosophy of Chemistry, the science philosophers have not paid to much attention to the periodic system, as they neglected in fact the entire Chemistry. The philosophical part of Mendeleev's work was neglected and there is much to do in this direction, especially on the question, how he regarded the fundamental nature of elements [2, 3].

* e-mail: rusu_iulian@hotmail.com

On the other hand, although the Philosophy has scarcely touched this sensitive and fundamental aspect of all Chemistry, and more specific of the Inorganic Chemistry, in the developing field of Science & Theology, according to our knowledge, there are no or few works dealing with this aspect [4, 5]. In this context, the present paper tries to bring a modest contribution to the researches in the domain.

2. Historical background

The crucial characteristic of the periodic system was that it illustrated ***a periodicity in the properties of the elements at certain regular intervals***. In an early attempt to organize the elements into a meaningful array, German chemist Johann Döbereiner pointed out in 1817 that many of the known elements could be arranged by their similarities into groups of three, which he called triads. Döbereiner's work encouraged others to search for correlations between the chemical properties of the elements and their atomic weights. One of those who pursued the triad approach further during the 19th century was Peter Kremers of Cologne, who suggested that certain elements could belong to two triads placed perpendicularly. Kremers brought thus a feature that later proved to be an essential aspect of Mendeleev's system.

In 1862, the French geologist Alexandre-Emile Béguyer de Chancourtois has developed a system relied on a fairly intricate geometric configuration: de Chancourtois positioned the elements according to increasing atomic weight along a spiral inscribed on the surface of a cylinder and inclined at 45 degrees from the base. Yet for a number of reasons, de Chancourtois's system did not have much effect on scientists of the time: his original article failed to include a diagram of the table, the system was rather complicated, and the chemical similarities among elements were not displayed very convincingly.

English chemist John Newlands suggested in 1864 that when the elements were arranged in order of atomic weight, any one of the elements showed properties similar to those of the elements eight places ahead and eight places behind in the list — a feature that Newlands called 'the law of octaves'. Some investigators openly ridiculed Newlands's ideas. At a meeting of the Chemical Society in London in 1866, George Carey Foster of University College London asked Newlands whether he had considered ordering the elements alphabetically, because any kind of arrangement would present occasional coincidences. As a result of the meeting, the Chemical Society refused to publish Newlands's paper!

William Odling, successor to Michael Farady at the Royal Institution in London, was another chemist to deal with the relationship among the elements and published a paper in the first volume of the Quarterly Journal of Science (1864) [6]. His arrangement of the elements came surprisingly close to that of Mendeleev's first attempt and he left gaps where there were missing elements.

Chemist Julius Lothar Meyer of Breslau University in Germany, while in the process of revising his chemistry textbook in 1868, produced a periodic table that turned out to be remarkably similar to Mendeleev's famous 1869 version — although Lothar Meyer failed to classify all the elements correctly. But the table did not appear in print until 1870 because of a colleague or a publisher's delay and at that time Mendeleev's definitive paper had appeared.

Around the same time, Mendeleev assembled his own periodic table while he, too, was writing a textbook of chemistry. Unlike his predecessors, Mendeleev had sufficient confidence in his periodic table to use it to predict several new elements and the properties of their compounds. He also corrected the atomic weights of some already known elements.

3. Actual trends

For as long as people have wondered about the nature of Science there has been considerable disagreement over the relative merits of predictions made by theories. Several articles have appeared inn an attempt to clarify this issue, and many of them concerned the periodic system of the elements [7, 8]. At present, the commonly held view is that ***successful predictions should be the chief criterion in the acceptance of a new scientific development***. On the other hand, it has become a common place in Philosophy of Science to emphasize that attention has largely shifted from theories to models or from a syntactic to a semantic analysis [1]. It seems that the periodic table is able to fulfill both these trends of our days' science.

The power of the modern table lies in its two- or even three-dimensional display of all the known elements (and even the ones yet to be discovered) in a logical system of precisely ordered rows and columns. The three-dimensional periodic tables display the fundamental symmetry of the periodic law, unlike the common two-dimensional form of the table in common use, being able to show also secondary relations in chemical properties (Figure 1) [9]. Another trend has been the invention of periodic systems aimed at summarizing the properties of compounds rather than elements [10-12].

Starting from similar considerations, Russian scientists have developed performing predicting expert systems based on Mendeleev's law, which asserts that the periodic nature of changes in the properties of chemical systems depends on the nature and properties of the elements that make the systems [13]. Therefore, all fundamental properties of the chemical elements (e.g. electron distribution over the energy shells, ionisation potentials, atomic, ionic and covalent radii, melting points, standard entropies of individual substances, etc.) are essential for the prediction process. Using these concepts, the following problems were successfully solved:

(i) Prediction of compound formation or non-formation for ternary systems;
(ii) Predictions of the possibility of forming ternary and more complicated compounds of desired composition;
(iii) Prediction of phases with definite crystal structure;
(iv) Estimation of phase quantitative properties (T_c for high temperature superconductors, homogeneity region, etc.).

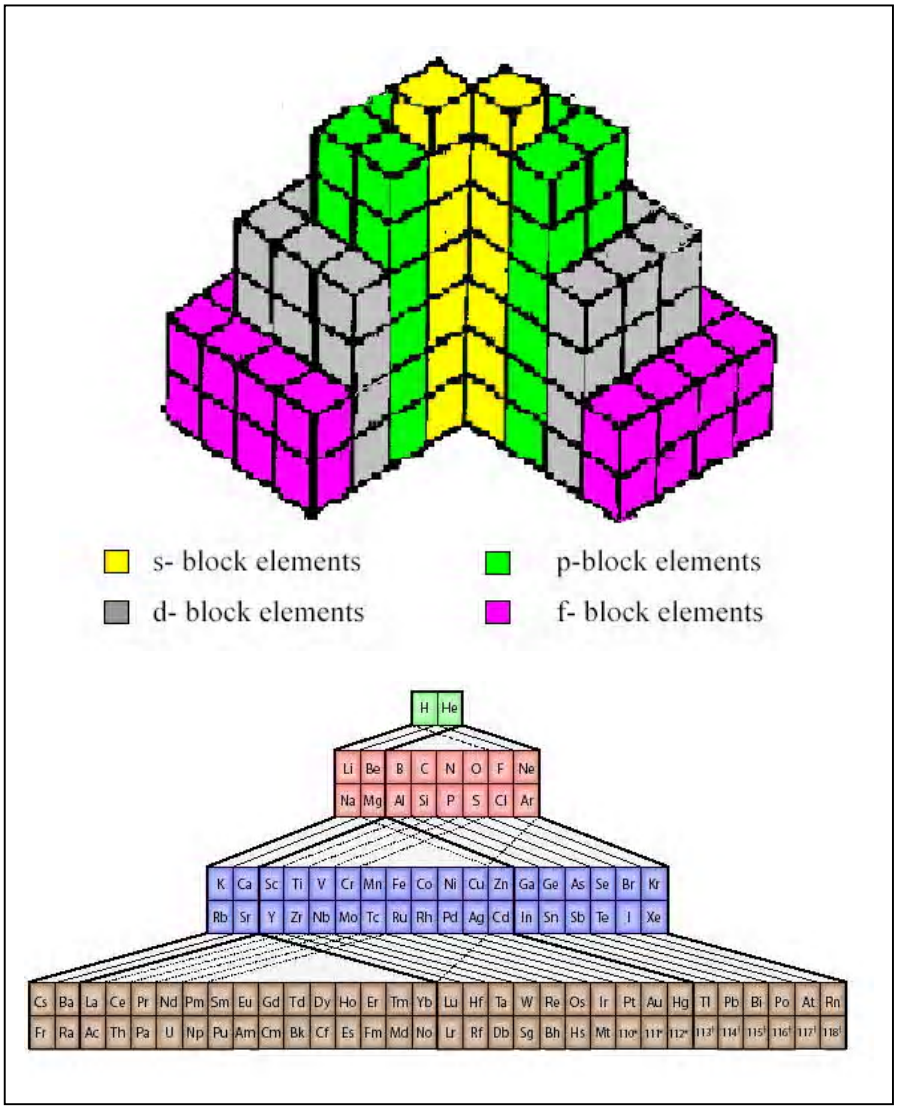

Figure 1. Different forms of three-dimensional periodic tables.

It is highly remarkable that the comparison of these predictions with the experimental data, obtained later, showed that the average reliability of predicted ternary compounds exceeds 90%.

4. Philosophical and theological implications

The recent systematic analyses of the periodic table, the results obtained by means of expert systems, based on Mendeleev's law, for the design of new materials and also our studies on new border compounds revealed the existence of a predefined order, of a fundamental matrix that frames the new synthesised chemical systems. Despite the fact that we don't know always the relations existing in the triad composition, structure, properties, none can deny, from the data that we got up to the moment, the presence of this order, which is transcending even the periodic system.

Even the manner in which Mendeleev has succeeded to order the elements in the table confirms this idea. He wrote the name of each element on individual pieces of card, together with its atomic weight, a few physical properties and the formulae of any hydrides and oxides it formed. He has made several attempts to order the cards in different ways but without success. Despite that Mendeleev tried to transform the problem into an intelligent puzzle game solution, it turned to him to be more a playing card game subjected to the chance. Being very tired he went to sleep and the periodic table came to him in dream. When he woke up, he made the arrangements accordingly with only minor changes, the result being the periodic system that we know today.

Let's see now how we can analyse the above conclusions from the Orthodox theological perspective. Obviously, in this context, most of quotations concern God's Creation. Among the patristic writings, we will deal with those of Clement the Alexandrine, Saint Basil the Great and Saint Gregory of Nyssa.

Clement the Alexandrine pays special attention to the role of the divine Logos in the act of Creation, because according to the Scripture: "Through Him all things were made; without Him nothing was made that has been made." (John 1.3) Thus, "… [God] had to name first whatever would have to be created. That's why, ***the first ones were prophesied***, from which were made the second ones, from a single substance, by a single power." [14] We do agree that the above quotation has a deeper meaning but one can consider in our context that the first ones are the chemical elements and the second ones are the chemical compounds. If true, the elements being prophesied do belong to a plan having its own order and rationality. On the other hand, one must take into account that the prediction is for Science what a prophecy is for Theology, and as told before the main characteristic of the periodic table have regarded and still regards the possibility of making predictions on new elements and compounds.

Saint Basil sees in the dynamic of existence, who's absolute origin is the will of God, a plan, an intelligent project discovered by the rational beings by the cognitive and spiritual act. The genius of Saint Basil the Great anticipates in fact the assertions of modern science that sees in the world not the unconscious and implicit hazard of an implacable necessity, but an aim, a transcendent finality of the Universe. The finality is no longer a philosophic dream but a scientific conclusion. Saint Basil perceives the Creation from a Trinitarian prospective, evidencing the role of the Holy Ghost in it. The material elements are not, in Creation, only something inert subjected to the divine work but manifest by their own origin an attraction toward the concrete forms wanted by God [15]. Without the will and the power of God would not appear a new order in existence, into conformity with all the others. An act of God puts into the anterior ones something that develops in new orders of existence [16-18]. Nevertheless, in a certain sense, all the posterior ones ***were predicted*** in whatever was created at the beginning.

The concept of creation is for Saint Gregory of Nyssa the Church's dogma articulated to Revelation and the term 'creation' defines a divine and wonderful act described by man's enquiring rationality in the objective interpretation of reality by means of composing elements that give the specific beauty of God's world [15, p. 65]. Saint Gregory states "that even from the beginning all existed due to God's work developed into order and wisdom, everything arranged at the right place according to the intransient power of God" [19]. And furthermore, speaking about the constitutive elements of creation, he says that "everything was still in darkness, because it wasn't shown yet the brightness of fire, which was hidden under the particles of matter. Because, as ***the mosaic stones*** do not shine when are hidden in darkness, despite they have the shining power, having the natural gift to shine, in turn when they appear together seem to produce fire, this is how the sparks come out of them and just then is seen their true shining". [19, p. 99] Apart of the beauty of this writing, we cannot ignore in the above quotations the similitude with the elements of the periodic system, which truly are like the stones of a mosaic arranged at the right place according to a well predefined plan of God.

Obviously, the idea of revelation, of passing from darkness to light, from ignorance to knowledge is also present. Being even more specific to the manner in which the immaterial God could be the origin of matter or how the unique and invisible Being could be the unique cause of the sensitive, visible and measurable matter's diversity, Saint Gregory claims that by thinking and contemplation the man reason perceives and understands the harmonious unity of the entire existence both in its ensemble and in its component parts.

5. Conclusions

Recent systematic analyses of the periodic table, the results obtained by means of expert systems, based on Mendeleev's law, for the design of new materials revealed the existence of a predefined order, of a fundamental matrix that frames the new synthesised chemical systems. Despite the fact that we don't know always the relations existing in the triad composition, structure, properties, none can deny, from the data that we got up to the moment, the presence of this order, which is transcending even the periodic system.

All these data are congruent with the patristic writings of Clement the Alexandrine, Saint Basil the Great and Saint Gregory of Nyssa. However, other patristic writings, as those of Saint Maxim the Confessor, and scientific data must also be further analysed in order to go thoroughly into the connexions that exist between this fundamental aspect of the Chemistry, as science, and Theology.

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