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THE ORIGIN AND EVOLUTION OF CHEMICAL ELEMENTS

The Big Bang was started by the evolution of elementary particles 10-15 billion years ago. It is a rapid expansion of (10^{-4} c) ultra-dense (1080 g/cm^3) and superhot (10^{27} K) points of the Universe size (10^{-33} cm). As a result, it was the formation of elementary particles. It is approximately known as 300 quarks, photons, neutrinos, electrons, positrons, protons, neutrons etc. in the universe. The whole Universe is viewed and formed as the only act. Nowadays it is still extended to different spheres. It is accompanied of matter cooling and radiations. This distribution indicates the shift of spectral lines remoted galaxies in the red part of the spectrum (“red shift”).

The evolution of chemical elements started after the coupling temperature cooling. It is connected with the protons and the neutrons and also with the formation of heavier isotopes of Hydrogen and Helium. Thermonuclear reactions of chemical elements formation from elementary particles (protons) are occurred at high temperatures and pressure. It determines the collision of the same name (positively) charged particles that are repelled. This “hydrogen burning” happens constantly in the Sun and provides energy to the biosphere for the thermodynamic support of homeostasis of life. So, the material source for the construction of all elements was Hydrogen. It formed the first stars [1].

There are a lot of kinds of stars such as blue, yellow, red giants, white midget, neutron stars and black holes. Protons merge in the blue stars due to the tremendous temperature. During the time that lasts billions years, Hydrogen is completely converted into Helium and meanwhile the star is compressed. Temperature and pressure are risen in this column to several billion degrees. Under these conditions, Helium-4 nucleuses are merged and then they form the nucleuses of heavier elements.

Theoretically, somewhere after Iron enlargement of the nucleus, the formation of heavier elements is occurred as the result of the first capture of neutrons followed by beta decay of the formed nuclides. Meanwhile, the shell of the giant star is slowly “wasting away” and dims while its nucleus shrinks and the temperature rises to ten or more billion degrees. The existence of such a luminary

is coming to an end and it takes ten or even hundred thousand years. The synthesis of heavier elements in the “nuclear forge” increases up to the formation of nucleus of Californium. The temperature in the nucleus of the “old” star suddenly increases to 20 billion degrees and it explodes. Its flash is brighter than the radiance of all the stars in the Galaxy. In astronomy, the star like this is called Supernova. Its explosion is so enormous that the shell of the star shatters into smaller particles. They are protons and electrons which again form Hydrogen atoms. So, the star cycle of “revolutionary” light starts and ends with “the universal firstborn” and is called Hydrogen.

In addition, as a result of this cosmic explosion, the nucleus and consequently atoms of heavier elements (He, C, N, O, F, Mg, Al, Si, P, S, K, Ca, Ti, Fe and others) are formed. And then the stars and planets form the clouds of these elements [2]. Carl Sagan said: “The Cosmos is within us, we are made of matter, we are the way in which Cosmos knows itself”. Silicium is in the rocks, Oxygen is in the air, Carbon is in our DNA, Iron is in our skyscrapers, Silver is in the jewelry. All elements were originated in the stars billion years ago. Our planet, our civilization and we are Stardust.

LITERATURE

1. Рудишин С. Д. Основи біогеохімії [Текст] : навч. посіб. для студентів вищ. навч. закл. / С. Д. Рудишин. - Київ : Академія, 2013. – С.29-32.

2. Максимов І. Поширеність хімічних елементів на Землі та у Всесвіті / І.Максимов // Хімія. Шкільний світ : газ. для вчителів хімії. – 2010. - N 29. – 8 с.