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CHILD OR ADULT? INFLUENCE OF SCIENCE ON INTERPRETATION OF SURROUNDING AS A MENTAL EVOLUTION OF PHYSICIST

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Abstract

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When a small child starts to explore the world, he or she learns to distinguish different shapes, flavors, smells and colors. The child moves his or her hand back when touching something hot or feels pain when hitting him- or herself against a hard object. While learning, we experience 'subsequent childhoods'. Once more we find out the existence of things we have already taken for granted, and with the growth of our 'physical know-how' we may repeatedly learn about a particular object, looking at it from the perspective of our knowledge.

We teach ourselves our first physics lessons. At the beginning, when we have already mastered 'the art of looking and touching' , we set out on our scientific hunting. During our exploration of the surrounding world we find out that an apple looks different than a chair. They differ e.g. in color and shape. A child is capable of distinguishing colors and tries to name them (according to his or her parents' prompts). A small child knows that an apple can hit him in the head with no consequences, but an unpleasant encounter with a chair may end in tears; the child will then say that the apple is soft and the chair is hard.

The "next" childhood is when the child goes to school. There, a student will hear that each object is made up of atoms. The child is happy to know what the apple really is, and having in mind those little balls that form the fruit he or she comes home. This level of intellectual evolution was first reached by Democritus of Abdera at the turn of the 5th and 4th century B.C. He divided the surrounding world into existence and nonexistence, where the existence is filled with atoms (from Greek atomos- indivisible), and the nonexistence is the empty space around the atoms.

The physicist delves deep into the world of optics, learns about light rays and finds out that white light is formed by all other light rays. He gets to know that some rays of light are reflected from an apple peel and some from the surface of a chair, and that is why we perceive them in different ways. The area of detailed optics, where colors may mix together and split, was also explored by Newton. He was the first to diffract white light into its component colors with the use of glass prism. He also succeeded in 'putting the rays together' again thus obtaining white light.

For some time our little hero is satisfied and proud of his knowledge. However, another question hits the young mind soon: if an

apple and a chair are composed of atoms, why is it safe to be hit in the head with an apple and not so safe to be hit with a chair? When our physicist asks him- or herself the question, he or she is in the middle of experiencing yet another childhood , which will probably take place in junior high school. The student then discovers that not all atoms are equal, that different objects are composed of different atoms which, depending on their structure and 'congestion' in objects, determine their hardness and density. Atoms differ in the number of protons and neutrons placed in an incredibly small nucleus which is orbited by even smaller electrons. The remaining part of this tiny atom is empty. At that moment the image of an apple filled with small balls collapses, but a new, better one is created- that of an apple composed of a giant bundle of ball sets. Such a high level of evolution can't have been reached by one person only, without the help of others. Through various conceptions, from a raisin cake by Thomas, through a planetary model by Rutherford, it was Niels Bohr who was the father of the most viable version. He explained that almost the whole mass of an object is clustered in its nucleus, where the electrons revolve around it in various, specified orbits.

Thus, for a period of time the little man stays at his stage of childhood. However, nothing lasts forever.

Soon, there appear some inaccuracies, and the child starts to ask questions. If an apple in its greater part is made up of nothing, how is it possible that we can see it? In the past, on the basis of what was taught at school the child imagined the light rays reflected by the small balls which get to human eyes. What is the answer now? What really reflects the rays? Is it the nucleus? Is it the electrons? Or maybe the emptiness? Why are they red? What are these rays, anyway??!!

It is then, that an insatiable hunger for knowledge appears. The influx of new information constantly redefines our concept of an apple. It is the new sophisticated concept "the corpuscular-wave light dualism" which alters our little hero's view on looking. Electromagnetic waves and photons occupy the physicist's mind, who is inquisitive enough to reach the next level of evolution. He or she finds out that light rays differ not only in wavelength and frequency, but also in energy quanta carried by photons. Curious to discover where light comes from, he or she learns about energy states in atoms, the pho-

toelectric phenomenon and the Compton effect. The young scientist finds out how atoms absorb light. This level of knowledge was jointly reached by some excellent minds. Compton, in his experiment where he dispersed electromagnetic waves (X-rays), highlighted this problem, and Bohr with Max Planck and Einstein solved the puzzle by explaining that in some situations light is a wave (e.g. interference), and in other situations it is corpuscular substance (a photoelectric phenomenon).

Further scientific readings introduce a new concept: matter waves. The child is astonished to discover the material-wave form of small objects, e.g. electrons. Disappointed, he or she realizes that electrons are invisible, and we can only guess what the probability of their occurrence in particular places is. There appears a new concept in the scientist's mind, and the original version of the phenomena is shattered. However, how can we imagine corpuscular-wave electron (whose wave, in addition, is three-dimensional) revolving round the nucleus? The concept that objects, so far considered only material, can have the nature of waves was first introduced by Louis de Broglie. For macroscopic objects (e.g. humans) waves are invisible because they are very short- and that is good for us because it would not be nice to interfere with our neighbors or to get our waves refracted. The inability to measure at the same moment the momentum and the position of e.g. an electron was explained by Werner Heisenberg, who announced his Uncertainty Principle. Examining the velocity of a particle we submit it to the influence of e.g. light and thus its position may alter.

However, it is not the end of the road yet. Our hero gets to know that elementary particles are not so elementary as he or she has expected. The revelation is that neutron and proton are also made up of something And the search for knowledge begins anew. Readings and some consultation bring ..new information. The physicist tries now to imagine the tiny quarks forming the tiny protons and neutrons. He or she imagines their shape and flavor, as the scientist discovers that quarks have various flavors. The child is able to distinguish six of them: up, down, charm, strange, top and bottom. That is not all however, because quarks also have different colors: red, green or blue. The young scientist discovers that a neutron and a proton are always made up of three quarks always in the three different col-

ors. The existence of quarks (the up, the down and the strange one) was first suggested by Murray Gell-Mann and George Zweig. Soon after that the electric charge of each of the flavors was measured: up+2/3e, down-1/3e, charm+2/3e, strange-1/3e, top+2/3e, bottom-1/3e. That is not all yet. According to the theory of supersymmetry, each quark must have its squark, which is its symmetrical particle.

There is a lot of knowledge to acquire. Is that all? There is no end in sight The only dream of our hero now is to see everything annihilated, to have his or her mind particles crashed against their antiparticles, electrons against their positrons, protons against their antiprotons, color quarks against their anticolor equivalents! Fortunately, a few days of rest can help regain energy and refresh the mind, and knowledge then no longer seems so terrifying.

At this very moment, the scientist can see a small, red apple, which can hit him or her in the head. And the little physicist realizes that he or she has not grown up yet and is proud of that.

Science will keep its progress if there are people who will always be children to some extent; children who are interested in the world, open to new concepts and different ways of interpreting the world and its bewildering phenomena.

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