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EDITORIAL

Albert Einstein: knowledge and belief

In a world, which knows a continuous and rash development, without precedent in whole history, is more as always necessary the founding of connection between the science–technologies as generator of economic resources, on a hand, and religion as moral force generator, on other hand. Some biggest thinkers saw the religion as being the moral support of all human activity. One of them, promoter of a revolution in basic sciences of XX century is Albert Einstein.

Albert Einstein was born in Ulm, Germany on March 14, 1879, and lived the first fifteen years in Ulm, where the family had a small business. Little Albert was a very good student in mathematics and Latin, two disciplines that spook him through intrinsic logic. He completed secondary school in Aarau and graduated in 1900 as a secondary school teacher of mathematics and physics to the Swiss Federal Institute of Technology. Between 1902 and 1909 he was working at the Swiss patent office in Bern and, in the same time, published some of his most important works in the field of theoretical physics.

His first paper was dedicated to the newest Plank's discovery, the light-quanta, whose energy was proportional to the frequency of the radiation ($E = h\nu$), in contradiction to the classical electromagnetic theory: 'On a heuristic viewpoint concerning the production and transformation of light' (light quantum/photoelectric effect paper) (17 March 1905) [1]. Einstein supposed that the light can be imagined as formed by discrete bundles of radiation and used this interpretation to explain the photoelectric effect. Today we can assert positively that it was one of the basic concepts of the quantum mechanics.

In the same year, 1905, he observed that the behaviour of the electron, as particle, can be extended to any non-accelerated particle or macroscopic body and formulated his special theory of relativity: 'On the electrodynamics of moving bodies' (special relativity) (June 1905; received 30 June 1905) [2]. He constructed this new kinematics on two principles: (1) the laws of physics had to have the same form in any frame of reference and (2) the speed of light remained constant in all systems of reference. In the frames of the new theory the assumption of a luminiferous ether plays no more any role. As a direct result Einstein recovered the time dependence, analogous to length and mass, of the reference frame velocity. In this way he successfully unified classical mechanics and the Maxwellian electrodynamics.

In the fall of 1905 he submits his paper 'Does the inertia of a body depend on its energy content?', where he formulated the famous relation between mass and energy ($E = mc^2$), to the same leading German physics journal (September 1905; received 27 September 1905) [3]. As a consequence of mass-energy

equivalence principle, he supposed the existence of an interaction between a gravitational mass and the equivalent mass of the electromagnetic radiation and predicted how it will be attracted by the Sun a ray emitted from a star. Later he was able to predict how much can be bent a ray from a distant star in the direction of the Sun and to explain the small, but persistent anomaly in the perihelion motion of the Mercury.

One of the most important scientific works of Einstein concerns the extension of the Boltzmann-Gibbs statistical mechanics, by elaborating the average trajectory of a microscopic particle in collision with molecules in a fluid or gas. These results were also discovered and/or handled independently by Marian von Smoluchowski and Jean Perrin [4, 5], but his work provided for the first time a very convincing, although indirect, evidence for the existence of atoms and molecules. In fact, Einstein obtained his PhD degree at the University of Zürich, in July 1905, with the doctoral dissertation: 'A New Determination of Molecular Dimensions' [6], which is one of his most quoted papers [7], and a lecturer position at the University of Bern with the article: 'On the motion of small particles suspended in liquids at rest required by the molecular-kinetic theory of heat' (Brownian motion paper) (May 1905; received 11 May 1905) [8].

From 1909 he is associate professor of physics at the University of Zürich, full professorship at the German University in Prague (1911), professor of theoretical physics at the University of Berlin (1914) and founding director at the Kaiser-Wilhelm Gesellschaft (1917). At this time he was considered as one of the leading scientific thinker throughout Central Europe.

Einstein applied the laws of gravity to his Special Theory of Relativity beginning with 1907 and published 'Die Grundlage der allgemeine Relativitätstheorie' in 1916 [9]. Few years later his ideas, concerning the General Theory of Relativity, were confirmed by the results obtained from the observations made by a British expedition during the solar eclipse, in 29 May 1919.

At the beginning of 20th century, physics was renewed by two great theories: 'General Theory of Relativity', due to Einstein, and 'Quantum Theory', founded by Max Plank and Niels Bohr. The first concerns the universe, the second, the interaction between the energy and matter at atomic level. While Einstein considered that Quantum Theory could describe only the interaction at atomic level, Bohr agreed that the quantum predictions, based on probability, accurately describe reality. Bohr argued that the mere act of indirectly observation of the atomic universe changes the results of the quantum interactions. This debate continued at the prestigious 1927 Solvay Conference, and culminated with the Einstein's paper: 'Can Quantum-Mechanical description of Physical Reality Considered Complete?' [10] and Bohr's reply: 'Can Quantum-Mechanical description of Physical Reality Considered Complete' [11].

Einstein agreed only partially with the methods and results of the Quantum Theory, but he never accepted that physical world could be described by the statistical basis. He expressed his discomfort in his celebrated saying: "God does not play dice" [12].

Consequently, Einstein began to formulate an even more ambitious theory, which should describe all physical phenomena in the known universe: 'Grand Unified Theory'. He never succeeded, but his works remai n, fifty years after his death, a source of inspiration for many researches, concerning the evolution of the universe or modern physics and technology, in an attempt to understand the links between the matter, energy, space and time.

However, Einstein (as discoverer of the photoelectric effect), Born and Plank are considered the founding fathers of Quantum Theory.

Unfortunately his revolutionary concepts concerning the relativity of the time and space were not correctly understood in the epoch, and not only, and he received the Nobel Prize for Physics in 1921, for his fundamental works in 'the theoretical physics, specially in the field of photoelectric effect' (1922) [1].

After returning in Germany (1914, Berlin) he did not reapplied for the German citizenship and adopted a pacifist and Zionist attitude. Its behaviour pitted him against conservatives, which launched savage attacks against him in the 1920s.

In 1933 Einstein moved, together with second wife, Elsa, to the United State and received a position at the Institute for Advanced Study, in Princeton. Together his co-workers, Infeld and Hoffmann, he (was 59) achieved new major results in the general theory of the relativity. Here he was continuing to work to his idea of a unified field theory, whereby the laws of gravitation and electromagnetism could be derived from one set of equations. But the scientific world changed its aims for more than half century and theoretical physicists focused more attention on the theory of quantum mechanics, which was elaborated by Max Plank, Niels Bohr, Werner Heisenberg, Paul Dirac, etc. Recently it takes place a returning to the Einstein's ideas; physicists are trying now again to use the results of relativity theory in a 'theory of everything'.

Einstein was sure that science, mathematics and technology, on a hand, and philosophy, ethics, spirituality and the arts, on other hand, were "different branches of the same tree". He considered that "both churches and universities serve the ennoblement of the individual" and "they seek to fulfil this great task by spreading moral and cultural understanding, renouncing the use of brute force". In this concern he saw the laws of science and ethics as being the same, considering that the lie destroys mutual confidence and making impossible or very difficult the social cooperation. "Thou shall not lie" is equivalent, in Einstein's opinion, with "Human life shall be preserved" or "Pain and sorrow shall be lessened as much as possible".

Concerning the religious sense, he also wrote in 'The Religiousness of Science' that "the religious feeling (of the scientist) takes the form of a rapturous amazement at the harmony of natural law, which reveals an intelligence of such superiority that compared with it, all the systemic thinking and acting of the human being is an utterly insignificant reflection" [13].

He was born Jew, but his family was not particularly observant, and his parents sent Albert to a Catholic public primary school at the age of six. As a child he strongly believed in the traditional Judaism, based on the precepts of Old Testament, but very soon he began questioning on the veracity of the Bible. It could be the first sign of Einstein's genuine freedom of thought and intellectual independence as scientist, the first sign of defiance of authority, which will remain a characteristic of his thinking and personality.

His spiritual tutor was Spinoza (the 17th century Dutch Jewish philosopher), which believed in a Universe strictly governed by the immutable laws between cause and effect. He saw God as devoid of ethical properties and therefore does not reward or punish human behaviour. Einstein and his friends from Olympia Academy in Bern shared with Spinoza the love of solitude and the experience of having rejected the Jewish religious tradition.

He observed at end of 30s that objective knowledge constitutes a method for the achievements of certain end, but the ultimate aim must come from another source. On other hand, years earlier he said that the results of scientific research is determined by the natural laws, that "events could not be influenced by a prayer, i.e. by a wish addressed to a Supernatural Being" [14]. He refused a God that rewards or punishes the human beings.

Nevertheless he declared that "never have I believed in a personal God and I have never denied this, but have expressed this clearly. If something is in me which can be called religious then it is the unbounded admiration for the structure of the world so far as our science can reveal it" [14]. He denied to admittance a punitive God or an individual that survives his physical death and declared himself satisfied with "the mystery of the eternity of life" [15].

Despite these declarations, he was not an atheist and this is confirmed by the next sentence, very often attributed to Einstein: "Science without religion is lame, religion without science is blind". Though he denied any sort of personal God, he shared Spinoza's faith in a superior intelligence that reveals itself in the beauty of nature.

Einstein was every time respectful concerning truth and justice and claimed that Jews have been united by the trust in truth, a democratic ideal of social justice and personal freedom. In Einstein's view, rather a cultural and intellectual, as a political point of view, the creation of a Jewish state should preserve these values for the world. The Israel must serve as a region sheltered from Europe's anti-Semitism of the epoch, able to constitute a centre of intellectual and spiritual life for the Jews.

He died on April 18, 1955 in Princeton Hospital with 'elegancy', as he wished. In agreement with his last desires, he was cremated and ashes scattered at an unknown location. He left it up to future generations to solve the lingering questions raised by his theories, many of which were years ahead of their time.

We are leaving in a world which moves with an increasing speed, the real reasons for the changes being less political or economic and more technological. But the technologies are provided directly from advances in basic and applied science and for the XX century the promoter of this revolution in science and technology has no better representative as Albert Einstein.

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