

Albert Einstein

BIOGRAPHICAL OVERVIEW

Albert Einstein, the most influential physicist of twentieth century and “Person of the Century” according to *Time* magazine, was born on 14 March, 1879, in Ulm, a city in the South of Germany. His parents, Hermann Einstein and Pauline Koch, were not observant Jews. In the year following his birth, Einstein’s family moved to Munich, where the young Albert attended the public elementary school and the Luitpold Gymnasium. In 1894 his parents moved to Italy in Milan and Pavia with their daughter, Maja (born in 1881), while Albert stayed in Munich to continue his studies. He was so upset by the loneliness that in the following year, he abandoned the gymnasium without graduating to rejoin the family. After a failing to be admitted to the Eidgenössische Technische Hochschule (ETH; Federal Institute of Technology) in Zürich, he finished secondary school in Aarau in 1896. On his second attempt at admission, Einstein entered the ETH and graduated in 1900. The following year he became Swiss citizen (he had renounced German citizenship in 1896 and for five years had been stateless).

The year 1902 was a critical one for Einstein: In January he had a child with Mileva Marić (they married in 1903); in June he began working at the Federal Office for Intellectual Property in Bern, having failed to gain a professorship in ETH; in October his father died in bankrupt in Milan. The work at the Federal Office for Intellectual Property did not engage him fully, and during his spare time Einstein wrote several papers on theoretical physics, which he submitted to the renowned journal *Annalen der Physik*. The five papers contributed in 1905 are so important in the history of physics that 1905 is called Einstein’s *annus mirabilis* (miracle year). These articles dealt with the determination of molecular dimensions, Brownian motion, the hypothesis of light quanta, the special theory of relativity, and the energy-mass equivalence.

Only in 1908 did the academic establishment begin to recognize Einstein's scientific competence. In that year he was appointed Privatdozent at the University of Bern; in 1909, associate professor at the University of Zurich; in 1911, full professor at the University of Prague; in 1912, professor at the ETH. After his return in Germany in 1914, he taught at the University of Berlin. In 1919 he became world-famous because his prediction of the bending of light in a gravitational field—a consequence of the general theory of relativity—was confirmed by observation of the apparent position of stars during a solar eclipse. In that year Einstein divorced Mileva Marić (they had three children) and married his cousin Elsa Löwenthal.

In 1922 Einstein was awarded the Nobel Prize “for his services to Theoretical Physics, and especially for his discovery of the law of the photoelectric effect”. Einstein's Nobel lecture was dedicated to relativity theory, although the Nobel Prize did not mention relativity theory, only his discoveries in quantum physics. In 1933, when Hitler became chancellor of Germany, Einstein was a visiting professor in the United States; he did not return to Germany and, after a brief stay in Belgium and England, accepted a professorship at the Institute for Advanced Study in Princeton, New Jersey, where he remained until his death. In 1940 he became an American citizen (he also preserved the Swiss citizenship). In 1952 he declined the offering of the Presidency of the State of Israel. Einstein died on 17 April, 1955, of an aortic aneurysm.

SCIENTIFIC CONTRIBUTIONS

The list of Einstein's scientific contributions is astonishing. The theory of relativity has utterly changed our conception of space and time, not only from a scientific point of view, but also from a philosophical viewpoint. Among the many consequences of relativity theory are energy-mass equivalence, the retardation of moving clocks, the deflection of light by gravity, the explanation of the anomalous precession of the perihelion of Mercury, and the effect of gravitational lens. Einstein utilized the equations for the gravitational field to build a model of a finite but unlimited static universe characterized by the repulsive force that finds expression in the so-called cosmological constant and thus initiated the field of contemporary cosmology. He contributed greatly to the

development of quantum physics, working on the determination of molecular dimensions, Brownian motion, the photoelectric effect, the stimulated emission of light, the wave-particle duality of light, and the Bose-Einstein statistics.

Einstein's notoriety moved many people to attack relativity theory, which became the preferred target of several philosophers, amateurs, and professional scientists. The attacks intensified with the advent of Nazism, when the German physicists affiliated to the Deutsche Physik movement denied the validity of relativity theory. Einstein is attacked even today, though for different reasons: Accusations of plagiarism are not unusual, and his theories are ascribed to other persons, such as Henri Poincaré, Hendrik Lorentz, David Hilbert, and Einstein's first wife, Mileva Marić. The source of many of these attacks is personal aversion, to which sometimes is added a prejudice against Einstein's Jewish origins.

Einstein fought a long, solitary battle against the most common interpretation of quantum mechanics, which regards the goal of describing the world of microphysics by means of exact causal laws as an impossible task. Einstein was a firm supporter of the necessity of employing deterministic laws in every field of physics. In his opinion, the probabilistic nature of the quantum mechanical description of microphysics was due to the inherent incompleteness of quantum mechanics. He designated a thought experiment, now called EPR (from Einstein, Podolsky, and Rosen, the three authors of the paper in which it is described), to prove this incompleteness. Years later EPR has become one of the most dramatic examples of the deep complexity of quantum theories and can be regarded as the first proof of the nonlocal character of quantum mechanics.

SCIENCE AND RELIGION

Einstein's thoughts about religion and its relationship with science are expressed in several short papers, written for different occasions and partially collected in *Out of My Later Years* and in *Mein Weltbild* (an English translation, with addenda and revisions, was divided into two books, *The World As I See It* and *Ideas and Opinions*). Especially interesting are the three papers "Religion and Science", published in *The New York Times* in 1930; "Science and Religion", which consists of two

parts, the first one being the text of a discourse that Einstein gave at Princeton Theological Seminary in 1939, and the second being a contribution to a symposium about science, philosophy and religion in 1941; and “Religion and Science: Irreconcilable?” published in *The Christian Register* in 1948. In these papers, whose main subject is the relationship between science and religion, Einstein denied the existence of an insurmountable antagonism between science and religion and claimed that their conflict is more apparent than substantial. Another interesting source is the 1931 article “The World As I See It”, in which Einstein stated his disbelief in a personal God and the immortality of soul and explained that he could be considered “a deeply religious man” (*Ideas and Opinions*, 12) only because true religiosity is “the knowledge of the existence of something we cannot penetrate” (11–12) and is the emotion raising from the experience of mystery, an emotion that “stands at the cradle of true art and true science” (11). According to this particular sense of the term *religious*, doing science is a deeply religious activity. Hence we can understand why Einstein said that “serious scientific workers are the only profoundly religious people” (43) and why, in the short 1934 paper “The Religious Spirit of Science”, he wrote that the religious feeling of scientists derives from the “amazement at the harmony of natural law” (43), which reveals a superior intelligence. This intelligence, however, acts only by means of strictly deterministic causal laws, which prohibit the interference of supernatural forces. There is no room for God’s miracles, and thus there is no room for a personal God, who punishes and rewards his creatures; moreover, there is no use for a class of priests acting as intermediaries between God and people.

What is the method of science? The letter that Einstein wrote to Maurice Solovine on 7 May, 1952, contains the best description, in my opinion, of Einstein’s conception of scientific method. In this letter, in four concise and clear paragraphs, Einstein explains the interaction between experience and theory. First, there are the experiences. Second, there are the axioms of the scientific theory; there is no logical law that permits one to deduce the axioms from the experiences—at most, there is a psychological connection. Third, from the axioms we can deduce particular statements.

Fourth, we control these particular statements by confronting them with the experiences. The most important point is that there is no logical connection between the experiences and the concepts occurring in the axioms and in the particular statements. Einstein had already expressed this conception in a 1936 paper about physics and reality (“Physik und Realität”, reprinted in *Out of My Later Years* and in *Ideas and Opinions*), where he said that the concepts are not identical with the totality of sense impressions, but are arbitrary creations of the human mind, logically independent from sense experiences. The justification of a scientific theory resides only in the success of the results: there is no inductive justification, because the theory does not logically derive from the experiences.

“I cannot conceive of a God who rewards and punishes his creatures, or has a will of the kind that we experience in ourselves. Neither can I nor would I want to conceive of an individual that survives his physical death; let feeble souls, from fear or absurd egoism, cherish such thoughts. I am satisfied with the mystery of the eternity of life and with the awareness and a glimpse of the marvelous structure of the existing world, together with the devoted striving to comprehend a portion, be it ever so tiny, of the Reason that manifests itself in nature.”

—Albert Einstein, *Ideas and Opinions*, 12

According to Einstein, there is no contrast between science and religion if each is properly intended. Science is the study of what is; thus it cannot determine what should be. This latter task—which embraces the search for the fundamental ends and values of human life, and for the foundation of ethical principles—is the subject matter of religion. The scope of religion is different and independent from the scope of science and includes value judgments, which are outside the domain of scientific reasoning. The fundamental aim of religion is to ground ethical principles and to search for the ends and values of life. There is no rational justification for ethics and for ends and values; indeed, there is no need for such a rational justification. Then what is the source of their

authority? We must sense their nature without searching for rational demonstration. “They came into being not through demonstration but through revelation, through the medium of powerful personalities” (*Ideas and Opinions*, 46). The importance that Einstein assigned to religion was thus very high, because religion’s main tasks are the foundations of the ultimate human ethical principles and the search for the true ends of human life, not through rational demonstration but through revelation, independent from science. In Part I of “Science and Religion” Einstein said, “To make clear these fundamentals ends and valuations, and to set them fast in the emotional life of the individual, seems to me precisely the most important function which religion has to perform in the social life of man” (*Ideas and Opinions*, 45).

Einstein reconsidered the independence of ethics from rational thought in later writings. In the 1950 paper “The Laws of Science and the Laws of Ethics”, reprinted in *Out of My Later Years*, Einstein declared that there is no difference between the laws of science and the laws of ethics: Both are judged by their consequences. “Ethical axioms are found and tested not very differently from the axioms of science. Truth is what stands the test of experience.” (*Out of My Later Years*, 115). Thus he separated the judgments of ethics from the scope of religion, bringing them under the control of rational thought.

GOD

In his analysis of the relationships between science and religion, Einstein identified three different concepts of God that correspond approximately to three different stages of the evolution of religious thought. The first concept of God was before human beings were conscious of the laws regulating the causal connections between natural phenomena. Thus they invented anthropomorphic supernatural beings who controlled the course of events and were responsible for natural phenomena. The main motive for this conception of God was fear: the “fear of hunger, wild beast, sickness, death” (*Ideas and Opinions*, 39). Thus Einstein spoke of a “religion of fear” (40), in which people followed traditional rituals in the hope of gaining the benevolence of God.

Einstein called the second concept of God “the social or moral conception of God” (*Ideas and Opinions*, 40) because social and moral concerns are the main source of religious practice. God is the father who protects, rewards, comforts, and punishes his children and guarantees the immortality of human soul. An important task of this kind of religion, which is typical in modern times, is to justify the adoption of specific views of morality and to provide the context for advocating social justice.

Both the religion of fear and the moral and social conception of God are ingredients, in varying degrees, in all historical religions. Primitive religions are mostly, but not exclusively, based on fear, and contemporary religions are primarily based on moral and social concerns, though fear is also a motive force. In these contexts, a special caste—the priests—occupies the important position mediating between God and the people. The priests, who are instrumental in stabilizing the ritual of religion, are usually linked with political rulers and privileged classes, are in control of the education, and guide people in their social behavior, crystallizing the division of society into classes.

In these two types of religious thought God is conceived of as an anthropomorphic being. Einstein identified in this concept of a personal God the main source of conflict between science and religion, because this concept of God conflicts with the main aim of science, that is, to establish unrestricted laws, which do not admit exceptions, governing the reciprocal connections of objects. These laws, which Einstein identified with causal laws, exclude the possibility of supernatural intervention: God cannot interfere with natural events. It is true, said Einstein, that science cannot definitely refute the conception of a personal God, because domains exist in which science has not been able to determine general laws. However, if religion restricts itself in these domains to find a protection from science, it will lose its influence on human society. Thus “teachers of religion must have the stature to give up the doctrine of a personal God, that is, give up that source of fear and hope which in the past placed such vast power in the hands of priests” (*Ideas and Opinions*, 52). Only thus it is possible to prevent a conflict between science and religion. A religious man is a man

who has liberated himself from “selfish desires” (48) and is preoccupied with “superpersonal value” (48), independently of any conception of a divine being.

Einstein called the third stage of religious thought the “cosmic religious feeling” (*Ideas and Opinions*, 41). God is not conceived of as an anthropomorphic being; in a sense, the only function of God is to guarantee the regularity of the universe. Among the forerunners of the cosmic conception of God, Einstein cites some books of the Bible (Psalm of David, Prophets), Buddha, Democritus, Spinoza, and St. Francis of Assisi. No religious practice corresponds to this conception of God because it is futile to try to secure God’s benevolence. God does not interfere with natural laws, does not make miracles, does not reward human beings, does not punish them. This mature conception of God has its main source in the scientific contemplation of nature, which discloses the exact regularity of the causal laws of nature and thus renders inconceivable the conception of a God interfering with nature in order to reward and punish his creatures.

Einstein explicitly subscribed to the cosmic conception of God. He believed in an impersonal God who is not concerned with the fate of human beings, but who reveals himself in the order and harmony of the universe. In 1929 the Boston Archbishop, Cardinal William Henri O’Connell, accused Einstein’s relativity theory of atheism. Rabbi Herbert Goldstein, the founder of the Institutional Synagogue in New York, cabled to Einstein, who lived in Berlin, asking, “Do you believe in God?” Einstein replied with the often cited statement “I believe in Spinoza’s God who reveals himself in the orderly harmony of what exists, not in a God who concerns himself with fates and actions of human beings” (see Clark, 502; Schillp, 659–660; Jammer, 49). Rabbi Goldstein concluded—I think correctly—that Einstein was neither atheist nor agnostic, and that relativity theory represents a scientific formula for monotheism; I do not subscribe to this latter point. Some scholars have regarded this declaration of Einstein as a sign of his atheism. However, a thorough analysis of his thought shows that even though his conception of God excludes the possibility of positive religion, Einstein was not an atheist. The cosmic conception of God asserts the ineffectiveness of religious practices, but it does not assert the non existence of God. Of the thinkers

cited by Einstein as forerunners of the cosmic conception, St. Francis of Assisi is secure from a charge of atheism, and Spinoza tried to prove the necessary existence of God in his *Ethics*. Einstein explicitly affirmed his disbelief in a personal God and denied the very possibility of conventional religion, but he indeed held a faith in a God who guarantees the order of the cosmos.

PEACE AND WAR

Einstein is usually depicted as a pacifist; however, his pacifism did not exclude the possibility of using military power to guarantee peace. In several circumstances he advocated the creation of a world government supplied with a suitable military force. In the 1945 paper “Atomic War or Peace”, reprinted in *Ideas and Opinions* and in *Out of My Later Years*, he suggested that this world government should be founded by the United States, the Soviet Union, and Great Britain, “the only three powers with military strength” (*Ideas and Opinions*, 130). He added, “The power of this world government would be over all military matters, and there need be only one further power. That is to interfere in countries where a minority is oppressing a majority, and so is creating the kind of instability that leads to war ... There must be an end to the concept of non-intervention, for to end it is part of keeping the peace.” (130-131). Einstein advocated the use of military force against countries in which there was oppression; he explicitly mentioned Argentina and Spain, which in those days had right-wing governments. For Einstein, the use of military force was admissible—in fact, necessary—for peacekeeping.

A similar line of reasoning was presented in the 1934 paper “On Military Service”, reprinted in *Out of My Later Years*, in which Einstein proposed an international court of justice capable of enforcing its decision by means of a permanent military force. In this paper he also spoke against conscientious objectors, claiming that they reduce the power of democratic countries against the totalitarian ones. Previously, in several circumstances, Einstein had spoken in favor of conscientious objectors, advocating international laws to protect them (*Ideas and Opinions*, 108) and proposing to give “moral and material support to the courageous conscientious objectors in each country” (117). Evidently, Einstein’s pacifism was mitigated by the advent of fascism and Nazism, so that he saw in

military force the only possible resistance to their menace. If this interpretation of Einstein's pacifism is correct—there is no general agreement on this point—the notorious letter that he wrote to President Franklin D. Roosevelt suggesting the development of a nuclear war program seems a necessary step, more than an accidental error due to political naïveté. This letter, signed by Einstein but drafted by Hungarian physicist Leo Szilard, is dated August 2, 1939, a month before the start of World War II. The letter warned President Roosevelt of the possibility of the construction of a nuclear bomb by Germany. Einstein suggested securing a supply of uranium for the United States and providing government funds to speed up the experimental work on nuclear chain reaction. Only on October 11—after World War II had begun—did the economist Alexander Sachs deliver the letter, with a memorandum by Szilard, to the president. Roosevelt responded on October 19, 1939, telling Einstein that he had instituted a board to investigate the matter; some funds were granted to the project. Years later, Einstein regretted having signed this letter, which is often regarded as the starting point of the American nuclear weapon project (in which Einstein did not take part) that ended with the dropping of the two atomic bombs on Japan in 1945.

I think that Einstein's pacifism was, at this time, superseded by practical considerations: Unilateral disarmament is dangerous; contentious objection, though admirable, is ineffective against a totalitarian regime; the keeping of peace requires a suitable military force; and international order must be enforced by military power. A striking example of these practical considerations can be found in the previously cited "Atomic War or Peace". Einstein suggested that the constitution of a world government should be prepared by the representatives of three governments (the United States, the Soviet Union, and Great Britain) because "three men can succeed in writing a workable constitution ... Six or seven men, or more, probably would fail" (*Ideas and Opinions*, 130). This consideration is probably correct from a practical point of view, but it does not seem to be not very democratic, to say the least. It is my opinion that Einstein applied to pacifism the same kind of considerations that he was accustomed to apply to physical theories: The justification of a scientific theory resides only in the success of its results, and in the same way the justification of pacifism

resides only in the success of its results. In the 1930s, facing fascism and Nazism, Einstein realized that pacifism, in its purest form, was ineffective, and thus his position shifted toward a kind of pacifism that does not refute the use of military force for peacekeeping.

Einstein himself recollected this episode in his paper “Why Socialism?” reprinted in *Out of My Later Years* and in *Ideas and Opinions*. He discussed with an intelligent and well-disposed man the threat of another war, which in his opinion would seriously endanger the existence of humans, and he remarked that only a supranational organization would offer protection from that danger. Thereupon his visitor, very calmly and coolly, said to him, “Why are you so deeply opposed to the disappearance of the human race?”

It is interesting how Einstein applied his pacifism to the Arab-Jew question in Palestine. In “Our Debt to Zionism” from 1938, reprinted in *Out of My Later Years* and in *Ideas and Opinions*, Einstein praised the Zionism movement. He said, with reference to the situation in Palestine: “Fields cultivated [by Jews] by day must have harmed protection at night against fanatical Arab outlaws” (*Ideas and Opinions*, 207), apparently justifying the fight of Jews against Arabs. However, in the same paper, Einstein’s position was different in writing about the establishment of a Jewish state. He opposed the creation of a Jewish state, preferring a peaceful coexistence with Arabs. His main concern was the possible development of a narrow nationalism in a Jewish state, which would result in damage for Judaism itself (207). Ten years later, Einstein signed, with more than twenty intellectuals, a letter to the editor of *The New York Times*, objecting to the visit to the United States of Menachen Begin, the leader of the Herut (Freedom), a right-wing political party in Israel. The first paragraph of the letter claimed that this political party was “closely akin in its organization, methods, political philosophy and social appeal to the Nazi and Fascist parties” (“New Palestine Party—Visit of Menachen Begin and Aims of Political Movement Discussed”, *The New York Times*, December 4, 1948). The letter condemned an Israeli attack against an Arab village, Deir Yassin, in

which about 240 Arabs were killed by “terrorist bands”. We can see that Einstein fought nationalism in the state of Israel and denounced without hesitation every form of violence, including violence perpetrated by his own people.

Few days before his death Einstein signed the so-called Russell-Einstein manifesto, which called for an international conference to discuss the threat posed by nuclear weapons. The manifest, signed by Einstein, Bertrand Russell, and nine other scientists, concluded with the following resolution: “In view of the fact that in any future world war nuclear weapons will certainly be employed, and that such weapons threaten the continued existence of mankind, we urge the governments of the world to realize, and to acknowledge publicly, that their purpose cannot be furthered by a world war, and we urge them, consequently, to find peaceful means for the settlement of all matters of dispute between them.”

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Scientific American Special Issue: Beyond Einstein 291, no. 3 (September 2004).

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