



## ALBERT EINSTEIN

### Introduction:

Albert Einstein was born in Ulm, in the Kingdom of Württemberg in the German Empire on 14 March 1879. His parents were Hermann Einstein, a salesman and engineer, and Pauline Koch. In 1880, the family moved to Munich, where his father and his uncle founded *Elektrotechnische Fabrik J. Einstein & Cie*, a company that manufactured electrical equipment based on direct current.

The Einsteins were non-observant Ashkenazi Jews. Albert attended a Catholic elementary school from the age of 5 for three years. At the age of 8, he was transferred to the Luitpold Gymnasium (now known as the Albert Einstein Gymnasium), where he received advanced primary and secondary school education until he left Germany seven years later.

In 1894, his father's company failed: direct current (DC) lost the War of Currents to alternating current (AC). In search of business, the Einstein family moved to Italy, first to Milan and then, a few months later, to Pavia. When the family moved to Pavia, Einstein stayed in Munich to finish his studies at the Luitpold Gymnasium. His father intended for him to pursue electrical engineering, but Einstein clashed with authorities and resented the school's regimen and teaching method. He later wrote that the spirit of learning and creative thought were lost in strict rote learning. At the end of December 1894, he travelled to Italy to join his family in Pavia, convincing the school to let him go by using a doctor's note. It was during his time in Italy that he wrote a short essay with the title "On the Investigation of the State of the Ether in a Magnetic Field."

In 1895, at the age of 16, Einstein sat the entrance examinations for the Swiss Federal Polytechnic in Zürich (later the Eidgenössische Technische Hochschule ETH). He failed to reach the required standard in the general part of the examination, but obtained exceptional grades in physics and mathematics. On the advice of the principal of the Polytechnic, he attended the Argovian cantonal school (gymnasium) in Aarau, Switzerland, in 1895–96 to complete his secondary schooling. While lodging with the family of Professor Jost Winteler, he fell in love with Winteler's daughter, Marie. (Albert's sister Maja later married Winteler's son Paul.) In January 1896, with his father's approval, he renounced his citizenship in the German Kingdom of Württemberg to avoid military service. In September 1896, he passed the Swiss Matura with mostly good grades, including a top grade of 6 in physics and mathematical subjects, on a scale of 1–6. Though only 17, he enrolled in the four-year mathematics and physics teaching diploma program at the Zürich Polytechnic. Marie Winteler moved to Olsberg, Switzerland for a teaching post.

Einstein's future wife, Mileva Marić, also enrolled at the Polytechnic that same year. She was the only woman among the six students in the mathematics and physics section of the teaching diploma course. Over the next few years, Einstein and Marić's friendship developed into romance, and they read books together on extra-curricular physics in which Einstein was taking an increasing interest. In 1900, Einstein was awarded the Zürich Polytechnic teaching diploma, but Marić failed the examination with a poor grade in the mathematics component, theory of functions. There have been claims that Marić collaborated with Einstein on his celebrated 1905 papers, but historians of physics who have studied the issue find no evidence that she made any substantive contributions.

### **Marriage and Children :**

The discovery and publication in 1987 of an early correspondence between Einstein and Marić revealed that they had had a daughter, called "Lieserl" in their letters, born in early 1902 in Novi Sad where Marić was staying with her parents. Marić returned to Switzerland without the child, whose real name and fate are unknown. Einstein probably never saw his daughter. The contents of his letter to Marić in September 1903 suggest that the girl was either adopted or died of scarlet fever in infancy.

Einstein and Marić married in January 1903. In May 1904, the couple's first son, Hans Albert Einstein, was born in Bern, Switzerland. Their second son, Eduard, was born in Zürich in July 1910. In 1914, the couple separated; Einstein moved to Berlin and his wife remained in Zürich with their sons. They divorced on 14 February 1919, having lived apart for five years. Eduard, whom his father called "Tete" (for *petit*), had a breakdown at about age 20 and was diagnosed with schizophrenia. His mother cared for him and he was also committed to asylums for several periods, including full-time after her death.

The marriage with Marić does not seem to have been very happy. In letters revealed in 2015, Einstein wrote to his early love, Marie Winteler, about his marriage and his still strong feelings for Marie. In 1910 he wrote to her that "I think of you in heartfelt love every spare minute and am so unhappy as only a man can be" while his wife was pregnant with their second child. Einstein spoke about a "misguided love" and a "missed life" regarding his love for Marie.

Einstein married Elsa Löwenthal on 2 June 1919, after having had a relationship with her since 1912. She was a first cousin maternally and a second cousin paternally. In 1933, they emigrated to the United States. In 1935, Elsa Einstein was diagnosed with heart and kidney problems; she died in December 1936.

### **Patent office:**

After graduating, Einstein spent almost two frustrating years searching for a teaching post. He acquired Swiss citizenship in February 1901, but was not conscripted for medical reasons. With the help of Marcel Grossmann's father Einstein secured a job in Bern at the Federal Office for Intellectual Property, the patent office, as an assistant examiner. He evaluated patent applications for a variety of devices including a gravel sorter and an electromechanical typewriter. In 1903, Einstein's position at the Swiss Patent Office became permanent, although he was passed over for promotion until he "fully mastered machine technology".

Much of his work at the patent office related to questions about transmission of electric signals and electrical-mechanical synchronization of time, two technical problems that show up conspicuously in the thought experiments that eventually led Einstein to his radical conclusions about the nature of light and the fundamental connection between space and time.

With a few friends he had met in Bern, Einstein started a small discussion group, self-mockingly named "The Olympia Academy", which met regularly to discuss science and philosophy. Their readings included the works of Henri Poincaré, Ernst Mach, and David Hume, which influenced his scientific and philosophical outlook.

### **Academic career:**

In 1900, his paper "Folgerungen aus den Capillaritätserscheinungen" ("Conclusions from the Capillarity Phenomena") was published in the prestigious *Annalen der Physik*. On 30 April 1905, Einstein completed his thesis, with Alfred Kleiner, Professor of Experimental Physics, serving as *pro-forma* advisor. As a result, Einstein was awarded a PhD by the University of Zürich, with his dissertation entitled, "A New Determination of Molecular Dimensions." That same year, which has been called Einstein's *annus mirabilis* (miracle year), he published four groundbreaking papers, on the photoelectric effect, Brownian motion, special relativity, and the equivalence of mass and energy, which were to bring him to the notice of the academic world.

By 1908, he was recognized as a leading scientist and was appointed lecturer at the University of Bern. The following year, after giving a lecture on electrodynamics and the relativity principle at the University of Zurich, Alfred Kleiner recommended him to the faculty for a newly created professorship in theoretical physics. Einstein was appointed associate professor in 1909.

Einstein became a full professor at the German Charles-Ferdinand University in Prague in April 1911, accepting Austrian citizenship in the Austro-Hungarian empire to do so. During his Prague stay Einstein wrote 11 scientific works, 5 of them on radiation mathematics and on quantum theory of the solids. In July 1912 he returned to his alma mater in Zürich. From 1912 until 1914 he was professor of theoretical physics at the ETH Zurich, where he taught analytical mechanics and thermodynamics. He also studied continuum mechanics, the molecular theory of heat, and the problem of gravitation, on which he worked with mathematician and his friend Marcel Grossmann.

In 1914, he returned to the German Empire after being appointed director of the Kaiser Wilhelm Institute for Physics (1914–1932) and a professor at the Humboldt University of Berlin, but freed from most teaching obligations. He soon became a member of the Prussian Academy of Sciences, and in 1916 was appointed president of the German Physical Society (1916–1918).

Based on calculations Einstein made in 1911, about his new theory of general relativity, light from another star would be bent by the Sun's gravity. In 1919 that prediction was confirmed by Sir Arthur Eddington during the solar eclipse of 29 May 1919. Those observations were published in the international media, making Einstein world famous. On 7 November 1919, the leading British newspaper *The Times* printed a banner headline that read: "Revolution in Science – New Theory of the Universe – Newtonian Ideas Overthrown".

In 1920, he became Foreign Member of the Royal Netherlands Academy of Arts and Sciences. In 1921, Einstein was awarded the Nobel Prize in Physics for his explanation of the photoelectric effect, as relativity was considered still somewhat controversial. Einstein was elected a Foreign Member of the Royal Society (ForMemRS) in 1921. He also received the Copley Medal from the Royal Society in 1925.

### **1921–1922: Travels abroad**

Einstein visited New York City for the first time on 2 April 1921, where he received an official welcome by Mayor John Francis Hylan, followed by three weeks of lectures and receptions. He went on to deliver several lectures at Columbia University and Princeton University, and in Washington he accompanied representatives of the National Academy of Science on a visit to the White House. On his return to Europe he was the guest of the British statesman and philosopher Viscount Haldane in London, where he met several renowned scientific, intellectual and political figures, and delivered a lecture at King's College. He also published an essay, "My First Impression of the U.S.A.," in July 1921, in which he tried briefly to describe some characteristics of Americans, much as Alexis de Tocqueville did, who published his own impressions in *Democracy in America* (1835). For some of his observations, Einstein was clearly surprised: "What strikes a visitor is the joyous, positive attitude to life . . . The American is friendly, self-confident, optimistic, and without envy."

In 1922, his travels took him to Asia and later to Palestine, as part of a six-month excursion and speaking tour, as he visited Singapore, Ceylon and Japan, where he gave a series of lectures to thousands of Japanese. After his first public lecture, he met the emperor and empress at the Imperial Palace, where thousands came to watch. In a letter to his sons, Einstein described his impression of the Japanese as being modest, intelligent, considerate, and having a true feel for art.

On his return voyage, he visited Palestine for 12 days in what would become his only visit to that region. Einstein was greeted as if he were a head of state, rather than a physicist, which included a cannon salute upon arriving at the home of the British high commissioner, Sir Herbert Samuel. During one reception, the building was stormed by people who wanted to see and hear him. In

Einstein's talk to the audience, he expressed happiness that the Jewish people were beginning to be recognized as a force in the world.

### ***Refugee status:***

In April 1933, he also discovered that the new German government had passed laws barring Jews from holding any official positions, including teaching at universities. Historian Gerald Holton describes how, with "virtually no audible protest being raised by their colleagues," thousands of Jewish scientists were suddenly forced to give up their university positions and their names were removed from the rolls of institutions where they were employed.

A month later, Einstein's works were among those targeted by Nazi book burnings, with Nazi propaganda minister Joseph Goebbels proclaiming, "Jewish intellectualism is dead." One German magazine included him in a list of enemies of the German regime with the phrase, "not yet hanged", offering a \$5,000 bounty on his head. In a subsequent letter to physicist and friend, Max Born, who had already emigrated from Germany to England, Einstein wrote, "... I must confess that the degree of their brutality and cowardice came as something of a surprise." After moving to the U.S., he described the book burnings as a "spontaneous emotional outburst" by those who "shun popular enlightenment," and "more than anything else in the world, fear the influence of men of intellectual independence."

Einstein was now without a permanent home, unsure where he would live and work, and equally worried about the fate of countless other scientists still in Germany. He rented a house in De Haan, Belgium where he lived for a few months. In late July 1933, he went to England for about six weeks at the personal invitation of British naval officer Commander Oliver Locker-Lampson, who had become friends with Einstein in the preceding years. To protect Einstein, Locker-Lampson secretly had two assistants watch over him at his secluded cottage outside of London, with the press publishing a photo of them guarding Einstein.

Locker-Lampson took Einstein to meet Winston Churchill at his home, and later, Austen Chamberlain and former Prime Minister Lloyd George. Einstein asked them to help bring Jewish scientists out of Germany. British historian Martin Gilbert notes that Churchill responded immediately, and sent his friend, physicist Frederick Lindemann to Germany to seek out Jewish scientists and place them in British universities.<sup>[73]</sup> Churchill later observed that as a result of Germany having driven the Jews out, they lowered their "technical standards," and had put the Allies' technology ahead of theirs.

Einstein later contacted leaders of other nations, including Turkey's Prime Minister, İsmet İnönü, who he wrote in September 1933 requesting placement of unemployed German-Jewish scientists. As a result of Einstein's letter, Jewish invitees to Turkey eventually totaled over "1,000 saved individuals."

Locker-Lampson also submitted a bill to parliament to extend British citizenship to Einstein, during which period Einstein made a number of public appearances describing the crisis brewing in Europe. The bill failed to become law, however, and Einstein then accepted an earlier offer from the Princeton Institute for Advanced Study, in the U.S., to become a resident scholar.

In October 1933 Einstein returned to the U.S. and took up a position at the Institute for Advanced Study (in Princeton, New Jersey), noted for having become a refuge for scientists fleeing Nazi Germany. At the time, most American universities, including Harvard, Princeton and Yale, had minimal or no Jewish faculty or students, as a result of their Jewish quota which lasted until the late 1940s.

Einstein was still undecided on his future. He had offers from several European universities, including Oxford where he stayed for three short periods between May 1931 and June 1933, however in 1935 he arrived at the decision to remain permanently in the United States and apply for citizenship.

Einstein's affiliation with the Institute for Advanced Study would last until his death in 1955. He was one of the four first selected (two of the others being John von Neumann and Kurt Gödel) at

the new Institute, where he soon developed a close friendship with Gödel. The two would take long walks together discussing their work. Bruria Kaufman, his assistant, later became a physicist. During this period, Einstein tried to develop a unified field theory and to refute the accepted interpretation of quantum physics, both unsuccessfully.

**World War II and the Manhattan Project:**

In 1939, a group of Hungarian scientists that included émigré physicist Leó Szilárd attempted to alert Washington of ongoing Nazi atomic bomb research. The group's warnings were discounted. Einstein and Szilárd, along with other refugees such as Edward Teller and Eugene Wigner, "regarded it as their responsibility to alert Americans to the possibility that German scientists might win the race to build an atomic bomb, and to warn that Hitler would be more than willing to resort to such a weapon."

To make certain the U.S. was aware of the danger, in July 1939, a few months before the beginning of World War II in Europe, Szilárd and Wigner visited Einstein to explain the possibility of atomic bombs, which Einstein, a pacifist, said he had never considered. He was asked to lend his support by writing a letter, with Szilárd, to President Roosevelt, recommending the U.S. pay attention and engage in its own nuclear weapons research. A secret German facility, apparently the largest of the Third Reich, covering 75 acres in an underground complex, was being re-excavated in Austria in December 2014 and may have been planned for use in nuclear research and development.

The letter is believed to be "arguably the key stimulus for the U.S. adoption of serious investigations into nuclear weapons on the eve of the U.S. entry into World War II". In addition to the letter, Einstein used his connections with the Belgian Royal Family<sup>[88]</sup> and the Belgian queen mother to get access with a personal envoy to the White House's Oval Office. President Roosevelt could not take the risk of allowing Hitler to possess atomic bombs first. As a result of Einstein's letter and his meetings with Roosevelt, the U.S. entered the "race" to develop the bomb, drawing on its "immense material, financial, and scientific resources" to initiate the Manhattan Project. It became the only country to successfully develop an atomic bomb during World War II.

For Einstein, "war was a disease... [and] he called for resistance to war." By signing the letter to Roosevelt he went against his pacifist principles. In 1954, a year before his death, Einstein said to his old friend, Linus Pauling, "I made one great mistake in my life—when I signed the letter to President Roosevelt recommending that atom bombs be made; but there was some justification—the danger that the Germans would make them ..."

### ***U.S. citizenship***

Einstein became an American citizen in 1940. Not long after settling into his career at the Institute for Advanced Study (in Princeton, New Jersey), he expressed his appreciation of the meritocracy in American culture when compared to Europe. He recognized the "right of individuals to say and think what they pleased", without social barriers, and as a result, individuals were encouraged, he said, to be more creative, a trait he valued from his own early education.

### **Personal life:**

#### ***Assisting Zionist causes:***

Einstein was a figurehead leader in helping establish the Hebrew University of Jerusalem, which opened in 1925, and was among its first Board of Governors. Earlier, in 1921, he was asked by the biochemist and president of the World Zionist Organization, Chaim Weizmann, to help raise funds for the planned university. He also submitted various suggestions as to its initial programs. Among those, he advised first creating an Institute of Agriculture in order to settle the undeveloped land. That should be followed, he suggested, by a Chemical Institute and an Institute of Microbiology, to fight the various ongoing epidemics such as malaria, which he called an "evil" that was undermining a third of the country's development. Establishing an Oriental

Studies Institute, to include language courses given in both Hebrew and Arabic, for scientific exploration of the country and its historical monuments, was also important.

Chaim Weizmann later became Israel's first president. Upon his death while in office in November 1952 and at the urging of Ezriel Carlebach, Prime Minister David Ben-Gurion offered Einstein the position of President of Israel, a mostly ceremonial post. The offer was presented by Israel's ambassador in Washington, Abba Eban, who explained that the offer "embodies the deepest respect which the Jewish people can repose in any of its sons". Einstein declined, and wrote in his response that he was "deeply moved", and "at once saddened and ashamed" that he could not accept it.

### ***Love of music:***

Einstein developed an appreciation of music at an early age. His mother played the piano reasonably well and wanted her son to learn the violin, not only to instill in him a love of music but also to help him assimilate into German culture. According to conductor Leon Botstein, Einstein is said to have begun playing when he was 5, although he did not enjoy it at that age.

When he turned 13 he discovered the violin sonatas of Mozart, whereupon "Einstein fell in love" with Mozart's music and studied music more willingly. He taught himself to play without "ever practicing systematically", he said, deciding that "love is a better teacher than a sense of duty." At age 17, he was heard by a school examiner in Aarau as he played Beethoven's violin sonatas, the examiner stating afterward that his playing was "remarkable and revealing of 'great insight'." What struck the examiner, writes Botstein, was that Einstein "displayed a deep love of the music, a quality that was and remains in short supply. Music possessed an unusual meaning for this student."

Music took on a pivotal and permanent role in Einstein's life from that period on. Although the idea of becoming a professional himself was not on his mind at any time, among those with whom Einstein played chamber music were a few professionals, and he performed for private audiences and friends. Chamber music had also become a regular part of his social life while living in Bern, Zürich, and Berlin, where he played with Max Planck and his son, among others. He is sometimes erroneously credited as the editor of the 1937 edition of the Köchel catalogue of Mozart's work; that edition was actually prepared by Alfred Einstein.

In 1931, while engaged in research at the California Institute of Technology, he visited the Zoellner family conservatory in Los Angeles, where he played some of Beethoven and Mozart's works with members of the Zoellner Quartet.<sup>[104][105]</sup> Near the end of his life, when the young Juilliard Quartet visited him in Princeton, he played his violin with them, and the quartet was "impressed by Einstein's level of coordination and intonation."

### ***Political and religious views:***

Einstein's political view was in favor of socialism and critical of capitalism, which he detailed in his essays such as "Why Socialism?". Einstein offered and was called on to give judgments and opinions on matters often unrelated to theoretical physics or mathematics. He strongly advocated the idea of a democratic global government that would check the power of nation-states in the framework of a world federation.

Einstein's views about religious belief have been collected from interviews and original writings. He called himself an agnostic, while disassociating himself from the label atheist. He said he believed in the "pantheistic" God of Baruch Spinoza, but not in a personal god, a belief he criticized. Einstein once wrote: "I do not believe in a personal God and I have never denied this but expressed it clearly".

### ***Death:***

On 17 April 1955, Albert Einstein experienced internal bleeding caused by the rupture of an abdominal aortic aneurysm, which had previously been reinforced surgically by Rudolph Nissen

in 1948.<sup>[113]</sup> He took the draft of a speech he was preparing for a television appearance commemorating the State of Israel's seventh anniversary with him to the hospital, but he did not live long enough to complete it.

Einstein refused surgery, saying: "I want to go when I want. It is tasteless to prolong life artificially. I have done my share, it is time to go. I will do it elegantly." He died in Princeton Hospital early the next morning at the age of 76, having continued to work until near the end.

During the autopsy, the pathologist of Princeton Hospital, Thomas Stoltz Harvey, removed Einstein's brain for preservation without the permission of his family, in the hope that the neuroscience of the future would be able to discover what made Einstein so intelligent. Einstein's remains were cremated and his ashes were scattered at an undisclosed location.

In his lecture at Einstein's memorial, nuclear physicist Robert Oppenheimer summarized his impression of him as a person: "He was almost wholly without sophistication and wholly without worldliness ... There was always with him a wonderful purity at once childlike and profoundly stubborn."

### **Scientific career:**

Throughout his life, Einstein published hundreds of books and articles. He published more than 300 scientific papers and 150 non-scientific ones. On 5 December 2014, universities and archives announced the release of Einstein's papers, comprising more than 30,000 unique documents. Einstein's intellectual achievements and originality have made the word "Einstein" synonymous with "genius". In addition to the work he did by himself he also collaborated with other scientists on additional projects including the Bose–Einstein statistics, the Einstein refrigerator and others.

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Renaissance