ALBERT EINSTEIN

Albert Einstein was born in Ulm, Germany on March 14, 1879. He was so slow to begin speaking his parents feared he was retarded. He attended a Catholic elementary school, and at age 10 (the normal age) entered the Luitpold High School in Munich. This school was run on rigid authoritarian lines and Einstein hated it. Five years later his father's business failed and the family moved to Italy to start fresh, leaving Albert behind to finish high school. He was too unhappy to do so, and dropped out of school to join his family. He brought with him a letter from his mathematics teacher saying his math was already at university level, but did not have a diploma.

He spent the next year hanging out (hiking, reading, playing the violin, visiting museums). At that point he wanted to become an electrical engineer, so he took the entrance exam for the well-respected Federal Institute of Technology in Zurich, and failed. Another way to get in was to obtain a Swiss high school diploma. So he enrolled in a progressive school in Aarau where the emphasis was on developing a qualitative picture of a subject rather than memorizing lots of detail.(Anschauung in German) He found it much more to his liking, and even changed his career goals, deciding to become a high school teacher of science and mathematics.

It was at this time, age 16, that he renounced his German citizenship. Five years later he became a Swiss citizen. He graduated from high school and entered the Federal Institute. There he attended classes sporadically at best. He was not simply goofing off, he just did not want to study subjects he was not interested in. There was clearly a serious mis-match of goals. The Institute wanted to provide a solid foundation in basic science, appropriate for someone preparing to become a high school teacher. Einstein on the other hand, spent his time reading physics journals. He was especially interested in Maxwell's electromagnetism, a subject not yet taught at the Institute. He wanted to do research on frontier questions in physics, and in some ways he was ready. The Institute was not set up to teach at that level. This resulted in personality clashes with his teachers.

Einstein's friend, Marcel Grossmann, was also a student at the Institute, and he attended class regularly, and took careful notes. Einstein was able to drift along doing what he liked until a few months before the final exams, when he stuffed legions of details into his head using Grossmann's notes, passed, and graduated in 1900.

He was unable to get a regular job in part because he had alienated those at the Institute who could have written letters of recommendation for him. Einstein supported himself with odd jobs, teaching, tutoring, etc. Grossmann's father came to the rescue, getting Einstein an interview with the director of the Swiss patent office in Bern. He was not fully qualified to be a patent examiner, but the director liked him and offered him a provisional job when the next opening appeared. He started in June 1902. The work involved reading patent applications, figuring out what the essentials of the invention were, and rewriting to make the description more clear. He was good at this work, and best of all, could do it quickly enough to allow free time during the day to work on questions in physics that interested him. It would later be said that the drawer in his desk where he kept his physics papers was the best department of physics in Europe at that time.

His years at the patent office were the most productive of his life, and in many ways, the happiest also. In 1903 he married Mileva Maric, a classmate of his at the

Institute. 1905 was his miracle year. In that year he published three papers, each world class and worthy of a Nobel Prize. The first was his paper of the particle theory of light – what came to be called the photon theory, that we have already described. The next was an interpretation of Brownian motion. This is the constant jiggling that tiny dust or pollen particles have while suspended in air. When Brown, a biologist, first observed this motion, he thought it meant the particles were alive. Einstein showed that this motion is due to the constant bombardment of the particles by the molecules of air. This was important because at the time the very existence of molecules was in doubt. The atomic model worked in helping to understand chemical reactions as Faraday had shown long before, but do atoms actually exist? Brownian motion indicates that they do.

The third paper is the one proposing the special theory of relativity. It is a gem of a paper in which Einstein said let's take seriously two principles, and see where they lead us, even if that means giving up our old notions of time and simultaneity. Then, with simple mathematics, he worked out a number of consequences. The community of physicists was accustomed to lengthy calculations based on Newton's laws and Maxwell's equations for electromagnetism. This short paper based entirely on two new principles was radically different. It was far enough out of the mainstream that other physicists paid scant attention to it. Two years later Einstein submitted the relativity paper to the University of Bern as part of his application for the position of Privatdozent, the first step towards a Professorship. The paper was rejected by the faculty who obviously did not appreciate its importance.

In that same year the mathematician Hermann Minkowski reformulated the relativity paper using a four dimensional space-time version of geometry. Three of the dimensions are the usual three dimensions of space, and the fourth is time. The content did not change, but the theory became more evident, and hence more noticed by the community of physicists. In 1909 Einstein became Herr Professor Doctor Einstein at the University of Zurich. He left the patent office in Bern, and his years of obscurity were over.

Soon after, he was offered a full professorship at the German University in Prague. While there he was invited to the first international research conference sponsored by Ernst Solvay, a wealthy Belgian industrial chemist. Only 21 people attended the conference, including Madame Curie and Henri Poincare. This was recognition indeed. Perhaps the most important new result presented at that meeting was Kammerlingh Onnes' announcement of his discovery of superconductivity.

In 1914 Einstein was offered the directorship of a physics institute in Berlin and membership in the Royal Prussian Academy of Science, perhaps the most prestigious position in physics in the world at that time. Einstein distrusted German militarism, and he hesitated, but then accepted the position. World War I broke out in August of that year. Mileva and the children went back to neutral Switzerland, and the move also signaled the end of their marriage. In 1919 he and Mileva were divorced and in June he married his cousin Elsa, a widow with two daughters whom Einstein had known since his youth.

When Adolf Hitler came to power in the winter of 1933, Einstein was in the US, as a visiting professor at Cal Tech. Its president, Robert Millikan, had confirmed Einstein's predictions about the photoelectric effect two decades earlier. Einstein resigned from his position in Berlin and announced he would not return to Germany. He

moved in October 1933 to Princeton and its new Institute for Advanced Studies, never to leave.

Einstein's scientific work after 1905 included most importantly, a generalization of the relativity paper to include gravity, the General Theory of Relativity, presented in 1915. After that he tried in vain to further generalize this work to include both gravity and electromagnetism, the Unified Field Theory. He also argued strenuously against the prevailing interpretation of quantum physics according to which probabilistic, rather than deterministic rules govern behavior at the atomic level. He died peacefully in April 18, 1955.

He was productive, if less creative after 1915, writing an average of four papers per year throughout his life.

Einstein has had a high profile in the public imagination. His most famous equation, $E = mc^2$ appears everywhere. He is associated with four dimensional space and time travel. SHOW SNL tape.

Another element in the public imagination is an association between modern physics and modern art, in particular between Einstein and Picasso.