

LIFE OF EINSTEIN*

K.K. Sen
University of Singapore

I must admit that I have accepted this invitation to speak on the "Life of Einstein" with a great deal of reservation. The age of Einstein was a glorious period of renaissance in Physics of which Einstein himself was the indisputed hero. But he was of a modest, unassuming, inostentatious kind, who hated to brandish his colours in victory parades. So one has to dig deep into his achievements to discover his excellence. This is not an easy job for a biographer. I am quite conscious of my limitations in this regard. However, in the next few minutes, I shall try to present before you the salient features of the life of Einstein as I understand it.

In 1930, introducing Albert Einstein to an English audience at Hotel Savoy in London, British novelist and playwright George Bernard Shaw remarked:

"There are great men who are great amongst small men. There are great men who are great among great men and that is the sort of man that we are honouring tonight."

He was the greatest among the greats indeed. That golden age of Physics was enlightened by a galaxy of luminaries such as Marie and Pierre Curie, Niels Bohr, Rutherford, Planck, Louis de Broglie, Laue, Nernst, Fermi, Otto Hahn, Oppenheimer, Heisenberg, Schrodinger, Dirac only to name a few. Why then should we single out Einstein as the greatest? Is it due to the quality of his discoveries, his attitude to life in general, novelty of his ideas, boldness of his convictions — or a combination of all of them? In the next few minutes, let us try to examine the problem.

In my judgement, there are three distinct phases of Einstein's life: Phase I (1879 — 1904), Phase II (1905 — 1924) and Phase III (1925 — 1955). Let us start with Phase I.

I (1879 — 1904)

On March 14, 1879, Albert Einstein was born at Ulm in the province of Wurtemberg, Germany, in a middle-class jewish family. He was raised in Munich, where his father owned a small electrochemical concern. In those days of Bismark's Germany militarism was the order of the day and gorgeous military parades were everyday spectacle. Contrary to usual expectation, this demonstration of iron discipline and regimentation evoked in young Einstein a sort of disdain for war machines and their uses. His behaviour as a school boy left much to be desired. He was graded at best a mediocre student with a special flare for mathematics. He had a kind of repulsion for the rigours of the German educational system. This developed into a resentment for his teachers which he carried up to his later age. He used to refer to his school masters as "Sergeants" and professors as "Lieutenants". He had a pathological horror for lies and even as a boy his religious beliefs were liberal. His biographer, Philip Frank writes

"A characteristic feature of Einstein's religious sentiments as a child was that he saw no great difference between what he learnt of Catholicism at school and the vague remains of jewish tradition with which he was familiar at home".

* Text of an invited address delivered on 17 March 1979 at the Singapore Science Centre on the occasion of the Einstein Centenary Celebration. Reproduced with the permission of the Singapore Association for the Advancement of Science.

His favourite classic writers were Schiller and Goethe. In playing violin he could be considered respectable amongst amateurs.

At the age of fifteen after graduation from Munich Gymnasium he went to join his family at Milan in Italy. His father had moved there earlier to seek new fortune. Young Einstein developed an inherent dislike for the Prussian spirit of ruled human behaviour. The relaxed mood of Italian life was much to his liking and one of the first things he did on arrival there was to abandon German nationality and turn his back on all religious sects. However, pressure from his family to continue his education and search for German-speaking institution outside the ultra-disciplined environment of Germany brought him to Switzerland to seek admission in the Federal Institute of Technology, Zurich. The Institute in Zurich was reckoned at that time to be one of the most famous technological institutes in Central Europe. Unfortunately, he failed in his entrance examination. However, the Director of the Institute, observing his extraordinary dexterity in mathematics, advised him to take a preparatory course in Cantonal Gymnasium at Aarau, which will exempt him from the entrance examination in Polytechnic. He found the atmosphere at the Gymnasium very congenial. He observed a very healthy rapport between professors and students, and much to his liking, there was complete absence of military training. At the end of the year there was immense improvement of his scholastic ability. He gained a rather easy entry into Polytechnic. Incidentally Minkowski was his mathematics teacher at the Institute. Strangely enough no personal contact developed between Einstein and Minkowski when he was a student. Later on, when Minkowski gave a geometrical description of Special Relativity in terms of four dimensional "World Geometry", this is what Einstein said about his teacher's contribution: "Since the mathematicians have invaded the theory of relativity, I do not understand it myself anymore." However, when he was developing the General Theory of Relativity, he acknowledge the indispensability of Minkowski's world space. Albert Einstein came out of Federal Institute of Zurich with flying colours.

Then followed the usual period of trials and tribulations, which every graduate of that time had to go through. Refusals for applications for job were plenty. At this stage, his situation was more complicated by the fact that he was keen on marrying a Hungarian student, Mileva Maritsch, and settling down in life. Ultimately he got a regular job as Engineer at the Patent Office in Berne, Switzerland. Mileva became his first wife and the couple was blessed with two sons. Here I end the story of the first chapter of his life. Nothing extraordinary happened at this period. He went through the usual struggles of life with overtones of successes and failures. Do we see here the shape of things to come in the next chapter of his life? Let us wait and see.

II (1905 — 1924)

The work at the Patent Office did not measure up to the intellectual capability of Einstein. He had ample time to brood over his pet scientific ideas and could nurture and develop them without being pressurised by his environment. In 1901, he published his first original paper in *Annalen der Physik* and this was followed by two in 1902 and one each in 1903 and 1904. And in 1905, Einstein burst into the horizon of science with three of the most outstanding discoveries of our time. The first one was on the theory of Brownian Motion, a phenomenon observed by the English botanist Brown about the zig-zag paths of particles in suspension. The second paper related to the ideas of space and time and was the foundation paper of what is now known as the famous principle of Special Relativity. In the third, he presented the explicit form of the basic photoelectric equation. The third paper earned him a Nobel Prize in Physics in 1921. All the three papers were eloquent documents of Einstein's extraordinary mind, his great sense of intuition and a telescopic insight into possible extensions of discoveries and above all courage to state forcefully the results which stood the test of his own conviction. In my humble opinion, it is the last trait of his character which puts him well above his contemporaries. I shall like to go back to George Bernard Shaw's estimate of Einstein. In Shaw's opinion, there were only eight great figures of Science (nobody knows, how he

arrived at that blessed number). All others were what he called "tinkers", who basked in the glories of these eight leaders. Shaws list of natural philosophers runs thus: Pythagoras, Aristotle, Ptolemy, Copernicus, Galileo, Kepler, Newton, Einstein. Einstein joins this dynasty of leaders of Science by his own right. His discoveries were startling departures from the classical thoughts, his scientific papers were brief and profound. Every inquiry he made had a special Einstein touch. Thus he interpreted the transformation formula of Lorentz as the physical bond between space and time. In proposing the photoelectric equation, he felt the necessity of returning to corpuscular behaviour in the frame-work of continuum physics. One could cite scores of examples of this type. Innumerable applications of his discoveries followed. However Einstein himself was still not satisfied. The restrictive nature of the Special Theory in being applicable only to Galilean inertial frame disturbed him. Guided by the ideas of Mach, and using his extensive knowledge of tensor and differential geometry, he built brick by brick the edifice of what is today known as "General Relativity" for accelerated frames. His results in the final form saw the light of day in 1916. Then in 1925, he combined the wave mechanics of Louis de Broglie with the recent work of the Indian physicist S. N. Bose to propose the Bose-Einstein Statistics for photons. Within this fateful twenty years or so, Einstein launched a relentless crusade against the established ideas of Science and traditional ways of thinking. In the words of G. B. Shaw: "Einstein has not challenged the facts of Science, but the axioms of Science and the Science has surrendered to his challenge."

After the discovery of Special Relativity Einstein was called to the University of Zurich as Associate Professor and in 1910, he was appointed a full Professor of Theoretical Physics in Prague University by decree of the Austrian Emperor Franz Joseph. In 1913, the wave of anti-semitism in the University placed Einstein in an un-supportable position. He returned to his old alma mater, Federal Institute of Technology, Zurich, as a Professor of Theoretical Physics. Unfortunately for him, at this period, his family life became unmanageably sour. His marriage with Mileva was on the verge of collapse. Just at that juncture, he received an offer from the German Emperor William II through two of the most distinguished physicists of the age in Planck and Nernst, to accept the post of Directorship of a Research Organisation in Germany. This would make him, in addition, a much coveted member of the Prussian Academy of Sciences and a Professor at Berlin University. They did not insist on his renewing German nationality, which he had forsaken at the age of fifteen. The lecture cycle which he was obliged to offer in Zurich was not in his liking. He was never a methodical teacher. His lecture notes were disorderly and disjointed. Moreover, the position in Berlin gave him the opportunity of separating from his estranged wife Mileva, who was subsequently divorced. He moved to Berlin. In the leisurely and tranquil academic climate of this German city, he developed the theory of General Relativity. While in Berlin, he married his vivacious and amiable cousin Fran Elsa so as to cut himself off from the world about him and to surrender himself to the peace and serenity of real family life. World War I was on the horizon, and Einstein, the most staunch anti-militarist, by the will of God, found himself within the bounds of the most militant country of the world. He noted with horror an exaggerated dose of nationalism even in the intellectual echelon of life. He considered the famous "Manifesto of 93" (which he incidentally refused to sign) as the "capitulation of German intellectual independence." In disgust, he wrote to Romain Rolland (then in exile from France to Switzerland):

"Will future generations really be able to glorify our Europe where three centuries of the most intensive cultural work have ended in nothing more than a change from religious to nationalist mania? Even the scholars here and in France behave as though their brains have been amputated."

His scientific conviction raised the eyebrow of religious leaders as well. Days of Socrates and Galileo raised their ugly heads again. Thus we find a cardinal of Boston warning the youths of America to "Beware of Einstein the atheist". Rabbi Herbert S. Goldstein of New York was more direct. He sent an anxious cable to Einstein, "Do you believe in God?" Quick came the reply from Einstein: "I believe in Spinoza's God, who reveals himself in the harmony of all beings, not in a God, which concerns himself with the fate and actions of men".

In this era of life, we find in Einstein the image of a full mortal, a bold pace-setter of modern science, a warm human being for whom the solutions to all world problems emanated from his soul, giving them a unique personal stamp. How much of this distinct individuality was carried to the next chapter of his life? Let us examine it.

III (1926 — 1955)

Around the year 1925, Einstein abdicated voluntarily his throne as the greatest physicist of his time and went into the background. The years 1924 — 1928 saw the phenomenal rise of quantum mechanics in the hands of Heisenberg, Born, Schrodinger and Dirac. In 1927, Heisenberg put forward his "Indeterminacy Principle". A new generation of physicists had come to the arena and many of the established ideas of Classical Physics were thrown to the winds. Einstein, along with Planck and Langevin, never reconciled himself to these new ideas. From time to time he raised his voice in favour of rigorous determinism, which he considered to be the corner-stone of rational Science. In fact, he wrote a paper in collaboration with Podolsky and Rosen to draw attention to the difficulties in the interpretation of quantum mechanics. However, in arguments on the new Physics, he found himself always on the losing side. Ultimately, he withdrew from the bickerings gracefully but without surrendering his preference for deterministic Physics. This attitude sounds rather strange as it comes from a man who has broken many new grounds and introduced many revolutionary ones in his own life time. He seemed to have found it difficult to keep pace with the changes. He wrote "Who would have thought around 1900 that in fifty years time, we will know so much more and understand so much less". He somehow did not fit into the environment of group work. He wrote:

"My passionate ideal of justice and social responsibility is always enviously opposed to my marked ineptitude for my desire to associate directly with men and women. I am a horse to be harnessed individually by no means cut out for a tandem or a team. I have never whole-heartedly belonged to any country or state or to my friends, nor even to my own family. These ties are always accompanied with a vague remoteness and the desire to retire into my shell has increased with my age. Such isolations are sometimes bitter, but I have no regrets at being cut off from the understanding and sympathy of others. I am certain that I loose something, but in return I free myself of opinion, customs or prejudices of others and I am not tempted to base my serenity of mind on such tenuous foundations."

This champion of individual excellence treaded his lonely path with the spirit of a Crusader to develop a "Unified Field Theory". However success evaded him. He somehow had lost the beacon light which guided him in his youth. He proposed a number of solutions, but none with the zest and vigour of conviction which was so typical of Einstein in his younger days. This master of intuition and foresight was led more and more into the mirage of Mathematics. Finally when providence threw her cruel veil on his life, he left it to posterity to untangle the intricate web which he built so carefully around his theory.

This period of his life was beset with myriads of episodes of personal anguish and disgust. It includes the black days of 1933, when he was driven out of Berlin and robbed of all his possessions in the wave of anti-semitism in Germany. Many countries extended their welcome hands of friendship, but he chose to settle down in America in the stimulating milieu of the Institute of Advanced Studies in Princeton. After Hahn's discovery of uranium fission, he foresaw the military implications of it based on his own principle of mass-energy equivalence. He was the first to write to President Roosevelt that the odious atom bomb could be made. The fact that he initiated the possibility of production of this deadly weapon was a matter of deep sorrow of his old age. As an avowed pacifist, he and his friends entreated the President not to drop the bomb on Hiroshima and Nagasaki, after the capitulation of the Nazis in Germany. He backed it up by a second warning to the President informing him of the monstrous devastation this

ugly war machine could cause. On April 12, 1945, when Roosevelt passed away, the two appeals lay unattended on his desk. His successor President Truman paid scant attention to the eager plea of this frail scientist.

He lived in recluse in the calm surrounding of Princeton. His was a solitary existence. He lost his second wife Elsa in 1939. His first wife Mileva never left Switzerland. At this time, he said, "I live in that solitude which is so painful to the young, but so delightful in maturity." He resigned from the Institute in 1945, but he maintained very close contact with the research programme of this temple of higher learning up to the last days of his life. One would often find him taking his leisurely stroll on the streets of Princeton in his loose outfit with only sandals on his feet, enjoying the taste of an ice-cream with a childish glee. He had his own share of successes and failures, laurels and persecutions. He lived his life as it came untouched by fame and glory. Alas, on April 18, 1955, fate drew the final curtain on the life of this stalwart of science and a prince amongst men. He breathed his last at the Princeton Hospital, bequeathing his brain and body in the service of the Faculty of Medicine. May his soul rest in peace!

References

1. Hilaire Cuny, *Albert Einstein, The Man and his Theories*. Profiles in Science, Souvenir Press, London, 1963.
2. Albert Einstein, *Essay in Science*, Philosophical Library Inc. New York, 1933.
3. Werner Heisenberg, *Physics and Beyond (Encounters and Conversations)*, World Perspectives, Vol. 42, Harper & Row, New York, 1971.
4. Cornelius Lanzos, *Albert Einstein and the Cosmic World Order*, Inter-science Publishers, New York, 1965.
5. Paul Arthur Schilpp, *Albert Einstein, Philosopher — Scientist*, The Library of Living Philosophers, Inc. 1949.