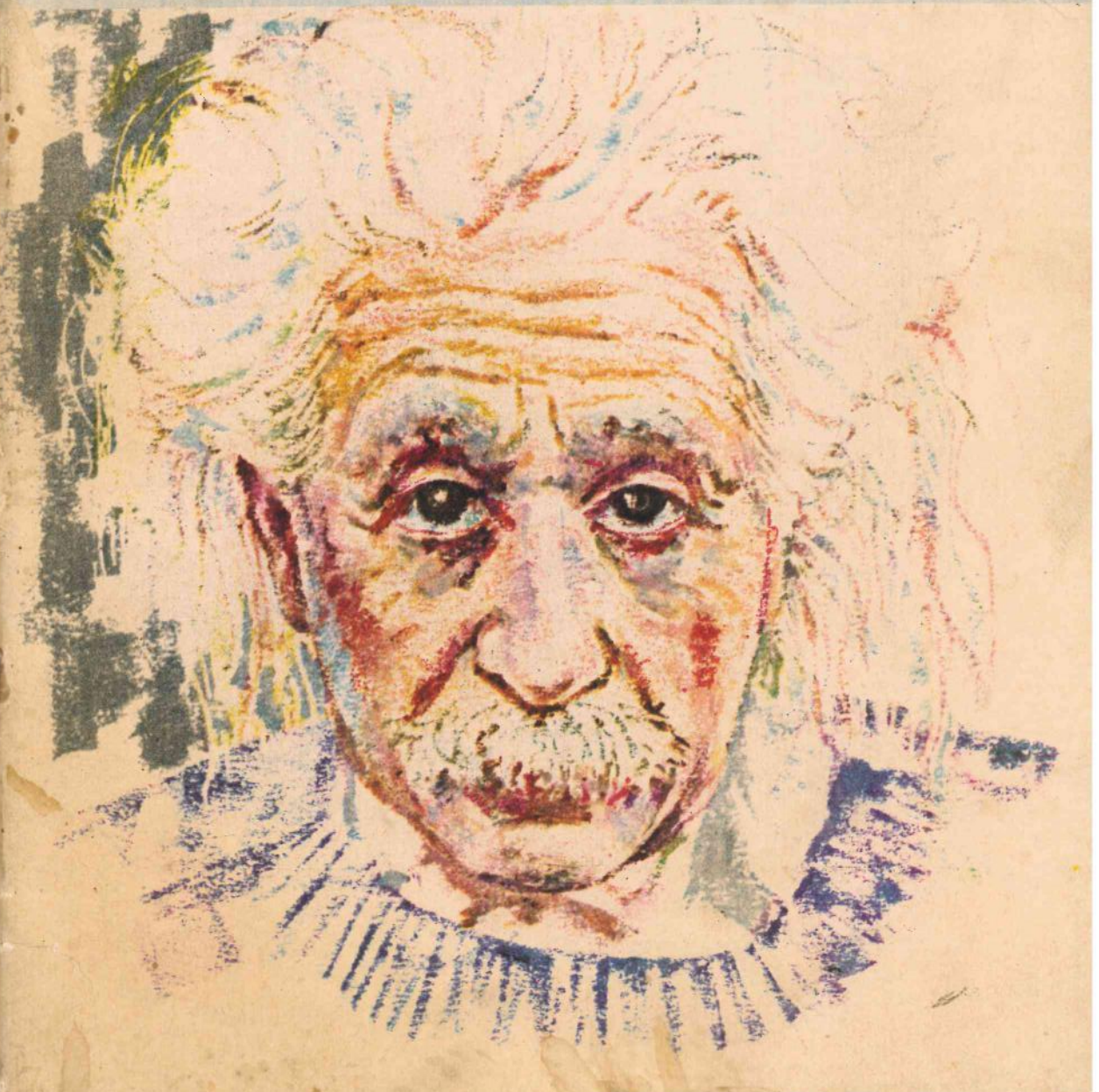
PATHFINDERS IN SCIENCE - 3 :

EINSTEIN



"CITIZENS OF TOMORROW" SERIES

Pathfinders in Science—3

EINSTEIN

Birth Centenary Publication: January 1980

PRINTER
N. S. RAY, The Book Centre Ltd., Sion East, Bombay-400 022.

PUBLISHER
G. S. KOSHE, Somaiya Publications Pvt. Ltd., Bombay-400 014.

Price Rs. 2.80

SOMAIYA PUBLICATIONS PVT LTD

172, MUMBAI MARATHI GRANTASANGRAHALAYA MARG,
DADAR, BOMBAY-400 014

Albert Einstein
(1879–1955)

1. The Childhood of a Genius

The great scientist of our age, he was truly a seeker after truth who would not compromise with evil or untruth.

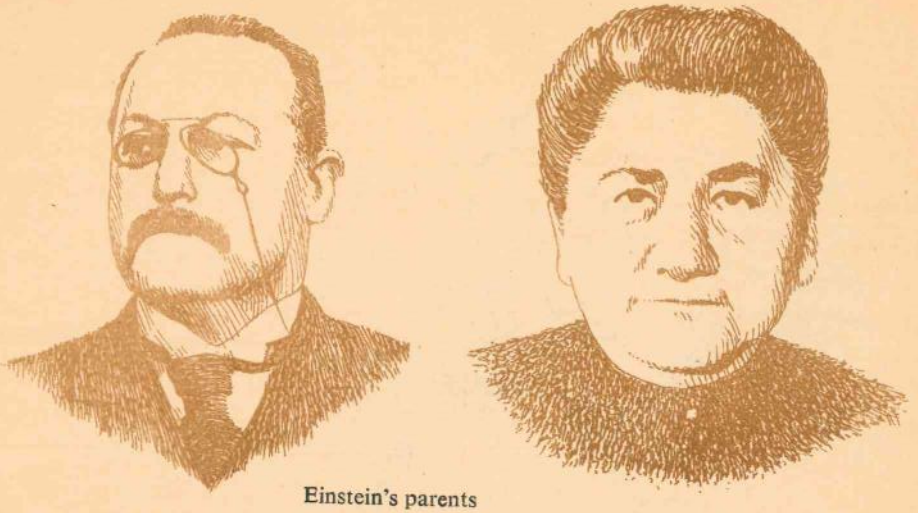
—Jawaharlal Nehru

This one man changed human thinking about the world as only Newton and Darwin changed it.

—New York Times

Who was this greatest scientist?

ALBERT EINSTEIN was his name. When he died on 18 April 1955, people all over the world mourned his death. Statesmen and philosophers, scientists and simple men, all had loved and respected him. He had once said:



Einstein's parents

There is no higher religion than human service. To work for the common good is the greatest creed.

And indeed, throughout his life, he had worked for humanity.

Though one of the greatest of scientists, Albert Einstein was a simple man—a very, very simple man. He said once that he did nothing to achieve glory, nothing to get money, and nothing to please people. He wanted, quite simply, to be a man who brought his grain of sand to the common fund.

In actual fact, he presented the world with a diamond mine. We will see later on what that diamond mine is. But you may be surprised to know that when he was a child his mother, Pauline Einstein, wrote to a friend, "I don't know what we are going to do with Albert! He doesn't seem to learn very much."

She was not alone in her opinion of Albert. In school, his Latin master had prophesied: "You will never amount to anything, Einstein." This master did not then know that, fortunately for the world

his prophesy was going to be proved very, very wrong.

Was it a miracle that proved the Latin master and the anxious mother wrong? No. Strange though it may seem, many a time a child is stamped 'a slow child' just because he does not prattle like an ordinary child. Though Einstein did not learn to talk till he was three he had a very keen mind.

He was born at Ulm, a small town in Germany, on 14 March 1879. At least in his case an old saying about the men of Ulm proved correct. It is *Ulmense sunt mathematici*, meaning, "The men of Ulm are mathematicians." The Einstein family moved to Munich one year after Albert was born. There Albert grew up with his younger sister Maja. Though slow in expressing himself, Albert was very, very inquisitive. The first glimpse of his great future was seen when he was about five.

At that time, as luck would have it, he fell ill and was confined to bed. It is natural for a child to have toys to play with. But with Albert things were different. The 'toy' that fascinated him was a toy compass with its magnetic needle that always pointed north. He must have said to himself, "I know a cart moves when I push it. But nobody touches this needle and yet it moves! It never stops moving!" He asked his father, "Papa, why does the needle move?"

Einstein with Maja

"Because it is magnetized," said his father Hermann Einstein.

"Magnetized!" Einstein wondered, "What does that mean?"

Hermann Einstein was puzzled by the interest his 'slow' child showed in the magnetic needle. It did not occur to him that this was the 'slow' child's first contact with the 'secret' power that moved the needle. The impact of this contact on Albert was so great that to his last days he remembered his first contact with 'the secret' power that moved the magnetic needle.

In the primary school his slow speech came in his way. Boys thought he was stupid and nicknamed him *Biedermeier*—meaning 'Honest John'—because he was not prepared to tell a lie even to protect himself. Those were the days when Germany was ruled by the iron-handed Bismarck. In the German schools of those days there was rigid discipline, absolute obedience, and no questioning. At a later age, Einstein remarked, "Teachers in the elementary school appeared to

me like sergeants." He always wanted to run away from school and was made to attend very much against his wishes. When he had grown up he said, "The worst of all, in my view, is when a school is mainly run by fear, power, and artificial authority. Such treatment destroys the healthy feelings, the integrity, and the self-confidence of pupils." He hated this type of school and this type of military rule.

Once, as a child, when he was waiting to cross a road he saw soldiers marching by. He felt very, very sad. A passerby saw the gloom on the child's face and said, "Cheer up, my boy, you will be soon old enough to march like these fine soldiers."

"Old enough!" Einstein replied in surprise, "But I was just thinking, Sir, that I should not like to be a soldier and become a machine."

In this gloomy atmosphere there was one escape : music. His mother had made arrangements for him to take lessons in music. Of course, here too Albert did not like the way in which the music teacher insisted on practice, but gradually he developed a real love for music, which remained with him throughout his life. Later on, when Albert was studying in Switzerland, he played the violin at a public concert. He played so well that one violinist asked him, "Do you count beats?"

'Heavens! Me!' Einstein laughed and added, "It's in my blood." To come back to his schooldays, at the age of ten he

left the primary school to enter a secondary school, called the Luitpold Gymnasium. Here too the atmosphere was not different from that in the primary school. The students were forced to follow the teachers without a word of argument. They had to learn things by heart. Being intelligent and independent, Einstein suffered.

It was at this juncture that his uncle Jacob Einstein came to the child's rescue. Hermann Einstein and Jacob Einstein were running a small factory to manufacture dynamos, measuring instruments, and arc-lamps. Uncle Jacob was a great friend of Albert's and many a time he helped the child to get over his dread of the school atmosphere.

As a result of the harsh treatment at school, Albert was gradually losing his interest in studies, especially mathematics. He said, "I hate the algebra and the geometry. What have these x's and these y's to do with studies?" and added with disgust, "I'll never learn them."

"Algebra!" exclaimed Uncle Jacob. "Oh! It's the lazy man's arithmetic. If you don't know the answer call it x and start chasing it. Just like a policeman chasing a thief."

Albert was fascinated by this game of tracking down unknowns. Indeed, he was so fascinated with it that, till the last day of his life, he kept chasing one unknown after another.

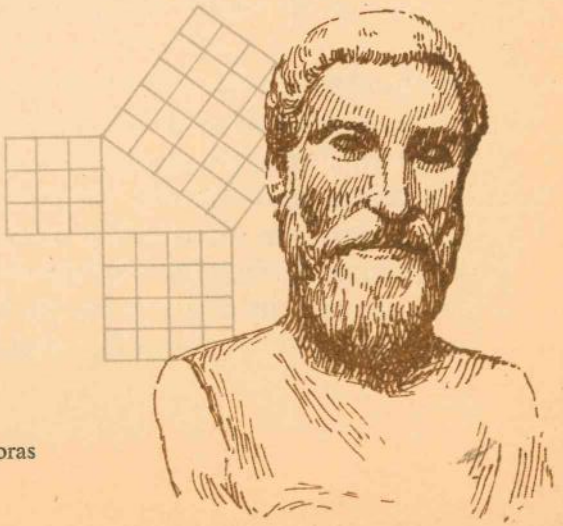
Once his dislike was overcome, he grasped the fundamentals of mathematical operations so fast that it amazed everyone. At the age of twelve he came across a popular textbook on Euclid. The plane geometry that is studied in our high schools is all based on Euclid's geometry. It taught him more than all the parrot work and the learning by heart that he was made to do in school. Einstein never forgot the enormous impression this book made on him. As in fact, he said later, "Anyone who was not transported by this book in youth was not born to be a theoretical searcher!" This book completed the change-over started by uncle Jacob when he introduced Albert to the game of chasing the unknown x.

Einstein was won over by mathematics.

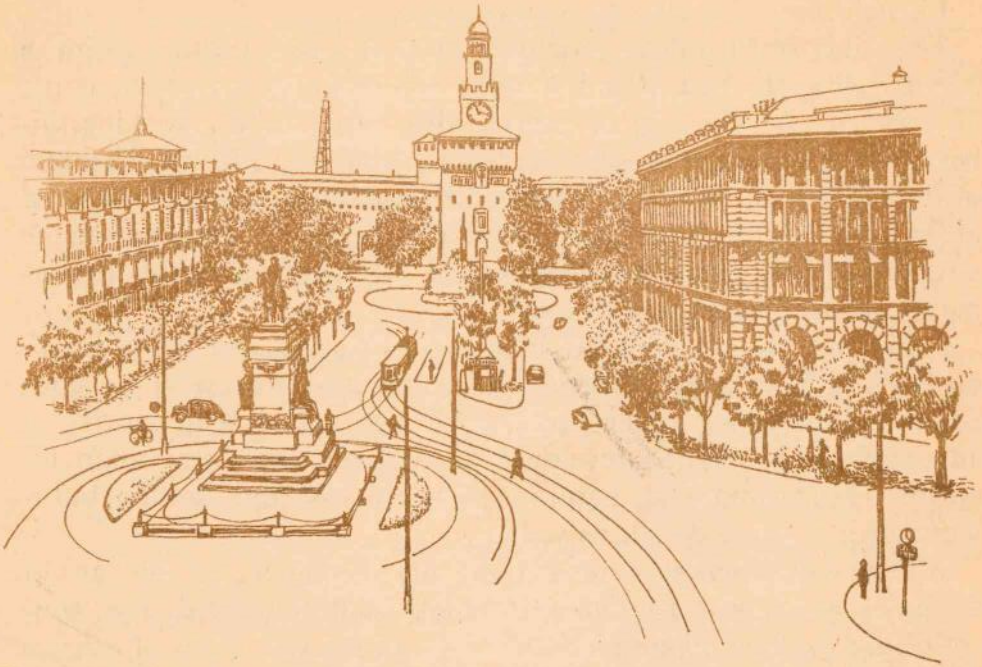
The study of Euclidean geometry became a real turning point in Albert's life. He had found a book where every statement could be proved. At the age of twelve, this 'slow child', rocking his head over his small desk, succeeded in proving the difficult Theorem of Pythagoras all by himself! Before the teaching of geometry started at the Gymnasium, Albert had solved all the exercises and finished the course! Can you imagine the amount of self confidence this performance must have created in him?

Albert was now introduced by a senior student to a set of books on Natural Science by Bernstein. He consumed them with the same passion with which other boys of his age would read stories of adventure. This reading developed in Albert a deep veneration for nature. He realized that nature is not only vast and limitless but is wonderful in small details as well.

All these experiences were shaping his character. At the age of fifteen he was a grown-up man. He knew what he wanted. The 'slow child' had realised where his future lay—in the vast fields of science and mathematics.



Pythagoras



Munich

2. The Preparation of a Scientist

The year was 1894.

The Einstein family had to leave Munich. We already know that Hermann Einstein, with his brother Jacob, was running a small factory. But things were difficult, the more so because Hermann was a Jew. Many Germans did not like Jews. There was another reason too for the failure of Einstein's business. The army was getting stronger and stronger and the military people forced the civilians to buy things only from certain shops. Hermann's profits started falling and, ulti-

mately, a time came when the family had to leave Munich. Hermann planned to go to Milan in Italy where a dry-goods and hardware store was available for purchase. It was decided that Albert would stay behind at the boarding house of a friendly old lady, and complete his schooling. The family was sad at leaving him alone, but there was no other way.

As a matter of fact, the moving of the Einstein family to Milan proved a blessing in disguise for Albert. It provided Albert with an opportunity to leave the Gymnasium, which he so hated with its iron-discipline atmosphere, and teachers like sergeants. Though Albert was a very mediocre student of languages, he was far beyond the graduates of his Gymnasium in mathematics. But the tragedy was that even his mathematics teacher did not like him. For sometimes he asked questions which the teacher could not answer.

On the other hand, he was receiving exciting letters from Milan describing the wonderful country and the cordial people. The attraction of Italy, as well and the ill-treatment at school, were too strong and Albert decided to leave Germany. He worked out a plan with the help of a doctor. The doctor certified that Albert Einstein was suffering from nervous exhaustion and should be allowed to leave the school. The school authorities were only too willing to fall in line. Of course, for their own reasons. And so, at fifteen and a half, Albert was on his way to Milan.

How wonderful to be with family again! For six months Albert did not join any institution. He was free and he wanted to enjoy his freedom to the utmost. He decided to abandon his German citizenship. He wanted to be free of all shackles. But this freedom did not make him negligent. He had become aware that an individual's greatest responsibility is towards himself. The absence of compulsion strengthened his character.

If Hermann's business had been prosperous, we do not know what

Albert would have done. As luck would have it, even in Milan Hermann's economic condition was worsening day by day. So the young Einstein was forced to think of a career. He was too young for any professional training and his schooling had yet to be completed.

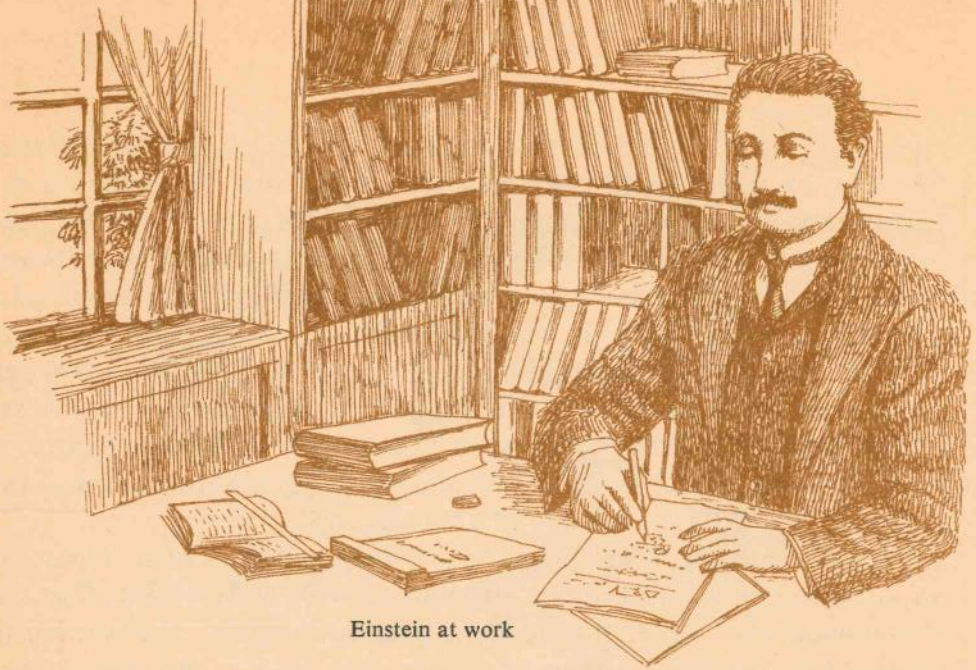
But Albert was determined never to return to the Gymnasium. He decided to go to Switzerland and join the famous FIT or 'Poly', the short for the Swiss Federal Polytechnic Institute at Zurich. As he had not obtained a diploma from the Gymnasium in Munich, he had to appear for an entrance examination.

The results gave Albert a rude shock. He was an utter failure. His performance in mathematics and physics astounded the professors. But he was miserably poor in language and in descriptive natural sciences.

The only way out was to join a high school again and pass his matriculation. As suggested by the rector of the 'Poly', he went in the autumn of 1895 to Aaran to join a technical school. He almost dreaded the thought, expecting that he would have to undergo the same tortures that he had suffered at the Gymnasium in Germany.

But fortunately he was proved wrong. A great German poet Schiller had said about Switzerland, "In these mountains dwells freedom." And Albert found this freedom, not only in the mountains, but also in the people, and the school and the teachers. He found a very liberal atmosphere at the school. A free and a youthful spirit prevailed. The teachers were approachable and human. He lived with a teacher whose son was to become his brother-in-law. A year passed and Albert passed his matriculation examination with ease. He came to Zurich not as a candidate but as a student of the 'Poly'!

The Swiss Federal Polytechnic Institute was famous for learning not only in Switzerland but throughout Central Europe. During the four years that he was there (1896-1900), Einstein studied mathematics, physics, astronomy and the history of scientific thought. In addition,



Einstein at work

he also studied subjects like anthropology, the fundamentals of economics, philosophy, etc. His great love was physics. "I worked most of the time in the physics laboratory, fascinated by the direct contact resulting from experiments," he wrote in his autobiography years later.

At the 'Poly' students were not compelled to attend particular classes. There were two examinations and, apart from them, a student could do more or less as he pleased. Einstein took advantage of this freedom and chose his own activities until a few months before the examination. Then, he borrowed the notes of a friend who attended the lectures regularly and prepared for the examination. Surprisingly, he did fairly well. He took the intermediate examination in the winter term and, in the spring of 1900, successfully passed the far more difficult diploma examination.

Still his professors did not find anything very exceptional in Einstein. Minkowski, who taught him, was one of the first to recognize the importance of Einstein's contribution to science when the latter published his Special Relativity Theory. But even he was really surprised by it. This is what he confessed to a student: "For me it came as a tremendous surprise for, in his student days, Einstein had been a lazy dog. He never bothered about mathematics at all." Professor Pernet, who taught practical physics often used to complain: "He always does something different from what I have ordered!" But, according to the Professor's assistant, Einstein's solutions were right and the methods he used were always of great interest!

During these years he made some very good friends. The most important among whom was a girl named Mileva Maritgeh. She had also joined the 'Poly' in the same year as Einstein. She wanted to obtain her teacher's certificate from the 'Poly' and devote her life to teaching and scientific work. Though in many ways opposite in nature, Einstein and Mileva fell in love during their years at the 'Poly', and decided to marry after Einstein obtained his diploma and found a satisfactory job.

As we saw earlier, Einstein completed his studies in the spring of the year 1900. At the turn of the century he entered a new phase of his life. Little did he know that within a short time he was going to shake the whole foundation of scientific thought and usher in a revolution in scientific thinking.

Mileva Maritgeh and Einstein

3. The Genius at a 'Shoe Maker's Job'

It was the first year of this century.

Einstein was jobless. The prospects for this dreamy young man were not at all bright, for three reasons: first, he was not yet a Swiss citizen; second, he was not very practical; third, he was a Jew. An allowance that he used to get from a rich relative stopped as soon as he became a graduate. We can well imagine the hardships that he must have suffered during this critical year. He did some

odd jobs like doing calculations for Professor Wolter in his researches, working as a substitute teacher in a school, and tutoring an English boy who wanted to study at the 'Poly'. But, for Einstein, these material and economic hardships had no importance. He had never bothered about material comforts and luxuries. His needs were the minimum, and so he was able to keep in good spirits.

At last he became a Swiss citizen and in June 1902 joined the Swiss Patent Office as a "technical expert, third-class" on a salary of 3,500 Swiss francs. The next year, when he was promoted and his salary was raised, he asked: "But what shall I do with all that money?"

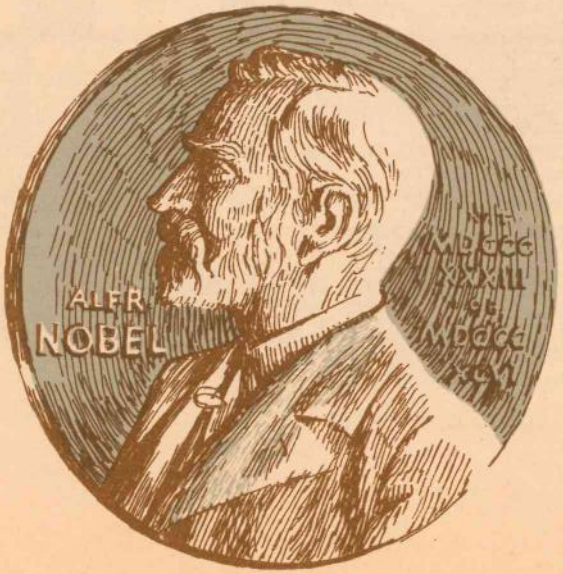
Now that he had a permanent job, Einstein and Mileva decided to marry. Einstein was now working on three 'fronts' so to say. The first was the home front, as a husband and later on as the dutiful father of two sons. The second was the 'office', where he had to sit for eight hours at a desk, examine various patents and prepare reports on them. Many a time he called this a 'shoe-maker's job'. It brought him a decent salary and, as it was not very absorbing, left him free to work on the third front. Shall we call it Einstein's own front? For it was the one nearest to his heart: research.

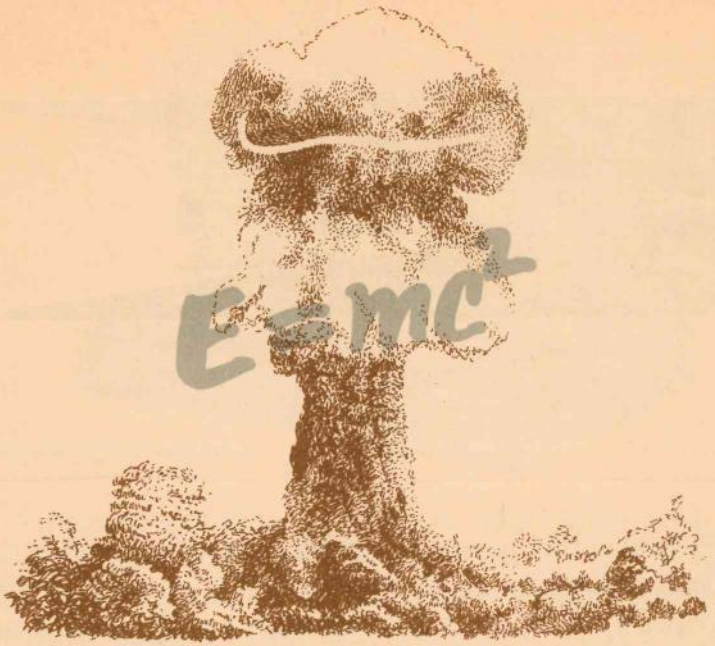
During his years of service at the Patent Office in Berne, Einstein was very active on the last 'front'. His first major contribution to science started taking shape in his mind, in the peaceful atmosphere of Berne. The year 1905 proved to be the most fruitful year. In this year he published in a scientific journal *Annalen der Physic* not one or two but five research papers of such importance that any one of them would have secured him a permanent place in the annals of science.

For the first paper, Einstein obtained his Ph. D (Doctor of Philosophy) degree. The second one dealt with the nature of light. In this paper, Einstein pestulated the photo-electric law (which dealt with the conversion of light energy into electrical energy and *vice versa*). This law was experimentally verified later on. In recognition

of this discovery, Einstein was awarded the Nobel Prize in 1921. The third paper explained the cause of the movement of pollen grains suspended in a steady liquid.

The fifth paper was titled: "Is the Inertia of a Body Dependent upon Its Energy Content?" It was a very short paper. But its contents almost literally shook the world, not in the year 1905 when it was published, but in the year 1945 when atom bombs destroyed Hiroshima and Nagasaki. In this paper, Einstein proved that matter and energy were not two separate things, as was believed till then. Matter could be converted into energy and energy into matter. For the scientists, this solved the mystery of the sun. The mystery was how the sun kept sending out light and heat for billions of years without much change. If it produced light and heat as a burning coal did, it would have burnt itself up ages ago. When scientists applied Einstein's formula to solve this mystery, they found that the temperatures in the interior of the sun are so high that at those temperatures some of the matter of the sun is converted into energy. It is this energy that is responsible for the heat and light that we get from it. The same



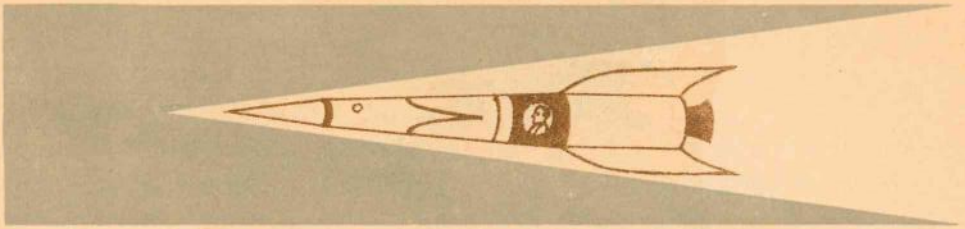


relation between matter and energy is utilized nowadays in nuclear reactors all over the world to convert matter into forms of energy, such as electricity.

This short survey of four of the five research papers that Einstein published shows the different directions in which Einstein's genius was flowering at that period. Had he done nothing else in his lifetime, he would still have been acclaimed as a great scientist.

But there is yet another paper, the fourth one, which we have not yet touched upon. It was this paper that revolutionized the thinking of scientists who came after him. When a famous Polish Professor read this paper he exclaimed, "A new Copernicus has been born."

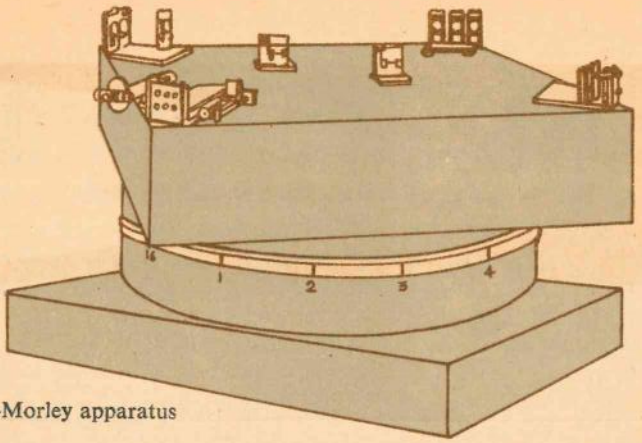
In 1943, when a copy of this paper in Einstein's own handwriting was auctioned to raise money for the American War Loan, it fetched



$ 6,000,000 ! It was this paper that made Einstein immortal. It was entitled "Electrodynamics of Moving Bodies". A very unattractive title ! This paper was indeed as revolutionary as, if not more so, than Copernicus's explanation of the solar system. It explained in thirty pages the very famous THEORY OF RELATIVITY; to be very exact, THE SPECIAL THEORY OF RELATIVITY.

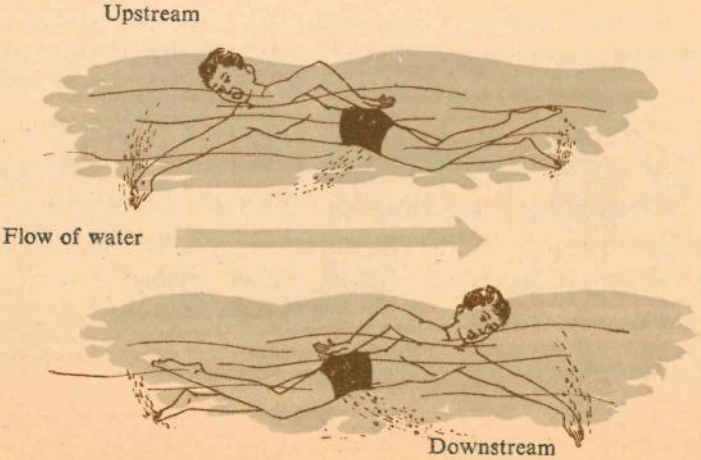
When Einstein was about 16 years old, a question started worrying him. What would happen if a person travelled with the speed of light? To us the question may seem rather queer with no relation to reality. But to Einstein it was very real and it worried him for at least ten years before he solved it. The Theory of Relativity was his solution to this question.

In those days the nature of light was creating many problems for scientists. It was believed that light rays travelled through a medium known as 'ether', just as a ship travels through a calm sea. Now, when we move in a train, the trees and all other objects appear to rush past us in the opposite direction. So if the earth moves round the sun in the 'ether' it is natural to suppose that the 'ether' would appear to move in the opposite direction, in other words that there would be a kind of ether-wind rushing past.



The Michelson–Morley apparatus

Two American scientists, Michelson and Morley, tried to detect this apparent motion of the 'ether-wind' with the help of light signals. But their experiment failed. They could not detect any 'ether-wind'. The experiment failed in another respect too. It is a common experience with swimmers that when they swim with the current of the stream they can swim faster. If the current flows at, say, 3 kilometres per hour and the swimmer can swim at 4 kilometres per hour, the resultant speed of the swimmer would be 7 kilometres per hour downstream and only 1 kilometre per hour upstream. Michelson



and Morley reasoned that if a ray of light travelled along the direction of the earth's motion, the resultant speed of the light ray must be the sum of the two speeds, i.e. the speed of light and the speed of the earth. And in the opposite direction, the resultant speed must be the difference between the two speeds. But when experiments were performed to verify this, they failed. The scientists had to conclude that "The speed of light is independent of the motion of the observer."

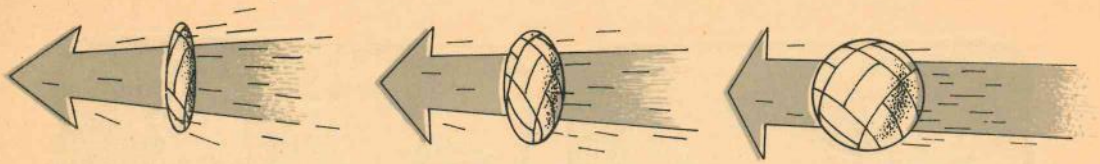
The two failures of the experiment, i. e. the failure to detect the relative motion between the earth and the ether, and the failure to detect any change in speed of light could not be accounted for on the basis of Newton's Laws of Motion. Scientists did not see any way out of the 'darkness' created by 'light' !

Then came Einstein. His arguments were based on two assumptions:

1. The laws of physics are the same whether there is relative motion or not.
2. If a source of light is itself in motion, this does not affect the speed of light. In other words, the speed of light is constant and independent of the speed of the source.

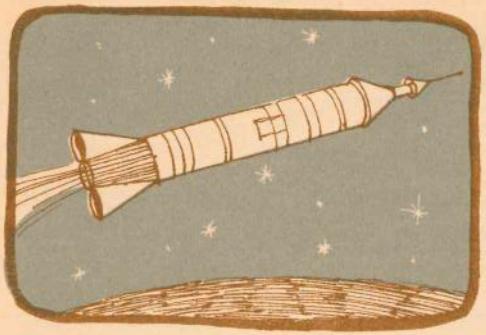
Both these assumptions are based on experiments. But when Einstein put them together and drew the logical conclusions the results were startling. Here we will discuss only some of them.

The most important conclusion that Einstein arrived at in his theory of relativity was regarding the velocity of light. He proved that when an object travels at a speed which is comparable to the speed of light, its length decreases and its mass increases. For example, if a football travelled at a very, very great speed, it would increase in mass and would get flattened. According to Einstein's calculations, if an object attained the speed of light (186,000 miles per second) its length would become zero and its mass infinite. Now this is absurd. So Einstein concluded that nothing could ever travel as fast as or faster than light.



His second conclusion was that if an observer with a clock were to travel at a very, very great speed, comparable to that of light, his clock would 'slow down', i.e. time itself would slow down. Popular science writers have tried to illustrate this by sending one of twin brothers travelling in a spaceship at speeds comparable to that of light. When the astronaut brother returns he finds that though he has remained young his brother has grown very fast. The flow of time is relative!

"That's nonsense! Absurd!" you might exclaim. Yes, it does seem absurd. But, though nobody has sent a twin brother into space, experiments have proved that these conclusions that Einstein drew are correct. In 1910, Professor Bucherer found that very fast-moving electrons did increase in mass. Later on, the slowing down of time was also conclusively proved by another scientist while working with hydrogen atoms. During the Second World War, when the research for preparing the atom bomb was in progress, the engineers had to



keep in mind this increase in the mass of particles moving at great speed while constructing their machines.

A third conclusion was regarding space and time. Up to that time space was considered to have three dimensions, viz. length, breadth and height. Time was considered to be independent of space. In 1908, Professor Minkowski said at a meeting of scientists, "Gentlemen, the views of time and space that I wish to develop before you grew on the soil of physical experiments. From now on Space in itself and Time in itself should descend into a shadow and only a union of both should retain its independence." This union gave rise to what is known as the Space-Time Continuum which has four dimensions, viz. length, breadth, height and time.

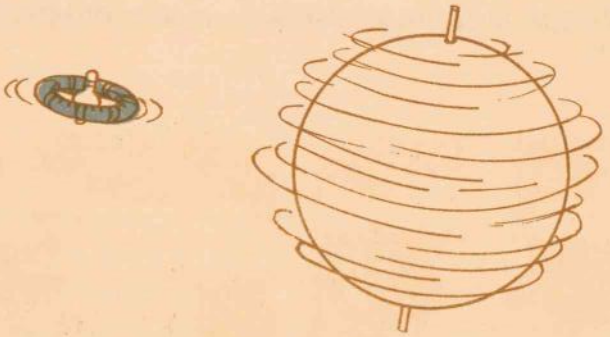
The relation between mass and energy that Einstein developed (we have discussed this earlier) was also a result of this Special Theory of Relativity.

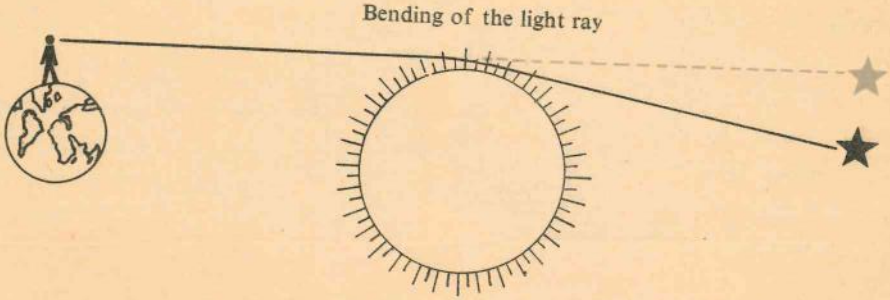
Einstein did not rest after formulating the Special Theory of Relativity in 1905. He started expanding that theory and ultimately, in 1916, completed what is known as 'The General Relativity Theory'. In this he showed that the force of gravity which is exerted by the

earth is the result of acceleration caused by the change of direction as the earth rotates on its axis, and that the same is true for all other heavenly bodies that produce gravitation. As a matter of fact, for the future spacestation, scientists plan to produce artificial gravity by rotating the spacestation on its axis. Einstein proved that, just as a magnet has a magnetic field round it, rotating bodies have gravitational fields round them—the more massive the body the stronger the field. The effects of this gravitational field, as calculated by Einstein, were at times different from those predicted by Newton's Laws of Gravitation.

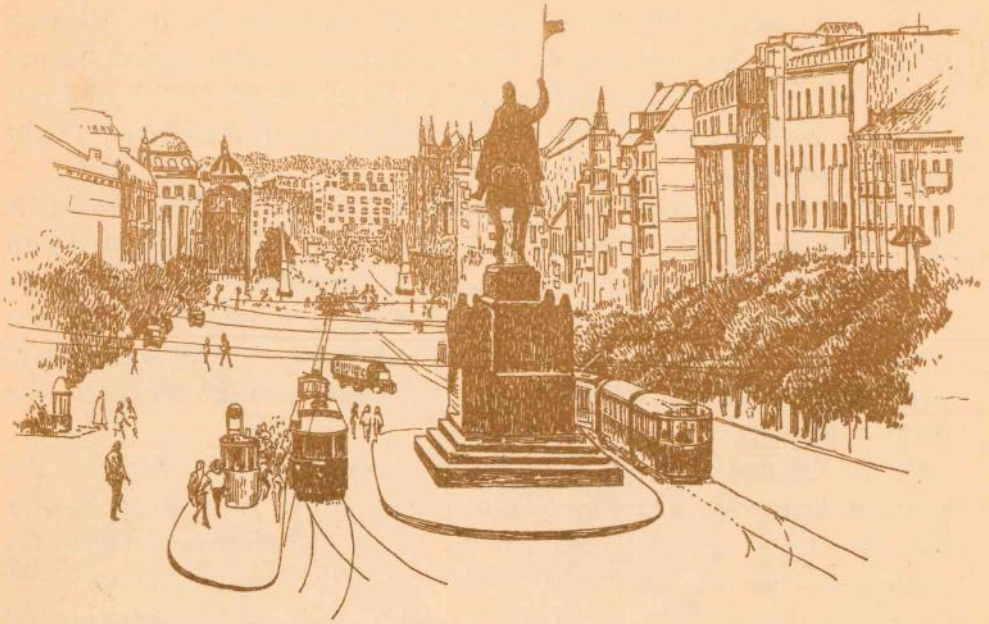
According to Einstein, one of the effects of this gravitational field is that a ray of light, in passing through it, would change its path and bend. In 1919 special expeditions were sent to Africa and Brazil to photograph the stars during a total eclipse of the sun. The purpose was to see whether the light coming from the stars changed its path when passing near the sun. The photographs conclusively proved that Einstein was right.

This is a brief and sketchy survey of the Theory of Relativity which shook the world and changed its whole attitude towards space and time.





Regarding the discovery of this theory Einstein once said: The normal adult never bothers his head about space-time problems. Everything...has been done in early childhood. I, on the contrary, developed so slowly that I only began to wonder about space and time when I was already grown up. In consequence I probed deeper into the problems than any ordinary child would have done.



Prague

4. For Freedom and Peace

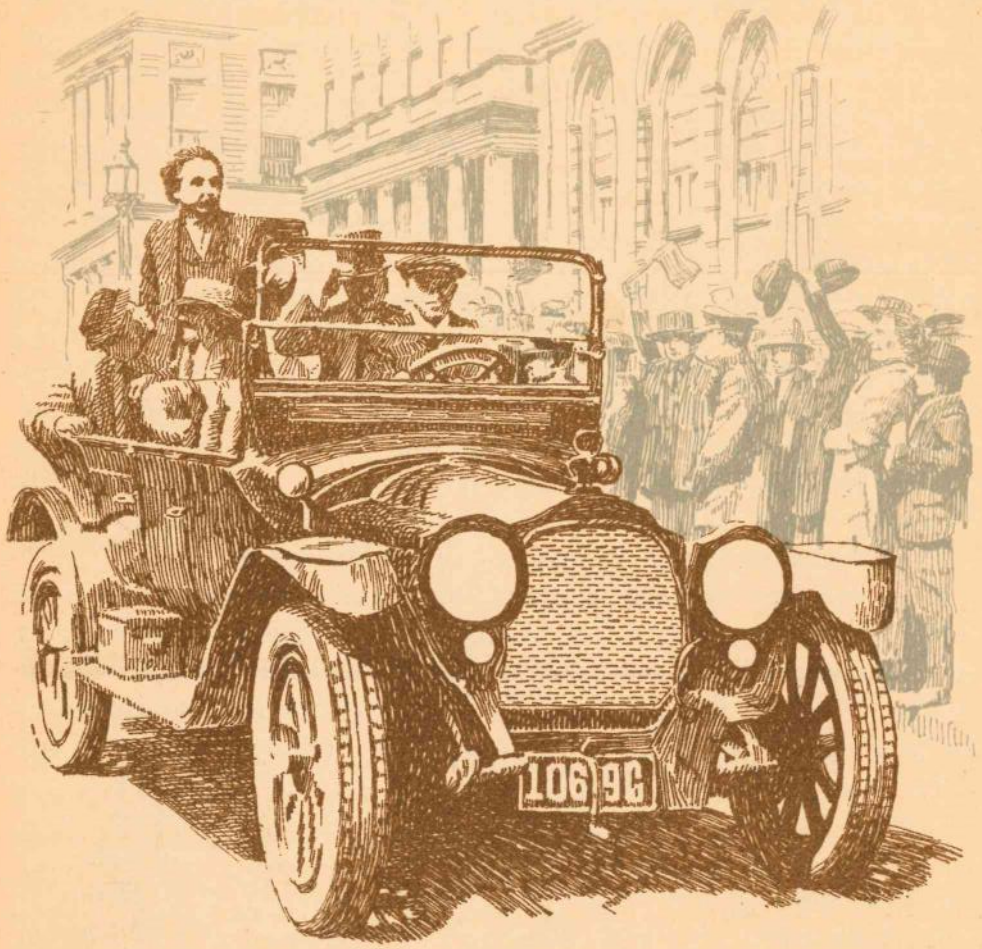
Gradually the importance of Einstein's work began to be realized. He who did not get even a modest teaching position in 1901 was now offered one position after another. There was, so to speak, a competition among various universities the world over to get him. Between 1905 and 1912 he taught at the Universities of Berne, Zurich, and Prague. In 1912 he joined his *alma mater* and taught Theoretical

Physics there for one year. Then he was invited to join the Prussian Academy in Berlin. He was promised full freedom for his research and so, in 1913, Einstein moved back to Germany after almost twenty years. His wife decided to stay behind in Switzerland. In the previous few years, husband and wife had been drifting apart and they thought it wise to separate.

Einstein was not at all carried away by his fame. This is what he said: "Today, I am considered in Germany a German scientist and in England a Swiss Jew, but if one day I become *persona non grata* [a non-acceptable person] I would become a Swiss-Jew for the Germans and a German Scientist for the English." Only a few years later he saw the bitter truth of this statement verified as far as the Germans were concerned.

Almost immediately after his return to Berlin as a member of the Prussian Academy, the First World War broke out. Einstein was from the very beginning against all kinds of violence. He was a pacifist, i.e. one who believed that war should and could be abolished. He buried himself more deeply in his researches in the General Relativity Theory. The end of the war found Germany defeated and in ruins. After the war Einstein visited the U.S.A. for the first time, to raise money for the Hebrew Institute in the city of Jerusalem in Palestine (now partly Jordan and partly Israel). He was accompanied by his second wife, Elsa, whom he had married in 1916. People in the U.S.A. gave Einstein an unprecedented welcome. Thousands waited in the streets to cheer him in New York. At a farewell dinner Einstein was greeted not only as a great scientist but also as a great Jew, "the possessor of a warm and beautiful heart."

After his return to Germany in 1921, Einstein received the Nobel Prize. As mentioned earlier, this was for his work on the photo-electric effect. Relativity was yet a subject of controversy. He sent half the money to his former wife. He wrote that this was in appreciation of

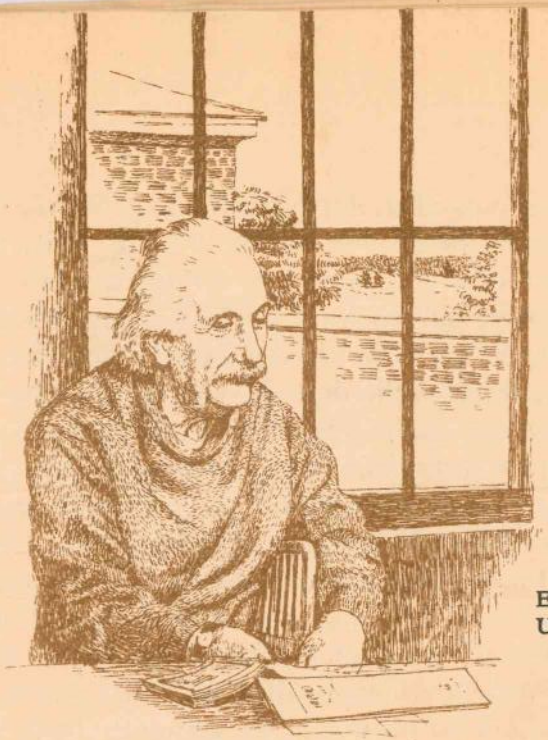


Einstein's arrival in the U.S.A.

her help and loyalty and love when times had been bad. The other half he donated to charity.

The economic condition of Germany was then worsening day by day. People were growing discontented. The democratic government had failed to improve the condition of people. The politicians were trying to find scapegoats to blame for the conditions. The pacifists, the democrats, and the Jews were excellent scapegoats. And Einstein was all three! He once wrote: "When the Germans lost the world war...immediate attempts were made to blame the Jews, first for instigating the war and then for losing it." It started becoming more and more difficult for Einstein to concentrate on his research in this atmosphere of hate and oppression. The Nazi Party, which was gaining more and more power and influence over the people, indicted them against all Jews. Einstein's books were burnt in public and a leaflet containing his picture with the caption, "Not yet hanged", was circulated. Einstein had no choice but to leave Nazi Germany. He declared: "I will stay only in a country where political liberty, toleration, and equality of all citizens before the law are the rule."

He decided to migrate to the U.S.A. and join the Institute of Advanced Study at Princeton. When the University asked Einstein to set his own salary he indicated that 3,000 dollars a year would be ample. "Could I live on less?" he asked. Ultimately the university decided to pay him 16,000 dollars a year. Einstein easily adjusted himself to his new surroundings. He soon became a favourite of the advanced students. He used to tell them, "If you have a problem, come to me with it. You will never disturb me, since I can interrupt my own work at any moment." And students did go to him with their difficulties. Not only advanced students, but also students at school approached him. Once a schoolgirl wrote to the great scientist about her geometry problem and Einstein found time to help her and to send her the solution. Students at Princeton had composed a



Einstein at Princeton University

song about their favourite teacher :

> The bright boys, they all study math
> And Albie Einstein points the path
> Although he seldom takes the air
> We wish to God he'd out his hair.

In those days Einstein was also busy helping immigrant Jews to settle in the U. S. A. He fought injustice on all fronts. The Jews were persecuted more and more in Germany, and more and more were migrating to the U. S. A. Einstein did all he could to help them. On his 'own front' he was working on the "Unified Field Theory", which he completed in 1949. In this theory he tried to show that gravitational fields and electromagnetic fields are two aspects of a single universal force. This theory has not yet been verified by experiment.

Though a born pacifist, during the Second World War Einstein felt it his duty during the Second World War to write to Roosevelt, the then President of the U. S. A., on 2 August 1939, advising him to speed up experimental work on nuclear chain reactions with a view to constructing an atom bomb. An extract from the letter will show how clearly he foresaw the destructive power of the bomb: "A single bomb of this type... might well destroy the whole port together with some of the surrounding territory." When the President received this letter he said, "This requires action," and the result was the atom bombs that destroyed Hiroshima and Nagasaki. Later on, Einstein said, "Had I known that the Germans would not succeed in developing an atomic bomb, I would have done nothing for the bomb."

Though it was difficult for his friends to believe this, Einstein was getting old. The death of his beloved wife Elsa was a severe blow. He sought consolation for his loss in his search for truth in science and his

Franklin D. Roosevelt

Einstein with Jawaharlal Nehru

search for peace for humanity. He said: "Taking an active part in the solution of the problems of peace is a moral duty which no conscientious man can shrink." In another place he wrote: "I would teach peace rather than war, I would inculcate love rather than hate."

Though he knew that time was running out for him, he found time for two causes, Freedom and Peace, which were always nearest his heart. In the international 'World Federation' his words were taken as law. Shortly before his death he had suggested to Jawaharlal Nehru that he sponsor a scheme for peaceful settlement of all problems arising between nations.

Throughout his life he had studied Time and proved that 'Time' is not absolute but relative, depending upon the speed with which one moves. On 18 April 1955 'Time' for Einstein stopped flowing.

Yes, on that day, Albert Einstein, the great scientist and greater man, died and became immortal.

Albert Einstein

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