

Looking Back

Einstein's *Annus Mirabilis*

This year marks the fiftieth anniversary of Albert Einstein's death, and the centennial of his most astonishing achievement—the rapid publication of a series of papers that transformed modern physics and changed our conception of the universe.

Despite flashes of brilliance, Einstein had always been a scholarly misfit. He was slow as a child; he received low marks in grammar school; he was a daydreamer kicked out of high school because of his bad attitude; he failed on his first attempt to get into a polytechnic institute; when he finally did get in, he cut classes so frequently that he only passed his exams by borrowing a friend's notes. After failing to get hired as a teacher and then getting fired from a position as a private tutor, he took a job in 1902 as a lowly assistant examiner in the Swiss Patent Office. Like so many other civil servants before and since, Einstein spent hours of his workday goofing off—which, in his case, meant filling scraps of paper with calculations and equations. To the scientific world, he was a 26-year-old nobody: He had, in this period, almost no feedback from academic colleagues and no real access to scientific literature. All he had were his own scribbles, with which he developed the mathematical tools needed to unriddle deep mysteries of the physical world.

His thinking came to a head in 1905. In that year, still working in the patent office, he finished a doctoral dissertation and published four major articles. One paper related to Brownian motion, the jittery movement of tiny particles. Einstein showed how the motion could be mathematically explained in terms of colliding molecules, a critical step in the validation and expansion of atomic theory. Another paper used quantum theory, then still quite new, to explain the photoelectric effect—a phenomenon that classical physics couldn't explain. This work gave quantum mechanics a new respectability, and eventually earned Einstein the Nobel Prize in Physics. But his greatest work that year came in two papers on what has come to be known as “special relativity.” This was a revision of the fundamentals of Newtonian physics and led to a new understanding of the unity of space and time. As part of this theory, Einstein worked out the famous equation $E=mc^2$ showing the relationship of mass and energy.

In later years, Einstein came to regret some of the ramifications of his *annus mirabilis* work. Despite his quantum mechanical explanation for the photoelectric effect, he remained forever uncomfortable with quantum theory. He disliked the way people would confuse his concept of *physical relativity* with *philosophical relativism*. And of course he came to despise the atomic bombs that were the best-known manifestations of his mass-energy equivalence.

Perhaps for us the greatest lesson of Einstein's 1905 genius is how it reveals a common misconception about science. It is often taken for granted that scientific discovery rudely strips away nature's secrets, banishing mystery in favor of cold fact. But in truth, as our understanding grows, the mysteries only multiply. As the age of science progresses, the universe only becomes a stranger and ever more beautiful thing to behold, deserving of our wonder and awe.