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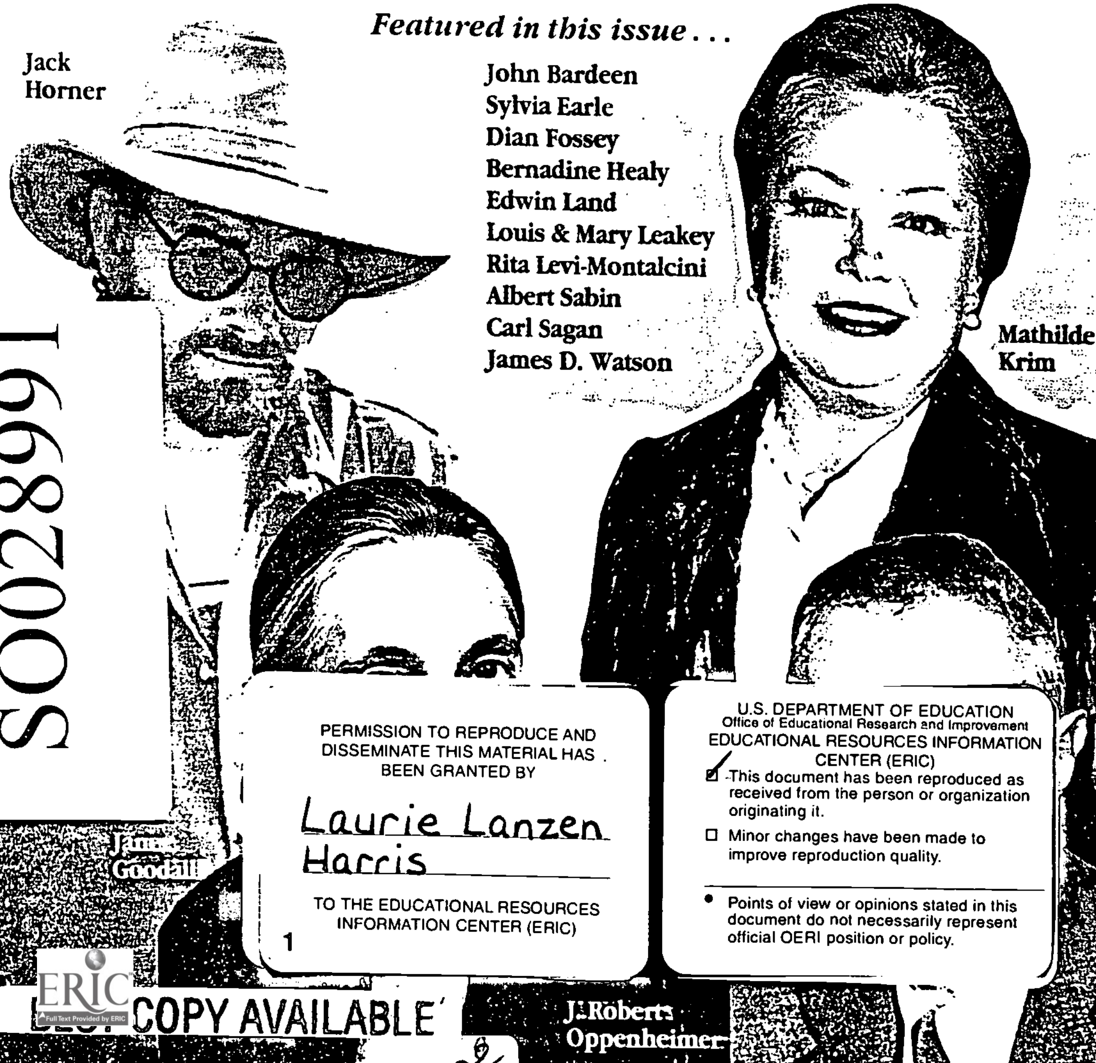
ABSTRACT

This issue of "Biography Today" looks at scientists and inventors and is created to appeal to young readers in a format they can and enjoy and easily understand. Each entry provides at least one picture of the individual profiled, and bold-faced rubrics lead the reader to information on birth, youth, early memories, education, first jobs, marriage and family, career highlights, memorable experiences, hobbies, and honors and awards. Entries also provide information on further reading for readers. Obituary entries are included to provide a perspective on an individual's entire career. Each issue concludes with a name index, a general index, a birthplace index, and a birthday index. The scientists and inventors highlighted are John Bardeen (obituary), Sylvia Earle, Dian Fossey (obituary), Jane Goodall, Bernadine Healy, Jack Horner, Mathilde Krim, Edwin Land (obituary), Louis Leakey, Mary Leakey, Rita Levi-Montalcini, J. Robert Oppenheimer (obituary), Albert Sabin, (obituary), Carl Sagan, and James D. Watson. (RJC)

Vol. 1
1996

Biography Today

Profiles of People of Interest to Young Readers



Featured in this issue . . .

John Bardeen
Sylvia Earle
Dian Fossey
Bernadine Healy
Edwin Land
Louis & Mary Leakey
Rita Levi-Montalcini
Albert Sabin
Carl Sagan
James D. Watson

Biography Today

Profiles of People of Interest to Young Readers

Scientists & Inventors Series

Vol. 1
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Preface

Welcome to the first volume of the new **Biography Today Scientists and Inventors Series**. We are publishing this new series in response to the growing number of suggestions from our readers, who want more coverage of more people in *Biography Today*. Five new volumes, covering **Authors, Artists, Scientists and Inventors, Sports Figures, and World Leaders,** will be appearing in 1996. Each of these hardcover volumes will be 200 pages in length and cover approximately 15 individuals of interest to readers aged 9 and above. The length and format of the entries will be like those found in the regular issues of *Biography Today*, but there will be **no** duplication between the regular series and the special subject volumes.

The Plan of the Work

As with the regular issues of *Biography Today*, this special subject volume on **Scientists and Inventors** was especially created to appeal to young readers in a format they can enjoy reading and readily understand. Each volume contains alphabetically arranged sketches. Each entry provides at least one picture of the individual profiled, and bold-faced rubrics lead the reader to information on birth, youth, early memories, education, first jobs, marriage and family, career highlights, memorable experiences, hobbies, and honors and awards. Each of the entries ends with a list of easily accessible sources designed to lead the student to further reading on the individual and a current address. Obituary entries are also included, written to provide a perspective on the individual's entire career. Obituaries are clearly marked in both the table of contents and at the beginning of the entry.

Biographies are prepared by Omni editors after extensive research, utilizing the most current materials available. Those sources that are generally available to students appear in the list of further reading at the end of the sketch.

Indexes

To provide easy access to entries, each issue of the regular *Biography Today* series and each volume of the Special Subject Series contains a Name Index, General Index covering occupations, organizations, and ethnic and minority origins, Places of Birth Index, and a Birthday Index. These indexes cumulate with each succeeding volume or issue. Each of the Special Subject Volumes will be indexed as part of these cumulative indexes, so that readers can locate information on all individuals covered in either the regular or the special volumes.

Our Advisors

This new member of the *Biography Today* family of publications was reviewed by an Advisory Board comprised of librarians, children's literature specialists, and reading instructors so that we could make sure that the concept of this publication—to provide a readable and accessible biographical magazine for young readers—was on target. They evaluated the title as it developed, and their suggestions have proved invaluable. Any errors, however, are ours alone. We'd like to list the Advisory Board members, and to thank them for their efforts.

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Our Advisory Board stressed to us that we should not shy away from controversial or unconventional people in our profiles, and we have tried to follow their advice. The Advisory Board also mentioned that the sketches might be useful in reluctant reader and adult literacy programs, and we would value any comments librarians might have about the suitability of our magazine for those purposes.

Your Comments Are Welcome

Our goal is to be accurate and up-to-date, to give young readers information they can learn from and enjoy. Now we want to know what you think. Take a look at this issue of *Biography Today,* on approval. Write or call me with your comments. We want to provide an excellent source of biographical information for young people. Let us know how you think we're doing.

And here's a special incentive: review our list of people to appear in upcoming issues. Use the bind-in card to list other people you want to see in *Biography Today.* If we include someone you suggest, your library wins a free issue, with our thanks. Please see the bind-in card for details.

Laurie Harris
Executive Editor, *Biography Today*

OBITUARY

John Bardeen 1908-1991
American Physicist and Educator
Co-Invented the Transistor and Developed the Theory of Superconductivity
Winner of Two Nobel Prizes in Physics, in 1956 and 1972

BIRTH

John Bardeen, whose scientific accomplishments gained him recognition as one of the great minds of the 20th century, was born May 23, 1908, in Madison, Wisconsin. He was the second oldest son of Charles Russell Bardeen, a professor of anatomy and dean of the University of Wisconsin Medical School in Madison, and Althea Harmer Bardeen, an artist. His grandfather was the author and educator Charles William Bardeen. He had two brothers, William and Thomas, a sister, Helen, and a half-sister, Anna.

YOUTH

Bardeen was a bright child who displayed an early talent for mathematics and a love for science. His mother encouraged him to make the most of his skills. She took an active role in his education, praising his curiosity about science and using flash cards to teach him arithmetic. Bardeen's parents wanted him to have a balanced academic and social life, though, so his childhood was a normal one in many respects. Although he skipped four grades and attended high school classes with students several years older than himself, Bardeen often played in the neighborhood with elementary school children who were his own age.

He also spent a lot of time playing with his brother Bill, with whom he was very close. The two boys were fans of the comedy duo Laurel and Hardy, and they often acted out the comedians' antics. Once, when John was eight or nine, a neighbor came to the house to report to his mother that she had seen John hanging by his feet from a third floor window sill, the result of a skit that went a little too far. Bardeen also loved sports, and as a youth he developed what would become a lifelong passion for golf.

EDUCATION

Bardeen sailed through his elementary and high school classes with amazing speed. Upon completing third grade, Bardeen skipped to the seventh grade at the University of Wisconsin high school in Madison. The next year, at the age of ten, he won a city-wide high school algebra contest. Bardeen's remarkable scholastic feats continued through his high school years, and in his junior year he transferred to the city's public high school because of its superior laboratory facilities. Bardeen pursued his love of science outside the classroom as well, setting up a laboratory in the family's basement to conduct electrical experiments and build radios. Bardeen graduated from high school at age 15 with his brother Bill, who was two years older.

Bardeen earned his bachelor's and master's degrees in electrical engineering in 1928 and 1929 from the University of Wisconsin in Madison. During his college years, he made the varsity swim and water polo teams for three years. Bardeen's competitiveness and skill at games also showed themselves in other ways during his college days. He was a sharp card player, and his poker winnings during college enabled him to pay his fraternity dues and other expenses. After receiving his master's degree, Bardeen followed his favorite professor, Leo Peters, to Gulf Research and Development Corporation in Pittsburgh, Pennsylvania. The three years Bardeen spent at Gulf as a geophysicist were very productive. During this time he invented a new electromagnetic method for oil prospecting. His approach was so new that Gulf, concerned that rival companies would learn too much, did not apply for a patent for it. In fact, his invention was kept secret for some 30 years. While at Gulf, he also collaborated with L. J. Peters on papers concerning electric methods of oil exploration which appeared in the March 1932 issue of *Physics*. After spending three years at Gulf, though, he left his $6,000-a-year job to return to school to study theoretical physics in 1933.

Bardeen enrolled at Princeton University in New Jersey in 1933 because he had heard that the famous scientist Albert Einstein, who had recently left Germany, was going to take a faculty position there. To Bardeen's great disappointment, Einstein joined the Institute for Advanced Study instead, indicating that he had no interest in taking on any students.

Bardeen received his Ph.D. in mathematics and physics from Princeton in 1936, but he also studied at Harvard at the same time. In 1935 he had become a junior fellow at the Society of Fellows, a group established by Harvard in the mid-1930s to foster the ideal of a community of scholars devoted to the advancement of learning and interdisciplinary communication. He remained with the society until 1938.

CAREER HIGHLIGHTS

After receiving his Ph.D., Bardeen was appointed to an assistant professorship in physics at the University of Minnesota in 1938. With the entry of the United States into World War II in 1941, Bardeen moved to Washington, D.C., to take a position as principal physicist at the Naval Ordnance Laboratory. (Ordnance is the military term for exploding weapons.) Even though he was thousands of miles from where the war was being fought, Bardeen and many others like him did their best to support their country's soldiers. Bardeen's efforts at the Naval Ordnance Laboratory were focused on designing submarines that could elude German mines and torpedoes. He worked at the laboratory until the war ended in 1945.

After the war, as Bardeen was deciding whether to direct his energies to solid-state or nuclear physics, he was recruited by William Shockley to work at Bell Research Laboratories, in Murray Hill, New Jersey. Bell had recently decided to establish a department dedicated to research in solid-state physics, the study of the properties of solid materials. Bardeen accepted the job offer, and for the next six years he worked on various aspects of solid-state physics, including studies of semiconductor materials. Semiconductors are crystals that conduct electricity in a special way—less well than a conductor, like copper wire, but much better than an insulator, like rubber or plastic.

THE TRANSISTOR

As time passed Bardeen became increasingly interested in studying electrical conduction in semiconductors. He teamed with fellow Bell scientists William Shockley and Walter Brattain to come up with a device that would replace the vacuum tubes then in use in telecommunications and early computing applications. Vacuum tubes were big, expensive, needed time to warm up, and burned out like light bulbs. The result of the effort of Bardeen and his colleagues was the "transistor." A transistor is a solid-state electrical device that amplifies or switches electrical current. What was unique about the transistor, and what made it superior to earlier electrical devices, was that it required no moving parts and no vacuum tubes. The term "transistor" was coined by another Bell scientist, John Pierce, as an abbreviation of "transfer" and "resistor," although the trio of inventors jokingly referred to it as the "persistor" since they had only been able to develop it because of their persistence.

Quiet and modest, Bardeen did not like to waste words. On the day he and his colleagues figured out the transistor, he returned home at the end of the work day at his usual time, walked into the kitchen where his wife was preparing dinner, and said, "we discovered something today."

Bardeen, Shockley, and Brattain unveiled the transistor to the executives at Bell in a demonstration on December 23, 1947, that amplified a human voice. The significance of their invention was not immediately recognized, in part because transistors required four more years of refinement before they could be mass produced. It was not until 1951 that the first commercial devices were produced. But Bardeen and his colleagues had, with their invention, ushered in the modern age of electronics.

The general public may not know John Bardeen's name, but they know the products brought about by his work on transistors. Today, transistors are crucial to the electronics that control every modern device. Cars, planes, CD players, televisions, video games, digital watches, and a host of other consumer products are possible because of transistor technology. Transistors are also core elements of missiles, heart pacemakers, computers, and other sophisticated equipment.

Bardeen left Bell Labs in 1951 to accept a joint appointment in physics and electrical engineering at the University of Illinois, Urbana, where he taught graduate classes in transistor technology. "The reason I came to Illinois was because Chicago was the center of consumer electronics industry at that time," he explained. Bardeen left Bell for other reasons too, though. The idea of returning to the academic world excited him because he wanted to work with students and concentrate on superconductivity research. But he also left in part because of his disappointment when Bell turned down his request to set up a new research group at the company.

THE THEORY OF SUPERCONDUCTIVITY

Once he settled in at Illinois, Bardeen turned his attention to the mystery of superconductivity. Since 1911, scientists had known that at low temperatures, electrons flow through certain metals smoothly without any resistance. This was known as superconductivity. Bardeen set out to develop a theory to explain the phenomenon. In 1955 he and two young colleagues—Robert Schrieffer, a graduate student, and Leon Cooper, a research fellow—began an intensive period of study. Bardeen scribbled formulas and equations in the basement of his home, and the three young researchers raced back and forth between their offices. Their enthusiasm for the project was so great that they often called each other in the middle of the night.

NOBEL PRIZE

Bardeen was always less interested in talking about past accomplishments than he was in meeting the next scientific challenge he had set out for himself. This was never more evident than when he was working on superconductivity. He was so absorbed with his work that he forgot to tune into the radio when the Nobel Prize winners for 1956 were announced. It was not until some time later, when he was at home scrambling eggs, that he heard on the radio that he had been awarded the Nobel Prize in physics for co-inventing the transistor. Amazed and excited, he dropped the frying pan and raced upstairs with his daughter to wake his wife. Yet rather than interrupt his work on superconductivity, he seriously considered not attending the award ceremony in Stockholm, Sweden.

The efforts of Bardeen, Cooper, and Schrieffer paid off in 1957 with the formulation of the theory that bears their initials, the BCS theory. Their work formed the basis for all subsequent theoretical work on the subject of superconductivity. The BCS theory stated that the current in the superconductor is carried not by individual electrons but by bound pairs of electrons that form as a result of interactions between the electrons and the vibrations of atoms.

Bardeen wanted to make certain that Cooper and Schrieffer received the recognition they deserved for their work on the BCS theory, so he arranged for his colleagues to make the first public announcement about the theory at the March 1957 meeting of the American Physical Society. He remained in Urbana while Cooper and Schrieffer told the world about their findings.

True to his modest nature, Bardeen informed a colleague of the trio's successful efforts by stating simply, "Well, I think we've explained superconductivity." Nonetheless, the soft-spoken scientist took great pride in his studies on superconductivity. Although superconductors do not have the same mass consumer appeal as do transistors, the success of the BCS theory led to a revival of interest in superconductors and their practical application. Many scientists regard Bardeen's work on transistors as a cornerstone of 20th-century technological development, but he viewed his insights into superconductivity as his most important contribution to our understanding of physics.

ANOTHER NOBEL PRIZE

Bardeen knew that the work the three men had done on superconductivity deserved a Nobel Prize, but he was also well aware that the Swedish Royal Academy of Science had never before awarded an individual two prizes in the same field. In 1972 the academy set a new precedent and awarded the Nobel Prize in physics to Bardeen, Cooper, and Schrieffer. "They might have gotten it sooner, if it hadn't been for me," Bardeen said. Bardeen thus became the first person ever to win two Nobels in the same field.

In 1975 Bardeen took an honorary position at the university in order to free up his position for a younger person. His colleagues wanted to honor him at his retirement with a party, but Bardeen insisted that he did not want a big fuss to be made. He agreed instead to a small research symposium to be held in his honor. Although retired, Bardeen kept a busy

schedule well into his 80s that nearly matched the one that he maintained in his pre-retirement days. He arrived at this office early and stayed late, unless he had a date to play golf.

ADVISOR TO INDUSTRY AND GOVERNMENT

Through almost all of his distinguished academic career, Bardeen also served as an advisor on scientific and technical matters to industry and government. In 1951 he became a consultant to Haloid-Xerox, known today as Xerox Corporation. His involvement with Xerox was a natural one, for the process of xerography involves other areas of solid-state physics. He helped shape Xerox's early research efforts, urging the company to use government contracts in specific research projects as a means of furthering its own research efforts. He was a frequent visitor to Xerox operations in Rochester, New York, and even had a voice in determining the membership of Xerox's research team. Bardeen also served on the company's technical advisory committee and was elected to the board of directors, on which he served until he reached the board's mandatory retirement age.

Bardeen's activities were not limited to Xerox. He served as a consultant to General Electric, visiting with GE scientists in their laboratories and conferring with senior management to discuss research strategy and future technical opportunities. He also helped start-up companies founded by former students of his and testified as an expert witness in a case regarding Texas Instruments' patent on integrated circuits.

In addition, he maintained a long-term relationship with Sony Corporation of Japan, visiting operations there and corresponding over the years with George (Mitio) Hatoyama, Sony's first research laboratory director, and with his successor, Makoto Kikuchi. Hatoyama would later remark, "If there were no transistor, there would be no Sony as we know it today." Sony acknowledged its debt of gratitude to Bardeen on the occasion of his 80th birthday in 1989 by endowing a $3 million chair in his name at the University of Illinois, its largest gift to a U.S. school. True to his modest nature, Bardeen said he wanted to hide from the press when Sony's gift was announced.

Bardeen also served as an advisor to the U.S. government. From 1959 to 1962, he was a member of the President's Science Advisory Committee under Presidents Eisenhower and Kennedy. He was appointed to the White House Science Council in 1982 during Ronald Reagan's first term as president. However, Bardeen quickly came to feel that Reagan was pursuing the Strategic Defense Initiative (SDI) and other military projects without seeking much input from the council or from other members of the technical community. Bardeen believed that the nation could best be served by directing its limited scientific manpower into activities aimed at strengthening the competitiveness of its economy rather than on SDI, a project he later said was "of dubious value." Bardeen's frustration with the administration became so great that, in April 1983, he resigned from the council in protest.

Bardeen died of a heart attack on January 30, 1991, at Brigham and Women's Hospital in Boston, Massachusetts. Only a day earlier, he had undergone surgery that had revealed that he was suffering from lung cancer.

LEGACY

Bardeen cared little for fame. "I'm happier without the recognition," he said. "My work is known to science, not the general public, and that's more important to me." Indeed, his work is well known to his fellow scientists, who consider him to be one of the greatest minds of the 20th century, a genius of the same caliber as Albert Einstein and Enrico Fermi. "The whole damn structure of civilization depends on Bardeen's technology," said Nick Holonyak, Bardeen's first graduate student and inventor of the light-emitting diode used in digital watches and pocket calculators. "It's impossible to measure the number of lives he's touched. He's not just a hero, but a hero beyond comprehension."

MARRIAGE AND FAMILY

Bardeen married Jane Maxwell on July 18, 1938. They had three children: James Maxwell, William Allen, and Elizabeth Ann. He did not pressure his children into pursuing careers in science, but each felt drawn in that direction. James studies astrophysics and cosmology, William is an elementary-particle theorist, and Elizabeth is a computer systems analyst. James recalled that their father "opened doors, but didn't try to push us through them." Bardeen's retirement in 1975 allowed him to spend more time with his family, including his six grandchildren, and to travel.

In addition to his own family, Bardeen cultivated an extended family that included his "academic children." He and Jane often invited his graduate and postdoctoral students to their home for dinner. After dinner the professor, his family, and his students would retire to the family's recreation room and play such games as table tennis, a sport that Bardeen particularly enjoyed. Golf, though, remained Bardeen's favorite recreational activity. Once, after hitting a hole in one out on the golf course, he was asked how it felt. He thought carefully before answering, "Well, I guess *two* Nobel Prizes are better than *one* hole in one."

WRITINGS

"Flow of Electrons and Holes in Semiconductors" (chapter in *Present State of Physics*), 1954

Interaction between Electrons and Lattice Vibrations, 1956
Research Leading to the Point-Contact Transistor, 1957
Theory of Superconductivity, 1957
Electron-phonon Interactions and Superconductivity, 1973

AWARDS

Stuart Ballantine Medal (Franklin Institute of the State of Pennsylvania): 1952, for work on the transistor
Oliver E. Buckley Solid State Prize (American Physical Society): 1954
John Scott Award (Board of Directors of Trusts of the City of Philadelphia): 1954
Nobel Prize in Physics (Swedish Royal Academy of Science): 1956, for co-inventing the transistor; 1972, for co-developing the theory of superconductivity at low temperatures
Fritz London Memorial Award (Duke University): 1962
Vincent Bendix Award: 1964
National Medal of Science (National Science Foundation): 1965
Michelson—Morley Award (Case Western Reserve University): 1968
Medal of Honor (Institute of Electrical and Electronics Engineers): 1971
National Inventor's Hall of Fame (U.S. Department of Commerce): 1974, for the transistor
Franklin Medal: 1975
Presidential Medal of Freedom (U.S. Executive Office of the President): 1977
Lomonosov Gold Medal (Soviet Academy of Sciences): 1988, for his overall contributions to physics

FURTHER READING

BOOKS

Aaseng, Nathan. *The Inventors,* 1988 (juvenile)

PERIODICALS

Chicago Tribune, Jan. 3, 1990, p.1; Jan. 7, 1990, p.2; Jan. 31, 1991, p.9
Current Biography Yearbook 1957
Financial Times, Dec. 24, 1987, p.10
Independent, Feb. 1, 1991, p.12
Los Angeles Times, Dec. 29, 1987, p.5
New York Times, Jan. 31, 1991, p.B1
Physics Today, April 1992 (special issue)
Times of London, Feb. 1, 1991, p.12

Sylvia Earle 1935-

American Marine Botanist, Conservationist, and Businesswoman
Pioneering Explorer of the Ocean Depths

BIRTH

Sylvia Alice Earle was born on August 30, 1935, in Gibbstown, New Jersey. Her father, Lewis Reade Earle, was an electrician, while her mother, Alice Freas (Richie) Earle, gave up her nursing career to remain at home with Sylvia and her two brothers, Lewis and Evan.

YOUTH

When Earle was three years old, her family moved to a farm near Camden, New Jersey. Their life out in the country gave Earle's mother, who had been raised on a farm herself, the opportunity to pass her profound love of animals on to her children. "I wasn't shown frogs with the attitude 'yuk,'" recalled Earle. "Rather my mother would show my brothers and me how beautiful they are and how fascinating it was to look at their gorgeous golden eyes."

Earle enjoyed a glorious childhood on the farm. She spent most of her time outdoors, scampering through the fields and around the woods. She was especially drawn to a nearby pond that teemed with wildlife. "I used to go sit on a willow tree and spend hours there," she remembered. "And I always had jars filled with fish and frogs and tadpoles, and I made observations and kept notebooks. Nobody had to tell me to do those things—I just did them."

In 1948 the Earle family moved to Clearwater, Florida, a coastal town midway down the Florida peninsula that looks out on the mighty waters of the Gulf of Mexico. The water-loving Earle was thrilled with the move, for although she had spent countless hours in fascinated study of the plants and animals that made their homes in the little pond on their farm, she was eager to explore the mysteries of the ocean. During her first few years in Florida, she investigated the rivers and coastline of the region, learning about the plants and animals that lived in those areas. By the time she was 17 years old, she felt that she was ready for the ocean. Earle enrolled in a summer scuba-diving course that was being held five miles off the Florida coast. This was considered a rather unusual and adventurous activity, as scuba gear had been invented only five years before. Of that first ocean dive, she recalled, "I practically had to be pried out of the water. . . . It was glorious."

EDUCATION

A bright and disciplined student armed with a boundless curiosity about the world around her, Earle graduated from high school at age 16. By this time she had decided that she wanted to pursue a career in the study of marine life, and her parents supported her decision. But she had many other interests as well, and her busy school schedule over the next several years reflected her desire to learn about and understand many other subjects. By the time she was 20, Earle had obtained an associate of arts degree from St. Petersburg Junior College, a bachelor of arts degree from Florida State University, and a master of arts degree from Duke University in North Carolina.

Earle decided to stay at Duke and earn a doctoral degree in botany, the study of plant life, so that she could pursue her special interest in a simple but important family of water plants known as algae. "If you study plants you look at everything—geology, chemistry of the environment," she once explained. "Plants are the energy base for the whole system.

A tree is not a tree all by itself. It hosts jillions of creatures—birds, insects, fungi. Botany leads to the universe." Earle left school around 1957, though, after marrying Jack Taylor, a fellow graduate student. By the early 1960s, Earle was the mother of two children. She also held several jobs during this time, serving in the National Park Service and working in a variety of teaching positions. She missed taking classes, though, and as time passed she became increasingly determined to resume her doctoral studies.

Earle returned to school, where she did her best to juggle the demands of her studies and her family life. In 1964 she was invited to join a research expedition to the Indian Ocean. Similar opportunities followed, including expeditions to Ecuador's Galapagos Islands and Chile's Juan Fernandez Islands. Earle made the most of her time on these journeys, and when she completed her doctoral degree in 1966, her doctoral paper received international attention. A culmination of her years studying the algae of the Gulf of Mexico, the paper was regarded as a major contribution to the field of marine botany. Before Earle, few marine botanists had ever studied their subject matter where it actually grew and thrived, but her paper made it clear that one could learn much more about the plants and animals of the deep by immersing oneself in their environment.

CAREER HIGHLIGHTS

After the publication of her doctoral paper, Earle became known as one of the world's leading experts on ocean marine life. Possessed of seemingly unlimited energy and enthusiasm for her work, she was asked to join a number of prestigious academic and research institutions around the country, including the Cape Haze Marine Laboratory in Sarasota, Florida (where she served from 1966 to 1967), the Farlow Herbarium at Harvard University (1967-81), the University of California at Berkeley (1969-81), the California Academy of Sciences in San Francisco (since 1976), and the Los Angeles County Natural History Museum (since 1989).

TEKTITE II

By the late 1960s Earle had embarked on a career that would make her one of the world's most renowned experts on the ocean. In 1970 she was asked to take part in Tektite II, a government-sponsored project that called for a small group of women scientists to live in an underwater structure in the Virgin Islands for several weeks. The structure, which was located 50 feet under the surface, was equipped with air and other facilities that allowed the scientists to eat, sleep, shower, and record their impressions, but they spent much of their time exploring the depths and taking note of the brilliant array of marine life in their underwater neighborhood.

For her part, Earle spent as much time outside the Tektite II structure as possible. Each morning she roused herself before dawn, threw on her scuba diving gear, and set out to collect data. By the time the two-week project concluded, Earle had observed and cataloged 153 plants, 26 of which were not known to be native to those waters. At night, she would return to the "Tektite Hilton"—as they had nicknamed their underwater living quarters—and share her discoveries with the other women divers.

When the women ascended from the ocean floor, the world watched and applauded. They were paraded through the streets of Chicago, received at the White House, and invited to lecture throughout the United States. Earle tried to build on the public's fascination with tales of the ocean and its many mysteries, and in the ensuing months she gave a series of speeches and articles that offered glimpses of the rich and exotic variety of life on the world's ocean floors. But much of America remained preoccupied at that time with efforts to put a man on the moon, and the focus of the nation soon returned to the conquest of outer space. Earle was frustrated that the government refused to grant the same amount of funding for underwater exploration that it did for space exploration, but she understood America's fascination with space. "We can see the moon. We can envision walking on it. No one can envision walking on the seafloor the same way."

"JIM DIVE"

Earle continued with her marine botany work throughout the 1970s. On September 9, 1979, in the waters off Oahu, Hawaii, Earle made a solo dive to a depth of 1,250 feet, far deeper than anyone had ever gone before. She was not connected by a life-support cable to any surface vessel. Instead, she wore a bulky plastic and magnesium alloy suit called a "Jim suit," named for Jim Jarratt, the first person to have worn one. The suit provided her with oxygen and enabled her to resist the incredible 600-pounds-per-square-inch water pressure that would be present at the depths to which she was diving. Her only company on this historic dive was a small mini-submarine piloted by Al Giddings, an underwater photographer. For safety reasons, Earle remained in voice contact with Giddings by a thin communications cable.

This dive, known as the "Jim dive," was in many ways comparable to astronaut Neil Armstrong's walk on the moon in 1969. Like the moonwalk project, Earle's dive was a journey to a cold, dark environment that no human had ever before entered, and it was extremely dangerous. The smallest leak in her pressurized suit, which resembled a spacesuit, would result in crushing and instantaneous death. But the suit performed well, and just as Armstrong had done on the surface of the moon, Earle planted an American flag in the soil of the new frontier. She then turned her attention to the brilliantly colored life flashing around her. Glowing plants and fish swirled along the bottom, their systems generating ghostly bursts of colorful light known as bioluminescence that illuminated the water. Earle marveled at the fascinating marine life she encountered as she explored the crags of the ocean floor. After two and a half hours, Earle reluctantly returned to the surface, disappointed that the dive had ended but inspired to find ways to go even deeper into the ocean's depths. The pioneering dive led her colleagues to dub the adventurer "Her Royal Deepness," and solidified her determination to spend the rest of her life studying the earth's deep-sea "critters," as she affectionately calls all sea animals.

Recalling the day of the dive, Giddings remarked on how calm Earle remained as the hours leading up to the event ticked by. "Sylvia really does have nerves of steel," he said. "That Jim-suit dive in Hawaii was *very* risky. I was *very* nervous about the whole thing. In fact, she and I had breakfast one morning, and I was saying 'What if *this* happens? What if *that* happens?' We were getting down to some real nitty-gritty stuff, and Sylvia decided she didn't want to hear any more about it, and that was the end of our breakfast. She wasn't huffy about it. She just got up and left."

DEEP OCEAN ENGINEERING

In 1981 Earle formed her own company, Deep Ocean Engineering (DOE), to aid her relentless quest to explore deeper parts of the ocean. DOE specialized in the design and production of submersibles, which are small underwater boats. A one-person submersible, called "Deep Rover," was the company's first product. Able to reach depths of 3,000 feet, it was easy to navigate and also easy to move by helicopter from one location to another. "Deep Flight" was the next stage in submersibles. Its unique design included an all-acrylic pressure-resistant dome to increase the view, and it was created so that the built-in buoyancy of the submersible caused it to resurface immediately if the vessel lost power. In the early 1990s Deep Ocean Engineering began work on another project called "Ocean Everest," in which Earle hopes to explore the greatest depths of the ocean. The project calls for a seven-mile-deep dive into an area of the Pacific Ocean near Guam. "I hope to reach bottom by the year 2000," Earle said.

"People are under the impression that the planet is fully explored," Earle has remarked. "That we've been to all the forests and climbed all the mountains. But in fact many of the forests have yet to be seen for the first time. They just happen to be underwater. We're still explorers. Perhaps the greatest era is just beginning."

CONSERVATION EFFORTS

Earle has always used her expertise and experience to promote environmental protection and public awareness of the earth's fragile treasures.

"The living ocean drives planetary chemistry, governs climate and weather, and otherwise provides the cornerstone of the life-support system for all creatures on our planet," Earle noted. "Our future and the state of the oceans are one."

In recognition of her tireless efforts on behalf of the environment, Earle was appointed chief scientist of the National Oceanic and Atmospheric Administration (NOAA) in October 1990. NOAA provides scientific data for the Environmental Protection Agency and other policy-making agencies of the federal government, operates the National Weather Service, and supervises America's fisheries, estuaries, and marine mammal programs.

As head of NOAA, Earle hoped to create additional marine sanctuaries, but instead she was forced to spend a lot of her time monitoring the environmental devastation created when Iraq burned the oil fields in Kuwait during the Persian Gulf War in 1991. This action, regarded by many as the worst environmental disaster in modern history, polluted Kuwait's air, fouled the Persian Gulf, and left 100 million barrels of oil on the region's sandy terrain. Earle used this crisis to bring people's attention to the delicate ecosystem we inhabit. "NOAA has a lot of experience responding to oil spills and catastrophes of all sorts, but nothing, nothing, has prepared anyone for this kind of spill, for this magnitude. . . . We're still

taking for granted these assets that are certainly not free: clean air, water, a habitable environment. Only if we learn from the devastation taking place in a situation like the one in Kuwait will we have a chance not to lose these great assets. We have to understand our dependence on these natural systems."

Earle resigned from the NOAA less than two years after her appointment, in large part because she came to feel that she could more effectively pursue environmental causes if she was unrestrained by governmental policy or politics. "I will continue to work closely with my friends at NOAA and my allies in science, business, and industry," she announced. "I have learned that every day must be used positively. The inaction of good people is more devastating than the evil actions of the few."

True to her word, Earle remained a highly visible spokesperson on ocean issues after her resignation. She continued to lecture and write on ecological matters, and was named president of the Charles A. and Ann Morrow Lindbergh Foundation, an organization devoted to balancing technological development with environmental preservation. Earle's continued devotion to ocean ecology surprises no one who knows her. "Underlying everything Sylvia does is a tremendously deep love of the sea," commented one colleague. "I think Sylvia's strength comes from the sea, from its wildness and beauty."

Earle hopes that the Ocean Everest project on which she has been working will eventually produce hundreds of new submersibles that will allow the public to travel to the deepest ocean floors, and that those people will be roused to action in helping to protect the seas. "I have to believe that in the process of getting to know the ocean, people would care about it, and be responsible if for no other reason than self-interest," she said.

Earle remains a firm proponent of the idea that "fish aren't just something to be served on a plate with lemon and butter." She refers to fish as "our fellow citizens with scales and fins," and while she admits that she used to eat certain common varieties of fish, she no longer eats any game taken from the sea. "I wouldn't deliberately eat a grouper any more than I'd eat a cocker spaniel. They're so good-natured, so curious. You know, fish are sensitive, they have personalities, they hurt when they're wounded." She also points out that she refuses to eat certain seafood because their populations have dwindled so alarmingly in recent years. "Indulging a taste for tuna or swordfish is comparable to dining on mountain lion steak or eagle pie," she has said.

MARRIAGE AND FAMILY

Sylvia Earle has been married three times. Her first marriage, to Jack Taylor, around 1957, ended in divorce in 1966. During this marriage, they had two children—a daughter, Elizabeth (nicknamed Lizard), and a son, John (called Richie). Earle was married to Giles Mead for nine years (1967-76), and they had a daughter, Gale (known as Mouse). In 1986, Earle married Graham Hawkes, the engineer who had designed the "Jim suit" and her co-founder and partner in DOE. The couple separated in 1990 and eventually divorced, but they remain friends and business partners.

Earle admits that she did not always handle the dual demands of marriage and career particularly well. "I was always trying to combine everything, combine science and traditional expectations. And I suppose it never occurred to me that there had to be a choice, or at least it didn't until quite recently. I'm beginning now to think I've had choices thrust upon me. . . . But it's repeatedly been my choice to opt for a career as a scientist—if you want to call 'being a scientist' a career. A scientist is what I am. It's who I am, fundamentally, beyond being a woman, beyond being a wife or beyond being a mother. It's just who I am."

Earle now lives in the hills of Oakland, California, with more than a half dozen cats and dogs. Over the years her stable of pets has also included geese, tarantulas, an iguana, and an alligator. Her home, which also includes a laboratory and a pool that she uses to test her submersibles, is decorated with the memorabilia of her years of ocean study. But whenever she can, she slips off to the ocean waters that have fascinated her since her earliest years. Earle has spent more than 6,000 hours—equivalent to a year of her life—underwater, and she has collected and pressed onto paper more than 20,000 marine plants as part of her ongoing quest to collect and catalog all of the plant life in the Gulf of Mexico.

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OBITUARY

Dian Fossey 1932-1985
American Zoologist
Expert on Gorillas

BIRTH

Dian Fossey was born on January 16, 1932, in San Francisco, California, to Kitty and George Fossey. Her parents divorced when Dian was six years old. A year later her mother married Richard Price, a building contractor.

YOUTH

Fossey endured a lonely childhood. She was close to George Fossey, her father, but frustration with his career in the insurance business caused him to drink too much, which led to her parents' divorce in 1938. Her father kept in touch for a little while, but he gradually faded away. A year after the divorce, her mother married Richard Price, a prosperous businessman. Her mother and step-father quickly established a distant, formal sort of relationship with young Fossey. She was told to call Price "daddy," but he never adopted her, and until she was ten years old she was not permitted to eat dinner with the Prices. "People of certain income levels, they prefer their children to develop table manners," Richard Price later said. "So Dian ate with the housekeeper until she matured enough to eat with us."

Fossey loved animals, and she desperately wanted a pet to call her own. The only pet she was allowed to have was a goldfish, though, and when it died she was not permitted to get a new one. "I cried for a week when I found [the goldfish] floating belly up in the bowl in my room. My parents thought it was good riddance, so I never got another. A friend at school offered me a hamster, but they considered it dirty, so that was out," she recalled.

EDUCATION

After graduating with honors from Lowell High School in San Francisco, Fossey enrolled at the University of California at Davis, where she hoped to pursue a career in veterinary medicine. She excelled in many of her studies, but struggled in such scientific subjects as physics and chemistry. Convinced that she would be unable to triumph over those subjects, Fossey decided to work with disadvantaged children instead.

Fossey transferred to San Jose State College, where she studied courses in occupational therapy. Her friends and professors at San Jose State remembered her as bright and intense. "Dian had a mind of her own," remarked one professor. "Some of my other students were scared of me, but Dian wasn't afraid to disagree."

Fossey's interest in animals remained strong during her college days. She became a prize-winning equestrian, riding horses at a number of regional events over her last few years of school. One summer she was even able to work at a ranch in Montana. She loved the job, and one of her co-workers recalled that Fossey was "completely wrapped up in animals—the horses, dogs, a pet coyote, anything that walked or flew. She liked people well enough, but didn't seem to rely on them as much as the rest of us do." Fossey graduated from San Jose State College in 1954 with a bachelor's degree in occupational therapy, then spent several months at area facilities completing her clinical training.

CAREER HIGHLIGHTS

LIFE IN KENTUCKY

In 1956 Fossey moved to Kentucky to take a position as director of the occupational therapy department at Kosair Crippled Children's Hospital. She found the position to be a difficult but rewarding one, and she worked very hard to make the lives of the children she saw a little easier. "These children have a variety of physical and emotional disabilities and are lost in this world of ours," she wrote. "All are much younger than their years and are like wild animals penned up with no hope of escape. They need a tremendous amount of care and kindness to make them feel life is worth living."

But while her life in Kentucky was in many ways a challenging and rewarding one, Fossey began to think about visiting Africa. "The thought of being where the animals haven't all been driven into little corners attracts me so much," she said. By the early 1960s her determination to go to Africa was so great that she took out an $8,000 loan to finance a trip. "I had this great urge, this *need* to go to Africa," she later said. "I had it the day I was born. Some may call it destiny. My parents and friends called it dismaying. I call it fortuitous." In preparation for her trip, Fossey read many books and magazines on Africa and its magnificent wildlife. One of the books, *The Year of the Gorilla* by George Schaller, provided a fascinating glimpse of the continent's mountain gorillas, who lived high in the Virunga Mountains in the Congo (now known as Zaire). She decided that she would have to stop at their home for a look.

MEETING LOUIS LEAKEY

In 1963 Fossey set out for Africa. Her first destination was Tanzania's Olduvai Gorge, where the famous anthropological team of Louis and Mary Leakey were conducting research. Fascinated by Fossey's plans to visit the mountain gorillas, Louis Leakey was also impressed by her grit. Shortly after arriving at his camp, Fossey broke her ankle. She did not let the injury change her plans, though; instead she used a crutch to limp up the rugged terrain to the remote jungle homes of the mountain gorillas.

After several days of tramping across the mountains, Fossey made her first contact with the mountain gorillas of the region. "The air was suddenly rent by a high-pitched series of screams followed by the rhythmic rondo of sharp pok-pok chestbeats from a great silverback male. . . . Immediately, I was struck by the physical magnificence of the huge jet-black bodies blended against the green palette wash of the thick forest foliage." The sight of the mountain gorillas excited Fossey in a way that nothing else ever had before, and though she eventually had to head back down the mountain, she told herself that she would return.

Fossey returned to Kentucky and her job as an occupational therapist at the conclusion of her trip to Africa. But in 1966 Louis Leakey paid a visit to the area, and he and Fossey met once again. Remembering her toughness and dedication, he asked her if she would be willing to study the mountain gorillas on a full-time basis. Fossey enthusiastically accepted his offer, and when Leakey jokingly suggested that she have her appendix removed so that it would not give her any trouble out in the jungle, Fossey actually had the operation. Several months later she was off to Africa again. "Quitting my job as an occupational therapist and saying goodbye to the children who had been my patients for 11 years was difficult, as were the farewells to Kentucky friends and my three dogs. The dogs seemed to sense that this was going to be a permanent separation," she wrote. "I can still recall them . . . running after my overladen car as I drove away from my Kentucky home to head for California to say farewell to my parents. There was no way that I could explain to dogs, friends, or parents my compelling need to return to Africa to launch a long-term study of the gorillas."

MAKING A LIFE IN AFRICA

Fossey returned to Africa and began making preparations for her studies. She knew that the next few months would be tough. She was unfamiliar with African languages, had no training in the science of animal behavior, and was an inexperienced camper. Leakey and Jane Goodall, a scientist known for her research on chimpanzees, both tried to prepare Fossey for the challenges ahead, but everyone knew that Fossey was taking on a difficult job.

In early 1967 Fossey was taken into the jungle-choked Virunga Mountains of east central Africa, sections of which were claimed by three different nations: Zaire, Rwanda, and Uganda. Fossey and her guide stopped at a spot deep in the jungle and set up camp. A few days later, the camp was complete. It included a tent for Fossey, a rickety old cabin for African assistants who would join her later, a latrine pit, and rain barrels which would be used to collect drinking water. Her guide jumped in the jeep that had brought them there and headed back to civilization, leaving her alone in the wilderness. "I'll never forget the feeling of sheer panic that I felt watching him depart," Fossey said. "He was my last contact with civilization as I had known it. I found myself clinging to the tent pole simply to avoid running after him."

Over the next several months, though, Fossey grew accustomed to her new existence. She hired several natives from nearby villages as assistants around the camp and in the bush, and their presence helped to ease her feeling of isolation. She also began her search for the mountain gorillas, and soon she was preoccupied with gathering data on their lives.

Observation of the gorillas in the region was difficult, for they are very shy animals, and Fossey was not a skilled tracker. As the weeks passed, though, she became more adept at following the gorillas' tracks and recognizing their favorite places. At first Fossey watched the gorillas from a distance, but over time she drew closer to the magnificent animals. They watched her with a mixture of fear and curiosity. Encouraged, Fossey tried to imitate some of the noises and gestures that they made in hopes of communicating with them. After awhile, she sensed that the gorillas liked it when she pretended to eat some of their favorite foods or when she imitated the ways that they groomed themselves. The apes allowed her to draw ever closer to them, and soon she was able to take notes that provided greater insight into gorilla life than those of any previous researcher.

On July 10, 1967, political unrest in Zaire spelled an end to Fossey's research in that country. She was captured by armed guards and held in custody for two weeks before she made a daring escape to Rwanda, where she resumed her research work. On September 24, 1967, Fossey established the Karisoke Research Centre in Rwanda, named after a nearby mountainous region that was the home of a number of gorillas.

STUDYING GORILLA FAMILIES

As director of the Karisoke Research Centre for the next two decades, Fossey emerged as one of the world's leading authorities on gorillas. She studied all aspects of their lives, from their eating and sleeping habits to their social interactions, accumulating a body of data that continues to be recognized as essential in the study of gorillas.

Several groups of gorillas lived in the area of Karisoke, and as the years passed Fossey became very close to a number of the great beasts. The gorillas allowed her to join their circles, and soon she was playing or lounging around with them as if she were part of the family. Fossey learned to recognize the meaning behind the grunts and noises that the gorillas made, and she noticed that the gorillas could be identified by the patterns on their immense noses. She even gave names to the animals she was studying, and soon her notes were full of references to Uncle Bert, Beethoven, Digit, and other gorillas that she had befriended.

Fossey provided valuable insight during this time into the nature of existence in gorilla clans. Fossey found that these clans, which included an average of about ten members, typically included a single sexually mature male, known as a silverback; a sexually immature male, known as a blackback; three or four sexually mature females; and three to six younger apes ranging from infancy to less than eight years of age. Fossey found that the apes were fiercely protective of their families, and that they often tried to nurse injured members of the group back to health. The gorillas also traveled slowly when necessary to allow weaker members to keep up, and she noted that an entire family of gorillas will fight to the death to keep one of its babies from being captured or injured. She also recorded instances of violence within the groups, and noted isolated incidents of apparent infanticide (the killing of an infant), but the portrait that Fossey painted was overwhelmingly one of gentle and intelligent creatures who wished to live in peace.

In 1970 Fossey left Africa to study for her doctorate in zoology at Cambridge University in England. For the next couple of years, she shuttled back and forth between Cambridge and Karisoke, where she was always glad to return. As Fossey's research work expanded and became better known, increasing numbers of visitors arrived at Karisoke. Some of these new arrivals were graduate students who helped Fossey with her research work. Another visitor was *National Geographic* photographer Bob Campbell. Fossey and Campbell became very close in the early 1970s, but he was married, and he eventually decided to leave Karisoke. As the time neared for him to depart, Fossey wrote in her journal that "never have I known such sorrow."

Within a matter of months, though, biographer Farley Mowat noted that Dian emerged "from the depths of her despair into one of the sunniest, most productive periods of her life. With her academic credentials well on the way to being secured, and with regular help provided by some of the students from Cambridge and elsewhere who were eager to work at Karisoke, Dian was able to devote much more of her time to doing what she loved best—being with her gorillas."

Fossey was a demanding leader, and some of the graduate students and village helpers at Karisoke quit over the next several years, citing verbally abusive behavior by Fossey. The mid-1970s was a productive period for the center, though, and Fossey and her volunteer assistants continued to add to their knowledge of gorilla behavior.

DEFENDER OF GORILLAS

By the mid-1970s Fossey became known as a determined defender of the mountain gorillas against poachers and encroaching settlements. Poachers sometimes killed gorillas and cut off their hands and heads, which were prized as decorations. Other poachers kidnapped infant gorillas to sell to zoos. Fossey found that government officials were often reluctant to institute protection for the gorillas, either because they had been bribed or because they felt trapped by the needs of the poor people of the region. Many government officials saw the habitat of the gorillas as land that could be converted to farming, so they sometimes ignored Fossey's pleas that they protect the great gorillas.

Frustrated by the inactivity of local governments, Fossey organized her own anti-poaching patrols. In 1978, though, the gorilla named Digit, who was one of her favorites, was slaughtered by poachers. After Ian Redmond, one of the graduate students, told her about Digit's murder, Fossey wrote in her journal that "there are times when one cannot accept facts for fear of shattering one's being. As I listened to Ian's terrible words, all of Digit's life since my first meeting with him as a playful little ball of black fluff ten years earlier, poured through my mind. From that dreadful moment on, I came to live within an insulated part of myself."

Despite being nearly paralyzed with grief, Fossey forced herself into action. She decided to rally support around her efforts to protect the gorillas by making sure that people back in America heard about Digit's murder. Digit's death was announced on the CBS evening news, and she established a Digit Fund to raise money to protect the gorillas from poachers. The publicity also spurred the creation of the Mountain Gorilla Project, an organization that tried to convince the poor Rwandan people that the gorillas could actually attract large amounts of tourism dollars if they were allowed to live in their natural habitats.

"By early 1978," wrote Fossey, "I had organized effective weekly poacher patrols capable of walking for miles and camping in bivouac tents, or even under trees when necessary, in their untiring efforts to clear the parklands of poachers." As the months passed, though, other gorillas were killed, and Fossey turned to increasingly drastic measures to protect them. As *Science* magazine noted, her actions against poachers turned increasingly violent. "She captured and interrogated poachers, burned down their camps, confiscated their property, and, in one instance, kidnapped a poacher's ten-year-old son." Her relationships with many of her graduate students deteriorated around this time as well. A number of the students argued that she often ignored them, and said that she was often cruel and unreasonable when she did pay attention to them. Some of the students even said that she drank too much, and that she believed in the black magic that was practiced across much of Rwanda. Fossey, meanwhile, felt that the students did not appreciate how close the gorillas were to being wiped out.

By this time Fossey had made enemies in many areas of Rwanda. The poachers hated and feared her, and many government officials were tired of dealing with her. Even other conservationists had distanced themselves from her because of disagreements over her methods. Fossey's health was failing by this time, too, as the cold, wet climate and her smoking habit took their toll. One of her friends commented that Fossey disregarded her health so that she could stay with the gorillas. "Once she fell into a ditch outside her cabin and she splintered some ribs, perforating one of her lungs. Only weeks later in Belgium would she take time to have it looked at, and when the doctors saw from X- rays what had happened to her, they removed part of her lung. She smoked three packs of cigarettes a day, and she suffered badly from emphysema. All of us who loved her spent most of our time worrying about her."

GORILLAS IN THE MIST

In 1980 Fossey left Africa to take a teaching position in the United States at Cornell University. The change of scenery gave her a chance to recover from her physical problems. "I was a walking skeleton," she told one interviewer. "Up where I lived, you can't get calcium. So your bones eventually break, and your teeth rot and fall out. I needed to leave for a while." Even in the United States, though, Fossey kept fighting on behalf of the gorillas that she had come to think of as her family. In 1983 she published *Gorillas in the Mist*, an account of her adventures in Africa that included her passionate thoughts on the endangered gorillas that made their homes there. The book included scientific charts and data, but it was her clear love for the gorillas that charmed critics and readers. One reviewer spoke for many when he said that Fossey "treats the apes with a dignity and a respect that makes her book a classic of its kind." In 1988 a movie version of the book, starring Sigourney Weaver as Fossey, was released.

In July 1985 Fossey returned to the Karisoke Research Centre. She resumed her coordination of the anti-poaching patrols, but her continued poor health prevented her from traveling far. Isolated from many of the people in the camp and unable to go see the gorillas that she loved, Fossey worked late into the night on her notes and papers.

On December 27, 1985, Fossey's body was found in her home up in the mountains. She had been murdered by an unknown person who had used a machete-like weapon in the attack. As word of the murder filtered through the scientific community and across the United States, those who knew of her confrontations with poachers, government officials, and students admitted that they were not surprised to hear that she had died in such a violent way. "I think it's amazing that she wasn't killed before," said her friend Jane Goodall. A graduate student who escaped to the United States with the help of U.S. officials was tried in absentia and found guilty of the murder by a Rwandan court, but it was widely believed that he was framed. The student remains free in the United States, which has no extradition treaties with Rwanda. Most people believe that Fossey was killed by poachers.

Fossey was buried next to Digit in a cemetery that she had set aside for slain gorillas high in the Virunga Mountains. More than a decade after her death, the identity of Dian Fossey's killer remains a mystery.

LEGACY

Dian Fossey is remembered as a trailblazing scientist who gathered important research on the lives of the great gorillas of Africa's Virungas mountains. The data that she gathered on those apes became the cornerstone of subsequent research into their lives, and greatly increased scientific understanding of the animals.

Fossey is best known to many, though, for her controversial efforts to defend her beloved gorillas from poachers and developers. Many scientists and observers disagreed with her methods, but no one ever questioned her passionate love for the great apes of the mountains. As her biographer Farley Mowat remarked, if the endangered gorillas of the Virungas do survive, "it will be due in no small measure to the dedication of a woman who was in love with life—with *all* of life—a woman who did what great lovers must always do: who gave herself completely to those she loved."

Fossey's Digit Fund was renamed the Dian Fossey Gorilla Fund after her death. To the present day, it has continued its worldwide campaign to save the apes of central Africa from extinction.. The Karisoke Research Centre, meanwhile, remains a center of mountain gorilla research, conservation, and education.

MARRIAGE AND FAMILY

Fossey never married or had children. The people who knew her in her later years all felt that Fossey viewed the great apes of the Virunga Mountains as her family.

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Jane Goodall 1934-
British Ethnologist
Expert on Chimpanzee Behavior

BIRTH

Jane Goodall was born on April 3, 1934, in London, England. Her father, Mortimer Herbert Morris-Goodall, was an engineer and amateur car racer. Her mother, Myfanwe Joseph Goodall, was a homemaker who also wrote novels under the pen name Vanne Goodall. The family also included Jane's younger sister, Judy. Her parents divorced when Jane was eight years old, and after that she and Judy lived with their mother.

YOUTH

Goodall has loved animals and the outdoors since she was a small child. When she was two years old, for example, she became upset when a man killed a dragonfly that was buzzing around her baby carriage. "I cried and cried," she recalled, "not because I was afraid, but because I felt bad that such a pretty thing was destroyed." Goodall's family moved to the English coastal town of Bournemouth when she was five years old. She loved exploring the countryside near her home on horseback and on foot, and she often brought home treasures like frogs, turtles, and bugs to show her mother. One time Goodall even went to sleep with earthworms under her pillow.

As a young girl, Goodall began developing the talents she would later use in her career as a scientist. For example, she learned to sit patiently and make careful observations of nature. "Once I disappeared for five hours to sit in a hen house to see how a chicken lays an egg," she noted. "My mother was very worried, but when I came home—all bedraggled and my hair tangled with bits of straw—she never rebuked me. On the contrary, she recognized my patience with animals and encouraged me to study them."

Goodall also liked reading books about animals. Her favorite was Hugh Lofting's *The Story of Dr. Dolittle,* which tells about an Englishman who travels all over the world and talks to animals. Goodall remembered that after reading all the descriptions of exotic places in the book, she decided that "someday I had to go to Africa." Throughout her childhood, Goodall's favorite toy was a large, hairy, stuffed chimpanzee named Jubilee. When her mother first gave her the toy, everyone "predicted that the ghastly creature would give a small child nightmares," Goodall recalled. Instead, Jubilee further inspired Goodall to achieve her dream of studying animals in Africa.

EDUCATION

"Although I always did well in my studies, I never liked school," Goodall admitted. "I just wanted to be outdoors, watching and learning." After graduating from high school, Goodall decided not to go to college right away. Instead, she followed her mother's advice and enrolled in a secretarial training program in London. "Mum said secretaries could get jobs anywhere in the world, and I still felt my destiny lay in Africa," she noted. In 1965, years after she had begun her ground-breaking study of chimpanzees, Goodall received her doctoral degree in ethnology (the study of animal behavior) from England's Cambridge University. She thus became only the eighth person in the history of the school to earn a doctoral degree without first having received a bachelor's degree from a four-year college.

CAREER HIGHLIGHTS

GETTING TO AFRICA

Goodall worked as a secretary for a short time, then took an interesting—but poor paying—job as an assistant editor at a documentary film studio in London. Before long, however, a friend from high school invited Goodall to visit her family's farm in Kenya, a country in eastern Africa. To earn enough money to pay for the trip, she quit her job at the film studio and returned home to live with her mother and work as a waitress.

Goodall first set foot in Africa in 1957, at the age of 23. It turned out to be everything she had hoped for, and she spent a great deal of time exploring and watching the amazing variety of wildlife. Determined to stay in the country after the visit with her friend ended, Goodall took a "dreary office job" in Nairobi, the capital of Kenya. Everyone she met there told her that if she wanted to study animals, then she had to meet the famous anthropologist Dr. Louis Leakey. Along with his wife, Mary, Leakey searched East Africa for fossils that would help him discover what life was like for the earliest ancestors of human beings. As soon as she could, Goodall went to meet Leakey at the natural history museum he managed in Nairobi. "Somehow he must have sensed that my interest in animals was not just a passing phase, but was rooted deep, for on the spot he gave me a job as an assistant secretary," Goodall recalled.

Goodall spent part of 1957 working at the museum, and then later that year Leakey asked her to join him on one of his trips to Olduvai Gorge, a rich fossil site in nearby Tanzania. There Goodall helped the Leakeys dig for bones and artifacts in 110-degree heat. "It was fascinating work, but I still wanted to study living creatures," she noted. "I wanted to come as close to talking to animals as I could—to be like Dr. Dolittle." As it happened, Leakey had been planning a long-term study of wild chimpanzees. Since chimpanzees are the closest genetic relatives to human beings, Leakey felt that studying their behavior in the wild might provide clues about early humans. Few studies had been conducted before this time. Impressed by her energy, patience, deep interest in animals, and careful work habits, Leakey invited Goodall—a former secretary and waitress with no formal scientific training—to conduct the study.

"It didn't matter that I had no degree and little experience," Goodall explained. "Not only did he feel that university training was unnecessary, but even that in some ways it might have been disadvantageous. He wanted someone with a mind uncluttered and unbiased by theory who would make the study for no other reason than a real desire for knowledge; and, in addition, someone with a sympathetic understanding of animals."

From the beginning, Goodall's study faced a number of problems. For example, Leakey wanted the field study to last for at least three years, but he had trouble raising enough money to secure equipment and supplies for even six months. In addition, the government of Tanzania initially denied Goodall permission to enter the country, claiming that it was too dangerous for a woman to travel alone. When she could not find anyone else willing to make the trip, Goodall convinced her mother to accompany her into this primitive wilderness to follow her dream.

FIRST STUDY OF CHIMPANZEES

Goodall and her mother arrived at the Gombe Stream Chimpanzee Reserve, near Lake Tanganyika in northern Tanzania, in 1960. The area, which later became known as Gombe National Park, was a protected range of about 30 square miles that was inhabited by many chimpanzees. "I'll never forget when Mum and I arrived at last in our little boat on the Gombe shore," Goodall recalled. "It was a dry, beautiful day. The hills were lush with green, and, after we set up our tents with the help of two African game scouts, I slipped away and climbed up into the hills. I met a troop of barking baboons and knew then that my dream had come true."

Though Goodall was eager to establish close contact with the Gombe chimpanzees, for the first few months she only heard them or saw them from

a long distance. They were nervous about the "peculiar, white-skinned ape" that had appeared in their forest, and they ran away whenever they saw her. Eventually Goodall found a large hill, which she called "the Peak," where she sat for countless hours among snakes and insects to observe the chimpanzees through binoculars. One day, after she had lived at Gombe for a year, the chimpanzees came within 20 yards of Goodall to munch on figs below the Peak. And this time when they spotted her, they did not run away. "Without a doubt, this was the proudest moment I had known," Goodall related.

The chimpanzees gradually became used to Goodall's presence and allowed her to sit quietly and watch as they went about their daily routines. Whenever she got too close, however, the male chimpanzees would screech, shake branches, and rush toward her in warning. The first time this happened, Goodall explained, "My instincts urged me to get up and leave; my scientific interest, my pride, and an intuitive feeling that the whole intimidating performance was merely a bluff kept me where I was. To prove myself utterly harmless, I feigned disinterest and pretended to chew up leaves and stems."

As her observations continued, Goodall noticed that each chimpanzee had a unique personality and facial characteristics and related to the others in a distinct way. In many ways, the chimpanzees' behavior was similar to that of humans. For example, they were often affectionate toward each other, with lots of physical contact and kissing. They also lived in large groups in which most of the members were related to each other, like an extended family. Each group was dominated by an adult male chimpanzee, and the other members of the group usually acknowledged his position by behaving submissively around him. A social structure also developed among the remaining members of each group, loosely based upon their age, size, aggressiveness, and the position held by their parents.

Goodall gradually became more familiar with the individual chimpanzees, and as the years passed she got the opportunity to observe the interaction of several generations of the same family. "As soon as I was sure of knowing a chimpanzee if I saw it again, I named it," she explained. "Some scientists feel that animals should be labeled by numbers, but I have always been interested in the differences between individuals. A name is not only more individual but also far easier to remember." Some of the chimpanzees Goodall came to know were named Flo, Figan, Goliath, Flint, Olly, Gilka, Fifi, Passion, and Pom.

The first chimpanzee brave enough to leave the safety of the forest and visit Goodall's camp was called David Graybeard. At first he snuck into her camp to take the bananas she left out for him. Later, in what Goodall viewed as a major breakthrough, David Graybeard trusted her enough to take a red palm nut from her hand. "As I held it nearer, he deliberately reached out, laid his hand over mine, and taking the nut between his thumb and palm he gently squeezed my hand. It was at least ten seconds before he released my hand from his firm warm clasp," Goodall recalled.

MAJOR DISCOVERIES

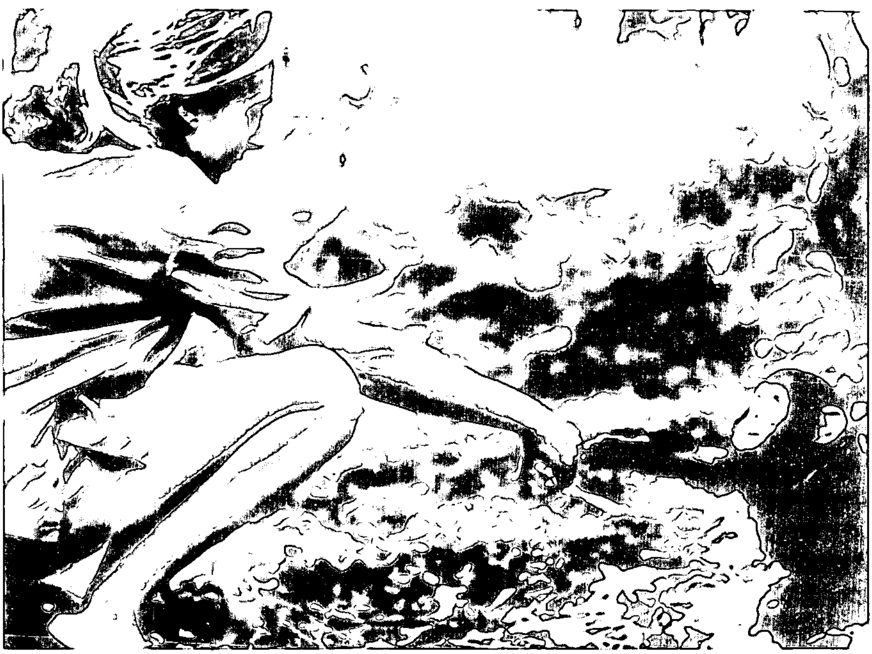
Goodall's patience, extensive observations, and careful note-taking helped her to become a leading expert on chimpanzee life in the wild. During her 35 years of field study, she made several major discoveries that completely changed previous ideas about the chimpanzee world. One day, she saw a male chimpanzee holding "a pink-looking object from which he was from time to time pulling pieces with his teeth," she noted. As she drew closer and noticed other chimpanzees sharing the pink treat, Goodall suddenly realized that they were eating meat. Before this time, scientists thought that chimpanzees were vegetarians, eating mainly fruit and leaves and an occasional insect. Goodall discovered that meat was a regular part of the chimpanzees' diet. The meat they ate was usually from baby bushpigs and small monkeys. She also witnessed them hunting in groups in order to catch their prey.

Goodall's second major discovery was that chimpanzees created and used tools. After tramping through the forest in search of the chimpanzees one morning, she finally came across David Graybeard squatting beside a termite mound. "I saw him carefully push a long grass stem down into a hole in the mound," Goodall recalled. "After a moment he withdrew it and picked something from the end with his mouth. I was too far away to make out what he was eating, but it was obvious that he was actually using a grass stem as a tool." When the grass stem became bent, David Graybeard picked up a nearby vine, stripped the leaves off of it, bit a piece from one end, and went back to work collecting termite grubs. Goodall was astonished to see that the chimpanzee not only could use an object as a tool, but also could create his own tool. Before this time, scientists thought that the ability to make and use tools was the main thing that distinguished humans from animals. Goodall's research "convinced a number of scientists that it was necessary to redefine man in a more complex manner than before," she noted.

In 1974, Goodall discovered another, less appealing way that chimpanzees resemble humans when two groups of chimpanzees began waging a bitter war against each other. "When I first arrived at Gombe, I thought the chimps were nicer than we are," Goodall stated. "But time has revealed that they are not. They can be just as awful." During what came to be known as the Four Year War between chimpanzees from the Kasakela and Kahama communities at Gombe, Goodall witnessed patrols of chimpanzees sneaking through the forest to attack their neighbors. Her assistants even saw two female chimpanzees that she knew well, Passion and Pom, kill and eat several babies belonging to the rival group. Goodall called the revelation that the chimpanzees practiced cannibalism "the hardest thing to understand and accept that's ever happened at Gombe." She agonized about whether she should take steps to stop them, but eventually the violence seemed to run its course. By the time the hostilities ended in 1978, however, the war had claimed the lives of at least ten adult and five baby chimpanzees.

DANGER AT GOMBE

From the earliest days of her field study, Goodall faced some danger due to the unstable political situation in several of the countries surrounding Gombe. The high profile of her project—and the fact that she and many of her assistants were white foreigners—raised the possibility that they might become the target of attention-seeking terrorist groups. Late in the evening of May 19, 1975, a group of 40 men wearing uniforms and carrying guns pulled up on the shore of Lake Tanganyika in boats. They were rebel soldiers involved in a conflict in nearby Zaire, and they came to Gombe to kidnap white foreigners to use as hostages to gain money and attention for their political cause. Many of the Gombe researchers and staff members managed to hide in the forest, and Goodall escaped harm in her darkened hut. But the soldiers kidnapped three American graduate students and one Dutch scientist and held them for ransom.



During this crisis, Goodall gathered up all of her research materials and retreated to the Tanzanian capital, Dar es Salaam. All of the foreign researchers were forced to leave Gombe, and the African staff members were the only ones left to observe the chimpanzees. The Tanzanian government eventually negotiated a settlement with the kidnappers, and the hostages were released in July. Goodall was not allowed to return to Gombe for about a year, however, and for several years afterward she could only go there in the company of bodyguards for a few days at a time. The one positive thing to come from the experience was that Goodall began devoting more time to protecting chimpanzees. "Gombe was still the best place in the world for me. But I came to realize the chimps needed me elsewhere," she explained. "I knew I had to use the knowledge the chimps gave me in the fight to save them."

CONSERVATION EFFORTS

Thanks to the success of Goodall's field research, her Gombe Stream Research Centre in Tanzania still exists and continues to attract students who want to expand the knowledge of chimpanzee life in the wild. People around the world have become familiar with her work through the many books and articles she has written. Goodall herself only spends about two months per year at the research site, however, since she has become a crusader to protect chimpanzees and their habitat worldwide. "For years I was selfishly concerned only with the Gombe chimps," she stated. "Now I'm worried about the treatment and survival of chimps everywhere—in labs, in zoos and in places where they're kept as pets or as amusements for tourists. Chimps are thinking, feeling beings capable of many humanlike traits. Genetically, they're our closest relatives, yet they face extinction because of human ignorance, greed and neglect."

Goodall lectures about the plight of the chimpanzee all over the world. A major problem is that their numbers are declining rapidly in Africa due to illegal hunting and the loss of habitat. She also makes frequent visits to medical research laboratories to ensure the humane treatment of chimpanzees. Though Goodall recognizes the current need to use chimpanzees in research to help find treatments for human diseases such as AIDS, she strongly supports the use of computer modeling and tissue-culture research to replace live-animal experiments. "If we're different from the animals, one of the ways we're different is that we have greater ability to be compassionate, we have the capacity to understand the suffering we inflict. Therefore we should be concerned about what we inflict upon the rest of the animal kingdom. The fallacy that animals are machines that can be used in any way we like, don't have emotions and don't feel pain is not acceptable anymore, even by the scientists who use them in the labs," Goodall stated. "The suffering of chimps can be reduced by putting them in bigger cages, exposing them to the outdoors and allowing them more contact with each other. Toys and even simple video games can relieve the deadly boredom you see in all those empty stares."

Goodall believes that children play a key role in the success of conservation efforts. She started the Roots and Shoots program—named after a rare set of twin chimpanzees born at Gombe—in order to teach African children about the importance of preserving chimpanzee habitat, and the program became so successful that it spread to schools around the world. "I want to give kids a passion, an understanding and awareness of the wonder of animals," Goodall explained. "Teaching them to care for the earth, and each other, is our hope for the future."

MARRIAGE AND FAMILY

Goodall met her first husband, the Dutch baron Hugo van Lawick, in 1961, when he came to Gombe to photograph her at work studying the chimpanzees. They built a life together at the Gombe camp and continued Goodall's research. They had one son, who was named Hugo but was always called "Grub." As a boy, Grub liked to antagonize the chimpanzees by staring and making faces at them, and he sometimes had to be kept in a wire cage for his own protection. He went away to school in England at the age of nine, but he returned to Africa as an adult to work as a wildlife photographer with his father.

Goodall and van Lawick were divorced in 1974. The following year, she married Derek Bryceson, a supervisor of Tanzania's national parks and the only white member of Tanzania's government. Goodall was heartbroken when Bryceson, whom she often called "the love of her life," died of cancer in 1980.

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ADDRESSES

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Bernadine Healy 1944-
American Cardiologist
Former Director of the National
Institutes of Health

BIRTH

Bernadine Patricia Healy was born on August 2, 1944, in Queens, a largely working-class borough of New York City. She was the second child born to Michael J. Healy and Violet McGrath Healy. Her parents, who were both descended from poor Irish immigrants, operated a small perfume factory in the basement of their home. Healy had three sisters, Suellen, Michelle, and Catherine.

YOUTH

Healy credits her father with encouraging her ambitions in an era when young girls were not usually expected to pursue careers. "My father had a strong sense of the world being a tough place. He lived through the Depression. He said you have to learn to take care of yourself," she explained. "Everything was oriented toward improving yourself, toward education, the business, the family."

Even as a child, Healy had a strong desire to help people. She initially planned to become a Catholic nun. "When I was a little girl, I used to think I wanted to be a nun, and my father would say you can't be a nun—you'd always be taking orders from a priest," Healy recalled. "My father was a very old-fashioned conservative Irish Catholic, but he was also an unbelievable feminist. He had a strong sense that no doors should be closed to women, especially his daughters." By the age of 12, Healy had decided to become a doctor.

EDUCATION

After graduating from a Catholic elementary school in Queens, Healy attended Hunter College High School, a well-regarded public school in Manhattan. "It was a school for girl eggheads, and our notion of an after-school activity was the philosophy club," Healy noted. "It was heavenly." In 1962, at the age of 18, she graduated first in her class from Hunter. She received a scholarship to attend Vassar College, an elite women's college in Poughkeepsie, New York. Three years later she graduated with high honors, with a major in chemistry and a minor in philosophy.

Healy went on to Harvard University Medical School, in Boston, Massachusetts, where she was one of only 10 women in a class of 100. This period as a medical student was the first time Healy faced discrimination because of her gender. "We women ignored the jabs, the lecturers who showed slides of naked women in distinctly nonmedical positions to lighten up a discussion, and the comments that disparaged female patients," she recalled. "We didn't take issue with the attitude that we were oddities and outsiders, invading a world that inalienably belonged to men, because we were grateful to be there." Healy received her medical degree from Harvard in 1970, again with honors.

Healy did her internship and residency at Johns Hopkins University in Baltimore, Maryland, completing these important and grueling steps toward becoming a doctor in 1972. During this time, she continued to encounter sexism among her colleagues. "The standard of the time," Healy noted, "continuing throughout my internship at Johns Hopkins, can be summed up in the words of a resident who—after frantically working with me for more than an hour to save a desperately ill patient—studied my blood-soaked clothes, face, and hair and said, 'You shouldn't be here doing this. You should be at home with a husband and children. This job is not for a woman. What's wrong with you?'"

CAREER HIGHLIGHTS

Healy spent two years doing research in pathology (the study of how diseases progress) at the National Heart, Lung, and Blood Institute in Bethesda, Maryland, which is part of the National Institutes of Health (NIH). A very prestigious and powerful government organization, the NIH is composed of 20 institutes, divisions, and centers that guide and conduct research into a variety of health-related topics. It is the world's largest research institution, with an annual budget of $9 billion and more than 16,000 employees. In addition, the NIH is responsible for giving out more than 20,000 grants each year to fund scientific work throughout the United States.

In 1974, Healy returned to Johns Hopkins University, where her academic career progressed rapidly over the next 10 years. She began work as a fellow in the cardiovascular division of the School of Medicine, where she developed a reputation as being a highly creative researcher in the pathology of heart attacks. She became an assistant professor of medicine in 1976 and earned a full professorship by 1982. Beginning in 1979, she also served as assistant dean of postdoctoral programs and faculty development. This administrative position broadened her skills and credentials even further.

While she was a professor at Johns Hopkins, Healy's resentment about the discriminatory treatment of female medical students and faculty members grew. One major target of her protests was the annual show that was presented by the all-male Pithotomy Club. The show consisted of a series of vulgar comedy skits that Healy described as "mean-spirited" and "X-rated." Though the members of the club assured her that the show—despite its disparaging portraits of women—was all in good fun, Healy campaigned to have it closed down. "Finally, perhaps in retaliation for my well-known disapproval of the all-male club and its activities, I was made a 'star' of the show, with no apparent limits on the sexual fantasies acted out at my expense by a student in drag," she recalled. This incident hurt Healy deeply, and she worried that it might damage her reputation. She threatened to sue the school for sexual harassment, but she decided to drop the matter when the Pithotomy Club agreed to clean up the show and to admit women. Unfortunately, the whole unpleasant experience affected her work, and Healy ended up leaving Johns Hopkins in 1984. "I was one of the leaders of that institution," she stated. "But after that episode I would go into a room and there were different vibrations. It did not make me popular."

Later that year, Healy was appointed deputy director of the White House Office of Science and Technology Policy by President Ronald Reagan. She served as Reagan's deputy science adviser until 1985. Healy then became the head of the Research Institute of the Cleveland Clinic Foundation, a prestigious private research facility in Ohio. Over the years, Healy has also played an important leadership role in many professional associations. For example, she served as the president of the American Heart Association from 1988 to 1989. In this position, she initiated a unique study of women and heart disease.

DIRECTOR OF THE NIH

In 1991, President George Bush appointed Healy as director of the National Institutes of Health, and the Senate confirmed her appointment. She took over the NIH at a time when the organization and its future were undergoing close scrutiny. By the late 1980s, a number of difficult problems faced the NIH. For example, as federal budget cuts limited the amount of money available, conflicts arose within the NIH about how research funds should be distributed and how the increasingly large organization should be managed. The NIH also suffered from "brain drain," as the most promising young scientists often left their poorly paid positions at the NIH in favor of more lucrative ones at pharmaceutical companies. In addition, the NIH had begun to come under unusually intense examination by the public. As medical issues such as research into acquired immune deficiency syndrome (AIDS) and research using fetal tissues from abortions became hot political topics, the American people took a greater interest in the way the NIH was run.

As a result of these problems, the position of NIH director became hard to fill. The salary was relatively low compared to what top health administrators are paid in the private sector, while the demands of the job were especially high. As the search for a new NIH director became increasingly politicized and confrontational, many qualified people chose not to be considered for the position. Other candidates were rejected after their personal views on issues such as abortion were subjected to close scrutiny. In fact, Healy's predecessor, James B. Wyngaarden, had reportedly been asked to leave the post in part because he refused to oppose abortion. The position remained vacant for almost two years before Healy's appointment, when she became the first woman ever to be director of the NIH. "NIH was a sick patient when I came here," Healy admitted. "Things were so bad they couldn't find a man to take the job."

In characteristic fashion, Healy immediately threw herself into the job and its challenges. "I was faced with a choice," she stated. "Do I become an apologist for NIH, or do I look at it and say, 'Let's fix it.' We had all been apologizing for years, and now was the time to fix it." First, Healy put together a sweeping plan to restructure the NIH. She also established new priorities for distributing money to different kinds of research projects. Her decisive actions changed policies that had been in place for many years and sent shock waves through the medical research community. "One thing I've learned in Washington is that if you make a decision, you are going to be criticized," Healy noted. "I am willing to go out on a limb, shake the tree and take a few bruises."

One of Healy's more controversial moves was to reorganize the NIH Office of Scientific Integrity (OSI). The OSI had been set up in 1989, under the guidance of Congressman John D. Dingell, Jr., of Michigan, to investigate ethical matters in medical research supported by NIH grants. Healy felt that the OSI was given too much power and argued that it had sometimes been unethical in its own procedures. Dingell disagreed with the changes Healy proposed and called her to testify before a congressional committee. The committee hearing turned into a power struggle to see whether the scientific community or Congress should control investigations of research fraud. Though Dingell raised issues about Healy's own professional conduct, she answered his questions forcefully and refused to back down from her criticism of the OSI. Though some NIH employees were pleased that Healy had stood up to an important congressman, others worried that the confrontation had created a powerful enemy.

Healy also drew criticism for supporting the Bush administration's ban on fetal tissue research. Though this type of research showed great promise for treating degenerative diseases such as Parkinson's and Alzheimer's, it had been banned because some people were concerned that it might encourage abortion. Before becoming director of the NIH, Healy had spoken out in favor of such research. She angered many people in the medical field, however, when she later supported the ban as NIH director. She responded to this criticism by stating that her personal opinions should not interfere with her performance on the job. "As NIH director, I have an obligation to uphold the policies, guidelines, and laws that govern the agency," she explained.

Healy was also involved in other controversies during her tenure as NIH director. For example, James Watson, the co-discoverer of DNA (deoxyribonucleic acid) who ran the NIH's Genome Center, resigned his job after public disputes with Healy. However, Healy's bold and self-confident style gained her admirers as well as critics. Many people appreciated her clinical experience as a physician and her passion for the job, while others felt she was inflexible and referred to her as "She Who Must Be Obeyed." On the whole, Healy seemed to take the controversy and criticism in stride. "You can't be NIH director if you want to be loved," she acknowledged. "You find your love somewhere else. From your husband, your kids, your dog."

EXTENSIVE STUDY OF WOMEN'S HEALTH

Healy's main focus as director of the NIH was on women's health issues. "Women's issues have been ignored because women have not been a force in our society," she stated. "Women have not been listened to." She particularly objected to the fact that most medical research on heart disease and other health problems was conducted only on men, even though the results were not always applicable to women. "The reactions of a woman's body to both illnesses and remedies are often vastly different from those of a man's, and gender is therefore a critical consideration in any responsible analysis of a patient's condition and in the choice of recommended treatment," she explained. "Isn't it inexcusable that we can't give women an answer about whether hormone therapy protects against osteoporosis because the research has not been done?"

As director of the NIH, Healy took important steps toward solving this problem. "Often, when women get into leadership positions, they're embarrassed or shy or unwilling or afraid to take on women's issues because they don't want to be seen only as a leader of women," Healy noted. "I view myself in my role as responsible for more than women's issues—but I also will not shy away from coming out on women's issues, because if I don't, how can I expect a man to?" In order to address the inequity of research on women's health, she created the Women's Health Initiative, a 15-year, $625 million study of about 150,000 women over the age of 50. Its goal was to measure the health effects on women of factors such as diet, vitamin supplements, and hormone-replacement therapy. Critics argued that the money would be put to better use in several smaller studies, but Healy believed that studying a large and diverse group would provide more answers in the long term. She called it "one of the most exciting clinical trials ever done."

After George Bush was defeated in his bid for reelection in 1992, Healy fought hard to keep her job as director of the NIH, but the controversy and political hostility she had aroused proved to be her undoing. In February 1993, the newly elected President Bill Clinton asked Healy to resign, and she left the NIH on June 30. "Maybe it's because I am a woman, but I have never felt like one of the boys," she commented. "I don't think I will ever be an insider. I have never been in anybody's club." Since leaving the NIH, Healy has continued her energetic professional career. In 1993, she unsuccessfully campaigned for the Republican nomination for the office of United States Senator from Ohio. In 1995, she published a book about the major issues affecting women's health, *A New Prescription for Women's Health*. In 1996, she was selected over several hundred other candidates to become the dean of the Ohio State University College of Medicine.

MARRIAGE AND FAMILY

In the early 1970s, Healy married Gregory Bulkley, a fellow physician at Johns Hopkins. They had one daughter, Bartlett Ann Bulkley, before divorcing in 1981. On August 17, 1985, Healy married Dr. Floyd Loop, a renowned cardiologist and chairman of the Cleveland Clinic Foundation. They have one daughter, Marie McGrath Loop.

During the years when she worked in Washington, D.C., Healy's husband and two daughters remained at their home in the suburbs of Cleveland. Regardless of the demands of her job, Healy flew home every weekend to see her family and spoke to them at least three times a day during the week. "Without a phone and without airplanes, I couldn't do it," she admitted. "It's not 'Ozzie and Harriet.' It's not 'Father Knows Best.' But I think what is really important is the love we give them and the security we give them." Since becoming dean of the Ohio State medical school, Healy has maintained a weekday home in Columbus as well as her family home in Cleveland.

HOBBIES AND OTHER INTERESTS

"Others may see me as boring, but I don't need hobbies," Healy noted. "I believe if you're having fun at what you do, you don't need a lot of other outside pursuits." In her very limited spare time, Healy enjoys reading. "I'm a newspaper junkie," she admitted.

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Matthew Vassar scholar: 1962-65
Harvard National scholar: 1965-70
Eloise Ellery fellow: 1965-66
Stetler research fellow: 1976-77
National Board Annual Award (Medical College of Pennsylvania): 1983
Special Award for Service (American Heart Association): 1983, 1984
Leadership of the American Federation of Clinic Research: 1983-84
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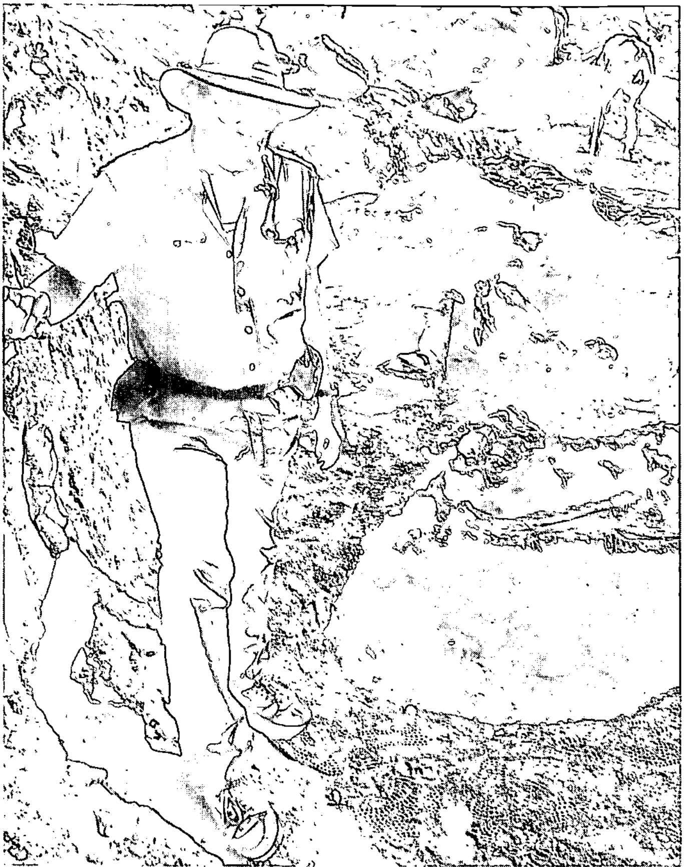

Jack Horner 1946-

American Paleontologist
Expert on Dinosaurs

BIRTH

John Robert Horner was born on June 15, 1946, in Shelby, Montana, a town in the northwestern part of the state. His parents were John Horner, the owner of a sand-and-gravel business, and Miriam Horner. He also has a brother, Jim, and a sister, Rosemary. From an early age, John was called "Jack" by everyone.

YOUTH

Jack Horner spent his childhood in Shelby. Unlike much of the rest of Montana, the region surrounding Shelby was flat and windswept, but young Horner loved the outdoors, and he often wandered across the plains surrounding the town. He particularly enjoyed going to the family ranch, though, which was nestled in the foothills of the Rocky Mountains. By the time he was seven or eight, Horner and his father would go on long walks through the foothills. It was on one of these walks that he found his first dinosaur bone.

Horner knew from a very early age that he wanted to become a paleontologist (a person who searches for and studies fossils of humans, animals, or plants), and his discovery of the dinosaur bone confirmed his desire. "I decided then I'd study dinosaurs. And not just any dinosaurs. Duck-billed dinosaurs," he recalled.

Throughout his teenage years, Horner spent hours by himself, wandering the countryside in search of fossils. He was a quiet boy, anyway, and he enjoyed the solitude of his fossil hunts. "He'd walk ten miles an hour," said his father. "Nobody could keep up with him." Back at home, he spent many evenings cleaning up items that he had found out in the hills.

Horner's dream of becoming a paleontologist, though, soon seemed to be in jeopardy. Paleontology is a career that requires a great deal of education, and he was having a very difficult time in school. Horner was born with dyslexia, a learning disability in which the brain cannot process words and concepts accurately, but he was not diagnosed as dyslexic until he was 31 years old. So, throughout his entire school life—even though he was quite intelligent—teachers though he wasn't very smart. "When I was a kid," he said, "I thought I was a real idiot, and I'm sure everybody else thought so too. I read real slow. If there were difficult concepts in a conversation, it took me a long time to understand what was being said. . . . I couldn't read half of a chapter overnight unless I stayed up until four in the morning."

EDUCATION

Despite his struggles with schoolwork, Horner worked hard in high school, and he managed to graduate in 1964. "I think the teachers were being generous," remarked his father. Horner knew that he would have to go on to college if he wanted to pursue a career in paleontology, but he worried about his ability to pass tough college courses. Nonetheless, he entered the University of Montana at Missoula in 1964. The courses that required outdoor study, like his paleontology classes, were easy for him. But his other science courses were held in lecture halls, and he had such a hard time following the coursework that he often failed. "Chemistry class was just terrible," he remembered, "because the guy would be talking about one thing and writing something else, and none of it was going in and staying in. I was still trying to sort out the first three sentences by the time they got to the end of the class. So I kept flunking everything."

After flunking out of the University of Montana in 1965, Horner was drafted by the Marines to fight in the Vietnam War. He served in Vietnam from 1966 to 1968, and his tour of duty included a year in which he was assigned to go out into the jungle and spy on enemy soldiers. "I was glad when I was done in Vietnam," he said. "It was a hard, scary job."

As soon as he was released from the military, Horner resubmitted his application for admission into the University of Montana. He was accepted again, but various math, English, and foreign language requirements kept tripping him up, and he flunked out again. A pattern soon developed in which Horner simply resubmitted his application for admission each time the college notified him that he had failed. He actually flunked out of the University of Montana seven times between 1964 and 1973 before finally abandoning his goal of obtaining a college degree.

The decision to quit school was a difficult one, because Horner wanted to continue taking the paleontology courses that he loved. In fact, he was taking graduate-level paleontology courses when he finally left college. "Just because I wasn't getting good grades didn't mean that it was bad," he said about his college experience. "I enjoyed . . . learning about lizards, snakes, reptiles, and mammals, and having access to a big library where I could read at my own pace." Horner was still unaware that he had dyslexia, though, and he continued to struggle with his other courses. In 1973 he finally decided that a college degree was beyond his reach.

FIRST JOBS

Putting his college days behind him, Horner helped his brother take over their father's sand-and-gravel business in Shelby, Montana, in 1973. Driving a truck and running the business did not stop Horner from continuing his explorations of the fossil-rich fields of Montana, though.

Horner's job often required him to drive long distances across the state of Montana. Seated in the high perch of the driver's seat of his 18-wheeler, he would scan the landscape, looking for promising areas. "When I'd come to what seemed like a fossily area, I'd just stop, unhook my trailer, and drive across the badlands in that tractor—to look for dinosaur bones."

Horner knew that dinosaur bones were plentiful in the area. About 75 million years ago, when dinosaurs roamed the earth, large areas of Montana had been home to the giant prehistoric creatures. Scientists believe that much of North America had been covered by water in the distant past, but that the hills and mountains of Montana had been above sea level. Dinosaurs had congregated there, and their bones now littered the region.

For the next two years, Horner worked in the family gravel business. At the same time, though, he sent letters to every museum "in the English-speaking world, looking for a job, anything from a janitor to curator," he said. Finally, in 1975, he was hired as a "preparator" at Princeton University's Museum of Natural History in Princeton, New Jersey. Horner did not even know where Princeton was, but he told his new supervisor that "I'll just drive east until I hit the ocean, and then I'll look around."

As a preparator, Horner was responsible for cleaning and piecing together fossil fragments found by others in the field. He did not like living on the East Coast as much as he enjoyed Montana, but the position allowed him to spend his days on dinosaur-related work. Members of the Princeton faculty quickly recognized that their new employee was an enthusiastic and knowledgeable dinosaur scholar. Donald Baird, who was Horner's supervisor, recalled that "we thought we were getting a preparator, a guy who hadn't finished college. But this fellow knew more about the dinosaurs in our collection than any of us did."

CAREER HIGHLIGHTS

HORNER'S FIRST DISCOVERIES

Horner spent seven years at Princeton, but every summer he returned to Montana to visit his family. During his visits, he and a friend named Bob Makela often took walking trips through areas where fossils had been found by other paleontologists. These journeys often turned into adventures of sorts, because they usually did not take much food with them. Sometimes they ate only what they could catch themselves, and Horner later noted that "squirrel tastes pretty good when you get used to it."

After one of these trips, Horner returned to Princeton with fragments of what appeared to be a smashed turtle. Don Baird encouraged him to study it and suggested that he compare it to a collection of dinosaur eggshells at the university that had been found years before in Montana. After days of studying his find, Horner realized that he had actually discovered fragments of a dinosaur egg. Excited by his success, Horner vowed to find more eggs.

Dinosaur eggs are regarded as the "gold" of paleontological discoveries because they are so rare. In the history of paleontology, there had been only one major find of dinosaur eggs and bones of young dinosaurs—in Mongolia, China, in 1922. Horner, though, was convinced that he would find more dinosaur eggs in Montana if he looked hard enough.

A MAJOR DISCOVERY

In 1978 Horner and Makela were on a routine dinosaur-bone hunt when they happened to stop in at a rock shop in Bynum, Montana. The owner of the shop, Marion Brandvold, asked the dinosaur specialists to identify some bones that she had found. Most of the bones were the standard fare, typical of what the area yielded, but she also showed them several pieces of a femur (thigh bone) and a rib, each about an inch in length. When Horner looked at these fragments, he was forced to conceal his excitement: "I didn't want the owner to think she had something that was worth millions of dollars." He knew that these were bones from a baby hadrosaur, also known as the "duck-billed" dinosaur. Horner told Brandvold that the fragments were very important fossils and asked where she had found them.

Horner and Makela traveled to the place described by Brandvold. It was known as the Willow Creek anticline (an upheaval of rock layers creating an arch), within the Two Medicine formation. This area is called a "formation" because that is the term used by geologists to identify a unique area of land that stands apart from its surroundings. The Two Medicine formation stretches from Canada to almost the southern border of Montana and covers 3,600 square miles.

The key element in a formation is the layering of soil and rock, because each layer represents a period of geological time. Over the passage of time—often millions of years—items on the surface are buried and, under the pressure of the shifting earth deposits, turned into rock. It is this process of shifting and settling, which is called sedimentation, that preserves dinosaur bones. The Two Medicine formation—with 2,000-foot layers of sandstone, shale, and rock—represented a record of approximately 12 million years of the earth's history.

Many paleontologists had worked in the Two Medicine formation over the years, and they had launched many excavations of dinosaur bones there. Hadrosaurs, hypsilophontids, horned dinosaurs, and even a cousin of the mighty *Tyrannosaurus rex* had been found in the region. No one thought there was anything unique left to find, but Jack Horner's knowledge of Brandvold's bone fragments convinced him to take another look.

After digging in the sandstone and shale in 100-degree heat at Willow Creek, Horner and Makela uncovered a nest containing bits of eggshells and the remains of at least 15 three-foot-long baby dinosaurs. These fossils eventually proved to be a new species of hadrosaur. Horner called Baird and told him of his findings, and his supervisor promptly sent him enough money to organize an excavation of the area. That funding, Horner later said, transformed him from a museum employee into "the principal investigator on a funded paleontological expedition."

EGG MOUNTAIN

Over the next several years, Horner spent each summer at the Willow Creek anticline, which he named Egg Mountain. The excavation was difficult, and Horner noted that the area still supported creatures of fearsome size. "It's the last place in America that still has the grizzly bear in its original habitat," he said. "Do you know what it's like to be on your knees, looking for dinosaur bones—and at the same time looking over your shoulder for grizzly? It's *exciting.*"

Horner made a number of notable discoveries during those summers. He found the remains of a huge nesting colony of duckbilled dinosaurs—which he named *Maiasaura peeblesorum* ("good mother lizard")—as well as remains of about 10,000 adult hadrosaurs. Encouraged by his discoveries, the National Science Foundation awarded him more than $700,000 in grants

to support his dig during the 1980s. At the height of the excavation, Horner was the leader of the largest paleontological research team in North America.

One of the skills of a paleontologist is the ability to interpret the fossils that have been unearthed. The scientific community soon learned that Horner was particularly adept at making such interpretations. He concluded that the baby hadrosaurs had stayed in the nest until they were about three feet long. This theory was based on studying bird nests. "You find the same thing today in nests of altricial birds [birds whose babies are too helpless to leave the nest immediately after hatching], because the babies move around and crush their shells," he said. Horner's theory suggested that dinosaur babies who stayed in their nests for such long periods must have been cared for by one or both of their parents. Such parental behavior was not normal among cold-blooded reptiles.

Dinosaurs had always been classified as cold-blooded creatures, but Horner's thoughtful interpretation of the evidence opened up a big debate among scientists about whether dinosaurs might actually have been warm-blooded animals. "Baby hadrosaurs are 13 inches long when they hatch, and they reach 10 feet by the end of their first year," Horner explained. "That means that they're growing as fast as an altricial bird, and that's something that, as far as we know, can't be achieved by cold-blooded animals. To sustain such growth, it seems to me you have to be warm-blooded."

Many of today's accepted theories of dinosaur behavior can be attributed to the discoveries and deductions made by Horner at the Egg Mountain site. Although a few doubters remain, most paleontologists respect and accept Horner's reasoning that at least some species of dinosaur exhibited parenting behavior found in many bird species of today. Horner himself defended his theories as simple attempts, using available information, to piece together the lives of the ancient dinosaurs. "You can say the same thing about murder: that if no one has seen the murder, then it's pie in the sky to think you could ever come up with a person that did it. And yet you know damn well that you can, given enough information. The more information you get, the closer you get to the murderer, and the same thing goes for dinosaur behavior."

Horner is best known for his research on *Maiasaura peeblesorum* eggs. But he and his Egg Mountain team made a number of other important finds as well. Horner's research team discovered a new kind of hypsilophodontid, a herbivorous (plant-eating) dinosaur. After examining untrampled eggs and the bones of 25 juveniles, Horner concluded that this species was able to take care of itself as soon as it emerged from the egg. A short time later he made another major discovery—a clutch of hypsilophodontid eggs that still contained the fully formed fetuses of these newly discovered dinosaurs. Horner named this new species *Orodromeus makelai* ("Makela's mountain runner") after his close friend and fellow fossil hunter, Bob Makela.

Horner also found evidence that duckbilled dinosaurs traveled together in great herds, and he helped locate previously unknown fossil information on a small, meat-eating dinosaur known as *Troodon*.

In the late 1970s Princeton closed its paleontology department. Horner joined the Academy of Natural Sciences in Philadelphia for a few years before being named curator of Montana State University's Museum of the Rockies in 1982. Montana was proud to have Horner back in his home state on a full-time basis, for by this time Horner was regarded as one of America's finest paleontologists.

Since joining the Museum of the Rockies, Horner has taught courses in paleontology at Montana State University and has traveled around the country, educating the public and writing several books to serve that aim. Horner's books include *Maia, A Dinosaur Grows Up* (1986), *Digging Dinosaurs* (1989), and *The Complete T. Rex* (1993). Horner explains his sense of public responsibility by remarking that "I think scientists often forget how interested the general public is about the earth sciences. All of my funding has been from the National Science Foundation. That's government money, paid for by taxpayers. Well, I think it's time to give them some information in return."

In 1984 Horner made yet another amazing discovery. Walking around an area of Montana known as Landslide Butte, Horner came upon "hillsides with bones just jumping out of them," he said. He later estimated that Landslide Butte contained as many as 53 million dinosaur fossils, some of them of gargantuan size. In fact, two styracosaur skulls found by Horner's team were so huge that they had to be airlifted out of the area by big Army helicopters.

A year later Horner traveled to France to work with another famous paleontologist, Armand de Ricqles, who was trying to gather evidence in the controversy about whether dinosaurs were cold-blooded or warm-blooded. This work was done not in the field, but in the laboratory, where the scientists used a microscope to study thin cross-sectioned slices of fossilized dinosaur bone. Horner concluded that the tissue looked as if it had probably come from warm-blooded animals. These conclusions were identical to those he made in the field during his investigation of the egg clutches of the hadrosaur.

In 1986 Horner received a MacArthur Foundation "genius" grant, a $200,000 award bestowed in recognition of his contributions to paleontology. From 1987 to 1989 he continued to search for dinosaurs, this time farther north, along the Two Medicine River. He and his team found two more species of duck-billed dinosaurs (hypacrosaurs and prosaurolophids) and a herd of horn-billed ceratopsians. Both the hadrosaurs and the ceratopsians were the dominant herbivores on earth during the Cretaceous Period, about 100 million years ago.

In recent years Horner has spent less time out in the field, but he can still often be found leading expeditions in North America and elsewhere. Recent Horner discoveries have included the fossilized remains of a herd of *Triceratops*, eggs from a flying reptile known as a peterosaur, and the most complete skeleton yet uncovered of *Tyrannosaurus rex*, perhaps the most famous of all dinosaurs. In 1992 Horner spent several days on the set of the movie *Jurassic Park*, which featured a paleontologist character based on Horner himself. During his time on the set, he advised director Steven Spielberg and his special effects crew on ways to make the dinosaurs in the film look, act, and sound more realistic.

Horner and others who know him continue to marvel at the twists and turns that his dinosaur-hunting career has taken. Horner's dyslexia prevented him from securing his degree in paleontology, but his discoveries have been so important that books and natural history museums have had to change their descriptions of dinosaurs and their lives.

MARRIAGE AND FAMILY

Horner has been married three times. Horner's passion for excavation and paleontological study took him away from his family for long periods of time during the 1970s and 1980s, and these long absences may have contributed to the break-ups of his first two marriages.

Horner's first marriage was to Virginia Lee Seacotte on May 30, 1972. They had a son, Jason, but were divorced in 1982. In 1986 Horner married Joann Katherine Raffelson. They divorced eight years later, in 1994. On January 21, 1995, Horner married Celeste Claire Roach.

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MacArthur Fellow (John D. and Catherine T. MacArthur Foundation): 1986
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Mathilde Krim 1926-
Italian Geneticist
Founder of the AIDS Medical Foundation

BIRTH

Mathilde Galland Krim was born on July 9, 1926, in Como, Italy. Her father was a Swiss agronomist, a scientist who specializes in the economics of agriculture. Her mother was Austrian but had grown up in Czechoslovakia. Mathilde was one of four children.

YOUTH

Krim was a spirited youngster with many interests. She showed an immediate talent for language, learning Italian from her father and German from her mother. She also learned French at school, so that even as a youngster she was fluent in three languages (she later learned Hebrew and English). Krim also loved painting on an easel given to her by her paternal grandfather. By the time she was six years old, she was convinced that she would be an artist when she grew up.

Krim's maternal grandfather, though, inspired her curiosity about science and natural history. At age seven she heard the word "biologist" for the first time. When she learned that the word referred to people who made careers out of studying science, she decided that she would pursue a similar course.

When Krim was eight years old, her family moved to Geneva, Switzerland, to make a better life, as the economy in Italy in the 1930s was severely depressed. In the Swiss schools, she continued to enjoy art and painting, but her real passion was science. Krim later explained that "art was something subjective and amorphous but science was straightforward and without ambiguities (although with age I've learned there are a lot of ambiguities in science). Anyway, as a teenager you have all these uncertainties in your life and for me science was an anchor."

During Krim's early childhood and adolescence, her viewpoints and social values were shaped by her parents. As she grew older, she noticed that her parents had a high regard for Germany, which was growing increasingly powerful in the late 1930s. Her parents also voiced some of the same bigoted attitudes toward Jewish people that many Germans and other people embraced at that time. "I didn't question it when my parents said that Jews were dirty, or not very honest," she recalled.

But Krim's attitudes would soon change. At the conclusion of World War II, Germany was defeated and the world learned about the Holocaust, in which German Nazis murdered millions of Jews. Krim was horrified. After watching a film detailing the 1945 liberation of the Jews from Nazi concentration camps, "I went around crying for a week afterward," she said. "I decided right then that I just didn't want to belong in the world that had done things like this."

EDUCATION

In 1945, Krim enrolled at the University of Geneva. She was one of only two women in the school's basic sciences department. But she was deeply troubled by her newfound realizations after the war. Krim soon abandoned the world that she had always known and joined a circle of young Jewish activists at the University of Geneva.

By the latter part of the 1940s, a movement calling for the creation of a Jewish state had gathered significant strength. This movement, known as Zionism, supported the idea of establishing a Jewish homeland in

Palestine, an area of the Middle East that had been captured by the British during World War I. Great Britain, which was sympathetic to the Zionist cause, continued to control Palestine until November 1947, when it agreed to the United Nations' division of Palestine into Jewish and Arab states. Six months later the British withdrew from the area, and on May 14, 1948, the Jewish state of Israel was born. Neighboring Arab states objected to the partitioning of Palestine and the existence of Israel, though, and bloodshed between the two sides erupted in 1948-49 and in subsequent conflicts over the years.

Krim was enthralled by her new life at the university and the passionate beliefs of her new Jewish friends. She converted to Judaism and joined Irgun, a militant Zionist underground organization that was headed by a young Jewish man named Menachem Begin, who would become prime minister of Israel some 30 years later. As a member of Irgun, Krim secretly cleaned guns for several months in the south of France. Because of her innocent appearance and brave nature, she was soon chosen to smuggle weapons, by bicycle, across the French-Swiss border for shipment to Palestine.

During this time she married a fellow Zionist, David Danon, a Jewish medical student from Bulgaria. When they married, her family disowned her, and her father even blamed her for the heart attack he suffered shortly thereafter. Krim refused to let her family's bitterness distract her from her goals, and she pursued her university studies in earnest. Krim received her bachelor of science degree in genetics in 1948 and her doctoral degree in biology in 1953, both from the University of Geneva.

During her graduate studies she assisted Jean Weigle, a physicist who was doing research in genetics and biology. One day she was asked to test a new electron microscope that had been delivered to the laboratory. Weigle wanted to know if the new microscope was powerful enough to detect genes in chromosomes, so Krim began examining the chromosomes in frog eggs. The work was boring, but Krim kept looking and her persistence finally paid off. "I remember it was late in the evening," she recalled, "and I was working alone with this big machine. . . . I switched to a new area and suddenly I saw these beautiful double threads." Krim believes that she was the first human ever to see the DNA structure of chromosomes through an electron microscope.

In 1953 Krim and Danon moved to Israel. They settled in Jaffa, where they lived with their baby daughter, Daphna, in the desert barracks left by the British when they had occupied the area.

CAREER HIGHLIGHTS

Krim's first job as a scientist was at the famous Weizmann Institute in Rehovot, Israel, in 1953. During her time at the institute she worked on a team that discovered how to determine the sex of an unborn baby as well as check for fetal abnormalities. This process, called amniocentesis, involves inserting a needle into the womb in order to extract a small sample of the fluid surrounding the fetus. Doctors are then able to examine the amniotic fluid for genetic information, ranging from the sex of the fetus to evidence of hereditary disease or disorders.

By 1956, Krim's marriage to Danon had ended in divorce. She then met and fell in love with a wealthy American movie executive, Arthur B. Krim, who served as a trustee of the Weizmann Institute. She married him in 1958 and reluctantly left Israel one year later to join him in New York City's high society circles. But within a matter of months she became "bored to tears" with that role. Determined to establish a career in the United States, she accepted a position as a research associate in virology (the study of viruses) at Cornell Medical College in Manhattan. Three years later, she transferred to the Sloan-Kettering Institute for Cancer Research in New York, where she studied how viruses affect the development of cancer.

Meanwhile, Krim's husband served as the finance chairman of the Democratic National Committee and adviser to Presidents Kennedy and Johnson. Because of these political connections, Krim soon found herself making frequent trips to Washington, D.C., where her scientific credentials attracted notice. In 1966 she was appointed to the President's Committee on Mental Retardation. Four years later, she was asked to prepare a report for a U.S. Senate panel on the history of cancer. This report greatly influenced the passage of the National Cancer Act of 1971, which authorized annual appropriations of $1.5 billion to the National Cancer Institute to fund cancer research.

INTERFERON

While Krim was working on the cancer report for Congress, she became intrigued by reports on the tumor-fighting potential of a naturally occurring protein known as interferon. The results of the animal research at that time showed that this protein tended to "interfere" with viruses, especially those that seemed to cause tumors. Upon first learning about interferon, Krim said to her husband, "I've just read something that is absolutely the most exciting thing I've read in years." She decided at that moment to devote herself to proving that "interferon is a substance that can inhibit tumors, and modify some properties of the immune system in animals. . . . I decided right then to go into that field because, although we knew very little at the time about interferons, I was certain that a big push would come."

Many other members of the scientific community were not as impressed with the experimental results of using interferon. Krim lobbied hard for money to support interferon research, but most of the government funding agencies were reluctant to allocate the funds. In 1975, however, she convinced the National Cancer Institute to fund a conference in which interferon researchers could share the results of their work. The conference was a resounding success and triggered renewed enthusiasm for interferon research. Krim "more or less singlehandedly rescued the field from oblivion," said Massachusetts General Hospital researcher Martin Hirsch.

Krim also established the Interferon Evaluation Program at Sloan-Kettering in 1975, and she was named head of the institute's interferon laboratory in 1981. During the 1970s, though, research into interferon produced disappointing results. Some scientists questioned Krim's judgment and said that she had been overly optimistic about interferon's disease-fighting capabilities. Krim remained defiant and insisted that the protein would eventually prove useful. Her tireless efforts to promote the effectiveness of interferon led some observers to refer to her as the "Interferon Queen."

In 1980 scientists at the University of Zurich devised a method of cloning the interferon gene. This allowed researchers to make large quantities of interferon without spending a lot of money, which gave a needed boost to interferon research. While its effectiveness in treating cancers has never been as great as Krim had hoped, the protein has proven successful in treating a rare form of leukemia.

AIDS RESEARCH

Krim first became aware of acquired immunodeficiency syndrome (AIDS) in the early 1980s. She was told about the disease by Dr. Joseph Sonnabend, a colleague in interferon research who had started a private medical practice in the Greenwich Village section of New York City. Sonnabend was one of the first doctors in the United States to report the HIV (Human Immunodeficiency Virus) syndrome that was appearing in gay communities in large American cities. HIV is a viral infection that can be passed on through sexual activity, exchange of blood, or sharing of needles by intravenous drug users. It can lay dormant in the system for years, then develop into AIDS (Acquired Immunodeficiency Syndrome). AIDS breaks down the body's immune system so that it is unable to fight off common bacteria, viral infections, types of cancer, and neurological diseases.

From the beginning, the identification of AIDS and the treatment of people afflicted with AIDS were politically charged issues. It was almost impossible to obtain funding from government agencies to investigate the disease, and many people attributed this scarcity of funding to the fact that most victims were gay men. In 1983 Krim started her own medical foundation, the AIDS Medical Foundation, to fund Sonnabend's research.

Krim was very angry with the government's attitude toward the disease. "They felt that this was a disease that resulted from a sleazy life style, drugs or kinky sex—that certain people had learned their lesson and it served them right," she recalled. "That was the attitude, even on the part of respectable foundations that are supposed to be concerned about human welfare." The climate of hate and hostility that many gay men faced reminded her of the way people in Europe during the 1930s and 1940s talked about the Jews. "I became very scandalized by the public reaction to the emergence of the epidemic," Krim said. "People were saying, 'Let's round them up. Let's isolate them. Let's imprison them.' . . . During the Holocaust, I heard the same thing said about Jews. And there it happened. They isolated them and destroyed them. So to hear the same kind of talk here really pulled a trigger in me." The fact that many homosexual men were abandoned by their families out of shame and fear also infuriated Krim, and she became even more determined to educate people about the deadly disease.

Krim's talent for organizing and spearheading projects proved essential in boosting AIDS research. She worked tirelessly on behalf of the AIDS Medical Foundation, recruiting famous people from the worlds of politics and entertainment to lend a hand. The famous philanthropist Mary Lasker—of the prestigious Lasker Medical Research Award—joined the foundation, followed by the president of the Magazine Publishers of America, Donald Kummerfeld. By November 1984, the first big-ticket AIDS benefit event was held in New York City—a fashion show with dresses donated by the world's top designers.

On the West Coast, meanwhile, where actor Rock Hudson had recently died of AIDS, Hudson's doctor, Michael S. Gottlieb, and actress Elizabeth Taylor were trying to establish a broad-based medical foundation. They joined forces with Krim's group in New York to form the American Foundation for AIDS Research (AmFAR). This group was led by Gottlieb and Krim, and Elizabeth Taylor became the foundation's honorary chairperson. Other famous Hollywood celebrities, such as Barbra Streisand, Warren Beatty, Paul Newman, and Woody Allen, joined the cause as well.

In 1985 Krim left Sloan-Kettering. A year later, armed with $640,000 from AmFAR and a $5 million grant from the National Institutes of Health, she built a highly sophisticated molecular-virology laboratory in New York City at St. Luke's-Roosevelt Hospital Center, a teaching site for Columbia University.

By this time, Krim was recognized across America as a passionate crusader against AIDS. In 1986 she testified before Congress to try to bring about changes in the way that a potential AIDS-fighting drug called AZT (azidothymidine) was being tested. Two hundred and sixty AIDS patients were being used in the testing of the drug, but only half of them were receiving AZT. The rest of them were receiving placebos. (A placebo is a substance that contains no actual medication. Placebo-controlled studies help to determine if a new drug has a beneficial effect, as patients are chosen randomly to receive either the drug or a placebo. The patients are not told which substance they are receiving. Thus, if the patients who receive the drug improve and the patients who receive placebo do not, it can be concluded that the drug is effective.) Krim objected to the study. She argued that it was unethical to enroll dying AIDS patients into a government-sponsored clinical study only to give them placebo medication. "People who are on their last legs should get anything they want," she said.

The trials continued as scheduled, but Krim helped to shorten the duration of those studies, and she was successful in eliminating placebo treatment for AIDS patients enrolled in further clinical studies. AZT was eventually found to be of value in prolonging the lives of some AIDS victims, and the drug is now used as the "benchmark" by which the effectiveness of any other AIDS drug is measured.

In the 1990s government funding for AIDS research has increased enormously, but AmFAR continues to provide financial assistance to scientists engaged in the battle against AIDS. AmFAR has also worked hard to educate people about the nature of AIDS, but Krim believes that many people still do not understand the disease. "The public ought to get the message that there's no need to panic at the thought of having HIV-infected people and AIDS patients around us—in our cities, buses, theaters, and restaurants. This is, first, because of the lack of evidence of contagion by casual contact." Krim also does her best to make the public see that AIDS sufferers are deserving of compassion rather than hatred. As the *New York Times* noted, "whether she is speaking to a group of high school students about the importance of prevention or engaging in a television debate with an official from the National Institutes of Health, her underlying message is the same: It is medically and morally wrong to dismiss AIDS as a gay plague or a scourge of the ghetto."

Although Krim is best known for her efforts on behalf of AIDS victims and researchers, she has worked for other causes over the years. She has written or contributed to many scholarly papers, and has contributed her time and energy to a wide range of philanthropic and educational organizations, including the African-American Institute; the Rockefeller Foundation; the Institute of Society, Ethics and Life Sciences; the International Alliance for Haiti; and the Presidential Commission for the Study of Ethical Problems in Medicine and Biomedical and Behavioral Research.

Krim's social contacts and political skills, combined with her knowledge of the scientific world, have made her a formidable champion of AIDS research. Although she left a promising research career to devote herself to fundraising, Krim remains satisfied that she made the right choice. Recalling her earlier years as a research scientist, she commented, "I could never give it 100 percent because of my husband's world and social life and house. Once you become involved in public affairs, it is very difficult to work in a lab . . . with your mind on what you're doing and nothing else. And I can't do that anymore. When I'm in the lab, I get terribly impatient. I worry about what goes on outside. . . . I came to the conclusion that it's better if I stay on the outside and help people inside the labs. I'm not such a genius that somebody else cannot do what I was doing. And these would be people who cannot do what I can."

MARRIAGE AND FAMILY

Krim's first marriage, to Irgun member David Danon in the early 1950s, produced one child, Daphna. She and her second husband, Arthur B. Krim, whom she married in 1958, have no children. They continue to live in the United States.

HONORS AND AWARDS

Spirit of Achievement Award (Albert Einstein College of Medicine): 1972
Humanitarian Award (Fund for Human Dignity): 1985
Human Rights Campaign Fund Award: 1986
John and Samuel Bard Award in Medicine and Science: 1986
Achievement Award (American Association of Physicians for Human Rights): 1987
Eleanor Roosevelt Leadership Award (National Organization for Women): 1987
Hall of Fame Award (International Women's Forum): 1987
Humanist Distinguished Service Award (American Humanist Association): 1987
Charles A. Dana Award for Pioneering Achievements in Health (National Academy of Sciences): 1988
Caring Award (Stewart McKinney Foundation): 1988
President's Award (American Equity Association): 1988
Edwin C. Whitehead Award (National Centre for Health Education): 1991
M. Carey Thomas Award (Bryn Mawr College): 1991
Myrtle Wreath Humanitarian Award (National Hassadah): 1991
Scientific Freedom and Responsibility Award (American Association for Advancement of Science): 1994

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New York Times Magazine, Feb. 14, 1988, p.30
New Yorker, Sep. 1, 1986, p.23
Omni, Nov. 1985, p.76
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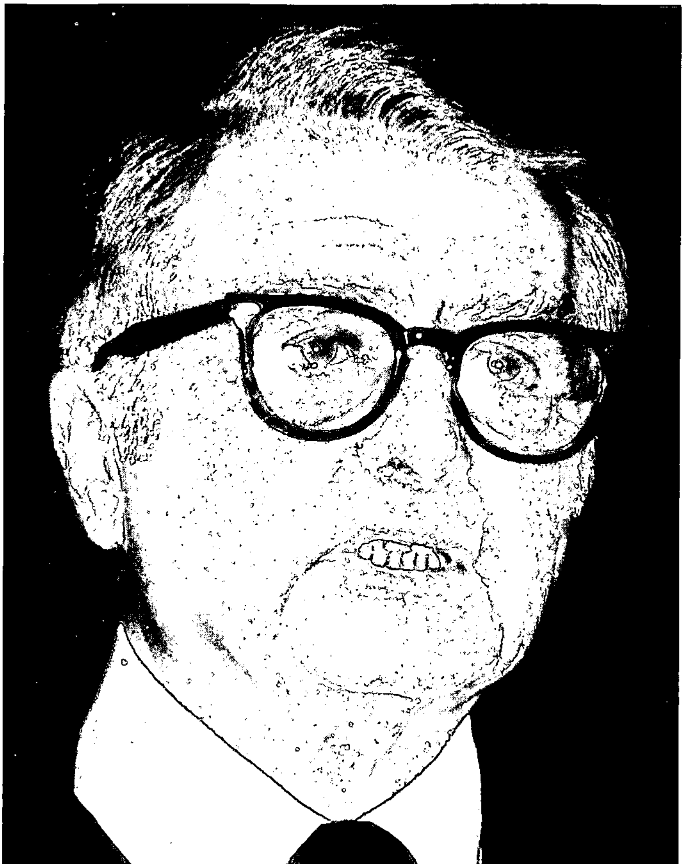
ADDRESS

American Foundation for AIDS Research
East Satellite
5900 Wilshire Blvd, 2nd Floor
Los Angeles, CA 90036-5013



OBITUARY

Edwin Land 1909-1991
American Physicist, Inventor, and Businessman
Inventor of Instant Photography and Founder of Polaroid Corporation

BIRTH

Edwin Herbert Land was born on May 7, 1909, in Bridgeport, Connecticut. He was the son of Harry M. Land, who owned a successful scrap-metal and salvage business, and Martha F. Land. Throughout his life, Land was known by the nickname "Din," which was what he called himself as a small child before he could pronounce "Edwin."

YOUTH

Land enjoyed a comfortable, upper-middle-class lifestyle while growing up in Connecticut. He loved to experiment with mechanical and electrical devices from an early age. One evening, after his parents had gone out, Land climbed up on a chair to retrieve a beautiful, chiming clock that sat on the mantel in their house. He had always been fascinated by the clock, so he used a small screwdriver to take it apart and see how it worked. As he removed the tiny pieces, he placed them in neat piles on the oriental rug on the floor of his family's living room. When his curiosity was satisfied, he worked quickly to put the clock back together again.

Unfortunately, his father came home before Land had finished, punished him, and collected all the remaining parts in a box and sent them to a clockmaker to be fixed. Land was disappointed because he knew he would have been able to make the clock work again, and from then on he decided it was important to be in complete control of his experiments. Later, his father allowed him to set up a laboratory in the basement of their house—as long as he agreed to leave their household items alone.

For several years of his childhood, Land spent his summers at a boys' camp in upstate New York. While there, he impressed the counselors by installing an electrical system for the camp when he was only 12 years old. Land also became interested in photography during his childhood. The first picture he ever took was of his family's French poodle, which was always running away. He found that preserving its image in a picture made a difference. "To a child, a photograph gives a permanent thing that is both outside himself and part of himself," he explained.

EDUCATION

Land attended public schools in Bridgeport until his family moved to nearby Norwich, Connecticut. He then enrolled at Norwich Academy, a private preparatory school. At Norwich, Land excelled academically and also found time to compete on the track and debate teams. He developed an early fascination with the sciences, especially physics and chemistry. It was at the academy that his interest in the polarization of light began. Light rays are composed of electromagnetic waves that typically vibrate in many directions. When the component waves of a light ray all vibrate in the same direction, the ray is then said to be polarized. Land was intrigued by the concept of polarization and read everything he could find on the topic. "I was fortunate enough to acquire Robert W. Wood's *Physical Optics*, which I read nightly the way our forefathers read the Bible," he stated.

After graduating from Norwich Academy in 1926, Land enrolled at Harvard University to study physics and continue his exploration of light polarization. As a 17-year-old freshman, Land was especially curious about how he could use the concept of polarization to devise a way to eliminate the glare caused by reflected light waves of the sun, car headlights, and other bright light sources. He believed that he could produce a special filter to polarize the light rays—making them all vibrate in the same direction—in order to eliminate the glare and control illumination. Before this time, the only available light polarizers were expensive and fragile crystals that were not suitable for use in everyday applications.

During a semester break in his freshman year, Land became so engrossed with this problem that he took a leave of absence from Harvard to devote all of his energies to finding the solution. He moved to New York City and began his research. Most of his days were spent at the New York Public Library, where he read book after book on optics, physics, light polarization, and physical chemistry. At night he would return to his makeshift laboratory in his tiny rented room on 55th Street or sometimes sneak through an unlocked window into the physics building at Columbia University to conduct experiments.

Land's leave of absence lasted three years. During this time away from his structured college classes, Land had gained enough knowledge to become a virtual expert in the field of light polarization. The research that he conducted at the library and in his crude laboratory paved the way for his first invention—the synthetic sheet polarizer, which was a durable device that artificially polarized light rays. When he returned to Harvard in 1929, Land showed his invention to a Harvard physics instructor, George Wheelwright III, who was so excited about it that he offered to become partners with Land in a business venture. Land left Harvard for good in 1932, just a few courses shy of graduation, to establish his first company, Land-Wheelwright Laboratories.

CAREER HIGHLIGHTS

Land was just 23 years old when he started Land-Wheelwright Laboratories in a barn in Wellesley, Massachusetts, a small town near Boston. His partner was just two years older and, like Land, had little experience in running a business. What the two eager young men lacked in business sense, however, they more than made up for in enthusiasm and confidence. They were so excited about finding new applications for Land's polarizing sheet that they barely gave a thought to making money. They firmly believed that they had such a unique and useful new product that selling it would be no problem.

Shortly after Land-Wheelwright Laboratories was established, Land was granted a patent on his polarizing sheet, which he had called "Polaroid." Within two years, the company received its first major contract when the Eastman Kodak Corporation agreed to use Polaroid for a new series of photographic light filters. Land-Wheelwright quickly outgrew its barn location and moved into a building in Boston. More contracts followed, including one with American Optical Corporation to manufacture polarized nonglare sunglasses. By 1937, Land-Wheelwright had caught the attention of several major investors, who provided the capital to allow Land to establish a new company, Polaroid Corporation, which absorbed all of Land-Wheelwright's assets. Land was named president and director of research.

EARLY YEARS AT POLAROID

During Polaroid Corporation's first three decades, Land led the company through an unprecedented period of invention and product development.

The company's employment grew tremendously and profits soared. The working environment at Polaroid reflected Land's inventiveness. It was one of the first companies to adopt progressive management practices like job rotation, profit sharing, and reimbursement for education.

During World War II, Polaroid made many important contributions to the war effort and national defense. For example, Land and his highly skilled staff of researchers invented infrared night vision devices that were used by American troops. They also developed filters used for gun sights, periscopes, and aerial surveillance cameras. When the war ended in the 1940s, Land directed the company through a whole new phase of innovations.

INVENTING INSTANT PHOTOGRAPHY

Land's most famous invention—instant photography—was inspired by his three-year-old daughter, Jennifer. Land was on vacation with his family in Santa Fe, New Mexico, at Christmastime in 1943. He was walking around with his daughter, taking pictures of things that interested her. After he had snapped one picture, Jennifer asked to see the image. She was puzzled when her father told her that she would have to wait for the film to be developed and printed. His daughter's reaction triggered an idea in Land's inventive mind, and he surprised his family by abruptly walking off alone to think. "As I walked around that charming town I undertook the task of solving the puzzle she had set me. Within the hour, the camera, the film, and the physical chemistry became so clear to me," Land recalled. In this short time, he had conceived the first instant camera. "What is hard to convey, in anything short of a thick book, is the years of rich experience that were compressed into . . . that first day in which I suddenly knew how to make a one-step dry photographic process," he noted.

After supervising painstaking research at Polaroid for almost five years, Land finally produced the instant black-and-white camera that he had envisioned. The Polaroid Land Camera, as it was named, used a complex combination of special paper and chemicals to develop the exposed film image within a few minutes of snapping the camera shutter. The camera became extremely popular among amateur photographers across the country. At one point in the 1960s, in fact, market research revealed that half of all American households owned a Polaroid Land Camera. Although some professional photographers considered the instant camera to be a toy, the invention soon found numerous applications in science and industry. Land expanded the concept to include instant color photography in 1959, and the Polaroid Corporation followed with a steady stream of photographic innovations during the next two decades. The final development in Polaroid camera technology was the one-step process, in which the chemicals, paper, and image development were completed in only one step. This was a landmark in photographic image development.

STEPPING DOWN FROM MANAGEMENT

Although Land was a brilliant and creative man, he could also be domineering and stubborn. He insisted on running the company his own way, and he always placed higher importance on research activities than he did on earning profits. In addition, some business analysts felt that his employee relations policies were too liberal and allowed employees to take advantage of the company. By the 1970s, Polaroid's employment and earnings began to drop. One of Land's pet projects—the Polavision instant home-movie system—cost the company millions of dollars to develop, and Land refused to stop funding its research even when the development of videotape technology threatened to make his system obsolete. Polavision never was perfected to the point of marketability, and the company was forced to claim a loss of more than $68 million in 1979. A year later, under pressure from stockholders, Land stepped down from management, ending more than 40 years at the helm of the company he had founded in 1937. During his tenure, Polaroid Corporation had grown from a tiny producer of lenses to become a $1.4 billion industrial giant that employed 18,000 people.

CUTTING-EDGE RESEARCH ENDURES

Even after he left Polaroid Corporation, Land continued to conduct research and invent new products. In 1980, he used millions of dollars of his vast wealth to create a nonprofit research center, the Rowland Institute for Science. Located near Land's home in Cambridge, Massachusetts, the institute's purpose was to conduct basic research that could lead to practical innovations in science, medicine, and technology. In recent years, the institute has developed laser beams so tiny that they can be used like microscopic tweezers to manipulate microorganisms as small as bacteria. The technology has a wide range of applications in the fields of biotechnology and genetic engineering.

By the time he retired, Land held an incredible 537 U.S. patents, second only to Thomas A. Edison in number. In addition to the synthetic sheet polarizer and the technology of instant photography, Land invented such products as polarized sunglasses, infrared night goggles, optical elements for weapons, components for three-dimensional movie projection, and instant X-rays. Land was awarded the Presidential Medal of Freedom for his achievements in 1963, and four years later he received the National Medal of Science. He was also presented with an honorary doctoral degree by Harvard University, which enabled the two-time college dropout to be referred to as "Dr. Land" for much of his career.

One person who worked with Land at Polaroid for many years said that as soon as he walked into a room, "You were immediately aware of a first-rate brain—maybe the best brain you ever saw." Land was often quiet and intense, yet he could excite and inspire people when he spoke about his ideas and inventions. One newspaper described him as having "the genius of Einstein, the sensitivity of an artist and the exuberance of a small child." Co-workers also noted that Land could be egotistical and strong-willed. "He could be too radical and manipulative and work people to exhaustion, although no one ever worked harder than he," one employee noted.

Land was frequently asked to describe his feelings about the creative process. "As I review the nature of the creative drive," he stated, "I find the first event is an urge to make a significant intellectual contribution that can be tangibly embodied in a product or process." About his life as an inventor, Land remarked: "I suppose that I am first of all an artistic person. I'm interested in love and affection and sharing and making beauty part of everyday life. And if I'm lucky enough to be able to earn my living by contributing to a warmer and richer world, then I feel that it is awfully good luck. And if I use all of my scientific, professional abilities in doing that, I think that makes for a good life."

MARRIAGE AND FAMILY

In 1929, Land married Helen "Terre" Maislen, who had assisted him with many of his experiments in New York City during his three-year leave from college. Their marriage lasted for 62 years, until Land's death after a long illness on March 1, 1991, at the age of 81. The Lands had two daughters, Jennifer and Valerie.

HONORS AND AWARDS

Hood Medal (Royal Photographic Society): 1935
Elliott Cresson Medal (Franklin Institute): 1938
Rumford Medal (American Academy of Sciences): 1945
Holley Medal (American Society of Mechanical Engineers): 1948
Duddell Medal (Physical Society of Great Britain): 1949
National Academy of Sciences: 1953
Howard N. Potts Medal (Franklin Institute): 1956
Progress Medal (Royal Photographic Society of Great Britian): 1957
Presidential Medal of Freedom: 1963
Industrial Research Institute Medal: 1965
Michelson—Morley Award (Case Western Reserve University): 1966
Frederick Ives Medal (Optical Society of America): 1967
National Medal of Science (National Science Foundation): 1967
Founders Award (National Academy of Engineering): 1972
Kosar Memorial Award (Society of Photographic Scientists and Engineers): 1973
National Inventor's Hall of Fame: 1977
Harvey Prize (Israel): 1979

Infinity Awards (International Center of Photography): 1988
National Medal of Technology (U.S. Department of Commerce): 1988

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BOOKS

Newsmakers, 1991
Olshaker, Mark. *The Instant Image: Edwin Land and the Polaroid Experience,* 1978
Wensberg, Peter C. *Land's Polaroid: A Company and the Man Who Invented It,* 1987

PERIODICALS

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Louis Leakey 1903-1972
Mary Leakey 1913-
British Archaeologists and Paleoanthropologists
Pioneers in the Study of Human Evolution

BIRTH

LOUIS

Louis Seymour Bazett Leakey was born in a primitive hut near Nairobi in Kenya, Africa, on August 7, 1903. His parents, Harry Leakey and Mary Bazett Leakey, were Christian missionaries who lived in Africa with the Kikuyu tribe. Louis had two younger sisters, Gladys and Julia, and a younger brother, Douglas.

MARY

Mary Douglas Nicol Leakey was born in London, England, on February 6, 1913. She was the only child of Erskine Edward Nicol, an established artist, and his wife, Cecilia Marion Frere Nicol.

YOUTH

LOUIS

During their unusual childhoods, both Louis and Mary Leakey were drawn to archaeology—the scientific study of ancient people through excavation of their bones and artifacts. Louis grew up among the Kikuyu people, and as a boy he considered himself one of them. In fact, the chief of the Kikuyu called Louis "the black man with a white face, because he is more of an African than a European." Louis strongly identified with the Kikuyu language, customs, and ways, and he learned to stalk wild animals as well as any native Kikuyu boy. At the age of 13, he became a member of the Kikuyu tribe by participating in a rite of passage that he kept secret all his life. At that time he was given the name *Wakaruigi*, which means "Son of the Sparrow Hawk," because he enjoyed watching birds. During his outings looking for birds, Louis began to find and collect primitive tools and stone arrowheads that had been used by ancient ancestors of humans thousands of years before. He soon gave up bird-watching in order to pursue his interest in collecting artifacts.

MARY

Though Mary grew up in Europe, her childhood was also unusual. Since her father painted landscapes, her family was constantly moving from one country or location to another. They spent several winters in southwestern France, where Mary explored the many prehistoric caves that dotted the countryside. One winter, a famous French prehistorian named Elie Peyrony was leading an excavation at nearby Laugerie Haute. Peyrony allowed Mary to sort through piles of the artifacts he had found, which sparked her interest in archaeology. Two years later, Mary learned the art of excavating from an amateur archaeologist, Abbé Lemozi, who had earlier discovered important prehistoric rock paintings in the area. Working with him "kindled my interest in prehistory and also gave me a very sound groundwork in excavating," Mary explained. "After that, I don't think I ever really wanted to do anything else."

EDUCATION

LOUIS

In 1919, at the age of 16, Louis Leakey left Africa for the first time to attend school in England. Before this time, his only education had come from tutoring by his parents, and the only white people he had known were his own family. He soon found that his unconventional childhood put him at a disadvantage in the British public schools. He had never played cricket or learned to swim like the other boys, for example, and he had never been to the theater. Nevertheless, within two years he was admitted to Cambridge University. During his second year of college, however, he received a head injury in a rugby match that caused severe headaches. Since the headaches interfered with his studies, Louis decided to take a leave of absence from school and join an expedition to the east African nation of Tanzania led by W. E. Cutler, a famous paleontologist. Over the next ten years, Louis alternated between doing fieldwork in Africa and taking classes at Cambridge, and he eventually earned his doctoral degree in archaeology and anthropology.

MARY

Since her family moved around so much, Mary was also tutored at home. She did not attend school until after her father died, when she was 13 years old. At this time, her mother became determined that Mary should receive a proper Catholic education and sent her to convent schools in Kensington and then Wimbledon, England. "The classwork seemed to me wholly unconnected with the realities of life, while the girls of my own age, and even many of the older ones, seemed utterly juvenile compared to the company I was used to keeping," Mary recalled. "I could not find a single kindred spirit among either the pupils or the nuns who taught us." After pretending to be ill by chewing on soap until she frothed at the mouth and intentionally causing an explosion in a chemistry laboratory, Mary was expelled from both schools. "After this second expulsion, even my mother gave up on convents," Mary admitted. "At least I ended my school career with a bit of a bang." From then on, her mother allowed her to study independently.

CAREER HIGHLIGHTS

LOUIS LEAKEY'S EARLY DISCOVERIES

With his intense and enthusiastic dedication to his studies, Louis was well on his way to becoming one of the world's great experts on the development of prehistoric man by the time he left Cambridge. Although most archaeologists of the time believed that early man had developed in Asia, Louis felt that many of the sites he had visited in East Africa were promising locations to search for fossils of the earliest human ancestors. He led his own expedition to Africa in 1929 and almost immediately made a major discovery. After almost falling over the edge of a cliff, Louis looked down and saw the edge of an ancient hand axe protruding from the rock below. This area turned out to be a major site of prehistoric human remains and artifacts dating back 200,000 years. Two years later, Louis made his first visit to Olduvai Gorge in Tanzania, an 800-foot-deep, 25-mile-long canyon cutting through an area that once held a shallow lake. The visible layers of rock and sediment in the walls of the gorge made it relatively easy to date fossils found there. This area would become central to Louis's work for the rest of his life.

MARY LEAKEY ENTERS THE FIELD

When Mary was in her late teens, she had a chance encounter with archaeologists Alexander Keiller and Dorothy Liddell, who were excavating ruins near where Mary lived in England. The fact that one of the archaeologists was a woman impressed Mary deeply. "Perhaps when I met Miss Liddell this first time I absorbed there and then the notion that a career in archaeology was certainly open to a woman," she noted. Mary became Liddell's chief assistant from 1930 to 1934. Since she had inherited her father's artistic talent, Mary drew precise pictures to help document the bones and artifacts Liddell found. Mary soon decided that she needed to learn more about geology and archaeology, so she spent the winters attending lectures at London University and at the London Museum.

Mary's drawings for Liddell were so good that a famous archaeologist, Gertrude Caton-Thompson, asked her to illustrate a book she was writing about her recent excavations in Egypt. In 1933, Mary accompanied Caton-Thompson to a lecture at the Royal Anthropological Institute in London and was introduced to the guest speaker, Louis Leakey. On the spot, he asked her to illustrate his book *Adam's Ancestors*.

LOUIS AND MARY LEAKEY FORM A PARTNERSHIP

Louis and Mary became instant professional companions. Although Louis was then married, their relationship became closer and more personal within a short period of time. When it became known that Louis intended to leave his wife and children to be with Mary, it caused a scandal in Cambridge, but they were deeply in love and determined to spend their lives together. Louis returned to Tanzania in October 1934, and Mary joined him in April 1935. Mary was thrilled when she first saw Olduvai Gorge. "It was just a place that was incredibly beautiful and where nearly every exposure produced some sort of archaeological or geological excitement," she recalled. "It was also the best time of the year to make a first visit, in the rainy season when animal life abounds, notably the huge herds of grazing animals congregated on the plains for the fresh new grass, and with them the predators." Mary and Louis spent the next several months digging in the gorge, cataloging their finds, and studying the herds of animals on the surrounding plains. They returned to England in September and lived together in a cottage in Hertfordshire for the next year. They were married on December 24, 1936, shortly after Louis's divorce became final, and immediately returned to Africa.

The Leakeys continued their research at a number of sites in East Africa over the next several years. In 1937, Mary went to the Great Rift Valley north of Nairobi, Kenya, to excavate at Hyrax Hill. She discovered examples of pottery from the Iron Age—which took place 4,000 to 5,000 years ago—as well as tools and a cemetery from the Neolithic Stone Age—about 8,000 to 10,000 years ago. From 1937 to 1939, Louis and Mary excavated together at the Njoro River Cave. This site held the cremated remains of a Neolithic Stone Age tribe, including many well-preserved examples of bead necklaces and wooden cups.

During World War II, Louis worked for the British military intelligence in East Africa. In the meantime, Mary excavated at an island in East Africa's Lake Victoria. There she found more Iron Age pottery, as well as stone tools that were among the oldest to be discovered at that time. It was not until 1946 that the Leakeys—by then with two young sons—returned to Olduvai Gorge to continue their excavations there. Due to their commitments to other projects, they were not able to spend as much time at Olduvai as they would have liked. After the war Louis was named director of the Coryndon Museum in Nairobi, Kenya, and he had to devote all but a few weeks a year to his work there. He and Mary worked jointly to organize the First Pan-African Congress of Prehistory and Paleontology, held in January 1947. They hoped that this event would help focus the world's attention on the significance of their discoveries.

DISCOVERY OF *PROCONSUL AFRICANUS*

Scientists think that between 5 and 8 million years ago, the evolutionary tree for primates split into two main branches. One branch of ancient primates began developing characteristics that would lead to modern humans, while the other branch began developing characteristics that would lead to modern apes. Some scientists believe that prior to this evolutionary split, a primate species existed that was the "common ancestor" for both humans and apes. They use this theory to explain the close genetic similarities that still exist today between human beings and the great apes.

In 1948, the Leakeys made another major discovery that provided new clues about this mystery. On the island of Rusing in Lake Victoria, Mary found the fossilized skull and bones of an apelike creature that lived about 25 million years ago. This creature, which was called *Proconsul africanus,* had apparently walked on two legs and had a jaw that was similar to that of modern humans. It was one of the oldest primate fossils that had been found up to that point, and it helped establish the time frame for the evolutionary split between the ancestors of humans and the ancestors of apes. Besides bringing worldwide attention to the Leakeys and their work, this incredible discovery convinced many archaeologists that the human race had indeed originated in Africa.

MARY'S MAJOR ART PROJECT

In 1951, Mary undertook a major project to reproduce a large number of the Neolithic Stone Age cave paintings in the Kindoa-Irangi region of Tanzania. She traced 1,600 of the ancient paintings onto sheets of clear cellophane, then transferred them onto sturdy drawing paper. The work was very challenging, since many of the figures were in inaccessible locations and often several figures were drawn on top of each other. Nevertheless, Mary has described this enormously time-consuming task as "one of the highlights" of her career, noting that the work provided her with "a great sense of happiness and well-being." The cave paintings provided a glimpse of what life was like for the hunter-gatherer tribes that had created them thousands of years before. "There were details like clothing, hair styles and the fragile objects that hardly ever survive for the archaeologist—musical instruments, bows and arrows, and body ornaments depicted as they would be worn," Mary recalled. "No amounts of stone and bone could yield the kinds of information that the paintings gave so freely." She published the results of this work in her 1983 book, *Africa's Vanishing Art*.

DISCOVERY OF *ZINJANTHROPUS*

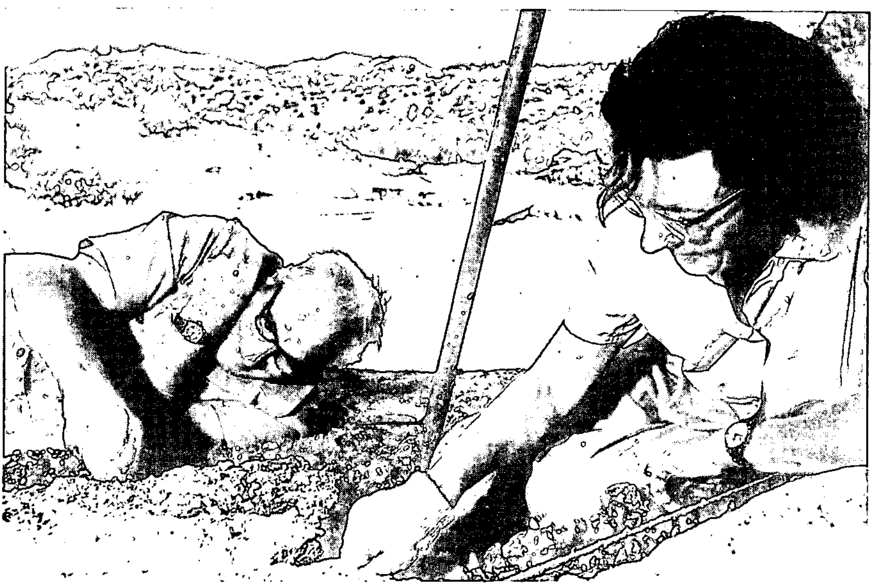
The discovery of *Proconsul africanus*, and the resulting publicity, made the Leakeys even more determined to complete an extensive excavation of Olduvai Gorge. Along with their sons, Louis and Mary spent as much time as they could searching the gorge throughout the 1950s. This type of archaeological search usually involved crawling on their hands and knees with their faces close to the ground, in temperatures often reaching 110 degrees, and using tiny dental instruments to carefully unearth any interesting objects.

One day—July 17, 1959—Louis stayed in camp with a fever while Mary went off on her own with only their dogs as companions. Mary had a keen eye for spotting the edges of fossils sticking up from layers of dirt, and on this day she spotted some fossilized teeth that appeared humanlike. Immediately sensing that this could be the jawbone of an early ancestor of man, she ran back to the camp and pulled Louis from his bed. The Leakeys worked side by side with camel-hair brushes and dental picks for several days until they had revealed a complete jaw belonging to a humanlike creature that had lived 1.75 million years ago. After further digging, they found more than 400 bone fragments that were pieced together to form the skull of this prehistoric man, which they named *Zinjanthropus*, meaning "East Africa man." A British television crew, which happened to be in the area filming a safari, captured the Leakeys' discovery for the world to see.

RETHINKING HUMAN EVOLUTION

The Leakeys, like many other archaeologists, were attempting to trace the evolution of the human species from its earliest ancestors to the present day. Each new find would take its place somewhere along that continuum, shedding new light on the mystery of the development of the human race. One of the earliest ancestors of human beings was called *Australopithecus,* which means "southern ape." Several species of the genus *Australopithecus* have been found in Africa, dating from between one and five million years ago. *Australopithecus* showed a combination of human and ape characteristics: they were about four feet tall, had brains only about one-fourth the size of modern humans, and were among the earliest hominids to walk upright. Even closer relatives of human beings belonged to the genus *Homo,* which developed about 1.7 million years ago. Early species of this genus, like *Homo habilis* and *Homo erectus,* had larger brains than *Australopithecus* and were the first hominids to use tools, wear clothing, build shelters, and use fire.

For many years, scientists generally believed that *Australopithecus* had evolved into *Homo,* which includes the modern human species (*Homo sapiens,* or "man the thinker"). Following the Leakeys' discovery of *Zinjanthropus,* Louis presented their findings in scholarly writings as well as in lectures at major universities throughout the world. At first Louis



declared that *Zinjanthropus*, nicknamed "Zinj," was the missing link between *Australopithecus* and *Homo sapiens*. He was later proved to be wrong. Zinj was, in fact, a newly discovered species of the *Australopithecus* line.

In 1961, the Leakeys unearthed a skull belonging to a hominid more similar to modern man in the same sedimentary layer where they had found *Zinjanthropus*. They named this discovery *Homo habilis*, which means "able man," since the species was the earliest known user of stone tools. It was soon determined that this species was not a member of the *Australopithecus* line. Instead, the Leakeys' discovery of *Homo habilis* suggested that two distinct prehistoric hominid lines had existed at the same location during the same time period. Louis used this evidence as the basis of his new theory that humans evolved through parallel evolution.

Instead of following the prevailing theory that *Australopithecus* had evolved directly into *Homo*, Louis proposed that *Homo* had evolved separately at about the same time, competed with, and eventually replaced *Australopithecus*. Since *Homo habilis* had a larger brain and was better suited to the environment than *Australopithecus*, he guessed that it had continued evolving into modern man, while *Australopithecus* eventually became extinct. During the 1960s, Louis caused a major disturbance wherever he lectured as other scientists openly disputed his theories. "Theories on prehistory and early man constantly change as new evidence comes to light," he responded. "A single find such as *Homo habilis* can upset long-held—and reluctantly discarded—concepts. A paucity of human fossil material and the necessity for filling in blank spaces extending through hundreds of thousands of years all contribute to a divergence of interpretations. But this is all we have to work with; we must make the best of it within the limited range of our present knowledge and experience."

Louis possessed a great deal of charm and charisma, so his lectures gained an enormous following despite the controversial nature of his theories. His passionate nature inspired many future archaeologists and other researchers, including primate experts Jane Goodall and Dian Fossey, two of his former students. Over time, as additional evidence became available from later finds, Louis Leakey's theory of parallel evolution gained widespread acceptance.

THE BREAKUP OF THE LEAKEY TEAM

The idyllic marriage of Louis and Mary Leakey, which had been energized for years by their shared passion for archaeology and anthropology, disintegrated over time. Throughout the 1960s, Louis worked at the museum in Nairobi during the week and traveled to the camp at Olduvai Gorge only on weekends and holidays. He also made frequent trips to the United States to present his theories and to raise money to support their work at the gorge. During this time, Mary became more independent and even disagreed publicly with the scientific basis of some of her husband's bold statements. As a result, Louis began to resent his wife for not being supportive of him. By 1968, Louis's health was failing and the Leakey team had dissolved. From then until Louis's death from a heart attack on October 1, 1972, Mary and Louis lived and worked apart, although they never officially separated.

MARY LEAKEY ON HER OWN

After Louis's death, Mary reluctantly made public appearances in his place to generate financial support for her work. At first, she was extremely shy and introverted, but later she blossomed into a captivating speaker and capable fund-raiser. "For many years I would have done anything to avoid lecturing in public: the very idea terrified me," she explained. "Latterly, however, public appearances . . . have become a major and essential part of my work in raising the enormous amounts of money required these days to finance archaeological research in remote areas. I have now, to my amazement, come to terms with lecturing to large audiences, and even find it exhilarating."

In 1978, Mary made what she considered to be "the most significant" of her discoveries. On the Serengeti Plain, 30 miles south of Olduvai Gorge, she found a 25-yard-long trail of hominid footprints, fossilized in volcanic ash, which dated back 3.6 million years. She described the footprints as "so sharp that they could have been left this morning." Her theory was that the tracks were made by three individuals, perhaps traveling in a family unit. One set of tracks was smaller than the others and often overlapped them, as if a child had been trying to step in his parents' footprints. Her discovery was significant because it suggested that man's early ancestors had walked upright and formed small communal groups earlier than previously believed. Mary explained that the ability to walk on two legs was an important step in human evolution: "This unique ability freed the hands for myriad possibilities—carrying, toolmaking, intricate manipulation. From this single development, in fact, stems all modern technology. Somewhat oversimplified, the formula holds that his new freedom of forelimbs posed a challenge. The brain expanded to meet it. And mankind was formed."

In 1982, Mary suffered a blood clot that caused her to lose the vision in her left eye. She retired from active field work at this time and turned the Leakey camp at Olduvai Gorge over to the Tanzanian Department of Antiquities. When she is not busy lecturing, Mary Leakey lives in Nairobi and breeds Dalmatians.

Over the course of more than 50 years of research in East Africa, the Leakey name became by far the best known in the field of archaeology. Louis and Mary were instrumental in shifting the study of human origins from

Asia to Africa, as well as in generating worldwide interest in the field. Their discoveries proved that the course of human evolution was much longer and more complex than anyone had dreamed before.

MARRIAGE AND FAMILY

Louis Leakey married Henrietta Wilfrida Avern in 1928. They had a daughter, Priscilla, and a son, Colin, before they were divorced in 1936. Louis married Mary Nicol in 1936, and they had three sons: Jonathan, Richard, and Philip. Before Richard was born, Mary gave birth to a daughter, Deborah, who died as an infant. Louis and Mary's sons helped out with their excavation work from a young age. Discussing the challenge of raising children at dig sites in Africa, Mary commented: "I quite liked having a baby—I won't put it more strongly than that—but I had no intention of allowing motherhood to disrupt my work as an archaeologist."

Richard Leakey became a noted paleoanthropologist in his own right after working with his mother for many years in her field studies. Many of his most significant discoveries helped support his father's belief in parallel evolution. Richard was also director of the Kenya National Museum and founder of the Louis Leakey Memorial Institute for African Prehistory in Nairobi. In addition, as director of the Kenya Wildlife Service from 1989 to 1994, he improved the country's national park system and helped reduce poaching. Philip Leakey became the only white member of the Kenyan parliament and an assistant minister of foreign affairs. Jonathan Leakey became a herpetologist involved in the study of reptiles and amphibians.

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LOUIS LEAKEY

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Rivers Memorial Medal (Royal Anthropological Institute): 1952
Henry Stopes Memorial Medal (Geological Association of London): 1955
Hubbard Medal (National Geographic Society): 1962 (with Mary Leakey)
Viking Medal (Wenner-Gren Foundation): 1962
Vega Medal (Sweden): 1963
Founder's Medal (Royal Geographic Society): 1964
Haile Selassie Award: 1968
Welcome Medal (Royal African Society): 1968
Commander, National Order of Senegal: 1968
Prestwich Medal (Geological Society of London): 1969
Andre Dumont Medal (Royal Geographical Society of Belgium): 1969
National Geographic Society Centennial Award (National Geographic Society): 1988 (with Mary Leakey)

MARY LEAKEY

Hubbard Medal (National Geographic Society): 1962 (with Louis Leakey)
Prestwich Medal (Geological Society of London): 1969
Linneus Gold Medal (Royal Swedish Academy): 1978
Bradford Washburn Award (Boston Museum of Science): 1980
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Rita Levi-Montalcini 1909-
Italian-American Neurobiologist
Winner of the 1986 Nobel Prize for Physiology or Medicine

BIRTH

Rita Levi-Montalcini (LAY-vee mon-tal-CHEE-nee) was born in Turin, Italy, on April 22, 1909. Her father, Adamo Levi—an engineer and factory manager—was descended from Jews who had settled in northern Italy many centuries before. Her mother, Adele (Montalcini) Levi, was a quiet, artistic woman who accepted the traditional female role of homemaker. Later in life, to set her apart from the rest of the Levi family, Rita added her mother's maiden name, Montalcini, to her own. Levi-Montalcini's fraternal twin sister, Paola, has been her closest friend throughout her life. She also had a brother, Gino, who was seven years older, and another sister, Anna, who was five years older.

YOUTH

Levi-Montalcini was raised in a loving, upper-middle-class Italian home. "My family were freethinkers, not religious, integrated and intermarried with Catholics," Levi-Montalcini noted. "We were all quite intellectually minded, and so were my friends. When I was three years old, my father taught me to repeat the sentence *'Sono una libera pensatrice'*—I am a freethinker." As a child, Levi- Montalcini tended to be shy and timid. She was afraid of the dark, for example, so her twin sister always had to walk with her down the long, dark hallway to their bedroom. "I was apparently a very mild, submissive child," Levi-Montalcini admitted. "But I was very strong inside; you might say there was a strong resentment in me."

The focus of Levi-Montalcini's resentment was the traditional role that women were expected to play in Italian society. Her father was the undisputed head of the family, and he had very clear ideas about how his daughters should be raised. He thought that they should get married, have children, and take care of their homes and families—just as his wife did. "My father's view was not against women; he respected them very much," Levi-Montalcini recalled. "Mother was a marvelous woman—intelligent, sensitive, and artistic—but submissive to him. . . . The ideal for my father was my mother: exceedingly beautiful, intelligent, refined, but accepting of being number two."

From an early age, Levi-Montalcini knew that being a wife and mother was not right for her, and she grew increasingly resentful as her father pushed her toward that goal. "My experience in childhood and adolescence of the subordinate role played by the female in a society run entirely by men had convinced me that I was not cut out to be a wife," she explained. "Babies did not attract me, and I was altogether without the maternal sense so highly developed in small and adolescent girls."

EDUCATION

Levi-Montalcini was always an excellent student, and she wanted very badly to attend a university. But her father had other ideas. His two sisters had pursued advanced degrees in literature and mathematics, and both of their marriages had failed. Concluding that having a college education was incompatible with being a good wife, Adamo Levi decided to send his daughters to a girls' school that would provide them with the skills they needed to be good wives and mothers. Levi-Montalcini found the school boring and was deeply disappointed that the courses there would not prepare her for entrance to a university.

After her beloved former governess died of stomach cancer in 1929, Levi-Montalcini decided that she wanted to become a doctor. Her certainty about this new goal made her more determined than ever to pursue a higher education. Although she was very nervous about his reaction, Levi-Montalcini informed her father that she did not plan to get married and instead wanted to be a doctor. After much pleading, Adamo Levi finally relented and told her that "if this is what you want, then I won't stand in your way, even if I'm very doubtful about your choice." He then hired a tutor to help his daughter prepare for the university.

After only eight months of study, Levi-Montalcini easily passed the university entrance examination. In 1930, she became one of only seven female medical students in a class of 300 at the University of Turin. The male students constantly harassed the female students, but Levi-Montalcini refused to be defeated. Instead, she concentrated on her research and tried to hide her feminine side. "I wanted to spend all my time on research. I was not receptive to courtship. I dressed like a nun. I despised everything with a feminine flair," she recalled. "I didn't want any sentimental contact with other students, only intellectual contacts. I didn't want any contact as a woman." Levi-Montalcini graduated from medical school in 1936. Unfortunately, her father died of a heart attack before she had achieved her dream of becoming a doctor.

CAREER HIGHLIGHTS

During her years in medical school, Levi-Montalcini worked with Giuseppe Levi, a leading scientist in the study of living tissues. Though Professor Levi had a quick temper and would sometimes fly into rages if his students did not do as he wished, he inspired Levi-Montalcini to become interested in medical research. She often used his technique of staining chicken embryos—which were removed from eggs before they hatched—with chrome silver to make the nerve cells stand out for study under a microscope. Since the nervous system in chickens is essentially the same as in all vertebrates, she hoped to learn things from these experiments that would shed light on human development. After she graduated from medical school, Levi-Montalcini continued to work with Giuseppe Levi, specializing in neurology (the study of the nervous system) and psychiatry.

At this point, Levi-Montalcini was not sure whether she wanted to practice medicine or pursue her interest in medical research. Sadly, this career choice was taken away from her by Italy's fascist government. Led by Benito Mussolini, who had taken power in 1922, the government had become increasingly oppressive and violent by the mid-1930s. One of the many strictly enforced fascist policies made it illegal for Jews to attend universities or pursue any professional career. This meant that Levi-Montalcini was forbidden to work in the laboratory, talk to her former medical-school classmates, or even go to the library. Though she provided medical services to the poor for a time, Levi-Montalcini was soon forced to abandon this practice since she was not allowed to write prescriptions. She considered fleeing the country with her family, but they decided to remain in Italy, hoping that fascism would soon disappear and life would return to normal.

WORLD WAR II

Conditions only got worse with the start of World War II in 1939, and Levi-Montalcini and her family were forced to go into hiding in the Italian countryside. Even in these desperate times, she was determined to continue her research. Her brother helped her to build her own makeshift laboratory in the small farmhouse where they lived, and she kept dissecting chicken embryos in order to study the early growth of nerve cells. "I had practically nothing—just eggs and an old microscope, like a 15th-century microscope. I used a sewing needle I sharpened myself on a stone. I kept things sterile with alcohol," she recalled. "Food was very scarce in those days, so I had to eat the chicken embryos. They were not too fresh, because I needed to experiment on them for about four days, but they were food."

One day, Levi-Montalcini read in a medical journal about some experiments that had been performed by Dr. Viktor Hamburger at Washington University in the United States. Hamburger had removed developing legs and wings from chicken embryos, which affected the nerves that normally would have grown into the limbs. He theorized that the limbs contained some organizing factor that "called out" to the nerve cells, and that in the absence of this factor the nerve cells did not form. Levi-Montalcini was excited about the possibilities of this line of research, so she duplicated Hamburger's experiments in her tiny laboratory. Professor Levi joined her in these research efforts, since he too had lost his position at the university because of his Jewish heritage.

In her experiments, Levi-Montalcini came to a different conclusion than Hamburger. She found that the nerve cells did form when a limb was amputated, but that they soon withered and died. She concluded that the limbs contained a growth factor that nourished the nerve cells, and that without it the cells could not survive. "It was a pure miracle that I succeeded with such primitive instrumentation," Levi-Montalcini noted. It was during this time—locked in a tiny room, looking into her microscope—that Levi-Montalcini became fascinated with the development of the nervous system and dedicated herself to a career in medical research.

Though Mussolini was forced to resign in July 1943, more hardships were ahead as German troops moved into northern Italy in September. After nearly being captured while attempting to flee to Switzerland, Levi-Montalcini's family managed to hide in Florence, Italy, until the British liberated the city in September 1944. "Many years later," Levi-Montalcini stated, "I often asked myself how we could have dedicated ourselves with such enthusiasm to solving this small neuroembryological problem while German armies were advancing throughout Europe, spreading destruction and death wherever they went, and threatening the very survival of Western civilization. The answer lies in the desperate and partially unconscious desire of human beings to ignore what is happening in situations where full awareness might lead one to self-destruction."

For nearly a year after the war ended, Levi-Montalcini helped war refugees as a physician with the Allied Health Service. Italy was in the midst of a typhoid epidemic at this time, and Levi-Montalcini noted that "my personal safety—my health—was more at risk than when we were hiding." She returned to her research work at the University of Turin in the summer of 1945, and before long she and Giuseppe Levi published a paper on the results of their chicken-embryo experiments. Their paper attracted the attention of Hamburger, who invited Levi-Montalcini to spend a semester working with him at Washington University to see whose conclusions were right.

Levi-Montalcini arrived in the United States in September 1946, expecting to stay for seven months. Instead, it became her home for the next 30 years. She called this time "the happiest and most productive years of my life. . . . I felt at home the day I landed. There is great cordiality, generosity. And America is a society in which merit is genuinely rewarded." Her first position at Washington University, in St. Louis, Missouri, was as a research associate. She became an associate professor of zoology in 1951 and a full professor in 1958.

DISCOVERS NERVE GROWTH FACTOR

At Washington University, Levi-Montalcini continued with the work she had done in Italy—amputating an embryonic limb and observing what happens to the surrounding nerve cells. Before long, she was able to convince Hamburger that her conclusions about the growth of nerve cells were correct: a specific chemical was present in the limbs that caused the nerve cells to grow. "Though in the years that followed, I was to taste the joy of discoveries of far greater import, the revelations of that day stayed permanently inscribed in my memory as marking not only the end of the long period of doubt and lack of faith in my research, but also the sealing of a lifelong alliance between me and the nervous system," Levi-Montalcini recalled.

Over the next several years, Levi-Montalcini conducted numerous experiments in order to identify the chemical substance that caused the nerves to grow. For example, she transplanted cancerous tumors from mice into chicken embryos and found that the nerve cells reacted by growing very rapidly. In 1953, Levi-Montalcini became partners with a biochemist, Dr. Stanley Cohen, in order to isolate the molecule responsible for nerve-cell growth. They injected various substances, including snake venom and mouse saliva, into chicken embryos to study their effect on the development of nerve cells. In 1959, their work culminated in the discovery of a specific protein that was necessary for the growth, development, and maintenance of nerve cells: nerve growth factor, or NGF.

Levi-Montalcini and Cohen's discovery had major implications for the field of medicine. NGF has played an important role in efforts to find a cure for many degenerative diseases, such as multiple sclerosis, Parkinson's disease, and Alzheimer's disease. Cohen's later discovery of a related substance, epidermal growth factor (EGF), which causes skin cells to grow, has proved valuable in treating cancer patients and burn victims. In addition, other researchers have built upon their work to make additional important discoveries. A member of the Nobel Prize committee stated that "every single discovery in the field of cell growth factors has followed closely in the footsteps of Levi-Montalcini and Cohen." Rather than involving herself in finding new uses for NGF, however, Levi-Montalcini returned to her studies of the nervous system. "Other people must see what applications can be found—I remain a researcher," she explained.

RECEIVES NOBEL PRIZE AND OTHER HONORS

Following her landmark discovery, Levi-Montalcini traveled around the world giving lectures about NGF. In 1968, Levi-Montalcini became only the tenth woman ever elected to the National Academy of Sciences in recognition of her work. The following year, she became director of the Laboratory of Cell Biology in Rome. By obtaining funding from the Italian government, Levi-Montalcini turned this small enterprise into one of the largest independent research institutes in Italy. She remained its director until her mandatory retirement in 1979.

In 1986, Levi-Montalcini and Cohen were presented with the coveted Albert Lasker Medical Research Award. Less than a month later, Levi-Montalcini and Cohen were jointly awarded the Nobel Prize for Physiology or Medicine, the most prestigious award in the scientific world. When the call came from the Nobel Prize committee in Stockholm, Sweden, to notify Levi-Montalcini of her award, she had almost reached the end of an Agatha Christie mystery novel. "At the moment that I was finding out about the criminal, they told me that I was awarded the Nobel," she recalled. "So I was very happy about it, but I wanted much more to know the end of the story." Later, Levi-Montalcini acknowledged that it was "a great honor" to win the Nobel, though she added that "there is no great a thrill as the moment of discovery."

Winning the Nobel Prize made Levi-Montalcini a national heroine in Italy. She has used her position in the public eye to help others, particularly young scientists. "I can do things that are very, very important, which I would never have been able to do if I did not receive it," Levi-Montalcini admitted. "It has given me the possibility of helping a lot of people." Besides working closely with students herself, she set up a foundation to provide mentors and career counseling to help students decide what field to pursue. She enjoys giving others the benefit of her experience. "When I was young I learned that life has to be faced," she noted. "I learned not to be afraid of danger, of illness, or of dying. I also discovered that I would always abandon what I was doing immediately if someone needed my help. It is very dangerous, especially for young people, to live in a state of obsession, always worried about career or success. It is egocentric; we must keep our minds open to the problems of the larger society. . . . The best of life is friendship—what you can do for the other."

In 1994, the public attention surrounding Levi-Montalcini turned ugly when an Italian newspaper charged that a pharmaceutical company had "bought" her the Nobel Prize by bribing a member of the committee. The newspaper based its story on the testimony of a former government official who was in prison for corruption. The charges were denied by the Nobel Prize committee and officials for the pharmaceutical company, and the newspaper later retracted the story. In fact, it would have been nearly impossible for any one committee member to influence the awarding of the Nobel Prize. Still, the incident was very upsetting for Levi-Montalcini.

HOME AND FAMILY

True to her childhood prediction, Levi-Montalcini never married. "I simply could not live with another person and adjust my own life to somebody else's," she explained. "A man, a husband, or children want a lot from you, and you are not always willing . . . *I* was not always willing to give anything. My work was important to me." Levi-Montalcini became a United States citizen in 1956, but she kept her Italian citizenship as well. During the years that she lived in the United States, she returned frequently to Italy to visit her family and her friends from medical school. In the late 1970s, Levi-Montalcini moved back to Italy so she could spend more time with her twin sister, Paola, who became an accomplished painter. They share an apartment near Rome University. Levi-Montalcini continues to work, because "the moment you stop working, you are dead," she stated. "For me, it would be unhappiness beyond anything else."

HOBBIES AND OTHER INTERESTS

When she is not working, Levi-Montalcini enjoys reading—especially about history or politics—and listening to baroque music.

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International St. Vincent Award: 1979
Knights of Humanity Award (International Philanthropic Society): 1979
Lewis S. Rosentiel Award for Distinguished Work in Basic Medical Research (Brandeis University): 1982
Albert Lasker Basic Medical Research Award: 1986
Nobel Prize for Physiology or Medicine: 1986
National Medal of Science (National Science Foundation): 1987
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OBITUARY

J. Robert Oppenheimer 1904-1967
American Physicist
Director of the Manhattan Project,
Which Created the Atomic Bomb

BIRTH

Julius Robert Oppenheimer, called Robert by friends and family for most of his life, was born on April 22, 1904, in New York City. Robert's father, Julius Oppenheimer, had emigrated from Germany in 1888 and established a successful textile importing business. Fifteen years later he married Ella Freedman, a well-known artist. Julius and Ella Oppenheimer also had a second son, Frank, who was born in 1912.

YOUTH

Robert Oppenheimer's first years were spent in comfortable and stimulating surroundings. His parents had a keen interest in art, music, and intellectual discussion, and their household reflected those passions. They even had a private art collection that included three paintings by Vincent Van Gogh.

Oppenheimer's parents introduced him to art, poetry, architecture, and other subjects through trips to area museums, vacations to Europe, and long talks at home. Their son was eager to learn, and before long he showed an amazing capacity to memorize long sections from books he had read or music that he had heard. As one biographer said, "Robert's memory astonished everyone. No matter what he heard or read, he could relate it back, almost word for word. Before he was six, he delighted his music-loving parents by recognizing even the most obscure selections from the symphonies of the great composers."

One visit to Europe had a particularly important effect on Oppenheimer. His German grandfather gave him a mineral collection when he was only five years old. The collection sparked Oppenheimer's interest in science, and for the next several years he spent hours combing the New York area for samples to add to his collection. By age 11 his knowledge of minerals had become so extensive that the New York Mineralogical Society accepted his application for membership. Convinced that he was a budding genius, Oppenheimer's parents did everything in their power to help him fulfill his potential. They encouraged his fascination with music, architecture, literature, and science, and made sure that he was supplied with all he needed to pursue those interests.

As bright as Oppenheimer was, though, he struggled to get along with other children his own age. He was a skinny, physically frail youngster who was not good at athletics, and he seldom played with other kids. In addition, he was often mean to people whom he thought were less intelligent than himself. "I repaid my parents' confidence in me by developing an unpleasant ego which I am sure must have affronted both children and adults who were unfortunate enough to come into contact with me," Oppenheimer recalled.

By his early teenage years, Oppenheimer's emotional maturity lagged far behind his intellectual maturity. His relationships with peers remained rocky during much of this time, and he endured a lot of taunting and abuse.

One year proved particularly tough for Oppenheimer. In the summer of 1918, shortly after his 14th birthday, Oppenheimer was sent to a boys' camp by his parents, who hoped that the experience would help him learn to get along with other people his own age. Instead, the other boys at the camp picked on him unmercifully for his interest in poetry, his good manners, and his disinterest in sports. As the weeks went by, the boys' teasing increased, but Oppenheimer did his best to ignore the taunts and name-calling. Finally, he was attacked one night while walking through the woods. His tormentors stripped him of his clothing and locked him in an icehouse overnight.

Despite the assault, Oppenheimer remained at the camp until it ended. "I don't know how Robert stuck out those remaining weeks," said one of his few friends from that summer. "Not many boys would have—or could have—but Robert did. It must have been hell for him." Oppenheimer's horrible summer camp experience pushed him further into his academic shell.

EDUCATION

Oppenheimer attended elementary school and high school at the Ethical Culture School, an institution in New York City that offered a much wider curriculum than most other schools of that time. He thrived in the creative, innovative atmosphere of the school, and he particularly benefitted from the emphasis on "hands-on" science studies. By the third grade Oppenheimer could often be found in the school laboratory, where he was given guidance on a wide range of projects. Within two years he was studying theories of elementary physics. One of his science teachers, Augustus Klock, proved especially important in Oppenheimer's early life. "I don't know what would have happened if Augustus Klock hadn't been the teacher in this school," wrote Oppenheimer, "but I know that I had a great sense of indebtedness to him. He loved [science], and he loved it in three ways: he loved the subject, he loved the bumpy contingent nature of the way in which you actually find out about something, and he loved the excitement that he could stir in young people. In all three ways he was a remarkably good teacher."

After moving on to high school, Oppenheimer continued to excel in his studies. His amazing memory allowed him to learn seven languages, and at one point he completed a year-long chemistry course in six weeks. But he remained unpopular with his peers, who viewed him as a humorless, skinny bookworm, and he spent most of his time engaged in scientific experiments and other studies. In 1921 Oppenheimer graduated from high school as his class's valedictorian.

Oppenheimer was accepted at Harvard University, but in the months leading up to his freshman year, he was struck down by illness (dysentery followed by colitis). After being bedridden for weeks, Oppenheimer gradually started on the road to recovery, but it was slow going. His doctors and family told him to spend some time in the dry, warm climate of the American Southwest, where he could regain his stamina and prepare for college life. Oppenheimer agreed that the change in scenery might do him some good, so he set out for New Mexico with a family friend. His time in New Mexico proved to be very important for both his physical and mental health. He spent weeks hiking, camping, and horseback riding through the canyons and deserts of the state, and the rugged desert country helped heal his body as well as his mind, which had become frazzled from his intensive studying and social difficulties. An enduring love for New Mexico's bleak beauty blossomed in him at this time, and he often returned to the region in subsequent years.

After returning from New Mexico, Oppenheimer resumed his studies, belatedly making his appearance at Harvard. He treasured his next few years at the school. His area of emphasis remained science, but Oppenheimer took courses in many other areas as well, dazzling professors with his abilities. He excelled in philosophy, language studies, and English, and he even had a number of stories and poems published in the university's literary magazine. "I had a real chance to learn," he said, looking back on his years at Harvard. "I loved it. I almost came alive. I took more courses than I was supposed to, lived in the [library] stacks, just raided the place intellectually." Oppenheimer graduated from Harvard with honors in 1925 after completing four years of studies in three years.

The early 1920s was a period of great intellectual growth for Oppenheimer, but it was also a time of social growth. He became more comfortable with other people, and at times his sense of humor and thoughtfulness shone through. One friend recalled that visits to the Oppenheimer home during this period were always a lot of fun. "There were high spirited goings on all the time. I think it is perfectly right to say that even then—and all my life I've felt this—he was the most intelligent man I've ever known, the most brilliantly endowed intellectually. And with this, in that period of his life, he combined incredibly good wit and gaiety and high spirits."

From Harvard Oppenheimer traveled overseas to pursue his growing interest in atomic physics. From 1925 to 1927 he studied at two major European institutions of atomic research, Cambridge University in England and the University of Gottingen in Germany. After obtaining his Ph.D. from Gottingen in 1927, Oppenheimer returned to the United States. In 1927-1928 he tackled postdoctoral studies as a National Research Fellow at Harvard and the California Institute of Technology. The following year he returned to Europe for his second year of postdoctoral work as an International Education Board Fellow at the University of Leyden, in the Netherlands, and the Technische Hochschule, in Switzerland.

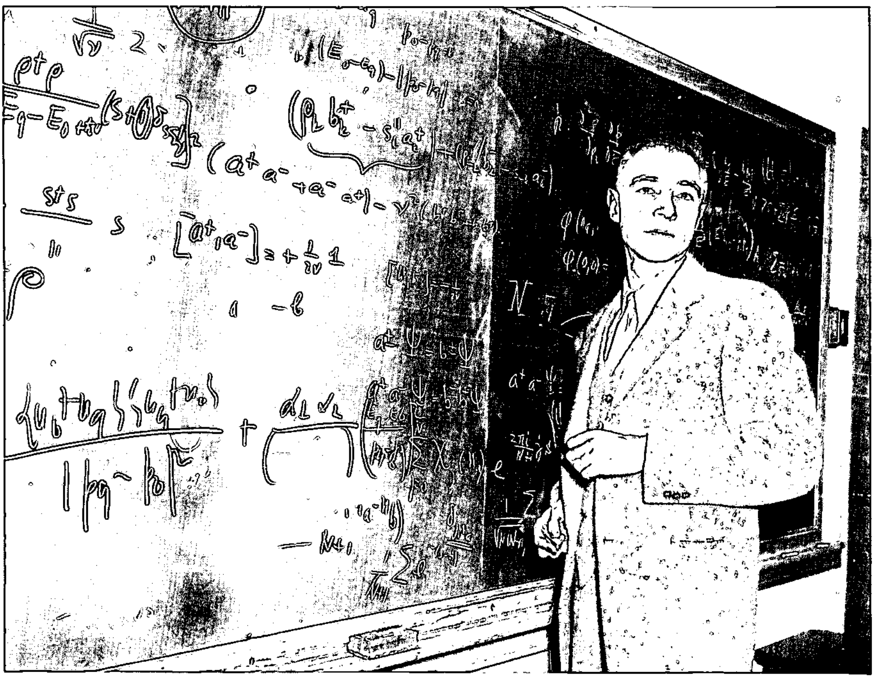
CAREER HIGHLIGHTS

ACADEMIC CAREER

After completing his studies, Oppenheimer was deluged with teaching offers from colleges eager to snap up the brilliant young scientist. In 1929 he headed for California, where he joined the faculties of the University of California, Berkeley, and the California Institute of Technology.

Oppenheimer maintained his links to both schools for the next 18 years. Starting as an assistant professor, he rose to the rank of professor, gaining a reputation as an excellent educator in the process. At first he was known as an impatient, bullying sort of teacher, but as time passed he became much more comfortable in his role, and he learned how to pass his love of science on to his students. One of his students, physicist Robert Herber, noted that Oppenheimer's "course was an inspirational as well as an educational achievement. He transmitted to his students a feeling of the beauty of the logical structure of physics and an excitement about the development of physics. Almost everyone listened to the course more than once: Oppie occasionally had difficulty dissuading students from coming for a third or fourth time."

After awhile students began to talk of Oppenheimer's magnetic personality as a key reason for the quality of his lectures, something that would have certainly amazed his tormenters from his teenage years. Some students followed the professor from campus to campus to listen to his lectures, and a number of them adopted Oppenheimer's fashion style and mannerisms. "I guess we revered the man as much as we venerated the scientist," said one student.



But while Oppenheimer's influence in the classroom during the 1930s was tremendous—many of his students went on to make major contributions in various areas of physics—he also made a number of important discoveries of his own. As one science historian noted, "Oppenheimer built the foundation for contemporary studies of molecular physics. He was the first to recognize quantum-mechanical tunneling, which is the basis of the scanning tunneling microscope, used to reveal the structure of surfaces atom by atom. He fell just short of predicting the existence of the positron, the electron's antiparticle. He raised several crucial difficulties in the theory of quantum electrodynamics. He developed the theory of cosmic-ray showers. And long before neutron stars and black holes were part of our celestial landscape, Oppenheimer showed that massive stars can collapse under the influence of gravitational forces."

INVOLVEMENT IN POLITICS

For years Oppenheimer had ignored events taking place elsewhere in the world. He still read a lot of classic literature—and he even learned Sanskrit so that he could read Hindu scriptures in their original language—but he did not pay attention to current happenings in the United States and around the world. "I was not interested in and did not read about economics or politics," he later said. "I never read a newspaper or a current magazine like *Time* or *Harper's*; I had no radio, no telephone; I learned of the stock market crash in the fall of 1929 only long after the event; the first time I ever voted was in the presidential election of 1936."

It was in the mid-1930s that Oppenheimer began to pay greater attention to current events. "I had had a continuing smoldering fury about the treatment of Jews in Germany," he said. "I had relatives there, and was later to help in extricating them and bringing them to this country. I saw what the Depression was doing to my students; often they could get no jobs, or jobs which were wholly inadequate. And through them, I began to understand how deeply political and economic events could affect men's lives. I began to feel the need to participate more fully in the life of the community."

By the late 1930s Oppenheimer involved himself in the activities of several Communist, trade union, and other left-wing organizations. A number of people in these organizations became Oppenheimer's good friends, and in 1940 he married Katherine Harrison, who had previously been married to a Communist Party organizer. His younger brother Frank, with whom Oppenheimer remained close, had also emerged as a supporter of left-wing causes. "I liked the new sense of companionship, and at the same time felt that I was coming to be part of the life of my time and country," he recalled. By late 1940 Oppenheimer and his wife had drifted away from many of their old Communist acquaintances, but this brush with leftist politics would eventually come back to haunt the scientist.

THE MANHATTAN PROJECT

In October 1941, just two months before the bombing of Pearl Harbor, Oppenheimer attended a meeting held by the National Academy of Sciences to discuss the possibility of building a new "super bomb." Anxious about German and Japanese successes in World War II, the U.S. government was interested in developing new weaponry in case the country was threatened. He and Dr. Arthur H. Compton, who led the meeting, soon established a loose working relationship, and Oppenheimer immediately dove into research on harnessing atomic power for use in a bomb.

Oppenheimer and his assistants made important advances in the study of uranium, a potentially powerful fissionable material, and in 1942 Compton asked him to spend all his time on the project. Oppenheimer and other scientists working at laboratories at the University of California spent the next several months concentrating on theoretical aspects of atomic bomb production. As their work progressed, Oppenheimer became convinced that if America was to build a new super bomb, it needed to gather the country's finest scientific minds together in one place to tackle the problem.

The top-secret bomb-building project, which was code named the Manhattan Project, was led by Major General Leslie R. Groves. Impressed with Oppenheimer's line of reasoning, Groves appointed him to serve as director of the project. Over the next few months, Oppenheimer recruited scientists from all corners of America, as well as England and Canada. "I traveled all over the country talking with people who had been working on one or another aspect of the atomic-energy enterprise, and people in radar work, for example, and underwater sound, telling them about the job, the place that we are going to, and enlisting their enthusiasm," he said. As the months passed, he gathered committals from many leading scientists, including Enrico Fermi, Emilio Segre, Niels Bohr, I. I. Rabi, Hans Bethe, Edward Teller, Otto Frisch, and Richard Feynmann.

Recalling New Mexico's beauty and isolation, Oppenheimer suggested that the United States base the Manhattan Project out in that state's remote desert region. Within a matter of weeks a series of homes and laboratories were erected in Los Alamos, New Mexico, and the scientists that Oppenheimer had recruited poured into the town in early 1943.

Over the next two years Oppenheimer showed a remarkable talent for administration. Life at Los Alamos was difficult for the scientists; they could not see their families, and the pressure on them was enormous. But Oppenheimer kept their enthusiasm high, and he displayed a talent for negotiating with often-temperamental researchers. His organizational talents also proved formidable, and observers praised him for his coordination of the research work. One of the scientists who worked on the

Manhattan Project later commented that "Los Alamos might have succeeded without [Oppenheimer], but certainly only with much greater strain, less enthusiasm, and less speed. . . . He was a leader. It was clear to all of us, whenever he spoke, that he knew everything that was important to know about the technical problems of the laboratory, and he somehow had it well organized in his head. But he was not domineering, he never dictated what should be done. He brought out the best in all of us."

THE FIRST ATOMIC BOMB

The intensive work at Los Alamos took its toll on Oppenheimer—at one point he was working so feverishly that his weight dropped to 115 pounds—but by the summer of 1945, the scientists of the Manhattan Project had constructed the world's first atomic bomb.

The atomic bomb's power is derived from isotopes known as Uranium-235 and Plutonium-239, which contain fissionable nuclei capable of undergoing chain reaction. When the mass of fissionable material exceeds critical mass, the chain reaction multiplies rapidly into a tremendous release of nuclear energy. Atomic bombs are detonated by bringing together two masses of fissionable material very quickly; the resulting explosion produces incredibly hot conditions, a shock wave of immensely destructive power, and intense radiation.

On July 16, 1945, the first atomic weapon was detonated far out in the New Mexico desert. Scientists and military officers, who watched the tremendous explosion from distant observation stations, were awed by the power of the explosion. A *New York Times* reporter who was the only journalist permitted to watch the test later wrote that the detonation "was like the grand finale of a mighty symphony of the elements, fascinating and terrifying, uplifting and crushing, ominous, devastating, full of great promise and great foreboding."

Oppenheimer, meanwhile, watched the giant mushroom cloud that formed over the bomb site with a mixture of pride and dread. The bomb on which he had worked so hard had worked. But he later admitted that the explosion made him think of a Hindu religious poem that read in part, "I am become Death / The destroyer of worlds."

Over the next couple weeks, American scientists and government officials debated about whether to provide Japan with a demonstration of their new weapon's power, but they ultimately decided that the Japanese government would not pay attention to anything other than a deadly strike. Determined to end the conflict with Japan before the lives of more American soldiers were lost, the United States decided to use their new weapon against two Japanese cities.

A month after the first atomic bomb was detonated in the New Mexico desert, the United States dropped atomic bombs on two major cities in Japan, first on Hiroshima and four days later on Nagasaki. The bombs utterly destroyed the cities, killing or maiming hundreds of thousands of residents. A few days after the bombing of Nagasaki, Japan surrendered, marking the end of World War II.

U.S. Secretary of War Henry Stimson later commented that "the development of the bomb itself has been largely due to [Oppenheimer's] genius and the inspiration and leadership he has given to his associates." But in the years following the bombings of Hiroshima and Nagasaki, Oppenheimer lobbied for the responsible use of atomic power. "If atomic bombs are to be added as new weapons to the arsenals of a warring world," he said, "or to the arsenals of nations preparing for war, then the time will come when mankind will curse the names of Los Alamos and of Hiroshima."

On October 16, 1945, Oppenheimer resigned from his position at Los Alamos to return to the University of California. In early 1947 he was named director of the Institute for Advanced Study at Princeton, and his status as the "father of the atomic bomb" led many scientific and governmental organizations to enlist his help in studying atomic energy issues in the late 1940s. He also served as chairman of the general advisory

committee to the Atomic Energy Commission from 1947 to 1952. As chairman he took a controversial stand against development of the hydrogen bomb, a project supported by many members of the scientific and military communities. Oppenheimer, though, thought that the hydrogen bomb was beyond America's technological grasp.

CONTROVERSY

Oppenheimer was hugely popular among the American public for his role in ending World War II, but by the early 1950s some members of the scientific and governmental communities were uneasy with certain aspects of his life.

In the 1950s many Americans worried that Communists were infiltrating the United States with the purpose of overthrowing the government. Some people thought that Communist spies had insinuated themselves into all aspects of American life, and that they needed to be rooted out if America was to stay strong. As paranoia about communism grew across America, Congressional investigating committees such as the House Un-American Activities Committee were formed, and some public figures harnessed this fear of communism to gain greater power and influence for themselves. The most well known of these opportunists was Wisconsin Senator Joseph R. McCarthy, whose vicious and unsubstantiated charges against various U.S. officials gave him great influence in the early 1950s.

As hysteria about communism swept across much of America, many of those who were accused of being Communists found themselves unable to find work and shunned by their fellow citizens. This discrimination, known as blacklisting, ruined the lives of many Americans.

Oppenheimer's earlier associations with Communist and other left-wing causes aroused suspicion in some quarters. These old friendships, combined with his criticism of hydrogen bomb research, spurred increased speculation about Oppenheimer's loyalty to his country. Then, in late 1953, a former director of a congressional committee on atomic energy wrote a letter to the FBI in which he accused Oppenheimer of being an agent for the Soviet Union.

Some scientists, meanwhile, expressed anger with Oppenheimer's decision to name a fellow atomic scientist as a former Communist in hearings before the House Un-American Activities Committee. One colleague wrote that Oppenheimer was "trying to buy personal immunity from attack by turning informer."

In late 1953 Oppenheimer's security clearance was stripped from him by the U.S. military, and President Dwight Eisenhower called for the erection of a "blank wall" between the scientist and all government secrets. Oppenheimer was shocked at the decision, and many Americans argued that he was an innocent victim of anti-Communist hysteria. He requested a review of his case, but even though the reviewing board admitted that Oppenheimer was "a loyal citizen," they decided not to reverse the earlier decision. The board said that Oppenheimer's old associations with Communists, his "susceptibility to [Communist] influence," and his reluctance to support the hydrogen bomb program all cast doubt on his ability to keep secrets.

Oppenheimer pointed out that he never joined the Communist Party, and his supporters noted that he had passed multiple security checks during World War II, a time when he provided invaluable services to his country. He made a final appeal to the government to have his security clearance restored, but the decision stood on the grounds that Oppenheimer had displayed "fundamental defects in his character." One writer spoke for many disgusted observers when he called the hearing "an act of consummate ingratitude toward a dedicated national servant." A friend of Oppenheimer's remarked that the scientist seemed almost relieved when his final appeal was turned down. "Although he was very much hurt and felt that he had been misused, he felt relieved that he no longer had to wonder when the storm would break."

A former U.S. ambassador to the U.S.S.R. tried to comfort Oppenheimer by noting that he would be welcomed in hundreds of universities and institutions around the world if he decided to leave America. "I asked him whether he had thought of taking residence outside this country," recalled the diplomat. "His answer, given to me with tears in his eyes: 'Damn it, I happen to love this country.'" In the aftermath of the decision, many Americans came to see him as a symbol of the destructiveness of McCarthyism—a reference to Senator McCarthy.

After his last appeal failed, Oppenheimer tried to put the whole affair behind him. He returned to Princeton in 1954 and concentrated on his work at the Institute for the next number of years. As time passed, he turned away from physics to issues of public policy, and he emerged as a thoughtful commentator on various issues facing America in the 1950s and 1960s.

In 1962 President John F. Kennedy invited Oppenheimer to a White House dinner being held for Nobel Prize winners. The invitation was widely regarded as an unofficial U.S. apology of sorts, and a year later Oppenheimer was awarded the prestigious Fermi Award. President Lyndon B. Johnson presented the award personally, proclaiming that "Your leadership in the development of an outstanding school of theoretical physics in the United States and your contributions to our basic knowledge make your achievements unique in the scientific world."

Oppenheimer's last years were marred by poor health. In 1966 he retired from the Institute for Advanced Study, and on February 18, 1967, he died of throat cancer.

Nearly 30 years after his death, controversy swirled around Oppenheimer once again. In 1994 a former Soviet general charged that Oppenheimer and several other scientists who worked on the Manhattan Project had leaked secrets on their atomic research to the Soviet Union. Scientists and historians alike rushed to defend Oppenheimer and the others. They pointed out numerous factual errors in the story told by the general, a self-described master of deception, and dismissed his accusations as a disgraceful attempt to smear the reputation of one of America's most important scientists.

MARRIAGE AND FAMILY

Oppenheimer married Katherine Puening Harrison in 1940. Harrison was a controversial figure who had been married three times before marrying Oppenheimer. One of her husbands had died fighting against the Fascists during the Spanish Civil War.

Oppenheimer and his wife had two children, Peter and Katherine. Both children were hurt by the controversy that surrounded their father in the 1950s, but their parents were attentive, and Oppenheimer's professional success allowed him to raise them in comfortable surroundings.

HOBBIES AND INTERESTS

Oppenheimer was a life-long sailing enthusiast who loved to spend hours out on the water in his sailboat. He first sailed at the age of 18, when his father bought his sons a 28-foot sailboat. After this first taste of sailing, Oppenheimer took to the water whenever he could. He sailed throughout his life, and often spent time in the Virgin Islands, where conditions were ideal for him to enjoy his hobby. After his death, Oppenheimer's body was cremated and his ashes scattered in the sea off those islands.

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OBITUARY

Albert Sabin 1906-1993
Polish-Born American Biologist and
Medical Pioneer
Developer of Oral Polio Vaccine

BIRTH

Albert Bruce Sabin [SAY-bin] was born on August 26, 1906, in Bialystok, Poland, an industrial city in the Russian Empire that was ruled by the Romanov Dynasty before the Russian Revolution of 1917 brought the Communists to power. His Jewish parents, Jacob Sabin and Tillie (Krugman) Sabin, had three other children in addition to Albert.

YOUTH

In the first part of the 20th century, when Albert Sabin was growing up, Jewish families in Poland and other European countries often endured cruel treatment from prejudiced neighbors. In 1920 Sabin's family left Poland and immigrated to the United States, where his parents hoped that they would be able to escape persecution. After their voyage across the sea, the Sabin family settled in the northeastern New Jersey city of Paterson. Albert's father began a textile manufacturing business while the rest of the family tried to get used to their new life in America.

Sabin was 14 years old when he arrived in America, so his parents made plans for him to enter the local high school. Two of his cousins who were already living in the United States agreed to give him a crash course in English and mathematics, two subjects that Sabin did not know very well, and Sabin proved to be a quick learner. Within a matter of weeks he was preparing himself to enter the unfamiliar world of an American high school.

EDUCATION

Sabin adapted to Paterson High School smoothly and went on to excel in the school's literary and debating societies. After graduating in 1923, he cast about desperately to find the money to go to college. His uncle, Sigmund Sidney, who was a dentist, offered Sabin a special deal: he promised to pay for Sabin's education if his nephew would agree to study dentistry and eventually join his uncle's practice. Sabin happily accepted the offer. He enrolled at New York University and earned his bachelor of science degree in 1928.

Sabin then enrolled in the university's dental school, but as the years of study accumulated he became increasingly unhappy. He found dentistry to be boring, and the thought of spending the rest of his life as a dentist depressed him terribly. At the same time, however, courses such as physiology (the study of how the body functions), microbiology (the study of microscopic organisms), and neurology (the study of how the brain and other parts of the nervous system work) fascinated him.

Sabin decided that no matter how angry his Uncle Sidney might be, he needed to change his area of study. Sabin transferred to the university's College of Medicine to become a doctor, a move that ultimately benefitted millions of people. "I couldn't stand it any longer," he would later say, "my imagination had been caught by medical research." As Sabin suspected, his Uncle Sigmund was furious when he heard the news, and he quickly cut off all financial aid to his nephew. Sabin's enthusiasm for medicine, though, captured the attention of Dr. William H. Park, a biologist at the school. Park helped him obtain various scholarships and fellowships, and Sabin earned additional money by working at odd jobs around area hospitals. In 1931 Sabin graduated from New York University with a medical degree, and over the next two years he completed his internship at nearby Bellevue Hospital.

CHOOSING A CAREER

At the time of Sabin's graduation from medical school in 1931, New York City was in the midst of a terrifying poliomyelitis epidemic. Poliomyelitis, commonly known as "polio," is an often fatal disease that can attack the nervous system and make the muscles of the body become extremely weak. The disease produced devastating summertime epidemics during the first half of the 20th century, especially in the 1930s, 1940s, and 1950s. Some victims of the disease died, while others suffered crippling paralysis of the legs. Polio even weakened the chest muscles of some victims to the point that normal breathing became almost impossible. These unfortunate people were forced to live their days in huge machines called iron lungs, which pushed air in and out of their lungs. Even President Franklin D. Roosevelt was struck by polio; he was partially crippled for much of his adult life.

Another aspect of polio that made it one of the most dreaded diseases of its day was that its victims were often children. Many who lived during that time were haunted by images of children unable to walk without the help of metal braces or unable to breathe without the assistance of an iron lung. Parents feared polio so much that they kept their children inside during the summer, refusing to let them play with others because they were afraid that they would catch the terrible disease. Swimming pools were closed and drinking fountains shut down. Summertime, which was usually such a happy and carefree season, became filled with panic, dread, and sadness.

Polio is caused by a virus, which is a tiny microorganism much smaller than bacteria. Some viruses are harmless, while others can cause disease. Measles, chicken pox, polio, influenza (flu), and AIDS are all diseases caused by viruses. Some viral diseases can be prevented through a procedure called "vaccination," in which a person is given a vaccine, usually by injection. A vaccine contains a form of the virus itself that stimulates the body's immune system to produce antibodies against the virus. Antibodies are tiny proteins in the blood serum that fight off invading bacteria or viruses, thus protecting the body from infection. The antibodies resulting from vaccination protect a person from getting the disease later on if he or she is exposed to it. Such a person is then said to be immune to the disease.

The terror that young Dr. Sabin witnessed among the citizens of New York during the summer of 1931 influenced his decision to study the virus that causes the polio disease and to find a way to prevent people from becoming infected with it. Sabin's search for a polio vaccine would dominate his life for the next 20 years.

CAREER HIGHLIGHTS

After his internship at Bellevue Hospital, Sabin spent a year at the Lister Institute of Preventive Medicine in London, England, conducting research on viral diseases. He then returned to the United States, where he spent four years at the Rockefeller Institute for Medical Research. In 1939 he joined the Children's Hospital Research Foundation at the University of Cincinnati. It was there that he began studying the polio virus in earnest. Only months later, though, Sabin suspended his research into the disease when World War II broke out. The United States military needed his expertise in disease research to help keep the American troops stationed around the world in fighting condition.

HELPING OUT DURING WORLD WAR II

As a lieutenant colonel in the Army Medical Corps, Sabin studied viral diseases that were threatening military personnel in various parts of the world. In Africa, a disease called "sandfly fever" was causing sickness among the troops. Sandfly fever is a nonfatal, flu-like illness carried by insects. Sabin successfully isolated the virus that causes the disease. He then instructed military leaders on how to use a common insect repellent to ward off the sandflies that carry the virus, thus preventing infection.

In the South Pacific, American soldiers faced a different problem. The threat in that region was "dengue fever," an illness that was usually not fatal but could severely weaken those who caught it. Sabin studied the virus that causes dengue fever and developed a vaccine that brought the disease under control. Finally, armed with a vaccine that he had developed before the war for Japanese encephalitis (inflammation of the brain), Sabin directed the vaccination of more than 70,000 American troops preparing to invade Japan. When World War II ended in 1945, Sabin returned to the Children's Hospital Research Foundation in Cincinnati and continued his studies on polio.

SABIN AND SALK: RIVALS IN THE QUEST TO BATTLE POLIO

For the next several years, Sabin bred millions of polio viruses. He worked tirelessly on isolating and growing various strains of the virus in an attempt to find the ones that would produce the safest and most effective vaccine. He concentrated on making a vaccine out of living but weakened viruses because he believed that this was the only way to stimulate enough antibody production to provide lifelong immunity.

Around the same time, many other researchers launched independent efforts to devise an effective polio vaccine. One of these researchers was Dr. Jonas Salk. Unlike Sabin, Salk believed that making a vaccine out of a killed virus would be the safest and most effective way to combat the disease. This dramatic difference of opinion fueled an intense rivalry between the two men that lasted throughout their lives. It also caused a deep split in the scientific community between factions who favored one approach over the other.

Ironically, the rivalry between Salk and Sabin developed despite the fact that they both faced similar obstacles to success. Both men were Jewish, for instance, and many Americans were bigoted against Jews. "Both were viewed by some as intruders in the medical establishment," remarked one historian. "At a time when anti-Semitism was an open feature of academic life and 'ambitious' was a popular synonym for Jewish, both Sabin and Salk were widely regarded as very ambitious people." Sabin, though, had the advantage of being well-known in the scientific community because of his research efforts during World War II. Salk was viewed by some scientists, including Sabin, as an unproven researcher. As a result, these scientists watched Salk's progress with skepticism.

By the early 1950s, though, Salk had triumphed. He had succeeded in making a polio vaccine out of a killed virus that would cause the body to produce enough antibodies to provide immunity. He tested the new vaccine on himself and his family and found it to be safe. In 1952, the U.S. government agreed to begin widespread testing of Salk's vaccine, and by the spring of 1955, it was approved for widespread use. Thousands received injections of the killed-virus vaccine and cases of polio declined rapidly across the nation. Unfazed by Salk's success, the persistent and self-confident Sabin continued with his research, convinced that a live-virus vaccine would be a superior vaccine.

Meanwhile, the war of words between those who favored Salk's vaccine and those who preferred Sabin's approach continued. Increasing numbers of scientists spoke out against the nasty atmosphere that surrounded the debate, and even Salk complained that "the vying for position was absolutely brutal." He went on to note that "long before a particular report was read, you heard a dozen whispered allegations about the lies contained in it and the number of deaths unmentioned by it."

As the scientific community bickered about the merits of polio-fighting approaches, Sabin went on with his studies. He soon succeeded in making an effective polio vaccine out of living but weakened viruses. The viruses he used had been carefully bred so that their harmful features were no longer active. Thus the vaccine was strong enough to cause the body to form antibodies (and produce immunity) but weak enough so that it would not cause the disease.

Sabin first tested the vaccine on himself and his family, just as Salk had done. It then went into widespread testing during 1958 and 1959 in several areas of the world, including the Soviet Union and Mexico. The program in Russia was particularly successful, and people around the world hailed Sabin's vaccine. "Opinion was swinging over to his side at a rate that even his admittedly impressive results hardly seemed to justify," said one observer. "Everybody likes to back a winner, and as soon as Sabin began to radiate an aura of success he began to gather support at astonishing speed. Just as Salk, in the years of triumph, had seemed to acquire an almost magical power, so did Sabin in 1959 and 1960."

The popularity of Sabin's vaccine over Salk's killed-virus vaccine could be traced in part to the fact that it was so easy to administer. The new vaccine was given to people orally—usually on a sugar cube or in a small cup of liquid. Painful injections required by the Salk vaccine were no longer necessary. Sabin's vaccine also provided longer protection. Finally, the new vaccine could be stored and transported easily by freezing, making it available to people in remote locations. Sabin's live-virus vaccine stopped polio in its tracks, and in 1962 the vaccine was licensed for use in the United States. Sabin's vaccine was so successful that more than 100 million Americans took it between 1962 and 1964. Polio was finally under control.

Although they remained bitter rivals throughout their careers, Albert Sabin and Jonas Salk together helped conquer a disease that occurs so rarely in the United States today that it is hardly ever mentioned. Unfortunately, polio can still occur in less-developed nations of the world, where vaccination programs are ongoing in the effort to completely eliminate the disease.

CONTINUED EFFORTS IN MEDICINE

Deeply committed to his profession, Sabin continued to study diseases well into his 70s and 80s. Eloquent and outspoken, he once said, "a scientist who is also a human being cannot rest while knowledge which might be used to reduce suffering rests on the shelf."

In 1975 Sabin warned that a national swine flu vaccination campaign was a bad idea. "I said the whole program was unfounded," he recalled. "There was no basis for vaccinating everybody." The campaign went ahead as planned, though, and "about 2,000 people were left permanently paralyzed because of reaction to the shots," Sabin said.

In 1980 Sabin consulted with the government of Brazil in an effort to help control polio outbreaks that threatened the people of that country. As he learned more about the situation, though, he realized that the government had been falsifying data on the disease for years. "There was ten times as much polio in Brazil as was being reported and . . . efficient vaccination efforts were being blocked by bureaucratic interference," Sabin charged. Angry and embarrassed by Sabin's public condemnation, the Brazilian government asked him to leave the country.

Sabin continued his research even after his recovery from a frightening nerve disorder that temporarily paralyzed him in 1983. During his hospital stay he received get-well wishes from more than 100,000 people, many of whom thanked him for his role in ridding America of polio. His wife, Heloisa Sabin, recalled that she read many of the cards to her husband while he was still in the hospital. "When I read them to him, I cry," she said. "All the people thanking him . . . the letters from schoolchildren— when I read those letters to him, I can hardly continue." Sabin himself regarded the cards and letters as an affirmation of his life of research. "To read those letters," he said, "I can't even tell you the feeling it gives me. It makes me feel that what I did was somehow worthwhile. You always have a feeling of doubting whether what you have done with your life is truly worthwhile. . . . As long as I live, these letters will give me a feeling of warmth."

On March 3, 1993, Sabin's long and distinguished career came to an end when he died of congestive heart failure. People from around the world mourned the loss of the scientist. President Bill Clinton called him one of the great heroes of American medicine, and Salk, his lifelong rival, called his death "a great loss. . . . His contributions toward the control of polio will endure long in the future." Indeed, Sabin's success in freeing millions from the shadow of polio serves as his legacy to this day and ensures his place as one of the world's great scientists and medical pioneers.

MARRIAGE AND FAMILY

Sabin was married three times. His first marriage, to Sylvia Tregillus in 1935, produced two daughters, Amy and Deborah. The marriage lasted 31 years, until his wife's tragic suicide in 1966. He was married for a second time in 1967 to Jane Warner, but the marriage lasted only a year before ending in divorce. Sabin met his third wife, journalist Heloisa Dunshee de Abranches, in Brazil when he was 66 years old. They were wed on July 28, 1972, and remained married until his death in 1993.

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National Academy of Sciences: 1951
Bruce Memorial Award (American College of Physicians): 1961
Antonio Feltinelli Prize (Italy): 1964
Albert Lasker Clinical Medicine Research Award: 1965
National Medal of Science (National Science Foundation): 1970
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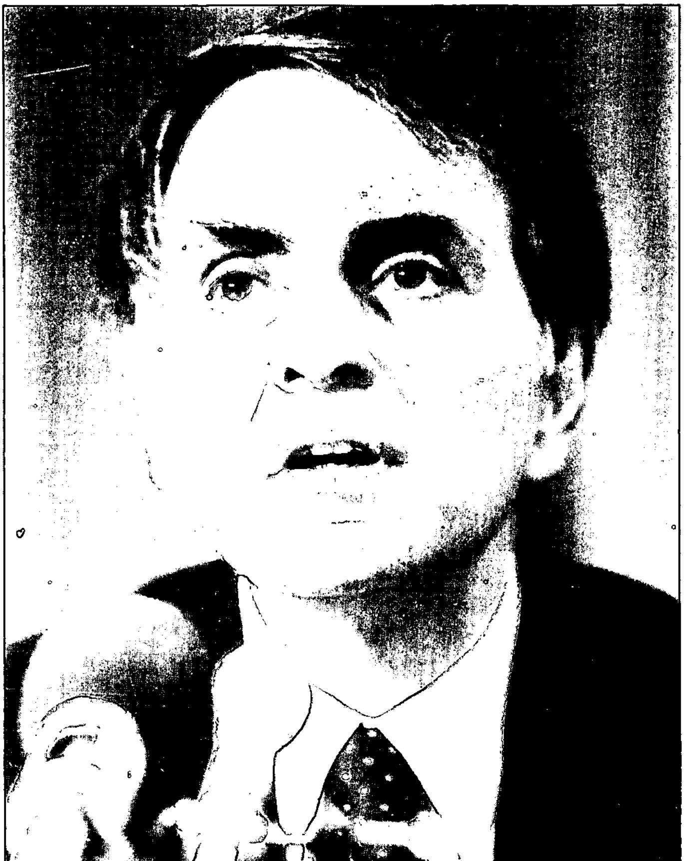


Carl Sagan 1934-
American Astronomer, Astrophysicist, Exobiologist, Educator, and Writer Host of the 1980s Educational Television Series "Cosmos"

BIRTH

Carl Edward Sagan was born on November 9, 1934, in Brooklyn, New York. His father, Samuel, immigrated to the United States from the Ukraine and worked his way up to become the manager of a garment factory. His mother, Rachel, was born in the United States and was a homemaker. Sagan also had one sister, Cari.

Sagan received valuable support from his family as he was growing up. "One very important thing was that my parents had a sense of the worth of knowledge—the value of learning just for fun. That was certainly communicated by both of them," he recalled. "One of the things I'm most grateful to them for is that they did not discourage even my wildest flights of fancy. In the 1940s—in the middle of World War II—when I decided that I was interested in being involved with sending rocket ships to the planets, they didn't say, 'Oh, come on.'"

YOUTH

As a child, Sagan was full of questions. When he first noticed the stars in the sky over his Brooklyn neighborhood, he asked his parents and friends what they were. Dissatisfied with their answers, the seven-year-old Sagan took a streetcar to the Brooklyn Public Library, where he asked for a book about stars. At first the librarian gave him a book about movie stars by mistake. When he finally got the book he wanted, though, it "had this stunning, astonishing thing in it—that the stars were suns, just like our sun, so far away that they were only a twinkle of light," Sagan recalled. "This just blew my mind. Until then, my universe had been my neighborhood. Now I tried to imagine how far away I'd have to move the sun to make it as faint as a star. I got my first sense of the immensity of the universe. I was hooked."

From this point on, Sagan was very interested in astronomy and tried to learn everything he could about outer space. When he was ten years old, Sagan discovered science-fiction stories. Among his favorites were Edgar Rice Burroughs's tales of John Carter, a young man who travels to Mars in a spaceship. Reading about Carter's adventures in domed cities populated by space creatures made Sagan want to travel in space himself. Later, Sagan became a regular reader of the magazine *Astounding Science Fiction*. The reality-based stories in this magazine—about things like time travel and atomic war—led Sagan to think more about the possibilities of science.

EDUCATION

"School was little more than a detention camp," Sagan commented about his early education. "There was schoolyard violence, a rigidly enforced system of intimidation—reading became my way out." Still, Sagan earned excellent grades throughout his school years, especially in science classes. In 1945, the Sagan family moved to the suburbs of Rahway, New Jersey, where Sagan attended high school. Though he always knew he wanted to study astronomy, up to this point Sagan thought he would have to find a "real" job to pay the bills and be an astronomer in his spare time. He was amazed when his high-school biology teacher informed him that astronomers were, in fact, paid for their work.

"I thought I would have to have some job I hated—a salesman in the coat and suit industry, for example, was proposed to me—and then I'd pursue [astronomy] weekends," Sagan admitted. "The idea that I could be a professional astronomer, that there was such a thing, that they pay you enough to have three square meals and spend all your time studying this stuff, that was a glorious discovery." He also gave credit to his family for supporting his career goals. "My parents, who knew nothing about science, encouraged it," Sagan noted. "They never said, 'All in all, wouldn't it be better to be a lawyer or a doctor?' I never once heard that from my parents. They said, 'If you're passionate about that, we'll back you to the best of our ability.'" Now that he knew he could make a career out of doing what he loved, Sagan became even more determined to achieve his goal.

When he graduated from Rahway High School in 1951, Sagan was voted "best male student" and "most likely to succeed." Because of his excellent grades, he could have attended almost any college he wanted. He decided to go to the University of Chicago largely because of the university chancellor, Robert M. Hutchins. Hutchins was an educational reformer who had challenged two traditions of college life—fraternities and football. The brochure Carl received from Chicago said he should not consider the school if he was interested in a great football team or wild fraternity parties. But it went on to say, "If you want an education, come to the University of Chicago." The school's emphasis on providing a quality education—along with its international reputation for science—helped Sagan make his decision to go there.

In the fall of 1951, when he was just 16 years old, Sagan became a student at the University of Chicago. Although he was thrilled with the school's excellent astronomy department, he was disappointed that the university did not have an engineering department. He wanted to pursue a degree in engineering, as well as astronomy, so that he would be able to build spaceships to help people explore outer space. Eventually, after talking with other astronomers who had been involved in rocket studies, Sagan decided that an engineering degree was not necessary, since "there was no reason an astronomer had to know every nut and bolt of a spacecraft in order to use it."

During the summer between his first two years of college, Sagan had the opportunity to work as a research assistant in the laboratory of Nobel Prize-winning biologist Hermann J. Muller. This experience helped Sagan to realize that in order to study life on other planets, he needed to learn biology and chemistry. "Muller had me doing routine things, such as looking at fruit flies for new mutations. But he ran a real research group, and for the first time I got a feeling of what scientific research was like," Sagan noted. When he returned to the University of Chicago that fall, he began to study under chemist Harold Urey, whose interest in the origin of life encouraged Sagan's own quest for answers.

Biology, chemistry, and astronomy were not the only things that interested Sagan during his undergraduate years at the University of Chicago. He was the captain of a championship intermural basketball team, and he organized and spoke at a series of campus science lectures. Sagan was a skillful speaker who always entertained audiences with his passion for science. Though some people criticized his popular approach to the subject and called his lecture series "Sagan's Circus," Sagan understood the importance of getting people excited about science and the unknown.

Sagan received his bachelor of arts degree in the natural sciences from the University of Chicago in 1954 and added a bachelor of science degree in physics the following year. From 1955 to 1960, Sagan continued his research in physics and astronomy at the university under grants from the National Science Foundation. He obtained his master's degree in physics in 1956 and his doctoral degree in astronomy and astrophysics (a specialized field of astronomy) in 1960.

CAREER HIGHLIGHTS

Beginning with his work as a graduate student, Sagan has made many important contributions to science over the years. In 1956, for example, he first presented his theory that the seasonal color variations that had been observed on Mars were due to violent dust storms. At that time, many scientists thought that the color changes were due to the growth cycles of plant life. Sagan's theory was proved correct in 1971, when the United States space probe *Mariner IV* orbited Mars and revealed that its surface is covered with a layer of fine dust, and that its atmosphere prevents plants from existing there.

In 1961, Sagan published a detailed analysis of the planet Venus in *Science* magazine. He concluded that the planet's dense atmosphere created a "greenhouse effect" that trapped sunlight, raised surface temperatures, and produced a giant, windy desert. Though Sagan's theories were questioned at that time, a Soviet space mission in 1967 confirmed his deductions about conditions on Venus. Thirty years later, scientists are worried about similar changes taking place in the Earth's atmosphere. They warn that an increase in carbon dioxide—coupled with a thinning of the protective ozone layer— threatens to create a greenhouse effect that could lead to significantly warmer temperatures on Earth.

In 1962, while at Stanford University in California as a visiting professor, Sagan began working with Nobel Prize-winning biologist Joshua Lederberg as part of a newly formed committee studying ways to search for life in space. At that time, many people believed that life on Earth had originated from other planets. Sagan disagreed, claiming that it would take too long for organic molecules to reach Earth and that radiation would kill them in space. Instead, he set out to prove that the basic materials that make up organic compounds could be created in a laboratory under conditions that existed on Earth. Sagan and his colleagues were the first to make amino acids, the building blocks of proteins, in a laboratory setting. From these experiments, he concluded that shock waves from thunderstorms helped produce the molecules responsible for the origin of life on Earth.

By this time, Sagan had begun to make a name for himself in the field of exobiology (the study of life on other planets). When the United States sent probes into outer space, Sagan expressed concern that space probes from Earth could contaminate the Moon or other planets with harmful viruses or bacteria. As a consultant to the National Aeronautics and Space Administration (NASA) in the late 1960s, Sagan convinced the American and Russian space programs to sterilize any equipment sent into space.

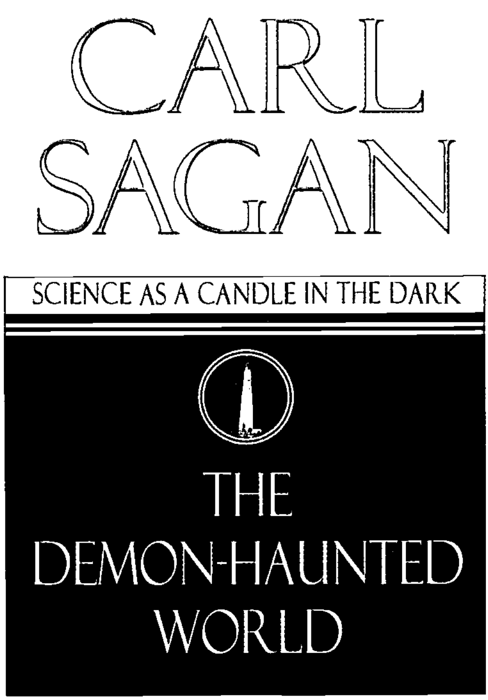
Throughout these years following his graduation from college, Sagan continued his research and lectured at many universities around the United States. In 1968 he became a professor and director of the Laboratory for Planetary Studies at Cornell University, and he has remained on the faculty there ever since.

In 1976, Sagan finally got the chance he had been waiting for to explore another planet. He was part of the Imaging Flight Team for the NASA space mission that landed two unmanned vehicles on Mars. "The results," Sagan noted, "were spectacular, the historical significance of the mission utterly apparent. And yet the general public was learning almost nothing of these great happenings" because the media thought the findings were too complex for most people to understand. "They believed that their audiences would be progressively disinterested as Mars was revealed to be less and less like the Earth," Sagan explained. "And yet the Martian landscapes are staggering, the vistas breathtaking. I was positive from my own experience that an enormous global interest exists in the exploration of planets and in many kindred scientific topics." Sagan then became determined to bring science to the public through television.

BRINGING SCIENCE TO THE PUBLIC WITH "COSMOS"

In the late 1970s, Sagan made several memorable appearances on "The Tonight Show" with Johnny Carson. Each time, he answered questions about complex scientific problems in an interesting and engaging manner. Before long, Sagan was recognized across the country for his ability to explain complex scientific principles in language that anyone could understand. Although some fellow scientists criticized him for trying to "popularize" science, Sagan stated that "the idea that scientists shouldn't talk about their science to the public seems to me bizarre." He understood that most people have a deep desire to learn about the unknown. He also knew that scientific research required money, and that money would be easier to find if he could create great public awareness of and interest in scientific problems. "Scientists who can get people excited about the field serve as role models for youngsters. Beyond that, if you're in love with something, then there is a natural tendency to want to tell people about it!" Sagan explained.

In 1980, Sagan used his TV popularity to create his own educational science series, "Cosmos." The ambitious project, which Sagan described as "a trip in the spaceship of the imagination," was filmed over a period of three years, on location in twelve different countries, at a cost of over eight million dollars. "We explore deep space and seek answers to the deep questions about which every culture has wondered; the origins of man and his universe, the mythology of science," Sagan explained. When the series was broadcast by the Public Broadcasting System (PBS), it became the most-watched science show ever, reaching a



worldwide audience of over 500 million people. As the show's enthusiastic narrator, Sagan became one of the best-known scientists in the world.

"We live in a time dominated by science and technology, and science is absolutely essential for our future survival. And yet it sometimes seems as if no one understands very much about science and technology. This is the road to disaster. Mankind must be able to make intelligent decisions about himself and his universe," Sagan said in explaining the series. "Perhaps by increasing public awareness that science is a characteristically human activity and a basic tool for our survival, 'Cosmos' will have made a small contribution."

In 1985, Sagan brought science to the public eye in yet another way: by publishing his first novel, *Contact*. "It's the story of the receipt of a first bona fide message from another civilization in space, and of the response here on Earth, which is very complex and diverse," Sagan noted. "I wrote it because it was an opportunity to get across scientific ideas to an audience different from that of *Scientific American*. Also, it seemed fun to try to write fiction. And many people have asked me what I think the consequences of receiving such a message would be. I never could give in a few sentences what seemed to me an adequate answer." In 1995, production began on a movie version of *Contact*.

WORKING TOWARD A PEACEFUL UNIVERSE

Building on the phenomenal success of "Cosmos," in the 1980s Sagan began speaking out on a number of issues that concerned him. One thing he was particularly worried about was the possibility of destroying the Earth through nuclear war. "The nuclear issue really worries me because we discover, unexpectedly, that we've created a doomsday machine. Yes, there are assurances: 'Trust me—we won't use it.' But that's like giving a loaded revolver to a child," Sagan stated. "It is by no means clear that the leaders of nuclear armed states have a keen appreciation of the realities of nuclear war." After studying the effects of nuclear weapons, Sagan published several books and articles about the disastrous "nuclear winter" he felt would result if a bomb were detonated. In 1986, Sagan was arrested at the Nevada Test Site along with 168 other people for protesting against nuclear-weapons testing by the United States government.

Another issue that troubles Sagan is the degradation of the Earth's environment. "One of the many benefits of astronomy is that it gives you a sense of our coordinates in space and time. . . . We're just a little blue dot in the heavens. The conceit that we're at the center of the universe, and that we've been here since the beginning, does fall heavily when confronted with the reality of modern science," Sagan stated. "To me, it underscores our responsibility to deal more kindly with one another, and to preserve and cherish that pale blue dot, the only home we've ever known." Sagan has actively encouraged industries to find alternatives to using oil and gasoline, which are scarce resources that cause air pollution when burned. In the mid-1990s, Sagan protested against cuts in government spending for environmental research. "Not to want to know about environmental trends seems especially foolish. What are conservatives conserving, if not the environment that sustains all of us?" he commented.

But perhaps most disturbing to Sagan is what he views as a decline in education in America, especially in the sciences. "It's clear that there's a rampant dumbing down in progress in which not knowing things is considered a virtue and in which knowing things is considered a cause for embarrassment," Sagan stated. "My life experience has shown that almost every child is a scientist in first grade. Kids are tailor-made for science. They ask tough questions, have insatiable curiosity and an intact sense of wonder. But all of that is gone by twelfth grade. Something awful has happened. They've decided science is not for them."

"Kids interested in science are usually defined as uncool, which is a way for those who are uncomfortable with science to deal with it," he continued. "This is an across-the-board problem, with teachers teaching who are not fluent in the subjects—the basketball coach teaching chemistry is all too common—students who don't try to learn, parents who don't encourage, the media who don't put science on for fear of losing the lowest common denominator to the competition. It's an extremely widespread problem, and it's going to take a lot to get a fix on. Meanwhile, the problems that require an understanding of science to fix are coming at us rat-a-tat-tat."

Sagan expanded on his views about the "dumbing down" of America in his 1996 book *The Demon-Haunted World: Science as a Candle in the Dark.* In this work, he expresses concern about the number of people who are taken in by "pseudo-scientific" ideas such as horoscopes, crop circles, alien abductions, and the power of crystals to focus energy. Sagan goes on to explain how applying the scientific method—which entails "logic, reason, attention to detail, obsession with evidence, [and] readiness to discard pet theories in the face of inconvenient facts"—can expose many of these popular myths as frauds. The book also includes a "baloney detection kit" to help people cut through the sensational stories that often appear in the media and instead focus on equally amazing scientific truths.

MARRIAGE AND FAMILY

Sagan has been married three times. His first marriage, to scientist Lynn

Alexander (later known as Lynn Margulis), lasted from 1957 to 1963 and produced two sons, Dorion and Jeremy. Sagan and his second wife, painter Linda Salzman, were married from 1968 to 1981 and had one son, Nicholas. Shortly after his second divorce, Sagan married writer Ann Druyan, with whom he had worked closely on the "Cosmos" series. Sagan's third marriage has produced two children: a daughter, Alexandra (called "Sachie"), and a son, Sam.

In 1995, Sagan was hospitalized for myelodysplasia, a rare bone marrow disease that can turn into terminal leukemia without treatment. Fortunately, Sagan recovered after having a bone-marrow transplant. His sister, who turned out to be a perfect match, was the donor. "If not for a bone-marrow transplant, I might not be alive right now," Sagan admitted. "And that acknowledgment of vulnerability is a very character-building experience. It certainly underscored my sense of the preciousness of life. In fact, it's such a beneficial experience that, except for the fact that you might die, I recommend it to everybody."

In July 1996, Sagan was readmitted to a hospital in Ithaca, New York, for further treatment of his myelodysplasia. At press time, the future prognosis was unknown.

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Apollo Achievement Award (National Aeronautics and Space Administration): 1970
Medal for Exceptional Scientific Achievement (National Aeronautics and Space Administration): 1972
Golden Plate Award (American Academy of Achievement): 1975
Medal for Distinguished Public Service (National Aeronautics and Space Administration): 1977, 1981
Pulitzer Prize for Literature: 1978, for *Dragons of Eden: Speculations on the Evolution of Human Intelligence*
Best Books for Young Adults (American Library Association): 1980, for *Cosmos*
George Foster Peabody Award for Excellence in Television Programming (University of Georgia): 1980, for "Cosmos"
Emmy Award (Academy of Television Arts and Sciences): 1981, for "Cosmos"
Humanist of the Year Award (American Humanist Association): 1981
Ralph Coats Roe Medal (American Society of Mechanical Engineers): 1981, for "contribution to planetary physics"
John F. Kennedy Astronautics Award (American Astronautical Society): 1983
Arthur C. Clarke Award for Space Education (Students for the Exploration and Development of Space): 1984
SANE National Peace Award: 1984
Sidney Hillman Foundation Prize: 1984, for contributions to world peace
Leo Szilard Award for Physics in the Public Interest (American Physical Society): 1985, for discovery of nuclear winter
Nahum Goldmann Medal (World Jewish Congress): 1986
Public Welfare Medal (National Academy of Sciences): 1994, for efforts in spreading understanding of science to the public

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James D. Watson 1928-
American Molecular Biologist
Co-Discoverer of the Structure of DNA
Co-Winner of the 1962 Nobel Prize for Physiology or Medicine

BIRTH

James Dewey Watson, Jr., was born in Chicago, Illinois, on April 6, 1928. His father, also named James Dewey Watson, was a debt collector, while his mother, Jean Mitchell Watson, was an admissions officer at the University of Chicago and a Democratic Party precinct leader. The Watsons also had one other child, Elizabeth, who was born two years after James.

YOUTH

Watson grew up on Chicago's South Side in a modest, hard-working community. Around the neighborhood, he was like most of the other children. He liked to roller skate and ride his bike up and down the street, and during the fall he and his sister loved to help their father rake leaves and burn them. As a student at Horace Mann Elementary School in Chicago, however, he was known as a bright and intensely curious child who kept even his teachers on their toes. One of his teachers once told his mother that "I have to go home at night and study to be one step ahead of little Jimmy Watson, because he's always one step ahead of me."

Looking back on his childhood, Watson credited his parents with helping him develop intellectually. His mother engaged James in stimulating discussions about world events and politics, and by the time he was eight years old, he was following presidential elections with great interest. His father, meanwhile, loved to read books and watch birds, and he passed both of these interests on to his son. As he grew older, Watson and his father spent hours watching birds in neighborhood parks, studying their songs, nests, and behavior. Watson later called this early interest in birds an important factor in shaping his interests. "It was the way I got into science," he explained.

Watson summed up his parents' influence by saying, "I was sort of trained to get pleasure from understanding the world around me, not from material things. We didn't have material things when I was a boy and I never got used to them." As he grew older, signs of his intelligence multiplied. He was able to read 500 words a minute, and both his parents and teachers noted that he was able to absorb and retain vast amounts of information. He even made a number of appearances on a national radio show called "The Quiz Kids," in which he competed against other bright children his own age.

During his teenage years, though, Watson did not have many friends. He was skinny and gangly and seemed more interested in his studies than in attracting friends. "I never even tried to be an adolescent," he said. "I never went to teenage parties. I never tried to talk like a teenager. That probably made people dislike me. . . . I didn't fit in. I didn't want to fit in. I basically passed from being a child to an adult."

EDUCATION

In 1943, at the age of 15, Watson finished high school and entered the University of Chicago on a scholarship. In part because he enjoyed bird-watching so much, Watson decided to work for a degree in zoology, the study of animal life. After graduating in 1947 with his B.S. in zoology, he puzzled over his next step. He wanted to go on to graduate school, preferably at the University of Indiana, but the school did not offer advanced ornithology classes. Around this time, Watson's interests changed to genetics, the study of the biological characteristics passed from parent to offspring. Indiana's strong reputation in genetics studies, coupled with the advice of his professors, convinced Watson that the school was right for him.

Already a graduate student at the young age of 19, it was clear that Watson had tremendous intellectual capacity. His social skills, though, left something to be desired. Intolerant of people whom he viewed as intellectually inferior, Watson was often rude to even casual acquaintances. "In those days, I used to think manners were terrible. The truth was important, and manners often hid the truth." Classmates and professors at Indiana agreed that Watson was an unusual student. "He was a very remarkable fellow," said one member of the faculty. "Even more odd then, than later. But tremendously intelligent, with this mixture of self-assurance and uncertainty of himself that very often bright kids have. . . . He is a person who looks completely disheveled all the time, a mess—except in things that matter. I have never known anybody whose notebooks, for example, were so perfect, as Jim's notebooks."

Accepted within a small circle of university scientists, however, Watson enjoyed the ever-present debates over scientific theories and opinions, and he soon felt like an equal member of the group. Around this time, Watson met two University of Indiana scientists who had a particularly important impact on his career. One was Nobel Prize-winning geneticist Hermann Muller, and the other was Nobel Prize-winning microbiologist Salvador Luria. It was through these men that Watson become interested in heredity and genetics.

Genetics is a branch of scientific study that examines how characteristics of plants and animals are passed on from generation to generation. All living things are composed of cells, and all living things reproduce, passing on certain characteristics—the color of eyes and hair in humans, for example, or the size and shape of apples in an apple tree. These characteristics are passed on through the part of a cell that is known as a "gene," which is the root of the word "genetics." The study of genetics really began with the work of Gregor Mendel, a 19th-century Russian monk. Mendel studied peas and discovered a pattern in the way that certain characteristics—size, shape, and color—of peas were passed on from parent to offspring. He was followed by Thomas Henry Morgan, an American scientist. During the late 19th and early 20th century, Morgan's studies of fruit flies and the way in which the shape and color of the flies were passed on is regarded as the next most significant contribution to the study of genetics.

As research into genetics continued in the 20th century, scientists gained additional knowledge about how genes in chromosomes, which are composed of deoxyribonucleic acid (DNA), determined which traits were passed on in species over time. But their limited knowledge of DNA structure hampered their genetic studies. Certain that a greater understanding of DNA structure would vastly improve their insights into the nature of heredity and genetics, microbiologists around the world worked diligently to unlock its secrets.

CAREER HIGHLIGHTS

THE SEARCH FOR DNA

Watson jumped into his studies of genetics and heredity with great excitement. But as he learned more and more about how genes perform their functions, he was forced to admit that his knowledge of advanced chemistry was too spotty for him to be the scientist he wanted to be. Despite his excellent academic record, Watson had avoided the hardest chemistry courses up to that point.

In 1950, in an effort to fill in the gaps in his knowledge of chemistry and continue his study of DNA biochemistry, Watson went to the University of Copenhagen in Denmark. A year later, while still in Europe, he attended a conference in Naples, Italy. The conference included a lecture by British scientist Maurice Wilkins, who discussed the possible structure of deoxyribonucleic acid, a subject of great debate at that time.

Wilkins's lecture inspired Watson to undertake the great scientific quest that eventually made him famous. He was only 24 years old, and he had no established scientific reputation, but Watson nonetheless began to dream about being the discoverer of the structure of DNA. "Before Maurice's talk I had been worried about the possibility that the gene might be fantastically irregular," Watson later wrote. After Wilkins's lecture, though, "I knew that genes could crystallize; hence they must have a regular structure that could be solved in a straightforward fashion." Excited by the lecturer's insights, he even asked Wilkins if he would consider teaming up with him on DNA research. Wilkins, whose reputation was well established, turned down the young, unknown Watson.

Undaunted, Watson left Denmark in 1951 and began working at Cavendish Laboratories at Cambridge University in England. His job at Cavendish was not to study DNA, but to research a virus that attacked tobacco plants. At Cavendish, Watson met Francis H. C. Crick, the man who would become his collaborator. Crick was older than Watson, but because his studies had been interrupted by World War II in the early 1940s, he had not finished his doctorate. Watson and Crick quickly discovered that they shared a passion to find the secret of the structure of DNA. Together, the two men worked to seek out the answer.

Watson and Crick were not the only people interested in figuring out how the various components of DNA fit together. An international race to unlock the mysteries of DNA had spread like fire across the global scientific community. Competing scientists knew that whoever found the answer would be famous and go down in history as one of the world's greatest scientists. But while the various scientific teams did keep some secrets about their research methods and findings, they also shared a great deal of the information they gathered in scientific papers and publications. Watson and Crick relied on data gathered over the previous 50 years in putting together their own research, and they especially relied on clues provided by researchers Maurice Wilkins and Linus Pauling.

After months of research, Watson and Crick were reprimanded by the director of Cavendish Laboratories for not focusing on their assigned tasks. He told them to stop their search for the structure of DNA and return to their other research responsibilities. For a few months, they reluctantly followed the director's advice, but as they learned about the progress that other researchers were making on unraveling the DNA puzzle, Watson and Crick once again concentrated their efforts in that area. They knew the discovery of the structure of DNA was just a matter of time. If they waited, they would lose their chance at being the discoverers.

Watson and Crick conducted their research in what others called "The Hut." It was an unlikely place for a great scientific discovery. It looked more like a messy room full of books and an elaborately constructed sets of wires, colored beads, metal rods, and pieces of sheet metal. It was from these bits of metal and wire that Watson and Crick were attempting to build a model of DNA. Sometimes their research was frustrating, because the problem they were working on was like an unknown jigsaw puzzle. They knew what pieces went into the puzzle, but they did not know how many pieces there were or what the puzzle looked like.

Watson and Crick kept hammering away at the task, though, and soon another scientist's work provided them with a valuable piece of the puzzle. Linus Pauling, a winner of two Nobel Prizes and a leading DNA researcher, had proposed that the structure of DNA was a three-strand rope configuration. Watson and Crick recognized that Pauling's proposal was incorrect, but it helped point them in the right direction. There was general agreement among scientists that DNA was built in some type of spiral, but the question of how the spiral was built remained a mystery. Watson became convinced that the spiral was made up of two coils—not three as Pauling had proposed, or four as other scientists had theorized. Watson's explanation for his two-coil theory was simple: In nature, two is the most common number. People have two eyes, and cells divide into

Watson teaching the day his Nobel Prize was announced two parts. DNA, Watson hypothesized, would also follow this pattern. He predicted that it would have two coils and make copies of itself by division.

Watson and Crick were given the final clues to the mystery by Maurice Wilkins, who had produced X-rays of DNA that seemed to confirm Watson's theory. The answer finally came to Watson in late February 1953, but since the machine shop at Cavendish could not produce what Watson wanted quickly enough, his first working model of the DNA structure was built of cardboard.

On March 7, 1953, less two years after he first heard Wilkins discuss his work on DNA, Watson, along with Crick, put the pieces of the DNA molecule together. DNA, as they theorized and then proved, resembles a long twisted ladder called a "double helix." As soon as other scientists saw this DNA model, they were convinced that Watson and Crick were correct. As one scientist said, "the structure was just too pretty not to be true." Their discovery of the structure of DNA was immediately hailed as one of the most important scientific breakthroughs of the 20th century.

Watson and Crick published the results of their research in the April 1953 issue of the British scientific journal *Nature.* It took only one page of the journal to describe what had taken the world's best and brightest minds a half century to find. Nine years later, in 1962, Watson, Crick, and Wilkins gathered in Stockholm, Sweden. There they were jointly awarded the Nobel Prize in Physiology or Medicine and an equal share of the $50,000 prize. "I was very pleased, but I can't say I was totally surprised," Watson said about the award. "People had been telling me, 'You're going to get it,' but my father was more certain than I."

The discovery made by Watson and Crick had a profound effect on subsequent scientific research. Molecular biologists were able to shape their research in accordance with the new knowledge about DNA structure, while researchers studying the causes of genetic diseases also were helped tremendously by the breakthrough.

In 1955 Watson became an assistant professor at Harvard University, and by 1961, he had been promoted to full professor. He proved that his ability to visualize and solve complex problems was not just the luck of a young geneticist. He built an international reputation and was noted for his insight into important biological problems.

Watson became even more famous when he decided to write a book about the race in the scientific community to be the first to unlock the mystery of DNA. Watson's book, *The Double Helix,* was extremely controversial. A funny and fascinating look into the lives of some of America's leading scientists, the book was also criticized as shallow and mean-spirited, and some of the scientists discussed in the book—including Crick—were outraged by some of the things that Watson said about them. Their curiosity aroused by all the fuss, many people rushed out to buy the book, and *The Double Helix* soon sat on the bestseller lists. Years later, Crick admitted that Watson had done a pretty good job in putting the book together. "I think he did it rather skillfully. A lot of people said it read like a detective story and they couldn't put it down. There's a lot more science in it than you might have thought. I complained originally that it simplified the science, but I now know that's what you have to do."

COLD SPRING HARBOR

In 1968 Watson accepted the position of director of Cold Spring Harbor Laboratory of Quantitative Biology, located in Cold Spring Harbor, New York. His always busy schedule became even more hectic at that time, for he was still a full professor at Harvard University. Watson, though, proved to be a good choice to lead the Cold Spring Harbor facility, which had fallen on hard times. Originally founded in the late 19th century as a facility dedicated to studying the evolution of organisms in their natural environments, the laboratory lost much of its funding in the mid-1900s. Watson, though, was able to attract millions of dollars in donations, which he used to recruit top biologists, and within several years the facility had been restored to its previous stature as one of the nation's top research institutions. In 1976, he resigned from Harvard University to devote all his energies to Cold Spring Harbor Laboratory.

CANCER RESEARCH

At Cold Spring Harbor, Watson focused on making the laboratory into a leading center for cancer research. He did this by steering the facility's energy and resources into the new tumor-virus field. This area of study was not viewed as a promising area of future research in the late 1960s, and many people thought he had made a serious error in judgment. Once again, though, Watson's insight proved correct, as cancer research became a top priority in the country in the 1970s and 1980s. Over the course of those years, scientists at Cold Spring Harbor came to be known as some of America's leading investigators of the causes and treatments of the disease.

HUMAN GENOME PROJECT

In 1989, Watson became director of the Human Genome Research Office at the National Institutes of Health. The purpose of the Genome Research project was to develop a genetic map of the locations of the 50,000-100,000 genes that make up the 46 human chromosomes. It was regarded as the largest biological research program ever undertaken. This project, combined with his position at Cold Spring Harbor, placed Watson at the helm of two major projects in the field of biological research.

Many people had criticized the Genome Project, in large part because the $3 billion attached to the program might have gone to other deserving research projects. In addition, noted the *New York Times*, other critics complained that "as increasingly detailed knowledge is gathered of the relationships of the genes to many aspects of health, the individual's genetic profile will be more and more revealing. Use of the information would be easy to abuse." But even Watson's critics agreed that without his support, the program would have never gone forward. "I'm convinced he's the right person [to lead the project] in the sense that he is the person who scientifically carries the most credibility for this project," said one scientist in *Smithsonian* magazine. "Jim is actually *the* heroic figure of science." Watson himself explained his support for the Genome Project by arguing that if the project helps scientists develop a greater understanding of our genetic makeup, they may have better luck finding new cures for some of the 30,000 diseases that are known to be genetically related.

In 1992, his investments in a number of biotechnology firms were challenged on possible conflict of interest grounds. Bernadine Healy, director of the National Institutes of Health, asked for an ethics review of his investments. Watson subsequently resigned as director of the National Center for Human Genome Research. Bitter about the circumstances of his departure, he said "I have a fine reputation, and they are trying to soil it when I've worked very hard for three and a half years on behalf of the country. I would say this is the lowest moment of my life—to work so hard and to be treated so badly."

Watson returned to Cold Spring Harbor Laboratory, where he has continued to direct its cancer research efforts through the mid-1990s. The facility that Watson helped bring back to life continues to be regarded as one of America's finest scientific establishments.

MARRIAGE AND FAMILY

Watson married Elizabeth Lewis in 1968. At the time, she was his 19-year-old laboratory assistant at Harvard. Elizabeth later became an architectural historian, and she was influential in restoring the Victorian buildings on the Cold Spring Harbor campus. The couple have two children, Rufus and Duncan.

HOBBIES AND OTHER INTERESTS

James Watson has maintained his interest in bird-watching since the days when he first considered a career in ornithology. He is also fond of tennis, and still maintains his interest in literature and film.

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8 Grisham, John (1955)
10 Norman, Greg (1955)
11 Brandy (1979)
12 Blume, Judy (1938)
15 Groening, Matt (1954)
17 Anderson, Marian (1897)
Hargreaves, Alison (1962)
Jordan, Michael (1963)
18 Morrison, Toni (1931)
20 Adams, Ansel (1902)
Barkley, Charles (1963)
Cobain, Kurt (1967)
Crawford, Cindy (1966)
21 Carpenter, Mary Chapin (1958)
Jordan, Barbara (1936)
24 Jobs, Steven (1955)
Whitestone, Heather, (1973)
25 Voigt, Cynthia (1942)
27 Clinton, Chelsea (1980)
28 Andretti, Mario (1940)
Pauling, Linus (1901)

March

1 Rabin, Yitzhak (1922)
Zamora, Pedro (1972)
2 Gorbachev, Mikhail (1931)
Seuss, Dr. (1904)
3 Hooper, Geoff (1979)
Joyner-Kersee, Jackie (1962)
MacLachlan, Patricia (1938)
10 Guy, Jasmine (1964)
Miller, Shannon (1977)
12 Hamilton, Virginia (1936)
13 Van Meter, Vicki (1982)
15 Ginsburg, Ruth Bader (1933)
16 O'Neal, Shaquille (1972)
17 Nureyev, Rudolf (1938)
18 Blair, Bonnie (1964)
de Klerk, F.W. (1936)
Queen Latifah (1970)
20 Lee, Spike (1957)
22 Shatner, William (1931)

March continued

25 Lovell, Jim (1928)
Steinem, Gloria (1934)
26 O'Connor, Sandra Day (1930)
27 Carey, Mariah (1970)
28 James, Cheryl
McEntire, Reba (1955)
30 Hammer (1933)
31 Chavez, Cesar (1927)
Gore, Al (1948)

April

2 Carvey, Dana (1955)
3 Garth, Jennie (1972)
Goodall, Jane (1934)
4 Angelou, Maya (1928)
5 Powell, Colin (1937)
6 Watson, James D. (1928)
12 Cleary, Beverly (1916)
Doherty, Shannen (1971)
Letterman, David (1947)
13 Brandis, Jonathan (1976)
14 Rose, Pete (1941)
16 Selena (1971)
Williams, Garth (1912)
17 Champagne, Larry III (1985)
19 Hart, Melissa Joan (1976)
22 Levi-Montalcini, Rita (1909)
Oppenheimer, J. Robert (1904)
26 Pei, I.M. (1917)
28 Baker, James (1930)
Duncan, Lois (1934)
Hussein, Saddam (1937)
Leno, Jay (1950)
29 Agassi, Andre (1970)
Seinfeld, Jerry (1954)

May

2 Spock, Benjamin (1903)
7 Land, Edwin (1909)
9 Bergen, Candice (1946)
10 Jamison, Judith (1944)
13 Rodman, Dennis (1961)
14 Smith, Emmitt (1969)
15 Johns, Jasper (1930)
Zindel, Paul (1936)
17 Paulsen, Gary (1939)
18 John Paul II (1920)
21 Robinson, Mary (1944)
23 Bardeen, John (1908)
O'Dell, Scott (1898)
26 Ride, Sally (1951)
27 Kerr, M.E. (1927)

June

1 Lalas, Alexi (1970)
4 Kistler, Darci (1964)
5 Scarry, Richard (1919)
6 Rylant, Cynthia (1954)
8 Bush, Barbara (1925)
Edelman, Marian Wright (1939)
Wayans, Keenen Ivory (1958)
Wright, Frank Lloyd (1869)
10 Goodman, John (1952)
Sendak, Maurice (1928)
11 Cousteau, Jacques (1910)
Montana, Joe (1956)
12 Bush, George (1924)
13 Allen, Tim (1953)
14 Bourke-White, Margaret (1904)
Graf, Steffi (1969)
15 Horner, Jack (1946)
16 McClintock, Barbara (1902)
17 Gingrich, Newt (1943)
Jansen, Dan (1965)

June continued

18 Morris, Nathan (1971)
Van Allsburg, Chris (1949)
19 Abdul, Paula (1962)
Aung San Suu Kyi (1945)
21 Bhutto, Benazir (1953)
Breathed, Berke (1957)
22 Bradley, Ed (1941)
23 Rudolph, Wilma (1940)
Thomas, Clarence (1948)
25 Carle, Eric (1929)
27 Babbitt, Bruce (1938)
Perot, H. Ross (1930)

July

1 Diana, Princess of Wales (1961)
Duke, David (1950)
McCully, Emily Arnold (1939)
2 Marshall, Thurgood (1908)
Thomas, Dave (1932)
5 Watterson, Bill (1958)
7 Chagall, Marc (1887)
9 Hanks, Tom (1956)
Krim, Mathilde (1926)
10 Ashe, Arthur (1943)
11 Cisneros, Henry (1947)
White, E.B. (1899)
12 Cosby, Bill (1937)
Yamaguchi, Kristi (1972)
13 Stewart, Patrick (1940)
15 Aristide, Jean-Bertrand (1953)
16 Sanders, Barry (1968)
18 Mandela, Nelson (1918)
21 Reno, Janet (1938)
Williams, Robin (1952)
22 Calder, Alexander (1898)
Dole, Bob (1923)
Hinton, S.E. (1948)
24 Krone, Julie (1963)
26 Berenstain, Jan (1923)
28 Davis, Jim (1945)
29 Burns, Ken (1953)
Dole, Elizabeth Hanford (1936)
Jennings, Peter (1938)
Morris, Wanya (1973)
30 Hill, Anita (1956)
Moore, Henry (1898)
31 Reid Banks, Lynn (1929)

August

1 Garcia, Jerry (1942)
2 Baldwin, James (1924)
Healy, Bernadine (1944)
3 Roper, Dee Dee
5 Ewing, Patrick (1962)
6 Warhol, Andy (1928?)
7 Duchovny, David (1960)
Leakey, Louis (1903)
9 Houston, Whitney (1963)
Travers, P.L. (1899?)
11 Haley, Alex (1921)
Hogan, Hulk (1953)
12 Martin, Ann M. (1955)
Myers, Walter Dean (1937)
13 Battle, Kathleen (1948)
Castro, Fidel (1927)
14 Berry, Halle (1967?)
Johnson, Magic (1959)
Larson, Gary (1950)
15 Ellerbee, Linda (1944)
19 Clinton, Bill (1946)
20 Chung, Connie (1946)
22 Schwarzkopf, H. Norman (1934)
23 Novello, Antonia (1944)

August continued

23 Phoenix, River (1970)
24 Arafat, Yasir (1929)
26 Burke, Christopher (1965)
Culkin, Macaulay (1980)
Sabin, Albert (1906)
28 Dove, Rita (1952)
Evans, Janet (1971)
Priestley, Jason (1969)
30 Earle, Sylvia (1935)
31 Perlman, Itzhak (1945)

September

1 Estefan, Gloria (1958)
2 Bearden, Romare (1912?)
Galeczka, Chris (1981)
5 Guisewite, Cathy (1950)
7 Lawrence, Jacob (1917)
Moses, Grandma (1860)
8 Prelutsky, Jack (1940)
Thomas, Jonathan Taylor (1982)
13 Taylor, Mildred D. (1943)
15 Marino, Dan (1961)
16 Dahl, Roald (1916)
17 Burger, Warren (1907)
18 de Mille, Agnes (1905)
Fields, Debbi (1956)
21 Fielder, Cecil (1963)
King, Stephen (1947)
23 Nevelson, Louise (1899)
24 Ochoa, Severo (1905)
25 Locklear, Heather (1961)
Lopez, Charlotte (1976)
Pippen, Scottie (1965)
Smith, Will (1968)
Walters, Barbara (1931)
26 Stockman, Shawn (1972)
27 Handford, Martin (1956)
29 Berenstain, Stan (1923)

October

1 Carter, Jimmy (1924)
3 Herriot, James (1916)
Winfield, Dave (1951)
5 Lemieux, Mario (1965)
7 Ma, Yo-Yo (1955)
8 Jackson, Jesse (1941)
Ringgold, Faith (1930)
Stine, R.L. (1943)
11 Perry, Luke (1964?)
Young, Steve (1961)
12 Childress, Alice (1920?)
Ward, Charlie (1970)
13 Kerrigan, Nancy (1969)
Rice, Jerry (1962)
15 Iacocca, Lee A. (1924)
17 Jemison, Mae (1956)
18 Marsalis, Wynton (1961)
Navratilova, Martina (1956)
20 Mantle, Mickey (1931)
21 Gillespie, Dizzy (1956)
26 Clinton, Hillary Rodham (1947)
27 Anderson, Terry (1947)
28 Gates, Bill (1955)
Salk, Jonas (1914)
29 Ryder, Winona (1971)
31 Candy, John (1950)
Pauley, Jane (1950)

November

2 lang, k.d. (1961)
3 Arnold, Roseanne (1952)
9 Denton, Sandi
Sagan, Carl (1934)
11 Vonnegut, Kurt (1922)
12 Andrews, Ned (1980)
Harding, Tonya (1970)
13 Goldberg, Whoppi (1949)
14 Boutros-Ghali, Boutros (1922)
15 O'Keeffe, Georgia (1887)

November continued

16 Baiul, Oksana (1977)
17 Fuentes, Daisy (1966)
18 Mankiller, Wilma (1945)
21 Aikman, Troy (1966)
Speare, Elizabeth George (1908)
24 Ndeti, Cosmas (1971)
25 Grant, Amy (1960)
Thomas, Lewis (1913)
26 Pine, Elizabeth Michele (1975)
Schulz, Charles (1922)
27 White, Jaleel (1977)
29 L'Engle, Madeleine (1918)
30 Jackson, Bo (1962)
Parks, Gordon (1912)

December

2 Macaulay, David (1946)
Seles, Monica (1973)
3 Filipovic, Zlata (1980)
7 Bird, Larry (1956)
8 Rivera, Diego (1886)
12 Bialik, Mayim (1975)
Frankenthaler, Helen (1928)
13 Fedorov, Sergei (1969)
16 McCary, Michael (1971)
18 Spielberg, Steven (1947)
22 Pinkney, Jerry (1939)
23 Avi (1937)
27 Roberts, Cokie (1943)
28 Washington, Denzel (1954)

People to Appear in Future Issues

Actors
Trini Alvarado
Gillian Anderson
Richard Dean Anderson
Dan Aykroyd
Tyra Banks
Drew Barrymore
Zachary Ty Bryan
Levar Burton
Cher
Kevin Costner
Courtney Cox
Tom Cruise
Jamie Lee Curtis
Patti D'Arbanville-Quinn
Geena Davis
Ozzie Davis
Ruby Dee
Michael De Lorenzo
Matt Dillon
Michael Douglas
Larry Fishburne
Harrison Ford
Jody Foster
Morgan Freeman
Richard Gere
Tracey Gold
Graham Greene
Mark Harmon
Michael Keaton
Val Kilmer
Angela Lansbury
Joey Lawrence
Martin Lawrence
Christopher Lloyd
Heather Locklear
Kellie Martin
Marlee Matlin
Bette Midler
Alyssa Milano
Demi Moore
Rick Moranis
Tamera Mowry
Tia Mowry
Kate Mulgrew
Eddie Murphy
Liam Neeson
Leonard Nimoy
Rosie O'Donnell
Sean Penn
Phylicia Rashad
Keanu Reeves
Jason James Richter
Julia Roberts
Bob Saget
Arnold Schwarzenegger
Alicia Silverstone
Christian Slater
Taran Noah Smith
Jimmy Smits
Wesley Snipes
Sylvester Stallone
John Travolta
Mario Van Peebles
Damon Wayans
Bruce Willis
B.D. Wong
Malik Yoba

Artists
Mitsumasa Anno
Graeme Base
Maya Ying Lin
Yoko Ono

Astronauts
Neil Armstrong

Authors
Jean M. Auel
Gwendolyn Brooks
John Christopher
Arthur C. Clarke
John Colville
Paula Danziger
Paula Fox
Patricia Reilly Gibb
Jamie Gilson
Rosa Guy
Nat Hentoff
Norma Klein
E.L. Konigsburg
Lois Lowry
Stephen Manes
Norma Fox Mazer
Anne McCaffrey
Gloria D. Miklowitz
Marsha Norman
Robert O'Brien
Francine Pascal
Christopher Pike
Daniel Pinkwater
Ann Rice
Louis Sachar
Carl Sagan
John Saul
Shel Silverstein
Amy Tan
Alice Walker
Jane Yolen
Roger Zelazny

Business
Minoru Arakawa
Michael Eisner
David Geffen
Wayne Huizenga
Donna Karan
Phil Knight
Estee Lauder
Sheri Poe
Anita Roddick
Donald Trump
Ted Turner
Lillian Vernon

Cartoonists
Lynda Barry
Roz Chast
Greg Evans
Nicole Hollander
Charles Schulz
Art Spiegelman
Garry Trudeau

Comedians
Billy Crystal
Steve Martin
Eddie Murphy
Bill Murray

Dancers
Debbie Allen
Mikhail Baryshnikov
Gregory Hines
Twyla Tharp
Tommy Tune

Directors/ Producers
Woody Allen
Steven Bocho
Tim Burton
Francis Ford Coppola
Ron Howard
John Hughes
George Lucas
Penny Marshall
Leonard Nimoy
Rob Reiner
John Singleton
Quentin Tarantino

Environmentalists/ Animal Rights
Marjory Stoneman Douglas
Kathryn Fuller
Lois Gibbs
Wangari Maathai
Linda Maraniss
Ingrid Newkirk
Pat Potter

Journalists
Tom Brokaw
John Hockenberry
Ted Koppel
Jim Lehrer
Dan Rather
Nina Totenberg
Mike Wallace
Bob Woodward

Musicians
Ace of Base
Babyface
Basia
George Benson
Bjork
Clint Black
Ruben Blades
Mary J. Blige
Bono
Edie Brickell
James Brown
Ray Charles
Chayanne
Natalie Cole
Coolio
Cowboy Junkies
Sheryl Crow
Billy Ray Cyrus
Melissa Etheridge
Aretha Franklin
Green Day
Guns N' Roses
P.J. Harvey
Hootie & the Blowfish
India
Janet Jackson
Michael Jackson
Winona Judd
R. Kelly

Anthony Kiedis
Lenny Kravitz
Kris Kross
James Levine
LL Cool J
Andrew Lloyd Webber
Courtney Love
Lyle Lovett
MC Lyte
Madonna
Barbara Mandrell
Branford Marsalis
Paul McCartney
Midori
Alanis Morissette
Morrissey
N.W.A.
Jesseye Norman
Sinead O'Connor
Luciano Pavoratti
Pearl Jam
Teddy Pendergrass
David Pirner
Prince
Public Enemy
Raffi
Bonnie Raitt
Red Hot Chili Peppers
Lou Reed
L.A. Reid
R.E.M.
Trent Reznor
Kenny Rogers
Axl Rose
Run-D.M.C.
Paul Simon
Smashing Pumpkins
Sting
Michael Stipe
Pam Tillis
TLC
Randy Travis
Terence Trent d'Arby
Travis Tritt
U2
Eddie Vedder
Stevie Wonder
Trisha Yearwood
Dwight Yoakum
Neil Young

Politics/World Leaders
Madeleine Albright
Harry A. Blackmun
Jesse Brown
Ronald Brown
Pat Buchanan
Mangosuthu Buthelezi
Violeta Barrios de Chamorro
Shirley Chisolm
Jean Chretien
Warren Christopher
Edith Cresson
Mario Cuomo
Dalai Lama
Mike Espy
Alan Greenspan
Vaclav Havel
Jack Kemp
Bob Kerrey
Kim Il-Sung
Coretta Scott King
John Major
Imelda Marcos
Slobodan Milosevic
Mother Theresa
Ralph Nader
Manuel Noriega
Hazel O'Leary
Leon Panetta
Federico Pena
Simon Peres
Robert Reich
Ann Richards
Richard Riley
Phyllis Schlafly
Pat Schroeder
Donna Shalala
Desmond Tutu
Lech Walesa
Eli Weisel
Vladimir Zhirinovsky

Royalty
Charles, Prince of Wales
Duchess of York (Sarah Ferguson)
Queen Noor

Scientists
Sallie Baliunas
Avis Cohen
Donna Cox
Stephen Jay Gould
Mimi Koehl
Deborah Letourneau
Philippa Marrack
Helen Quinn
Barbara Smuts
Flossie Wong-Staal
Aslihan Yener
Adrienne Zihlman

Sports
Jim Abbott
Muhammad Ali
Michael Andretti
Boris Becker
Barry Bonds
Bobby Bonilla
Jose Canseco
Jennifer Capriati
Michael Chang
Roger Clemens
Randall Cunningham
Eric Davis
Clyde Drexler
John Elway
Chris Evert
George Foreman
Zina Garrison
Florence Griffith-Joyner
Anfernee Hardaway
Rickey Henderson
Evander Holyfield
Brett Hull
Raghib Ismail
Jim Kelly
Petr Klima
Carl Lewis
Willy Mays
Paul Molitor
Jack Nicklaus
Joe Paterno
Kirby Puckett
Pat Riley
Mark Rippien
David Robinson
Deion Sanders
Daryl Strawberry
Danny Sullivan
Vinnie Testaverde
Isiah Thomas
Mike Tyson
Steve Yzerman

Television Personalities
Andre Brown (Dr. Dre)
Katie Couric
Phil Donahue
Kathie Lee Gifford
Ed Gordon
Bryant Gumbel
Arsenio Hall
Ricki Lake
Joan Lunden
Dennis Miller
Diane Sawyer
Tabitha Soren
Alison Stewart
Jon Stewart
Vanna White
Montel Williams
Paul Zaloom

Other
James Brady
Johnnetta Cole
David Copperfield
Jaimie Escalante
Jack Kevorkian
Wendy Kopp
Sister Irene Kraus
Jeanne White

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