Facts and ideas from anywhere

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ALFRED LEE LOOMIS AND WEALTH, SCIENCE, TUXEDO PARK, AND THE LAST OF THE PRIVATE RESEARCH LABORATORIES

Jennet Conant, a granddaughter of the former president of Harvard University, has written *Tuxedo Park: A Wall Street Tycoon and the Secret Palace of Science That Changed the Course of World War II* (1).[1] Alfred Lee Loomis (1887–1975) (hereafter Loomis) was an American attorney, investment banker, physicist, philanthropist, and patron of scientific research *(Figure).* He established "the Loomis Laboratory" in Tuxedo Park, New York, in the late 1920s, and that laboratory attracted some of the world's best scientists during the decade just before World War II.

Few Wall Street tycoons of his generation could match Loomis's extraordinary intellect and versatility. He achieved an immense fortune in business, earned worldwide recognition for his scientific endeavors, and won accolades for his service in war time. Yet, he contrived to do it all as unobtrusively as possible; he was a mysterious and remote figure who shunned publicity. Anonymity served his interest. Loomis exiled himself from the glittering world of New York society because he wanted to devote his time to science. He set himself up in a castle on a high hill in Tuxedo Park and financed his own audacious investigations of the stars, the heart, and the brain. He built his private laboratory not as a shrine to himself but because he desired nothing more than to be actively involved in the daily research. He provided both the brains and backing for all kinds of inventions, medical advances, and scientific studies. He also helped invent modern warfare. Loomis erected a wall between his scientific Valhalla and his business life. Although he socialized with close friends from both walks of life, he never introduced a single Wall Street associate to any of his Tuxedo Park experimenters or vice versa.

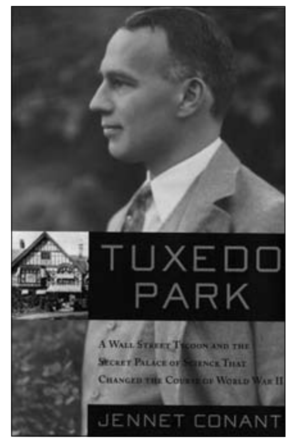

Figure. Jennet Conant's book on Alfred Lee Loomis.

Although not from great wealth, Loomis enjoyed all the same privileges. He possessed a quiet self-confidence. He dressed immaculately, had a calm demeanor, and never raised his voice. He took control of every conversation and every room he entered. He had an enigmatic charm that both men and women found compelling. He avoided small talk. Despite his elegance, good looks, and brilliance, he had warmth. As one of his friends said, "He was just the best man you ever met."

His gift was an inventive ingenuity, an almost childlike ability to look at something as if for the first time and take it apart. He attacked new problems with a single-minded zeal. As soon as he made a contribution in one endeavor, he would take off in an entirely new direction. He loved puzzles and never tired of working out explanations for life's riddles. He excelled at games of all kinds. By age 9, he was a chess prodigy. By 13, he could play mental chess without the aid of a board or pieces and he could play blindfolded, carrying on two games simultaneously. As a small boy, he was fascinated by the art of magic and became a master at sleight-of-hand, making quarters appear and disappear behind ears and inside pockets and performing thrilling card tricks. He collected the apparatus used by professional magicians and staged elaborate shows for his siblings and cousins. He awed people. As his grandson, Alfred Lee Loomis III, said, "He was a very imperious type. The whole idea of having your own laboratory, and inviting people to come and live there, like kings and do science—it was a pretty extraordinary arrangement. The whole concept has to do with exercising a sort of subtle power and control."

Family. Science was a part of Loomis's heritage. His grandfather, Alfred Lebbeus Loomis (1831–1895), earned worldwide recognition for his advances in the treatment of pulmonary diseases and was one of the most honored physicians of his

[1]Nobel Prize Winner Luis W. Alvarez also wrote a biographical memoir entitled *Alfred Lee Loomis 1887–1975* published by the National Academy of Sciences in 1980. Virtually all of the information in this piece, however, is from the Jennet Conant book.

generation. He was an educator, reformer, and a leading philanthropist who was elected president of nearly every prestigious medical society, including the Association of American Physicians. He lived in a big house in Manhattan and, despite giving away large sums of money, left an estate worth in excess of $1 million. Loomis's grandfather's achievements and his deeply ingrained belief that the rich should repay their debt to society affected Loomis immensely, for he would feel that money-making alone was not a satisfactory existence. His paternal grandfather was active in establishing retreats for patients with tuberculosis. These retreats in Saranac, New York, and Liberty, New York (later renamed the Loomis Sanitarium) were one of the first to provide poor invalids with a level of care that had previously been available only to the rich. His grandfather later channeled his considerable charisma and passion into fundraising, becoming a tireless campaigner for medical research. In 1886, he gave his medical school $100,000 from an unnamed wealthy "friend" to build and equip a new laboratory, which was named the Loomis Laboratory.

The grandfather had two children, Henry Patterson Loomis and Adeline Eliza Loomis. Henry followed his father into medicine after graduating from Princeton and New York University Medical College. He went abroad to study for a number of years, returning to New York City in 1887, where he joined the staff of Bellevue Hospital and continued his research in diseases of the heart and lung. Henry married a daughter of a Wall Street banker. Loomis was born on November 4, 1887, and named for his grandfather, although the biblical "Lebbeus" was changed to "Lee." Two more children followed, Julia Atterbury Loomis followed by Henry, who was named after both his father and uncle. The marriage, however, was not a good one, and it eventually ended in divorce. The younger boy died from rabies. Loomis was almost 10 and he never forgot Henry's terrible screams and convulsions. The suddenness of Henry's death taught Loomis what it meant to take care of his family, and he always did.

When growing up, Loomis often went to Long Island where his Stimson aunts rented houses each summer. Loomis and his sister, Julia, spent much time with their large band of Stimson cousins. The family was presided over by Louis Atterbury Stimson, who had a commanding personality and had served with distinction in the Civil War. He went on to become an accomplished physician and one of the first American surgeons to operate using antiseptics. Louis never recovered from the tragic death of his wife 9 years after their marriage. He withdrew into the workaholic grind of medicine, abandoning his son and daughter to be raised by his aging parents and an unmarried sister. Nevertheless, although a removed figure, he remained the undisputed patriarch of the "fifty uncles, aunts and cousins" that constituted the extended Stimson clan and were the abiding influence of Loomis's life.

It was within this family circle—bonded by unhappiness, orphaned children, absent parents, and interconnected households—that Loomis and his cousin, Henry Stimson, 20 years his senior, formed their extraordinarily close, lifelong allegiance. When Henry Stimson discovered early in his marriage that he had been left sterile by mumps, his young cousin Loomis became the son he would never have. Loomis idolized Henry Stimson, and Henry became the surrogate father from whom he inherited his single-minded purpose, as well as a dominant characteristic that was famously known by members of the clan as "the Stimson reserve." The most important decisions in Loomis's early life proceeded from the collective wisdom of the Stimson men who were consulted at every turn and weighed in with their expectations, imperatives, and stern injunctions. It was determined that Loomis should follow the same path as Henry Stimson—first Andover, then Yale, then Harvard Law School.

Education. Loomis was a gifted if somewhat distracted student. At Andover he reportedly "burnt up" courses in mathematics and science but demonstrated only passing interest in the required language and arts courses. Throughout schooling he was more interested in his hobbies and inventions than he was in the daily classroom assignments. He was captain of the chess and tennis teams and was voted "brightest in the class" his senior year. At Yale, Loomis and Henry Stimson continued their correspondence on all matters large and small, whether it was requesting permission to keep his automobile in New Haven so he could "take it all apart and overhaul it" or requesting help on a paper about the power of the president. (Stimson at the time served as President Theodore Roosevelt's US attorney for the southern district of the State of New York. He went on to preside in the cabinets of five US presidents, becoming attorney general, secretary of state, and secretary of war at various times.)

At Yale, Loomis majored in mathematics and distinguished himself as a brilliant and highly original thinker. His interest in physics first revealed itself in his study of boomerangs, which he threw all around the campus trying to get them to conform to a theoretical formula for boomerang flight that Loomis had worked out. At the time, Loomis was intrigued by the aeronautical advances being made by the Wright brothers, and he carried out his own experiments with kites and gliders. He designed a model airplane based on a theory he had evolved. He also had a fascination with artillery weapons, developing a huge store of arcane data on their country of origin, design, and capabilities—information that would later prove useful to him.

Loomis was a sophomore at Yale when his father died unexpectedly after a 5-day battle with pneumonia. His father was only 48 years old, but he had long ceased to be the major influence in Loomis's life. While Loomis had given little thought to a career up to that time, although he knew that he would probably engage in some kind of scientific work, he laid aside those dreams and set out on a career in the law, fully aware that the responsibility to support and protect his family now fell to him. He enrolled at Harvard Law School and threw himself into his coursework, also becoming the editor of the *Harvard Law Review*. He graduated cum laude in 1912.

Law career and marriage. Loomis started as a law clerk in Henry Stimson's firm in New York City, although Stimson was in Washington, DC, serving a 2-year stint as secretary of war in the Taft administration. Loomis was assigned to corporate and financial work and soon showed a flair for security issues, mortgages, and reorganizations. He quickly earned a reputation as one of the more outstanding young lawyers on Wall Street and in only 3 years was made a partner in the firm.

At 24, Loomis married Ellen Holman Farnsworth, 2 years his junior, a delicate beauty from a distinguished Boston Brahmin family and the sister of a Harvard classmate, Henry Watson Farnsworth. She was reputed to be "the prettiest girl in Boston, and typical of her day and social class: intelligent, educated—she could read French, Latin, and Greek—but impractical. Tutored at home, she had been immersed in music, poetry and opera since childhood and had a commitment to the life of the mind." The couple soon moved to Tuxedo Park, and for the next few years Loomis focused on his career and family and blended with so-called young marrieds who had settled there. They played tennis and golf and attended soirees. The couple had two sons in quick succession, Alfred Lee Loomis Jr., known as "Lee," and William Farnsworth Loomis, known as "Farney." In 1915, Ellen was rocked by the news that her brother Henry Farnsworth had been killed in World War I. Loomis was unprepared for the depth of his wife's sadness, but she had been extraordinarily close to her brother, who had joined the French Foreign Legion.

Military service during World War I. When the USA declared war against Germany in April 1917, Loomis, then 29 years old, promptly enrolled in officer's training camp, where his mathematical skills quickly became apparent. Artillery work came easily to him, and he amazed his fellow officers with his knowledge of modern field artillery, an obsession dating back to his college days. By January 1918, Loomis, on the basis of his inventiveness and a constant stream of ingenious ideas for new armaments and new solutions to old tactical problems, became chief of the development and experimental department at Aberdeen. There he joined some of the most distinguished physicists and astronomers in the country. They had been mobilized to help adapt the army to the needs of modern warfare. One of Loomis's responsibilities was to test ideas for new weapons submitted to the Army Ordnance Board.

Soon Loomis was promoted to major and put in charge of experimental research on exterior ballistics. He developed an ingenious new method for measuring the velocity of shells, and the device became known as the Loomis chronograph (later, the Aberdeen chronograph). Loomis was promoted to lieutenant colonel. Up to the close of the war, he worked on a variety of ideas, from a recoilless cannon to a low-slung French 75 mm field gun hung on a tripod mount for concealment purposes that was dubbed the "snake in the grass." These would later materialize as the military advanced. The chronograph was Loomis's first invention—his first scientific triumph. He took enormous pride in his accomplishment. His name was listed first on the patent filed by the US Army. Not long afterward, "Alfred L. Loomis of Tuxedo Park" applied and received a second patent on his own "for an improvement in chronographs" designed to enhance the construction and thus the accuracy of the rotating drum within the recording device. Loomis became an enthusiastic champion of the new armored tanks and at every opportunity stressed to Stimson that they, and not horses and guns, were the future of modern warfare. He built a scaled-down model of a tank in his garage at Tuxedo Park to see if he could make further improvements in the design.

Collaboration with Robert Wood. While at Aberdeen, Loomis struck up a friendship with Robert W. Wood (1868–1955) (a future Nobel Prize nominee) of Johns Hopkins University, widely considered to be the most brilliant American experimental physicist of his day. Wood was from a wealthy New England clan and, like Loomis, the precocious son of a physician. From childhood he too had an absorbing interest in all sorts of scientific phenomena. Wood later earned fame as an investigator of scientific fraud and as an inventor; he invented various applications of invisible ultraviolet radiation and was the first to make successful photographs in infrared and ultraviolet light, applying this technique to the detection of art forgeries. Wood also invented what became the standard way to thaw frozen underground water pipes by passing an electrical current through them. Like Loomis, Wood was a compulsive tinkerer and inventor and a lifelong gadgeteer. Wood, almost 2 decades older, had become Loomis's mentor and role model.

By 1919, Loomis's scientific education at the hands of Wood was just beginning. Loomis returned to his law practice but barely lasted a year before his restlessness, combined with a redoubled interest in science and inventions, prompted a career change. He was determined to find a way to finance his interest in science, and he needed a fortune to do so.

Business career. He looked to his brother-in-law, Landon Ketchum Thorne (1888–1964), who had been a year behind him at Yale, for his new partner. After graduating from the Yale Sheffield Scientific School in 1910, Thorne had made a good start on Wall Street selling bonds. Loomis thought Thorne was a comer at college and had introduced him to his sister, Julia, and Loomis could not have been happier than when the two were married in Tuxedo Park in 1911. At first glance, it seemed an unlikely alliance, with the gregarious back-slapping Thorne, a popular college football star, almost in every way Loomis's mirror opposite. But Thorne recognized his brother-in-law's mathematical genius and its application to the financial game. Thorne persuaded Loomis, the fair-haired young lawyer at a major New York firm, to give up law and join him on Wall Street.

Thorne and Loomis soon bought up majority control of Bonbright, the firm that had employed Thorne. Together Thorne and Loomis reorganized the firm to move into financing utility companies. Loomis had all the right contacts. At Aberdeen, he had met many of the top scientists at General Electric who were developing new things for the utility business, including bigger transmission lines and other modernizations. The two brothers-in-law pooled their resources and scrounged capital from relatives. Bonbright became theirs. Loomis believed that if they could speed the growth of the power industry—rural electrification being the key to the growth of new factories, industries, and economic opportunities—both the firm and the country would benefit. Little time passed before Loomis and Thorne grew to be close colleagues and friends, discussing business deals, supporting each other's best efforts, and sharing their weekend enthusiasm for golf, tennis, fishing, and sailing.

In the 1920s, Loomis and Thorne financed the expansion of the public utility companies. They underwrote security issues that most of the old-line Wall Street houses shied away from. Between 1924 and 1929, their firm did upward of $1.6 billion of utility financing, underwriting roughly 15% of all the securities issued in the USA. Loomis's and Thorne's phenomenal 9-year run vaulted their firm to the leading private investment house specializing in utilities. They were lauded not only for their spectacular financial success but for not being motivated solely by concern for money. They applied scientific principles and long-term economic planning to the management of public resources to provide less expensive and more reliable service to customers. Together they conceived and promoted the concept of the big holding company. Their advice was sought by foreign governments. In a matter of a few years, Loomis and Thorne had become both powerful and very prosperous.

But Loomis was never at peace with himself about spending his days preoccupied with money. He had come to believe that science was a higher calling and was troubled by the growing sense that much of his work was self-serving and profited men he neither liked nor much admired. He could not forget the pride and achievement he felt at Aberdeen, culminating in the award of the chronograph patent. Even in the midst of exhaustively analyzing and preparing deals for his company, he was always absorbed by some new discovery or advance in research he had stumbled across in his readings.

Inventions and scientific pursuits. Throughout his early years as an investment banker, Loomis repeatedly badgered his patent attorney to apply for copyright registration on various small devices he had invented, ranging from designs for his own slide rule for calculating securities to drawings for a simple reliable fire extinguisher. Loomis eventually obtained a patent for his new and improved fire extinguisher, which replaced the then common pump model with a closed receptacle that contained the fire extinguisher liquid under constant pressure. Loomis also kept in close touch with many of the physicists he had met at Aberdeen and followed the new research they were doing.

On a visit in 1924 to his Stimson aunts in East Hampton, New York, he called on Wood, who had a farmhouse nearby that he kept as a summer retreat. Loomis found Wood at work in his barn laboratory behind the house. They had a long chat about postwar research. After that, Loomis dropped by to talk to Wood almost every afternoon, finding the atmosphere of the old barn more interesting than that of the beach and the country club. It was during one of these leisurely afternoon sessions that Loomis asked if there was any research Wood could contemplate the two of them doing together, perhaps an area "which required more money than the budget of the physics department could supply." Loomis added that he "would like to underwrite it."

Wood had become interested in physical optics. In the barn, Wood was putting the finishing touches on a 40-foot spectrograph, then the largest and most powerful in existence. It performed superbly and Loomis was transfixed. Wood's preferred method for cleaning the giant spectrograph—which when unused for an extended period became clogged with spider webs—was simply to drop the family cat in one end. To escape, the cat had to make its way through the whole length of the tubing, effectively running a fur duster through the works.

Like most researchers Wood was always short of funding. He knew of Loomis's wartime interest in supersonics. Paul Langevin in Paris had developed a method for detecting submarines by sweeping the sea with a narrow beam of high-frequency sound waves and picking up the echo or reflective sounds with a special electrical apparatus. During the war, Wood had gotten himself assigned to Langevin and had gone with him to the naval arsenal at Toulon, where his apparatus was in operation. He saw that when fish swam across Langevin's beam of high-frequency sound waves, they turned belly up and died, and when a hand was held in front of it in the water there was a painful burning sensation. Wood outlined an elaborate course of research he knew Loomis would find impossible to resist. Wood suggested that he and Loomis continue Langevin's work and investigate some of the biological and chemical effects of high-frequency sound. In return, he knew he could count on Loomis's general support of his own research in optics.

Loomis was impatient to begin. The two arranged a trip to General Electric's research laboratory to purchase the high-powered vacuum tube oscillator they would require for their research. Loomis returned home and began making plans to equip a laboratory behind his house in Tuxedo Park. After the birth of his third son, Henry, Loomis had purchased a much larger Tudor home on Club House Road in Tuxedo Park. The stately brown stucco mansion was nestled on the side of a steep incline, with 3 acres of lush gardens and rolling lawns spreading out behind it. Just down the road at the bottom of the hill was an old barn that served as a garage. It was there that Wood proceeded to train his wealthy protege in his methods. Their first project was the development and design of a far more powerful model of the General Electric oscillator. Using their newly designed pliotron oscillator, similar to the high-frequency oscillator then used in radio broadcasting, and increasing the voltage from the usual 2000 up to 50,000 watts, Loomis and Wood were able to produce "super sound waves" with a frequency of over 200,000 per second, >10 times beyond what is audible to the human ear. Transmitted through water, the super sound waves caused the water to churn furiously as though boiling but with little increase in temperature, kicking up a disturbance or "pulse wave" very much like the cloud of white spray that used to arise on the surface of the ocean after a depth charge was exploded.

The work Wood and Loomis were doing at Tuxedo Park was garnering attention in scientific journals in the USA and abroad, due to some extent to the sensational way Wood had of presenting scientific data. He had the "P. T. Barnum touch" for creating the excitement and publicity that guaranteed that his talks were always well attended. After one of Wood's talks, *The New York Times* went on to explain the possibility of applying the super sound waves to medicine. Wood and Loomis did indeed create a method for stimulating the circulation without injury, and that was valuable information.

Tower House at Tuxedo Park. As the scope of their research expanded, they became pressed for room in the garage, and Loomis began hunting for a larger building in which he could house his workshop. Tuxedo Park was a planned community started in 1886 with extravagant mansions. In 1926, Loomis settled on the Tower House, as it was known to locals, a huge crumbling mock-Tudor pile of stone and masonry built on a high land on the most southeastern tip of Tuxedo Park. Tower House was a large 3-story mansion constructed on solid bedrock, complete with a steep gable, stone tower, elaborate stained glass, and leaded diamond-paned windows. Though it had been derelict for more than a decade, the house had charm and lodge-like simplicity that appealed to Loomis. It had a panoramic view of the wooded hills and lake below. The mansion contained 16 master bedrooms. Loomis bought the mansion in 1926 for $50,000. Its concrete floors were ideal for science so Loomis converted the cavernous basement into an elaborately equipped experimental room. Much of the first floor, including some 20 servant quarters, pantries, and storerooms, was turned into office space. He installed a machine shop complete with a full-time mechanic. Loomis restored the impressive exterior of the house, refurbished the upstairs bedrooms and lounges, and preserved the chapel and splendid grand salon and ballroom with their dark wood paneling and heavy furniture. He also kept the small theater.

When Wood arrived to inspect their new headquarters, he described the building as almost palatial, "a huge stone mansion with a tower like an English country house, perched on the summit of one of the foothills. . . . This he transformed into a private laboratory de-luxe, with rooms for guests or collaborators." Loomis had moved Wood's 40-foot spectrograph from the barn in East Hampton and installed it in the basement so that Wood could continue his spectroscopic work in a better environment. To Wood's surprise, Loomis had made a few minor adjustments on Wood's huge instrument.

Loomis was eager to meet some of the celebrated European physicists and visit their laboratories. He asked Wood to go abroad with him. In the summer of 1926, the two men set off on a grand scientific tour of Europe, which they repeated 2 years later. They met many prominent scientists on the continent including Thomas R. Merton at Oxford and John Saidman in France. After returning to the USA, Loomis now had a blueprint for the kind of research facility he envisioned at Tuxedo Park, where he hoped to do the kind of significant scientific work accomplished in the first Loomis Laboratory built by his grandfather. He purchased an enormous leather guestbook with gilded pages in which to record the names of all the famous scientists who would make the pilgrimage to the Tower House in the years to come. The first name was that of Robert Williams Wood, whom Loomis appointed as the laboratory's eminent "director of research."

Supersonic sound waves and other studies. Loomis and Wood began a series of experiments to explore the effect of their discovery of supersonic sound waves on living organisms. For help, they called in E. Newton Harvey, professor of biology at Princeton and a national authority on living cells. Looking through a high-powered microscope, Harvey saw that the waves had the faculty of breaking down blood vessels and therefore would have a deadly effect on small animals and fish eggs and even on certain kinds of plant life. Over the next 2 years, they experimented with the supersonic "death rays."

In September 1927, Loomis and Wood published their findings in the highly respected *British Philosophical Magazine and Journal of Science.* Their article was entitled "The physical and biologic effects of high frequency sound waves of great intensity." It was labeled "Communication Number 1 from the Alfred Lee Loomis Laboratory." They later received a patent for their methods and apparatus for forming emulsions through powerful high-frequency compression waves and liquid. The same year, working with William Richards, who was then a young chemistry professor at Princeton, Loomis published a second paper, "The chemical effects of high frequency sound waves." Loomis wanted to be published in prominent scientific journals, and in the years to come he had articles in the *Journal of the American Chemical Society, Proceedings of the National Academy of Sciences, Journal of Bacteriology, Journal of Experimental Medicine, Science, Journal of General Physiology, Journal of Physiology, Journal of Neurophysiology,* and *American Journal of Physiology,* among others.

In the coming years the Loomis Laboratory would publish 20 articles on the effects of high-intensity sound waves. Loomis was a coauthor of the first four and, several years later, on another four papers. Together he and Wood did the first major work in the field now commonly known as ultrasound, and their names still appear in some textbooks as the "fathers of ultrasonics" (echocardiography).

By the summer of 1927, Wood's own research in spectral studies was opening up new fields. He had been absorbed in the study of fluorescence of various gases. Wood's discoveries in spectroscopy led to his being nominated that year for a Nobel Prize in physics. Wood's research was attracting prominent scientists to the Loomis Laboratory; in all, 10 papers in optical spectroscopy would come out of the laboratory, including one by Loomis and George Kistiakowsky.

Loomis continued in his capacity at his investment firm 5 days a week, devoting nights, weekends, and vacations to an expanding array of research experiments under way at Tower House. He was now thoroughly committed to his second career as a scientist and spent every spare hour reading journals and books, usually recommended by Wood as part of Loomis's ongoing education. The Loomis Laboratory was a much better laboratory than any university laboratory at the time. It had better and more expensive equipment. He hired Wood as his private tutor, and Wood spent every summer at Tuxedo Park doing experiments that he couldn't do at the Johns Hopkins University because he didn't have enough money.

The single-minded zeal with which Loomis pursued his research meant that he absented himself from his family's house on Club House Road. Repeating the Yankee tradition in which he was reared, he packed all three of his boys off to boarding school from the age of 7. Although his wife, Ellen, admired and supported her husband's passion for research and took pleasure in arranging the elaborate dinners and soirees at Tower House, she increasingly felt like an outsider in his new world. At the Tower House, he had set up an independent household removed from Club House Road, where women were tolerated but not welcomed.

Tuxedo Park's worldwide reputation and collaborations. In the winter of 1927, Loomis hosted a congress of physicists designed to be the new laboratory's official coming-out party. The congress was titled "Certain Aspects of Anatomic Physics" and was in honor of James Franck, professor of physics at Göttingen University, who along with Gustav Hurtz had won the Nobel Prize in 1925 for their work on laws governing the transfer of energy between molecules. Franck had agreed to give his first lecture in the USA at the Loomis Laboratory, and dozens of leading scientists traveled to Tuxedo Park for the event. Papers were presented by Wood and a young physicist from the Massachusetts Institute of Technology (MIT), Karl T. Compton (1887–1954), brother of the recent Nobel Prize winner, who had struck up a close relationship with Loomis. Held in the library at Tower House, a room of "cathedral-like proportions with stained-glass windows," the conference proved such a success that Loomis immediately made plans for another one the following year.

Loomis discovered that he enjoyed the role of host and began regularly holding large house parties complete with honored guests, designated lectures, music recitals—often featuring virtuoso performances by one of the visiting scientists—and lavish formal dinners with a servant standing behind each chair. Loomis later recalled that on many weekends he would invite 30 or 40 people as guests. When Neils Bohr (1885–1962) first came to the USA, he gave a series of seminars. Guglielmo Marconi did as well. A number of distinguished European scientists came to Tuxedo Park and lectured. Loomis's private laboratory was rapidly acquiring world fame as a center of research. It had truly become, in Einstein's phrase, a "palace of science."

By the summer of 1928, Loomis was the subject of frequent press reports. His Tuxedo Park laboratory made him more of a public figure than he had anticipated, and he found that he lacked Wood's taste for the limelight. He had wanted only to join the nation's men of research. Historian Daniel Kevles described Loomis as "the world's most celebrated scientist. . . . His cult status not only helped enlarge the prestige of pure science, it endowed the entire profession with a kind of awesome glamour." Loomis's name appeared in tabloids as "the wizard of Tuxedo Park" or "the scientist of Wall Street."

Loomis was a large but by no means constant presence at Tower House. He was at the Manhattan office during the week and was often away for extended periods on business trips and holiday excursions. The day-to-day running of the laboratory was left to Garret A. Hobart III (1908–1963), the grandson of McKinley's vice president by the same name and a Tuxedo Park neighbor. Hobart was painfully shy, nervous but bright, and passionate about electrical gadgets. He had spent most of his time building microscopes and tinkering with his short-wave radio sets in a workshop in his home. As he was heir to a sizeable fortune, he had no need of regular employment and on Wood's recommendation he went to see Loomis at Tuxedo Park. Loomis took an immediate liking to him and made Hobart his protege and secretary of the laboratory. He proved to be extremely handy at all sorts of wiring and repairs. He and his lovely wife, a Belgian named Manette Seeldrayers Hobart (–1991), took a house only minutes from Loomis's home in Tuxedo Park, and the young couple became a fixture at Tower House.

In the early days, the laboratory was very much a family affair. Many young researchers earned their keep by acting as part-time tutors and companions to Loomis's three boys, a handful for their mother. Ronald Christie, a medical student from McGill University in Montreal, spent several summers at Tuxedo Park and became virtually a member of the family. Loomis took Christie, who was specializing in lung diseases, under his wings. The mornings were spent doing research in physiology. They published several papers together. Afternoons and weekends were taken up swimming, sailing, and fishing for trout on the lake with Lee, Farney, and Henry and any other lab hands that cared to tag along. With so many young men about and so many country evenings, an inordinate amount of drinking went on. Prohibition had made alcohol a thriving cottage industry, and the scientists often whipped up a bathtub batch of ethanol and Jupiter drops. Christie, like many other of the young men who congregated at the Tower House, regarded Loomis as a mentor and second father. Loomis had an ease and warmth with them that he seemed to lack with his own boys. Over the years Loomis attracted a devoted coterie of brilliant young scientists he came to call his "other sons."

Loomis's business often took him to Europe, and in 1928, with his laboratory up and running smoothly, he took off on another scientific tour of the continent with Wood. It was essentially a shopping expedition. Loomis had an unlimited budget when it came to gadgets and experimental gear. At the top of his list was one of the famous astronomical Shortt clocks, a new instrument invented by William Hamilton Shortt in 1921 for improving accuracy in the measurement of time. Loomis's fascination with exact timekeeping was probably an outgrowth of his interest in navigation, a hobby he had cultivated since boyhood days sailing the waters off Long Island. The Shortt clock had a free pendulum swinging in a vacuum in an enormous glass cylinder and was reportedly accurate to 1/10th of a second in a year. It was so expensive that only the five biggest, best-endowed observatories in the world could afford to own one. Loomis and Wood beelined it to the workshop of F. Hope-Jones who made the clocks. While climbing up a dusty staircase, they saw in one corner of the room one of the superb clocks. It was almost completed. It was the sixth one ever made. Loomis asked about the price of the clock and was told $1200, which was roughly what the average American worker earned at that time in a year. Loomis ordered three clocks.

While in England, they visited Sir Oliver Lodge, the imminent British physicist known for his pioneering research in radiofrequency waves. They then called on Sir Charles Vernon Boys (1855–1944), another noted physicist, who was famous for his highly sensitive instruments, including the radiomicrometer for measuring radiant heat and an automatic recording calorimeter for testing manufactured gas. In Copenhagen they met Niels Bohr and in Berlin, Max von Laue and Max Planck. Loomis bought Boys a first-class ocean liner ticket from Plymouth so that he could visit Tuxedo Park. Upon returning to Tuxedo Park, Loomis and Boys spent the rest of the summer doing lightening experiments using a special high-speed camera designed by Boys expressly for photographing rapidly moving objects such as bullets and lightening bolts. Together they succeeded in taking photographs demonstrating Boys' theory that the lightening bolt was preceded by an "electric beam."

Studies of timekeeping and precision mechanical devices. When the Shortt clocks arrived, Loomis installed them in a vault excavated from the solid rock in the mountain on which the laboratory stood, mounting them on three massive masonry piers that were in effect part of the bedrock. This meant that the 14-pound pendulums were swinging in a near vacuum and in planes 120° apart. Loomis then went to Bell Laboratories and bought the best quartz crystal clocks they made to use for comparison purposes. The 1-100-1000-cycle quartz oscillators, invented in 1928, were accurate to 1 second in 30 years and were built primarily for the US Bureau of Standards. The advantages of the quartz crystal clocks were their inherent stability and relative freedom from extraneous effects. Because they were not dependent on gravity, they could operate without any adjustment at the same rate in any latitude and at any altitude.

Equipped with the most accurate, reliable, and expensive clocks then available, Loomis began collecting all sorts of data previously impossible to record. He was able to publish spectacular results, in part because quartz crystal clocks were still such a novelty and few scientists at the time had access to the superb assembly at Tower House. Loomis proved that there was no such thing as keeping perfect time, showing that even the five most accurate clocks in the world—the three in his vault and the other two in the Naval Observatory and in Greenwich, England—were subject to numerous errors. All that was possible was to make comparisons between the different clocks.

Over the next several years Loomis and W. A. Marrison, a researcher at Bell Labs, conducted a series of important experiments comparing the performance of Loomis's three pendulum clocks and the quartz clocks at Bell Labs in New York, 50 miles away. Loomis installed a private line to carry the Bell oscillator signals, and he designed an ingenious chronograph to compare the time-keeping abilities of the short pendulum clocks and the quartz oscillator clocks. Loomis used his chronograph to show the moon's effect on pendulum clocks, something that was known but had never been demonstrated before. Loomis's work won him memberships in both the Royal and American Astrological Societies. He became so obsessed with precise time that he kept a radio set in his basement laboratory that automatically tuned in Berlin, Greenwich, Arlington, and other observatories just in time to catch their time signals, which were then recorded. Loomis would read the record of official time signals, compare it to his own clocks, and predict with a chuckle the exact corrections that the various observatories would have to broadcast at the end of the month. Loomis remained a "time nut" for the rest of his life, according to Luis Alvarez (future Nobel Prize winner and biographer of Loomis, 1911–1988), who recalled that Loomis always wore two Accutrons, one on each wrist.

Working alongside accomplished scientists, Loomis excelled as an innovative designer of precision mechanical devices. His main contribution to the studies carried out by brilliant scientists in his laboratory was the designing and building of the complex apparatus that advanced the basic knowledge in the field. He had a string of inventions of the kind he had loved coming up with since boyhood. Working with John C. Hubbard, a visiting professor from Johns Hopkins, Loomis developed a "sonic interferometer" to analyze the molecular effects of supersonic waves in liquids. He also was especially proud of the microscope centrifuge he developed with E. Newton Harvey, who was a professor of biology at Princeton. The device enabled biologists to witness for the first time what happened to cells when they were subjected to high gravitational forces, and it led to new discoveries in cell structure. They received a patent for the new microscope. Until its invention, scientists had been handicapped by the inability to observe and measure the various steps in the deformation of cells and in the movement of particles within them.

Business pursuits before and after the Depression. Despite his commitment to science, Loomis was far too competitive and too committed to his company's success to allow himself to be distracted for long. He remained deeply involved in his company's day-to-day transactions, his brilliant analytical skills proving the perfect complement to Thorne's keen judgment. Loomis sat on the board of half a dozen companies and knew most of what there was to know. By early 1929, Loomis and Thorne had pulled off what was in many regards their largest and most important enterprise, merging three important holding companies into a new group known as the Commonwealth and Southern Corporation.

While the two brothers-in-law divided the teamwork according to their individual talents, they were of one mind when it came to doing everything together on a partnership basis. This included adhering to a strict policy of keeping the bulk of their profits in cash. Their company, unlike most other investment houses, never carried large inventories of the securities it underwrote, something that would prove to be the undoing of many of the biggest promoters of the then bull market. Particularly by 1929, Loomis and Thorne were chary of the speculation fever and doubted it could continue unchecked. After all, they had been the architects of the so-called second industrial revolution of the 1920s: they had helped build the generators that powered the big new automobile, telephone, and appliance factories that fueled the thriving consumer economy. Experts in the law of supply and demand, they understood that the conveyor belt factories that had proliferated across the country were now in danger of saturating the market and watched with foreboding as first automobile sales slumped and then department store earnings dipped for the first time. By the time the market crashed in October 1929, Loomis and Thorne were completely in cash.

Loomis made an estimated $50 million during the first few years of the Depression. He was among the few street veterans who had foiled Black Thursday. In the years following the crash of 1929, Loomis and Thorne turned increasingly to the field of investment banking. By the beginning of 1932, with their many directorships and overlapping spheres of influence, Loomis and Thorne were towering figures on Wall Street. The others were the Rockefellers and the Morgans. The two financiers took an active role in trying to restore confidence in the banking industry and avoid further collapse. On April 9, 1933, exactly 1 month after the Emergency Banking Act was passed, Loomis and Thorne announced that they would be stepping down as chief executives of their firm. Their "retirement" had essentially been forced by the bill, which prohibited investment bankers from being directors of Federal Reserve member banks. By leaving their firm they would be free to hold their many bank directorships without conflict with the new stricter provisions. Over the next few months, however, Loomis and Thorne resigned from a succession of bank directorships and utility boards. By Christmas 1934, the only title Loomis retained was president of the recently formed American Superpower Corporation. He and Thorne had sold out virtually all of their holdings, and he and Thorne formed a holding company that Loomis entrusted Thorne to manage as a personal investment company. Without so much as a backward look, Loomis quit Wall Street for good. He was only 45 years old and may have been one of the 10 richest men in the USA.

His life had now come full circle, with his enormous wealth enabling him to recapture his schoolboy love of inventions. Loomis never once expressed any regret at leaving the business world. In some ways, he seemed to have no regard for money. When he needed it to buy things like new instruments or new technology, he bought them. That was all he really cared about. And he gave away a lot of money, but he never talked much about that. Thorne continued to keep one foot in the financial world and ran the Thorne & Loomis Investment Company out of an office on Wall Street. In the coming years, Thorne's assets would far outstrip those of Loomis. There were always hurt feelings on Thorne's part that Loomis did not invite him to participate in scientific work. Nevertheless, Thorne was always very supportive of Loomis's scientific work and on several occasions contributed substantial sums to his research projects.

Loomis retreated to Tuxedo Park. His business associates were shocked by his self-chosen exile. When Loomis was honored by the American Association for the Advancement of Science in March 1933, a *New York Sunday* writer observed that his growing fortune "had clearly become secondary to his scientific preoccupation," and the transition from finance to physics was now complete. He was chosen as one of the 250 top American scientists. He was now a full-time physicist.

While he enjoyed living well (he maintained two large mansions in Tuxedo Park staffed by a dozen or more servants along with a 20-room duplex penthouse on 79th Street off Fifth Avenue in Manhattan), Loomis's primary interest was comfort and convenience. Despite their contrasting personalities, Loomis and Thorne were as close as two men could be, professionally and personally, and Loomis enthusiastically joined in Thorne's extravagant hobbies and sporting pursuits. The two partners spent whatever it took to win America's Cup, for example.

Purchase of Hilton Head property. In 1931, finding Long Island too tame and increasingly suburban, Thorne saw an opportunity to buy Hilton Head Island in South Carolina, which, before the bridge was built, was an isolated strip of beach reachable only by boat. The island paradise once home to wealthy southern landowners and small plantations was occupied by Union forces during the Civil War and on General William Sherman's orders the confiscated land was sold to freed slaves for $1 an acre. When the cotton crops failed, many abandoned Hilton Head, and the island was almost forgotten. In the 1890s hunters began buying the property for recreational purposes, and a New Yorker named William B. Clyde eventually managed to acquire 9000 acres, including the last of the antebellum houses, Honey Horn. When Thorne, whose ancestors had owned plantations in the Sea Islands for generations, heard that the current owner and a Northern industrialist had been ruined by the 1929 crash, he proposed that he and Loomis buy the land and turn Hilton Head into a private hunting and fishing resort for family and friends. Loomis, who was by nature a loner, loved the idea of having his own island and was all for it. They paid $120,000 in cash for the 20,000 or so acres, which was virtually the entire island. There was almost nothing on it except what had been an old confederate fort and the Honey Horn plantation, a 1-story house that dated back to the Civil War. They fixed that up and expanded it and turned it into a marvelous sporting preserve. They built another boat together and took it there. They had the island virtually to themselves until World War II when it became the site of the Marine encampment. Gun placements for target practice over the Atlantic Ocean were set up on the beach, and Loomis's sons collected the shell casings that washed up on shore.

Relationships and influence in the scientific community. Loomis was not interested in public acclaim so much as a certain respectability, and many of his large charitable donations and anonymous gifts were designed to court favor with the scientific establishment. Aware of their deep-seated prejudice against "gentlemen scientists," Loomis launched a calculated campaign to win over influential members of the profession. His famous laboratory gave him a strategic advantage, and he sponsored dozens of scientific conferences, meetings, lectures, and dinners, increasingly ingratiating himself with cash-poor universities and scientific agencies. Loomis, along with Wood, sat on the planning committee to select science exhibits for the 1933 Chicago World's Fair, and several of the meetings were held at Tuxedo Park. The fair's triumphant theme that year was "The Century of Progress," highlighting the benefits of science and technology.

With his dedication to pure research and with unlimited funds, Loomis turned himself into a powerful behind-the-scenes force. His friend, Karl Compton, thanks in part to Loomis's maneuvering, was offered the presidency of MIT in 1933. Compton in turn stated that one of his conditions for taking the job was that his influential patron (Loomis) be named a trustee. Loomis was so appointed and went on to help establish MIT's graduate school, providing substantial financial aid and raising funds from other business leaders. In June 1933, Yale University conferred an honorary degree of master of science on him, lauding Loomis as a man who defied traditional categories and whose experimental approach made him a bold example for the times. The citation listed his several identities—"lawyer, businessman, physicist, inventor, and philanthropist"—and called him a "20th-century Benjamin Franklin."

When he "retired" to Tuxedo Park at age 45, Loomis's finest work was still ahead of him. His reputation had spread to Europe, and the Tower House had gained international fame as one of the best-equipped and interesting American laboratories. In the 1930s, some of the world's best physicists spent the summer at Tuxedo Park, including Enrico Fermi, Neils Bohr, and Albert Einstein, all Nobel Prize winners, and all their expenses were paid by Loomis.

Neurology studies. In the mid 1930s, any visitor to Tower House had to submit to the ritual known as "putting on the electrodes," which was part of the preparation of the measurement of brain waves. This research consumed Loomis for the next few years. Guests who thought they were being taken on a guided tour of the laboratory would suddenly find themselves being eased into a chair as Loomis cheerfully talked them into undergoing a few harmless tests. Eminent biologists, chemists, physicists, psychiatrists, and neurologists, along with their wives and any other houseguests who happened to be stopping overnight in Tuxedo Park, were all recruited as volunteers for his experiments. Loomis would take his "victims" to one of the downstairs laboratories that had been converted to a "sleeping room," where they would be asked to take a supervised nap. Working with William Richards, Loomis would record the brain waves after placing the electrodes in the proper position on the cranium. Thus, electroencephalography came into being. Loomis and his coworkers found that when the subject was awake, the pins would draw little trains of perfectly symmetrical waves, but as the subject fell asleep, there would be bursts of faster waves interspersed with little activity, when the pins would move sluggishly, dragging jagged spikes. As the subject fell into deep sleep, the waves became larger and appeared more frequently. The ink tracings made on the paper were known informally as an "afternoon sleep record."

Loomis had first become interested in the discovery of brain waves in the early 1930s after reading about the work of Hans Berger, a German psychiatrist. Berger had published his observations on the rhythmic electrical output of the human brain in 1929, but American physiologists had been unable to duplicate his results and many were inclined to doubt the existence of the low-voltage signals he described. Loomis was intrigued and wanted to see if he could replicate Berger's observations using an electronic apparatus of his own design. In June 1935, in the first of a series of pioneering studies of brain waves, Loomis excitedly reported his findings in *Science.* While Loomis's brain wave experiments were made light of in the popular press, his research was taken seriously in academic journals. His electroencephalograph was of a novel and highly efficient design, and his results had considerable influence on the field, which was still in its infancy.

At the same time Loomis was doing his pioneering research in Tuxedo Park, Hollowell Davis, a professor at Harvard Medical School, was also conducting experiments with the electroencephalogram. In 1934, Davis had failed to detect the rhythmic electrical output of the brain and had initially discounted Berger's observation as an artifact. Davis later was the first to replicate Berger's findings west of the Atlantic. Only a few months later, Loomis successfully tapped the electrical output of the brain in a second set of experiments in his laboratory. Davis had immediately recognized the clinical potential of the electroencephalogram and in collaboration with other researchers soon identified the characteristic wave pattern of petit mal epilepsy. After hearing about their research, Loomis invited Davis and his wife to Tuxedo Park and offered to fund further studies investigating the clinical applications of the electroencephalogram. Between 1937 and 1939, Loomis, working together with the Davises, made major advances in relating the electrocephalographic disturbance patterns to various levels of consciousness—from emotional tension and mental activity to relaxation to different stages of sleep.

Throughout the 1930s, Loomis kept up his active exploration of a wide range of fields. In addition to electroencephalography, he was absorbed in measuring very small increments of time and was still playing around with his perfect clocks. He was also fascinated by the new field of high-energy physics and had even tried building a particle accelerator, known as a "cyclotron." With the same boundless enthusiasm he bestowed on the most important projects at the laboratory, Loomis would attack innumerable other problems that caught his fancy, whether they were apparently frivolous or on the very fringes of science. He was interested in practically everything, and if he found a problem, at one time or another he probably pursued it if only to try his hand at making some sort of headway. Carl Haskins, who first visited the laboratory in Tuxedo Park in the late 1930s, stated: "He never had one idea. He always had dozens of ideas. There were a lot of people working on things Alfred was directing and suggesting. I thought he was quite remarkable—unique figure."

World War II and the study of radar and nuclear physics. By the late 1930s, as the Nazi assault on Europe gained momentum, Loomis's scientific interest changed. He once again became obsessed with Germany's artillery and machinery of war, just as he had in the years before World War I. He also heard disturbing reports of the staying power of Mussolini and Hitler from the physics grapevine and his many foreign guests, including Bohr and Fermi. Loomis made several trips to Europe and in 1938 traveled to Berlin and Copenhagen to visit Bohr. He was very troubled by what he learned about the highly developed state of applied scientific research in Germany. He heard unsettling things about advanced weaponry and the work German physicists were rumored to be doing in nuclear physics. In 1933, Einstein made headlines when he immigrated to the USA to escape the Nazi tyranny, and afterwards many Jewish physicists who worried that they might be soon forced to leave their teaching positions also fled the war-torn continent. By December 1938, Enrico Fermi and his wife left Rome via Stockholm (to collect his Nobel Prize) traveling to New York, where he took a position at Columbia University.

For most scientists in the USA without close friends or relatives abroad, foreign problems were a matter for politicians and policy experts. They generally shared the cheerful view that if Germany wanted to let its brightest minds leave, it was their loss and America's gain. Loomis was not as sanguine. He could not help but share his cousin Henry Stimson's view that the USA had crept into a hole and was trying to forget the world. Loomis believed that if Europe was going to fall apart, it was far better for the USA to be vigilant. It was a lesson he had learned back in his days at Aberdeen.

When Hitler rode into Austria in 1938 and then decimated Czechoslovakia, Loomis made note of the tank models, the destructiveness of the field artillery, and the brutality of the bombings. His exposure to army procedures at Aberdeen had left him convinced that the military could not be counted on to develop and build a stockpile of modern weapons for defense.

A call from Karl Compton in 1939 helped crystallize his views. Compton had correctly sensed that Loomis was at loose ends and was casting about for a new direction for his research. He had told Compton that his work on brain waves, while far from complete, needed to be carried on under the auspices of a hospital, and to that end he had donated most of his equipment to the Harvard Medical School. Compton suggested that given the portentous events in Europe, it might be useful if Loomis looked into the present state of microwave radio technology or radar (though the later term had not been coined). Loomis was intrigued and began exploring the subject on his own. In the summer of 1939, Loomis joined Compton at a conference on ultra shortwave radio problems held at MIT. The symposium was attended by the representatives of all the major companies doing research in the field. The basic principle, that radio waves had optical properties that could reflect solid objects, had been demonstrated in 1938 by the German scientist Heinrich Hertz for the detection of ships. Little was done to exploit that discovery even though in 1922 Guglielmo Marconi (1874–1937) had urged the development of short radio waves for the detection of obstacles in the fog or darkness.

In the 1930s airplanes became military weapons, and then radar began to be developed in earnest. Most countries exploring radar had concentrated on the Doppler, which used ordinary continuous radio waves and required two widely separated and bulky stations: one for transmitting and one for receiving. Airplanes that penetrated between transmitter and receiver were detected by the Doppler beep between the direct signals from the transmitter to the receiver. Unfortunately, the equipment was limited in its effectiveness.

Loomis, operating in a manner that Compton described as "typical of him," spent the next few months mastering the new subject and "worked with his little permanent staff at Tuxedo Park on the fundamentals of microwave until he felt capable of inviting collaboration." Late that summer, a group of MIT physicists arrived at the Tower House and began an in-depth study of ultra high frequency propagation. Most were surprised at Loomis's keenness and knowledge. Loomis, thrilled to be involved with the challenge of perfecting this critical new technology, dropped all of his other experiments to concentrate on the microwave project. In the process, Tower House, once a bastion of pure science, became a private research center devoted to the development of secret war-related technology—the radar systems used to detect airplanes.

Ernest Lawrence (1901–1958) and Loomis first met in 1936, and they immediately hit it off. Working at Berkeley, California, Lawrence had invented the cyclotron and was working to improve it. Loomis arrived in Berkeley to work with Lawrence in November 1939. Loomis organized a small laboratory on Berkeley's campus to carry out microwave experiments and also brought some other men from Tuxedo Park. The main purpose was to bring him up to speed on the microwave radar system based on the Klystron Tube invented by the Stanford physics instructors. When he was not working on radar, Loomis spent every spare minute in the Radiation Laboratory (commonly called the Rad Lab) studying cyclotron engineering. After listening to Lawrence's plans for an enormous 100- to 200-million-bolt cyclotron, Loomis became convinced and threw his considerable support and money behind the giant machine. That same year, Lawrence won the Nobel Prize in physics for his invention and development of the cyclotron.

By early 1940, Loomis was so caught up in his work with Lawrence that he purchased a home in California and accepted a position as research scientist in the Rad Lab. The experience of working at the Berkeley lab was intoxicating for Loomis. The 60-inch cyclotron, after numerous delays, was up and running, and it was a marvelous site. It would greatly advance nuclear physics, and Loomis loved the chance to be a part of it. Loomis had also decided that his next big project would be to back the new research being done by Enrico Fermi, the brilliant young professor of physics at Columbia, who had won the Nobel Prize in 1938, a year before Lawrence did, for his discovery of new radioactive elements and his related discovery of nuclear reactions brought about by slow neutrons. Loomis arranged funding for Fermi to build a nuclear chain reactor.

Loomis, always quick to seize on the next new thing, offered to help underwrite the cost of any new experiments that might determine how fission could be exploited for atomic energy. If the explosive power of fusion could be realized, it would give mankind command of an almost limitless supply of energy. With characteristic confidence and enthusiasm, Loomis plunged into nuclear physics. He was prepared to devote all his energies and resources to develop the new field as quickly as possible. To Loomis, the discovery of fission by German physicists in early 1939, in light of the events in Europe, was both exhilarating and profoundly disturbing. Such enormous energy, if harnessed and controlled, would be a terrible weapon in the hands of Hitler. He had first heard the momentous news from Niels Bohr upon the Danish physicist's arrival in the USA in 1939. Bohr and Fermi spoke publicly about uranium fission in Washington, DC, in 1939. Fermi theorized that when a neutron knocked uranium apart, more neutrons might be emitted. He suggested the possibility of a chain reaction, namely, the release of atomic energy and a bomb. In the next few days, key experiments on uranium fission had been replicated in several laboratories, including the Rad Lab, the Carnegie Institution, and Johns Hopkins. During the summer of 1939, the intense activity and concern in the world of physics prompted Einstein's letter to Roosevelt warning him of the seriousness of atomic weapons.

When Loomis returned east in April 1940 to help Lawrence navigate Wall Street, he was more determined than ever to dedicate his private resources to scientific problems that might have value for defense purposes. Convinced that the USA would inevitably be drawn into the war, the Rad Lab was set up at MIT in Boston, and by mid December the lab had almost doubled in size to 36, including 30 physicists. Loomis moved into the Ritz-Carlton Hotel in Boston where he occupied a lavish suite and often hosted private dinners for members of the lab. By late December 1940, a complete 10-cm pulsed microwave radar set was assembled. By January 1941, Loomis and his band of microwave novices had built a working prototype of a radar system.

By June 1941, Roosevelt, by executive order, created a new greatly expanded organization called the Office of Scientific Research and Development, which would be a flexible, fast-moving, and creative source for new weapons. The group would be independent of military control and unburdened by the military's outdated notions of what was and was not possible. The scientists had prevailed! Substantial federal funds would be poured into university laboratories, not only greatly accelerating the pace of work, but enabling them to move beyond pure research to the production of revolutionary new devices. By spring 1941, the Rad Lab staff had grown to 140, including 90 physicists and engineers; 45 mechanics, technicians, guards, and secretaries; and 6 Canadian guest scientists. By the summer, there were 500 people, and more than $19 million was committed to this secret radar system being developed and assembled. Loomis and Lawrence handpicked the crew, which was evolving into a massive research and development organization. By January 1942, the 10-cm microwave radar set could pick up an enemy plane on the screen, lock in on it, and follow it while continuously feeding the coordinates into a computer, which would point the antiaircraft gun at the target. During the war, thousands of microwave radar sets would be deployed in battle, and they played a crucial role in protecting the ground troops from air attacks.

At the same time, Loomis's Rad Lab was making headway on a long-range system of navigation independent of weather conditions. The system was originally called Loomis Radio Navigation, but Loomis objected to its being named after him, and the name was changed to LORAN for long-range navigation. Loomis had proposed a rather ingenious scheme in which pulse radio waves from fixed shore stations would produce a grid of hyperbolic lines from which planes or ships equipped with the specially designed pulse receiver could fix their position. The key to LORAN was Loomis's use of a time-measuring technique—a system of receiving and comparing the time of arrival of pulses—an expertise he had accrued during his long obsession with precision timekeeping. LORAN was Loomis's own idea. His proposal was quickly approved by the microwave committee, and a group was set up to order the necessary parts, test equipment, and oversee the installation. LORAN proved to be an extremely important new method of navigation. It was simple and highly successful. While Loomis was congratulated for the dazzling ingenuity of LORAN, some found it similar to the British system. The two schemes turned out to be virtually identical, though at the time the Americans were not permitted to know the details of the British system. Loomis's loyalists credited him with arriving at the idea independently.

During the long spring of 1941, weeks that had been marked by heightened political tension, Loomis's involvement with the Rad Lab became increasingly sporadic as he found himself pressed into service on another scientific front, namely that of nuclear fission. Although scientists in both England and the USA were whispering about the possibility of constructing a bomb of enormous power, no one on the uranium committee could be persuaded that fission was critical to the war effort. Worried that the Germans might already be ahead of them, the uranium committee turned to Loomis, who had been instrumental in starting the radar lab and was widely liked and respected. Loomis was asked to use his influence to spur the government into action. Thus, Loomis began working behind the scenes to solve the uranium problem and pushed the government to get on with building the bomb. Despite many obstacles, a year of research had yielded some important findings at various laboratories in the USA. Loomis shared his colleagues' doubts about Congress's ability to appreciate the implications of nuclear fission. Loomis was involved in the uranium project from the beginning, not as an originator of ideas so much as an individual who knew how to exploit them, and his actions contributed to the remarkable lack of administrative roadblocks experienced by the Army's Manhattan District, the builders of the atomic bomb. Loomis's work had placed him at the very center of the atomic bomb debate.

The terrible and unexpected defeat at Pearl Harbor also showed just how poor the nation's radar defenses were against an air attack. The Pearl Harbor disaster, which resulted in the loss of >2400 servicemen and civilians, converted the Rad Lab from being a speculative radar operation to being in the business of building detection devices for the offense. The USA had paid a high price for its lack of preparedness for World War II. German U-boats controlled the waters off the East Coast and the Gulf of Mexico and were inflicting devastating losses. In February 1942 alone, 82 merchant ships were sunk by Nazi submarines. Almost every day 2 or 3 US tankers were sunk, and their steel carcasses littered the Atlantic shore. Without the aid of radar, army and navy pilots managed to attack only four Nazi submarines in the first 2 months of patrol. On April Fool's Day 1942, the first modified radar search units were placed in 18 airplanes. On its first night's patrol, it spotted three U-boats and sank one submarine. From then on America's scores improved steadily.

As the war progressed, the Rad Lab under Loomis took on dozens of new projects and came up with many innovative gadgets. Due to Loomis's drive, the lab greatly expanded. The Rad Lab scientists no longer confined themselves to their cubbyholes but often developed their weapons in the field. They traveled to the European and Pacific theaters of operation to assess the military's needs, went back to the lab to fine-tune their designs, and then returned to the front to oversee the deployment of their devices. Under Loomis, the Rad Lab moved from research into development, design, and manufacturing and was reorganized into 10 divisions working in parallel and reporting to a steering committee. The Rad Lab entered the big time with a total of 50 projects on its books within months after the USA entered World War II. With Luis Alvarez, who later won a Nobel Prize, Loomis developed a design in his Boston Ritz-Carlton suite for a blind landing system that is still used today!

In a sense the Rad Lab was a catalyst for the burst of creativity and inventive effort that would propel American scientists toward the pioneering achievements in Los Alamos. In the early days of the war, it was Loomis, in his role as scientific agitator, who had been the primary force in organizing the country's nuclear physicists to work on radar, at a time when the atom splitters had little to do and fission's useful applications still seemed remote. By the fall of 1942, when steps were taken to form the highly secret atomic bomb development program, which was then known as the Manhattan Engineering District (later as the Manhattan Project), they had to look no further than Loomis's Rad Lab scientists. Robert Oppenheimer (1904–1967) was appointed scientific director of the Manhattan Project, and he recruited his top men from Loomis's brain trust of physicists at the Rad Lab. The Rad Lab, whose experimental microwave technology had once been labeled by the army as "something for the next war," had produced over 100 distinct radar systems, most of which were in service and helped speed victory. The excitement of developing new radar equipment had been replaced by the administrative tasks of seeing the devices produced and mobilized. Loomis spent much of 1943 in Washington, DC, expediting patent filings so that the radar projects could move forward quickly. By June 1943, nearly 6000 radar sets of Rad Lab design had been delivered to the army and navy, 22,000 were on order, and production was >2000 sets per month of all types. The cost was nearly $1 billion. Loomis presided over a laboratory that had ballooned into an organization of nearly 4000, including 500 physicists with emissaries all over the world implementing its war-winning ideas and devices. It had grown to >15 acres of floor space in Cambridge, Massachusetts, and spent approximately $80 million in federal funds. In its last year, the budget had grown to $125,000 a day, or close to $4 million a month. One scientist said, "It was the greatest cooperative research establishment in the history of the world."

Loomis had helped to force the development of radar within the army, and in the opinion of many of his peers, his greatest contribution lay in his brilliantly orchestrated effort with Henry Stimson, his cousin and the secretary of war, to mobilize the products of science and technology, break down military resistance to the flow of innovative ideas and applications, and continuously press for further experimentation and acceptance of new weapon systems and tactics. As Lawrence told an interviewer at the time,

> If Alfred Loomis had not existed, radar development would have been retarded greatly, at an enormous cost in American lives. . . . He had the vision and courage to lead . . . as no other man could have led. He used his wealth very effectively in the way of entertaining the right people and making things easy to accomplish. His prestige and persuasiveness helped break the patent jams that held up radar development. He exercised his tact and diplomacy to overcome all obstacles. He is that kind of man. He steers a mathematically straight course and succeeds in having his own way by force of logic and of being right.

Exhausted by the end of the war, Loomis spent the first few months after the end of the war overseeing the dismantling of his Rad Lab and winding up million of dollars in contracts. Every piece of equipment was accounted for. Out of the $30 million in outstanding claims for the government, MIT did not have to pay one cent. For most of the people who had worked there, it was hard to believe that an institution as big and vital as the Rad Lab could simply be shut down, but Loomis did just that. The Rad Lab formally closed on December 31, 1945. Most of the physicists returned to their university jobs and resumed their careers as professors and research scientists.

Quiet pursuits and honors after the war. After completing all his administrative duties as head of the Office of Scientific Research and Development's radar section in 1947, Loomis returned to his former activities as a philanthropist, withdrawing quietly into private life. Almost from the moment the Rad Lab ceased operating, Loomis began to disappear. He refused requests for interviews and photographs and proved so elusive that to get his portrait for *Fortune's* glowing account of his adventures in business and science, the magazine had to pursue him by plane on the way to his private 22,000-acre retreat on Hilton Head Island. He turned down prestigious job offers and university appointments.

After the war he was besieged by letters asking for his support of various scientific causes and research projects, along with innumerable invitations to speak before civilian groups. Except for occasional appearances at various advisory committee meetings, including an atomic energy commission panel on radiologic warfare and the joint research and development board to counsel the army and navy on strategic matters, Loomis was absent from the Washington scene, where he had earlier been such a forceful presence. He was, by disposition, an extremely understated man who really did not care for being center stage. A large part of his success as the laboratory's leader had been his charisma and persuasiveness, which enabled him to win the confidence of so many brilliant scientists and convince them that supporting and furthering their work was his only goal.

Although he attempted to avoid attention and public recognition whenever possible, he continued to collect laurels. There was another honorary degree from Wesleyan. The king of England awarded him His Majesty's Medal for Service in the Cause of Freedom in recognition of the valuable services he rendered to the Allied War effort in the various fields of scientific research and development. President Harry Truman awarded him the Presidential Medal of Merit, the highest civilian award, for his contribution as one of the leading scientific generals of the war. Loomis never reopened his Tuxedo Park laboratory. In 1950, President Truman offered Loomis the position of scientific advisor to the president, but Loomis declined. Loomis, however, remained involved with the work being done by his former colleagues and generously supported their pet projects at MIT, Berkeley, and Cal-Tech. He returned to his early love of astronomy and became actively involved in funding and building observatories. He never stopped collecting brilliant men. In the late 1940s he met an engineer named Avery Fisher, who had a small stereo store in New York. They became great friends right away. When he learned that Fisher was having trouble getting financing for his new high-fidelity speakers, Loomis took him straight up to the office he kept with Thorne and instructed his partner to set him up with "an open line of credit." It was the beginning of Fisher Electronics.

Loomis died of a stroke at age 87 at his East Hampton home on August 11, 1975. His last obsession was programming tricks for the Hewlett-Packard Model 65 handheld computer that was his constant companion.

THE PILL

Nancy Gibbs (2) recently reviewed the story of "the pill." Fifty years ago, in May 1960, the Food and Drug Administration (FDA) approved a new oral contraceptive—the first medicine designed to be taken regularly by people who were not sick. In 1960, the typical American woman had 3.6 children; by 1980, the number had dropped to <2. For the first time more women identified themselves as "workers" than homemakers. In 1970, 70% of women with children under 6 were at home, and 30% worked. Today, these percentages are roughly reversed. The pill was blamed for unleashing the sexual revolution among singles despite the fact that throughout the 1960s women usually had to be married to get the pill. Its supporters hoped it would strengthen marriage by easing the strain of unwanted children; its critics still charge that the pill gave rise to promiscuity, adultery, and the breakdown of the family. In 1999, *The Economist* named it the most important scientific advance of the 20th century. A study released in March 2010 of 46,000 women followed for nearly 40 years found that women who took the pill were less likely to die prematurely from any cause, including cancer and heart disease. Nevertheless, many still question whether the health risks outweigh the benefits.

Although in 1873 Congress had passed a law banning birth control information as obscene, 6 years later Margaret Sanger was born in Corning, New York, to a Catholic mother who died at the age of 50 after 18 pregnancies. The daughter confronted her father over her mother's coffin and charged, "You caused this. Mother is dead from having too many children." Margaret Sanger went on to train as a nurse and by 1912 dreamed of a "magic pill" that would prevent pregnancy. She coined the phrase "birth control" in 1914, the year she was arrested for mailing her magazine, *The Woman Rebel,* with its discussion of contraceptive use. In 1917, Sanger met Catherine Dexter McCormick, the second woman to graduate from MIT, who had married the heir to the International Harvester Company fortune. McCormick, an ardent feminist like Sanger, wanted to help women who did not want to have children to be able to prevent pregnancy without their husband's help or knowledge. In the years that followed their meeting, Sanger provided the ingenuity and energy to drive the birth control movement, and McCormick provided the capital. The movement gained momentum during the Depression, when limiting the size of families became practically a matter of survival. The USA went from 55 birth control clinics in 1930 to more than 800 by 1942, the year the Sanger Birth Control League changed its name to the Planned Parenthood Federation of America.

The idea of a hormonal approach to birth control had been around for years, but going from a theory to a pill that women could take required money and genius. The latter came from Gregory Pincus, whom Sanger met at a dinner party in 1951 and whom she persuaded McCormick to bankroll. Pincus had been a promising assistant professor of physiology at Harvard in the 1930s, when, at the age of 31, he succeeded in creating a rabbit embryo in a petri dish, the precursor of in vitro fertilization. It was lauded as a brilliant scientific breakthrough until a 1937 profile in *Collier's* magazine suggested he was creating a world of Amazons in which men would be unnecessary. Harvard denied him tenure and Pincus left to form his own research lab.

He found that injections into animals of progesterone, which a chemist in Mexico had been able to synthesize from wild yams, could block ovulation. Testing humans would require someone with a clinical practice. Pincus had met Dr. John Rock, the country's preeminent infertility specialist, at a conference in 1952. A devout Catholic with 5 children and 19 grandchildren, Rock had made it his mission to help barren women have babies. When Pincus and Rock began to collaborate, Rock was experimenting with using hormones to help women conceive. The idea was to use progesterone to suppress ovulation for 4 months, then withdraw the drug and hope for a rebound effect. Several women in his trials got pregnant. Using hormones to prevent pregnancies followed the same logic; the progesterone prevented the release of a fertilizable egg, thus making it impossible for a woman to conceive.

Testing hormonal pills in women for infertility was not illegal, but testing the pill as a contraceptive was. So in 1956, Rock and Pincus conducted clinical trials in Puerto Rico, where many women were desperate for some better means of birth control. The pill proved effective at blocking ovulation and was approved in Puerto Rico in 1957 for the treatment of "female disorders." Thirty US states still had laws against promoting birth control—so for its early life the pill existed only undercover.

In 1959, G. D. Searle & Company applied to the FDA for approval of the pill, which would be marketed as Enovid. On May 9, 1960, the FDA gave its blessing. Despite disapproval by Pope Paul VI, by 1972, two thirds of Catholic women were using birth control, and more than a quarter of those were using the pill.

Whatever the public arguments in its favor, the pill was embraced by millions of women for very personal reasons: it provided, for the first time, an effective, convenient, and non-obtrusive means of avoiding pregnancy. The number of women using it climbed from roughly 400,000 in 1961 to 1.2 million a year later.

In 1965, Dr. C. Lee Buxton, chairman of the Department of Obstetrics and Gynecology at Yale Medical School, and Estelle Griswold, head of the Planned Parenthood League of Connecticut, opened a clinic that provided women with contraceptive information. They were promptly arrested because use of birth control was still a crime in their state. The case attracted national attention and advanced to the Supreme Court. In 1965, in *Griswold v Connecticut,* the justices ruled 7 to 2 that the Bill of Rights implicitly included a right to privacy and overturned the bans on contraceptive use by married couples. By that time, however, the pill was already the most popular form of birth control in the USA, with 6.5 million American women using it.

H. EDWARD ROBERTS, MICROSOFT, AND MEDICINE

Paul Allen, who with Bill Gates started Microsoft, described H. Edward Roberts as the architect of the personal computer revolution (3). Allen indicated that Microsoft was born after Bill Gates and he sold their first piece of software—a version of Basic—to Ed in 1975. It ran on a small computer built by the gruff former Air Force officer. Allen indicated that he and Gates told Ed that they had software in hand but actually wrote it only after he invited Allen to fly to Albuquerque, New Mexico, to demonstrate it. Ed was the first businessman that Gates and Allen got to know well, and his mentoring became important as Microsoft launched and grew. As Allen indicated, Ed Roberts did a lot of things right in business. He built a quality product—the first industrial-grade personal computer. He took risks, and he was always thinking about what came next. Years after selling his company, Ed Roberts entered medical school at age 39. After graduating, he went into general practice and saw up to 30 patients a day as a country doctor in Cochran, Georgia. He died of pneumonia at age 68 on April 1, 2010.

ERECTILE DYSFUNCTION AND CARDIOVASCULAR DISEASE

Böhm and colleagues (4) studied 1519 adult men and found that those with erectile dysfunction had twice the risk of death from any cause compared with those without erectile dysfunction. Men with erectile dysfunction were also 60% more likely to have a heart attack, stroke, or heart-related hospitalization or death.

COAL MINE CASUALTIES

The unfortunate coal mine accident in West Virginia in April 2010 killed 26 miners (5). The deadliest year for coal miners was 1907, when a single explosion killed 362. Another mine explosion in 1913 killed 263 miners, and a coal mine fire in 1909 killed 259 miners. In 1907, 48 fatalities occurred per 10,000 miners; in the last 20 years that annual rate per 10,000 miners has been <2, and in 2009 it was 1.3. Thus, as sad as the most recent accident is, coal mining safety has improved a great deal in the last 100 years.

JET LAG ANTIDOTE

It's another lifestyle-type drug, a further step in the "medicalization" of something that is not an illness. The drug is called Nuvigil from Cephalon, a drug company in Frazer, Pennsylvania (6). Nuvigil is a slight modification of Provigil, an older stimulant that will face generic competition in 2012. Nuvigil went on sale in June 2009. Both Nuvigil and Provigil are approved to treat excessive sleepiness associated with narcolepsy, sleep apnea, and shift-work sleep disorder. For jet lag, Nuvigil is approved to treat only the sleepiness associated with jet-lag disorder—not to shift the body's clock to the new time zone. Unfortunately, Nuvigil costs at least $9 a pill, and one pill is usually taken each day. Jet lag of course results when the body's internal clock is out of sync with daily life, making people sleepy when they want to be awake and wakeful when they want to sleep.

STATE CIGARETTE TAX RATES

State taxes on cigarettes range from $3.46 per pack in Rhode Island to $.07 per pack in South Carolina, according to the Centers for Disease Control and Prevention (7, 8). The national average is $1.34. I think the tax in each state should be what it is now in Rhode Island, and if it were, the number of smokers would drop drastically and health care costs would decrease.

THE MAYO CLINIC IN ROCHESTER, MINNESOTA

The American Osler Society's 2010 Annual Meeting was in Rochester, Minnesota, in May. The Mayo Clinic was the host. Dr. Marvin Stone has gotten several staff physicians from Baylor University Medical Center at Dallas into the American Osler Society and, indeed, Baylor Dallas had a larger delegation at that meeting than any other medical center in the world. This meeting is the most enjoyable one I attend virtually every year. Both the papers presented and the congeniality among its members are outstanding.

This year's program included tours of the Mayo Clinic, which surely is the best medical institution the world has ever created. On a typical day at the Mayo Clinic there are approximately 5800 outpatient visits, 210 surgical procedures, 3800 radiology procedures, 250 computed tomography scans, 250 magnetic resonance imaging procedures, 41,000 laboratory tests, 215 units of blood and blood components used, and nearly 250 patient admissions to the two hospitals. The Mayo Clinic has approximately 1500 staff physicians, 500 nonphysician scientists, and approximately 2800 residents, fellows, and medical students. The total staff at the clinic and the hospitals is about 32,500.

William Mayo started practice with his father in Rochester in 1885, and his brother, Charles, joined them in 1889. Both operated until 1931, and both died in 1939. The standards they set up for the clinic in 1904 to a large extent exist today. Their goal was to provide the best care to every patient every day.

All physicians at the Mayo Clinic are on salary, but that salary varies a great deal among the physicians. The surgeons at the Mayo Clinic operate every other day and consult the days in which they do not operate. Thus, one week the surgeons operate 3 days, and the next week they operate 2 days. All Mayo Clinic physicians wear ties with suits or sport coats. Scrubs are worn only in the operating rooms or procedure laboratories. Scrubs are never worn in the clinic or hospital wards or on the streets. White coats are never worn by physicians. These codes are easier to adhere to in a setting where all physicians are on salary from the same institution. Such behavior in a setting of private practice would be of course more difficult to control.

It is inspiring to visit the Mayo Clinic. Over 8 million people have been treated there since its frontier founding. Through growth and change, the Mayo Clinic remains committed to its guiding principle, as articulated by Dr. Will Mayo, "The best interest of the patient is the only interest to be considered."

DOHA, QATAR, AND CARDIOLOGY

In April 2010, I participated in the 8th Gulf Heart Association Cardiovascular Conference held in Doha, Qatar. It was the first time that I had visited that nation, and the experience was a good one. The meeting was superb and similar to most cardiology meetings held in the USA. Doha, the capital city of Qatar, is located on the Persian Gulf, and its population of approximately 1 million people represents 80% of those in the entire country (9, 10). It is the seat of government of Qatar and the home of the "Education City," an area devoted to research and education. The city is modern with numerous skyscrapers. Taxi cabs and police cars are often Mercedes Benz automobiles. The people are friendly. The city is bustling. The convention center adjacent to the hotel where the meeting was is beautiful.

The city of Doha began apparently in 1825 and was originally a fishing village. A fortress was built there in 1882, and the following year the Qatari Army was victorious over the Ottomans. The city was made the capital of the British protectorate of Qatar in 1916. (Independence was gained in 1971.) During the early 20th century much of Qatar's economy depended on fishing and pearling. Doha had about 350 pearling boats until the introduction of the Japanese cultured pearls in the 1930s. The whole region including Doha then suffered a major depression, and Qatar became a poor country. This lasted until the late 1930s when oil was discovered. Today, the nation produces over 800,000 barrels of oil a day, and it apparently has the largest gas reserves of any country. Qatar has opened its doors to many US and other Western oil companies. Today, the majority of its residents are expatriates, who are not granted citizenship although they are certainly welcomed into the country. Their intelligence and labor is what has allowed its spectacular modernization, which has occurred mainly in the last 3 decades. At the moment approximately 50 large buildings are currently under construction in Doha, including numerous hotels and apartment houses. The government is rapidly trying to diversify and move away from its dependency on oil and natural gas.

Education has been a major focus of the Qatari government in recent years. In addition to Qatar University, established in 1973, the government has solicited several US universities to establish campuses in Doha, most at Education City, a main project of the nonprofit Qatar Foundation for Education, Science, and Community Development. Cornell operates its medical school; Texas A&M operates its school of petroleum engineering; Virginia Commonwealth University provides a fine arts program; and Georgetown University has a liberal arts program. Virgin Health Bank, part owned by British entrepreneur Richard Branson, has established a stem cell bank. They plan to create a regional stem cell hub that attracts biomedical research firms.

A country with a large positive cash flow can do many things quickly. Qatar is trying to invest its riches in human capital. It is unfortunate that all of the progress in Qatar is leading to an explosion of cardiovascular disease. Hypercholesterolemia, hypertension, diabetes mellitus, and atherosclerosis are becoming as frequent as in the Western world. This I presume is the cost of progress. Traffic accidents are also one of the leading causes of death in Doha. Poverty appears to be absent in Doha.

—William Clifford Roberts, MD
17 May 2010

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