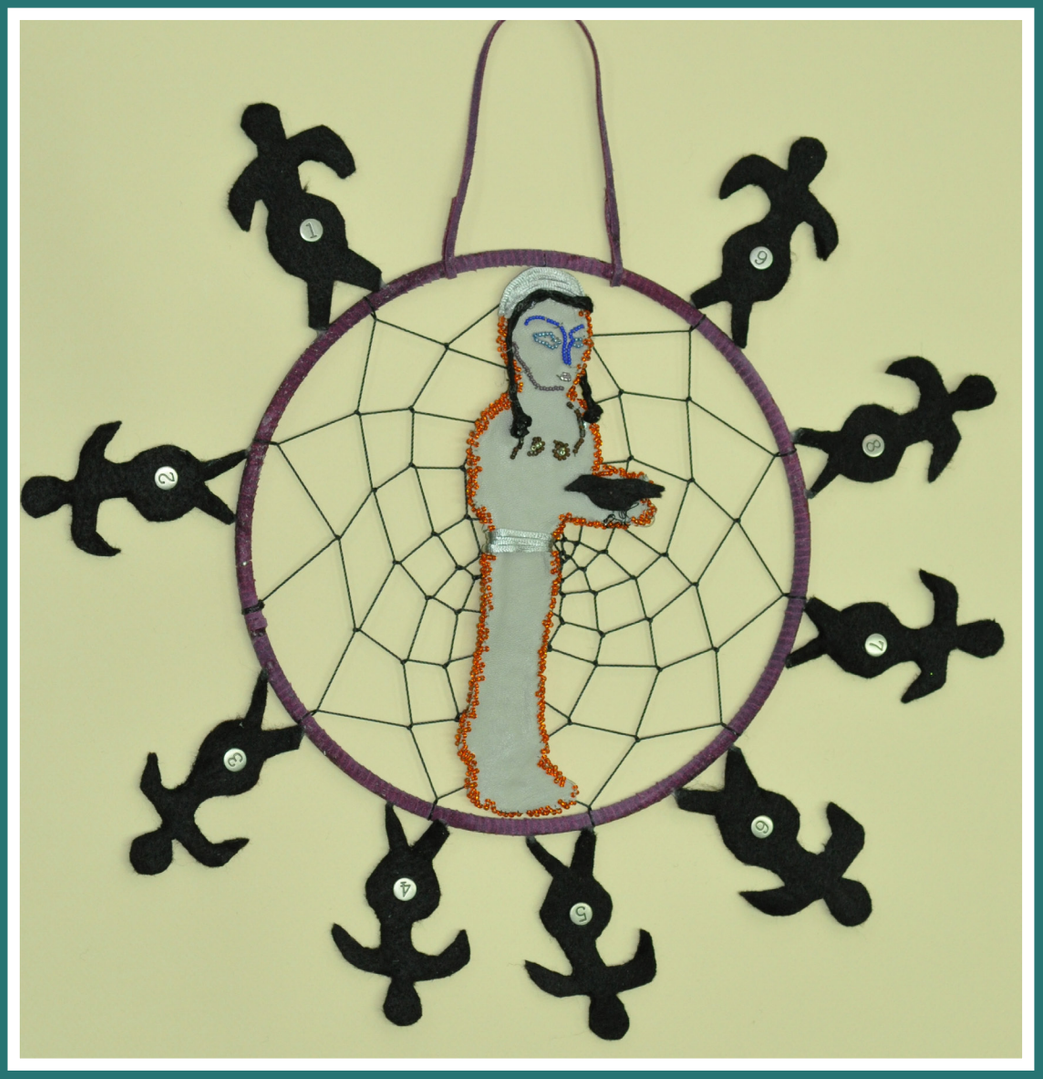


Spirituality and Science

Dr. Chien-Shiung Wu

DR. CHIEN-SHIUNG WU

Chien-Shiung Wu was born on May 31, 1912 about 40 miles from Shanghai on May 31, 1912. She and her father were extremely close and he encouraged her interests, creating an environment where she was surrounded by books, magazines, and newspapers. Wu left her hometown at the age of 11 to go to the Suzhou Women's Normal School No. 2.

In 1929 Wu was admitted to the National Central University in Nanjing. According to the governmental regulations of the time, "normal school" students wanting to move on to the universities needed to serve as schoolteachers for one year. Hence, in 1929 Wu went to teach in the Public School of China.

From 1930 to 1934, Wu studied at the National Central University, first in mathematics, but later transferring to physics. She received a BS in Physics from National Central University in Nanjing. For two years after graduation, she did graduate-level study in physics and also worked as an assistant at the Zhejiang University. After this, Wu became a researcher at the Institute of Physics of the Academia Sinica. In 1936, Wu moved to the United States.

Wu decided that she needed to continue her studies at a higher level than was possible in China. She was accepted by Michigan State University. Wu and her female friend, Dong Ruofen, a chemist from Taicang, arrived in San Francisco in 1936.

Wu's plans for graduate study changed after visiting the University of California, Berkeley. She met her future husband and physicist, Luke Chia-Lin Yuan. Wu's achievements earned her an offer to study under Ernest O. Lawrence, who would soon win the Nobel Prize for Physics in 1939. Wu enrolled at Berkeley. She made rapid progress in her education and her research, completing her Ph.D. in physics in 1940. Wu got married two years later, in 1942 to Yuan. In 1947, she gave birth to a son, Vincent Yuan, who would also grow up to become a physicist.

Wu died on February 16, 1997 in New York City at the age of 84 after suffering a stroke. At the time of her death, Wu was Pupin Professor Emerita of Physics at Columbia.

In 1963 Wu and Yan moved to the East Coast of the U.S., where Wu became a faculty member at, first, Smith College, then Princeton University in New Jersey from 1942 – 44, where she became the first female instructor in the Physics Department. Finally, she found herself at Columbia University in New York City, beginning in 1944 and continued there all the way through 1980.

In 1958, Wu became a full-time professor at the University of Berkely and was elected to the National Academy of Sciences. At Columbia University, Wu also did research and development for the Manhattan Project. In 1946, she served in

the Physics Department of Columbia as a research associate until 1952. From 1952-58, Wu was an associate professor and then became a professor until she retired in 1981 as a Michael I. Pupin Professor of Physics.

At Columbia Wu knew the Chinese-born theoretical physicist Tsung-Dao Lee personally. In the mid-1950s, Lee and another Chinese theoretical physicist, Chen Ning Yang, grew to question a hypothetical law in elementary particle physics, the "Law of Conservation of Parity". Their research into experimental results convinced them that this "Law" was valid for electromagnetic interactions and for the strong nuclear force. However, it had not been tested for the weak nuclear force, and Lee and Yang's theoretical studies showed that it would probably not hold true for this kind of interaction.

Lee and Yang's theoretical calculations predicted that the beta particles from the cobalt 60 atoms would be emitted asymmetrically if the hypothetical "Law of Conservation of Parity" proved invalid. Wu's experiments at the NBS showed that this is indeed the case: parity is not conserved under the weak nuclear interactions. This was also very soon confirmed by her colleagues at Columbia University in different experiments, and as soon as all of these results were published—in two different research papers in the same issue of the same physics journal—the results were also confirmed at many other laboratories and in many different experiments.

The discovery of parity violation was a major contribution to high-energy physics and the development of the Standard model. In recognition for their theoretical work, Lee and Yang were awarded the Nobel Prize for Physics in 1957. Wu received the first Wolf Prize in Physics in 1978 for her experimental work. Wu's book titled *Beta Decay* (published 1965) is still a standard reference for nuclear physicists.

An additional important experiment carried out by Wu was the confirmation of the Pryce and Ward calculations on the correlation of the quantum polarizations of two photons propagating in opposite directions. This was the first experimental confirmation of quantum results relevant to a pair. Wu also did an experiment in 1956 that would overthrow the Law of Symmetry and therefore that governed all interaction in the nuclei.

In 1957, Wu published her findings about the beta decay experiment she completed on June 4, 1956 titled "Experimental Test of Parity Conservation in Beta Decay."

After her retirement, she lectured widely and encouraged the participation of young women in scientific careers and became known as the "First Lady of Physics". She died on February 16, 1997 in New York.

Dr. Gerty Radnitz Cori

DR. GERTY RADNITZ CORI

Gerty Radnitz Cori was born in Prague on August 15, 1896 in the then Austro-Hungarian Empire, now the Czech Republic. Growing up at a time when women were marginalized in science and allowed few educational opportunities, she gained admittance to medical school, where she met her future husband Carl Ferdinand Cori.

Gerty Theresa Radnitz was born on August 15, 1896 into a Jewish family in Prague in 1896. Her father, Otto Radnitz, was a chemist who became manager of sugar refineries after inventing a successful method for refining sugar. Her mother, Martha, a friend of Franz Kafka, was a culturally sophisticated woman. Gerty was tutored at home before enrolling in a Lyceum for girls, and at the age of 16 she decided she wanted to be a medical doctor.

She was admitted to the medical school of the Karl-Ferdinands-Universität in Prague in 1914 and was awarded a Doctorate in Medicine in 1920. While studying she met Carl Cori who was immediately attracted to her vitality, sense of humor and her love of the outdoors. They married in 1920 following graduation. Gerty converted to Catholicism, enabling her and Carl to marry in the Roman Catholic Church.

They moved to Vienna, Austria, where Gerty spent the next two years at the Carolinen Children's Hospital, and her husband worked in a laboratory. While at the hospital, Gerty Cori worked on the pediatrics unit and conducted experiments in temperature regulation, comparing temperatures before and after thyroid treatment, and published papers on blood disorders.

Life was difficult following World War I, and Gerty suffered severe malnutrition due to food shortages. These problems, in conjunction with the increasing anti-Semitism, contributed to the Coris' decision to leave Europe.

In 1922, the Coris immigrated to the United States to pursue medical research at the "State Institute for the Study of Malignant Diseases" (now the Roswell Park Cancer Institute) in Buffalo, New York. In 1928, they became naturalized citizens of the United States.

Although the Coris were discouraged from working together at Roswell, they continued to do so, specializing in investigating carbohydrate metabolism. They were particularly interested in how glucose is metabolized in the human body and the hormones that regulate this process. They published fifty papers while at Roswell, with first author status going to the one who had done most of the research for a given paper. Gerty Cori published eleven articles as the sole author. In 1929, they proposed the theoretical cycle that later won them the Nobel Prize, the Cori cycle. The cycle describes how the human body uses chemical

reactions to break some carbohydrates such as glycogen in muscle tissue into lactic acid, while synthesizing others.

In 1931, after publishing their work on carbohydrate metabolism, the Coris left Roswell. A number of universities offered Carl a position but refused to hire Gerty. Gerty was informed during one university interview that it was considered "un-American" for a married couple to work together. They moved to St. Louis, Missouri in 1931, where Carl had been offered a research position at Washington University School of Medicine. Despite her research background, Gerty was only offered a position as a research associate at a salary one tenth of that received by her husband. She was warned that she might harm her husband's career. In 1943, she was made an associate professor of Research Biological Chemistry and Pharmacology. Months before she won the Nobel Prize, she was promoted to full professor, a post she held until her death in 1957.

They continued their collaboration at Washington University. Working with minced frog muscle, they discovered an intermediate compound that enabled the breakdown of glycogen, called glucose 1-phosphate, now known as the Cori ester. They established the compound's structure, identified the enzyme phosphorylate that catalyzed its chemical formation, and showed that the Cori ester is the beginning step in the conversion of the carbohydrate glycogen into glucose. It can also be the last step in the conversion of blood glucose to glycogen, as it is a reversible step.

Gerty Cori also studied glycogen storage disease, identifying at least four forms, each related to a particular enzymatic defect. She was the first to show that a defect in an enzyme can be the cause of a human genetic disease.

Gerty and Carl Cori collaborated on most of their work, including that which eventually led to winning the 1947 Nobel Prize in Physiology or Medicine "for their discovery of the course of the catalytic conversion of glycogen". They received one half the prize, the other half going to Argentine physiologist, Bernardo Houssay. They continued through their work to clarify the mechanisms of carbohydrate metabolism, advancing the understanding of the reversible conversion of sugars and starch, findings which proved crucial in the development of treatments for diabetics.

Despite rampant gender discrimination and nepotism rules, Gerty never stopped pursuing her lifelong interest in medical research. Brilliant and quick-witted, she was a superb experimentalist as well as a perfectionist.

In 1947 Gerty Cori became the third woman—and first American woman—to win a Nobel Prize in science. She was the first woman to be awarded the Nobel Prize in Physiology or Medicine.

President Harry S. Truman appointed Cori as a board member of the National Science Foundation, a position she held until her death. She was elected to the National Academy of Sciences, the fourth woman so honored.

Just before winning the Nobel prize and while they were on a mountain climbing trip, the Coris learned that Gerty Cori was ill with myelosclerosis, a fatal disease of the bone marrow. She struggled for ten years with the illness while continuing her scientific work; only in the final months did she let up. On October 26, 1957, she died in her home at age 61. Her husband and their only child, Tom Cori, survived her.

Dr. Jean Shinoda-Bolen

DR. JEAN SHINODA-BOLEN

Jean Shinoda was born in the United States in 1938. Although she is an internationally known author, lecturer, psychiatrist and Jungian Analyst, very little is publicized about her parents, early life, and later her married life.

She dedicates her book, *Goddesses in Every Woman,* with the following, " To my mother, Megumi Yamaguchi Shinoda, M.D., who was determined to help me grow up—as she hadn't—feeling that I was fortunate to be a girl, and could do whatever I aspired to as a woman."

Dr. Bolen attended UCLA and Pomona College prior to graduating from the University of California at Berkeley in 1958. She then entered the University of California School of Medicine in San Francisco, receiving her M.D. in 1962. This was followed by a rotating internship at Los Angeles County General Hospital and a residency in psychiatry at Langley Porter Psychiatric Institute, University of California Medical Center in San Francisco. Her analytic training was done at the C.G. Jung Institute in San Francisco. She became a certified analyst in 1976.

Dr. Bolen is a Distinguished Life Fellow of the American Psychiatric Association, and a past Chairperson of the Council of National Affairs of the APA, a Diplomate of the American Board of Psychiatry and Neurology, a Fellow of the American Academy of Psychoanalysis and Dynamic Psychiatry, a former member of the Board of Trustees of the American Orthopsychiatric Association, and a former Board member of the International Transpersonal Association. She is an Analyst-member of the C.G. Jung Institute of San Francisco and the International Association for Analytical Psychology. She is a past member of the Board of Governors of the C.G. Jung Institute of San Francisco, and past Chairperson of the Joint Certifying Board of the Northern and Southern California Societies of Jungian Analysts. She has been a member of the Board of Directors of the Ms. Foundation for Women. She founded and co-chaired Psychiatrists for ERA, which was a major influence within psychiatry in the early 1980's that evolved into the Association for Women in Psychiatry.

Dr. Bolen was a recipient of the Institute for Health and Healing's "Pioneers in Art, Science, and the Soul of Healing Award." She was in two acclaimed documentaries, the Academy-Award winning anti-nuclear proliferation film *Women—For America, For the World*, and the Canadian Film Board's *Goddess Remembered*. The Millionth Circle Initiative was inspired by her book and led to her involvement at the UN. She is the initiator and the leading advocate for a UN 5th World Conference on Women, which was supported by the Secretary General and the President of the General Assembly on March 8, 2012.

She brings an emphasis on the question for meaning and the need for a

spiritual dimension in life to all aspects of her work, while also taking into account the powerful effects of archetypes within us and family and culture upon us. Her books are used as college and university texts in gender studies, women's psychology, mythology, spirituality, east-west philosophy, and psychology courses. She has been an advocate for women, women's issues, and ethics in psychiatry. With her former husband, she co-founded Psychic and New Realities magazines, publications about parapsychological, and mind-body-spiritual subjects. She is in the widely acclaimed documentary, "Goddess Remembered," the first of the Canadian Film Board's trilogy.

Publications: Books

The Tao of Psychology: Synchronicity and the Self (HarperCollins 1979, 25th anniversary edition, 2004) *Goddesses in Everywoman: Powerful Archetypes in Women's Lives* (HarperCollins 1984, 20th anniversary edition, 2004) *Gods in Everyman: Archetypes that Shape Men's Lives* (HarperCollins 1989) *Ring of Power: Symbols and Themes in Wagner's Ring Cycle and in Us* (HarperCollins 1992, Nicolas-Hays 1999) *Crossing to Avalon: A Woman's Midlife Quest for the Sacred Feminine* (HarperCollins 1994) *Close to the Bone: Life Threatening Illness as a Soul Journey* (Scribners 1996, Simon & Schuster 1998, Red Wheel /Conari, Revised Edition, 2007) *The Millionth Circle: How to Change Ourselves and the World* (Conari Press 1999) *Goddesses in Older Women: Archetypes in Women over Fifty* (Harper Collins 2001) *Crones Don't Whine: Concentrated Wisdom for Juicy Women* (Red Wheel/Conari 2003) *Urgent Message from Mother: Gather the Women, Save the World* (Conari Red Wheel 2005) Like a Tree: How Trees, Women, and Tree People Can Save the Planet (Red Wheel /Conari, 2011)

Katharine Dexter McCormick

KATHARINE DEXTER MCCORMICK

Katharine Dexter McCormick was a U.S. biologist, suffragist, philanthropist and, after her husband's death, heir to a substantial part of the McCormick family fortune. She is remembered for funding most of the research necessary to develop the first birth control pill.

Katherine Dexter was born August 27, 1875 in Dexter, Michigan, and grew up in Chicago where her father, Wirt Dexter, was a prominent lawyer. When she was fourteen, her father died. She and her mother Josephine move to Boston in 1890. Four years later, her brother Samuel died of meningitis at age 25.

Dexter graduated from the Massachusetts Institute of Technology in 1904, earning a BSc in biology.

She planned to attend medical school, but chose to marry Stanley Robert McCormick, youngest son of Cyrus McCormick, an heir to the International Harvester fortune. They married on September 15, 1904. In September 1905, they moved into a home in Brookline, Massachusetts. The couple did not have any children. For over a decade, since graduating *cum laude* from Princeton University in 1895, Stanley had been showing signs of progressively worsening mental illness. In September 1906, he was hospitalized for over a year at McLean Hospital and diagnosed with schizophrenia.

In June 1908, Stanley was moved to the McCormick's Riven Rock estate in Montecito, California where Stanley's schizophrenic older sister, Mary Virginia, had lived from 1898–1904 before being placed in a Huntsville, Alabama sanitarium. While there, he was examined by the prominent German psychiatrist Emil Kraepelin and diagnosed with the catatonic form of dementia praecox. In 1909, Stanley was declared legally incompetent and his guardianship split between Katharine and the McCormick family.

In 1909 McCormick spoke at the first outdoor rally for woman suffrage in Massachusetts. She became vice president and treasurer of the National American Woman Suffrage Association and funded the association's publication the *Woman's Journal*. McCormick organized much of Carrie Chapman Catt's efforts to gain ratification for the Nineteenth Amendment. While working with Catt, she met other social activists, including Mary Dennett and Margaret Sanger. In 1920 McCormick became the vice president of the League of Women Voters.

Throughout the 1920s McCormick worked with Sanger on birth control issues. McCormick smuggled diaphragms from Europe to New York City for Sanger's Clinical Research Bureau. In 1927 she hosted a reception of delegates attending the 1927 World Population Conference at her home in Geneva. In that year McCormick also turned to the science of endocrinology to aid her husband, believing that a defective adrenal gland caused his schizophrenia.

She established the Neuroendocrine Research Foundation at Harvard Medical

School, and subsidized the publication of the journal *Endocrinology*. Katharine's mother Josephine died on November 16, 1937 at age 91 leaving Katharine an estate of more than 10 million dollars. Stanley died on January 19, 1947 at age 72 leaving an estate of over 35 million dollars.

In 1953 McCormick met with Gregory Goodwin Pincus. Pincus had been working on developing a hormonal birth control method since 1951. McCormick agreed to fund the Pincus research into oral contraception. She and Pincus persuaded Dr. John Rock to conduct human trials. The Food and Drug Administration (FDA) approved the sale of the Pill in 1957 for menstrual disorders and added contraception to its indications in 1960. McCormick had provided almost the entire $2 million it took to develop and test the oral contraceptive pill. She continued to fund birth control research through the 1960s.

While MIT was always coeducational it could only provide housing to about fifty female students. Therefore, many of the women who attended MIT had to be local residents. However, the place of women at the Institute was far from secure.

In order to provide female students a permanent place at MIT, she would donate the money to found Stanley McCormick Hall, an all female dormitory that would allow MIT to house 200 female students. This effort went a long way in assuring the equality of male and female students.

Following her death in 1967, aged 92, her will provided $5 million to Stanford University School of Medicine to support female doctors. $5 million to the Planned Parenthood Federation of America, which funded the Katharine Dexter McCormick Library in New York City, and $1 million to the Worcester Foundation for Experimental Biology.

Lynne McTaggart

LYNNE MCTAGGART

Lynne McTaggart was born January23, 1951 in New York. She is an American journalist, author, publisher and lecturer, now living in London with her husband and two children.

According to her author profile, she is a spokesperson "on consciousness, the new physics, and the practices of conventional and alternative medicine". McTaggart is the author of six books, including *The Intention Experiment* and *The Field*.

In her autobiography, McTaggart reports that after recovering from an illness using alternative medical approaches her husband suggested she start a newsletter on the risks of some medical practices and devised the title: "What Doctors Don't Tell You".

In 1996, McTaggart published a book using the same name. She also published a "What Doctors Don't Tell You" handbook criticizing childhood vaccinations in 1992 and a cancer handbook, which was updated in 2000.

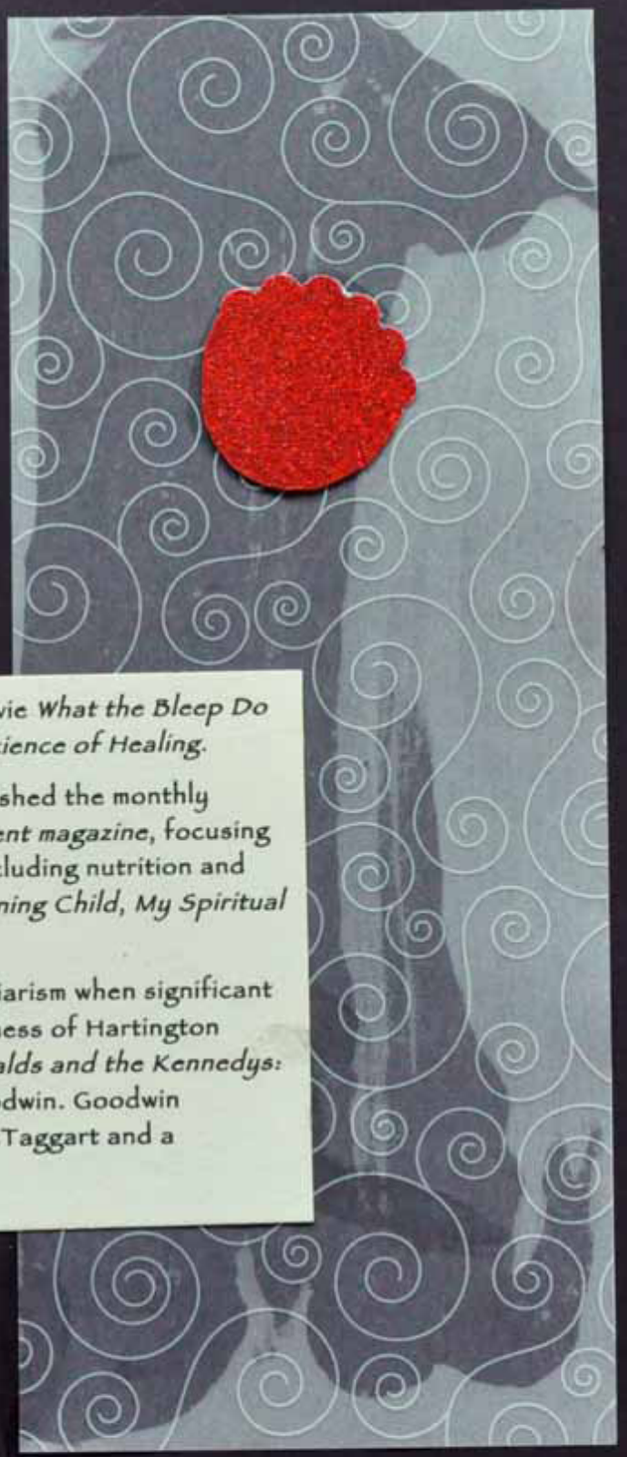
She and her husband set up a public company in 2001, *What Doctors Don't Tell You plc*, later *Conatus plc*, which published newsletters, magazines and audio-tapes based on conferences and seminars including, *What Doctors Don't Tell You, PROOF!*, and *Living the Field*.

A new company, *Wddty Publishing Ltd*, run by McTaggart and her husband, took over the *What Doctors Don't Tell You* website and *New Age Publishing Ltd* was created for McTaggart's other publishing and public speaking activities. Publication of their monthly magazine *What Doctors Don't Tell You* restarted in August 2012 aimed newsagent and high street distribution, instead of the previous subscription model.

McTaggart says about the relationship of the medical industry and the public: "the roles are the reverse of what many people think: we debate with fact against an establishment which argues with emotion."

In her book *The Field*, McTaggart discusses scientific discoveries that she says support the theory that the universe is unified by an interactive field. The book has been translated into fourteen languages. In a later book, *The Intention Experiment*, she discusses research in the field of human consciousness which she says supports the theory that "the universe is connected by a vast quantum energy field" and can be influenced by thought. This book has been translated into eighteen languages.

McTaggart has a personal development program called "Living The Field," which is based on an interpretation of the zero point field as applied to quantum



mechanics. She appears in the extended version of the movie *What the Bleep Do We Know!?*,as well as the movie, *The Living Matrix - The Science of Healing*.

From 1996 until 2002 McTaggart and Hubbard published the monthly newsletter *Mother Knows Best*, later renamed *Natural Parent magazine*, focusing on home schooling, environmental and health concerns, including nutrition and homeopathy. They also published related books: *My Learning Child*, *My Spiritual Child* and *My Healthy Child*.

McTaggart became the victim of a major act of plagiarism when significant portions of her book about Kathleen Cavendish, Marchioness of Hartington appeared without attribution or permission in *The Fitzgeralds and the Kennedys: An American Saga*, by popular historian Doris Kearns Goodwin. Goodwin eventually resolved the matter with a public apology to McTaggart and a substantial monetary settlement.

Maria Mitchell

MARIA MITCHELL

Maria Mitchell once said, "We especially need imagination in science. It is not all mathematics, nor all logic, but is somewhat beauty and poetry."

Maria Mitchell, the first acknowledged female astronomer in the United States, was born August 1, 1818 on Nantucket, Massachusetts to William and Lydia Mitchell. Maria was the third child of a Quaker family with ten children and received her education at Cyrus Peirce's School for Young Ladies. Her father, William Mitchell, contributed much to Maria's education in astronomy, as he was an astronomer and teacher himself. A strong believer of equality for all, Maria's father deeply encouraged his daughter to receive the same education as boys. She attended the school at which her father was the master, where she developed a love for nature. She then spent a year with the school presided over by Cyrus Peirce, but left in 1835 at the age of 17 to open her own school to train girls in science and math.

In 1836, Maria went to work as the librarian of the Nantucket Athenaeum. Over the next twenty years, she further developed her passion for knowledge by reading as many books as she could when the library was closed. While she spent her days reading, she spent her nights observing the sky with her father. William had built an observatory on top of the nearby Pacific Bank, where he was the principal officer, and this served as a catalyst for her achievements in astronomy.

On October 1, 1847, at the age of 29, Maria Mitchell discovered a comet. Not only was this a first in American science, she used a mere two-inch telescope, which illustrates her true skill as an astronomer. After some controversy with an Italian man who claimed the discovery, she was awarded the international medal for this achievement. The comet was named "Miss Mitchell's Comet" and was featured in Elias Loomis' *The Recent Progress of Astronomy*. As a result, she became the first woman elected to the American Academy of Arts and Sciences in 1848. Just 30 at the time, she would be the only woman thus recognized for almost a century into the future.

Later elected to the American Association for the Advancement of Science and the American Philosophical Society, Mitchell also t the first woman employed in a professional capacity by the federal government. Although women had been hired as cooks, and laundresses, her 1849 employment appears to be the first case of a woman earning an annual salary for work based on knowledge of an academic field. The U.S. Coastal Survey paid her $300 a year as a celestial observer. Much of the project's purpose was to develop the science of weather forecasting, and it involved computing distances. She and others who did this were called "computers." Boston feminists were extremely proud of her achievements. It was botanist Elizabeth Agassiz who persuaded her husband to nominate Mitchell for membership in the American Academy of Arts and Sciences,

while innovative educator and publisher Elizabeth Peabody led wealthier women in purchasing a new telescope for her. A decade after she became famous with her discovery, Mitchell was able to spend a year in several countries of Europe. She met with other astronomers, including Sir John Herschel, whose aunt, German-born Caroline Herschel, had been a pioneering astronomer prior to her 1848 death. Mitchell also visited Scotland's Mary Somerville, who published *The Mechanisms of the Heavens* in 1829 and went on to innovative work on ultraviolet rays and molecular structure. With an extreme passion for science, Maria Mitchell continued her pursuit in the scientific field through the Civil War, when she also was involved in the anti-slavery movement. A strong believer in freedom for all, she refused to wear cotton grown by slaves in the South. The Civil War transformed the roles of American women, and many eastern states that had not provided colleges for women began to do so. One of the most prestigious was Vassar College, which was founded by Matthew Vassar in 1865. He persuaded Mitchell to join its faculty, where she was the only woman. There she had access to a twelve-inch telescope, the third largest in the United States, and began to specialize in the surfaces of Jupiter and Saturn. Equally important, she refused to enforce the petty rules of female behavior that were expected in this place and time. The Vassar faculty respected Mitchell, but they initially expected her to teach astronomy – while insisting that the college's female students were not allowed to go outside at night! A sensible person who distained Victorian rigidity, Mitchell also was a leader in the formation of the American Association for the Advancement of Women (AAW), which evolved into today's American Association of University Women. She served as AAW's 1873 president and also was elected vice president of one of the few mixed-gender professional associations of the era, the pioneer American Social Science Association. Her interest in this "soft" science, as opposed to the "hard" science of astronomy, demonstrates Mitchell was a well rounded person. Always a powerful advocate of women's potential, she became increasingly feminist as she aged. Beyond that, she questioned the era's religiosity, and when Vassar insisted that she attend chapel, made a point of sitting at the far back, where she could ignore the preacher and "think of something pleasant." She even gave up her membership in the Society of Friends (Quakers.) When the nation celebrated its first centennial in 1876, she chaired the Women's Congress held in Philadelphia. She retired from Vassar in 1888, but continued her research in Lynn, Massachusetts. She passed away on June 28, 1889, but not before proving women's potential in science. After her death, the Maria Mitchell Association on Nantucket was founded in 1902; they preserved her home, which is open to visitors. Maria Mitchell was elected to the Hall of Fame of Great Americans at New York University in 1905, and in 1994, she was elected to the National Women's Hall of Fame. She was a true founder of modern science.

Dr. Maria Goeppert-Mayer

DR. MARIA GOEPPERT-MAYER

Maria Goeppert was born on June 28, 1906, in Kattowitz, Poland, the only child of Friedrich and Maria Wolff Goeppert.

In 1910, when her father was appointed as as the professor of pediatrics at the University of Göttingen their family moved to Göttingen.

Goeppert was closer to her father than her mother. "Well, my father was more interesting," she later explained. "He was after all a scientist."

Goeppert was educated at the *Höhere Technische* in Göttingen, a school for middle-class girls who aspired to higher education. In 1921, she entered the *Frauenstudium*, a private high school run by suffragettes that aimed to prepare girls for university. She took the *abitur*, the university entrance examination, at age 17, a year early. All the girls passed, but only one of the boys did.

In the spring of 1924, Goeppert entered the University of Göttingen, where she studied mathematics. A purported shortage of women mathematics teachers for schools for girls led to an upsurge of women studying mathematics at a time of high unemployment, and there was even a female professor of mathematics at Göttingen.

Goeppert became interested in physics, and chose to pursue a Ph.D. In her 1930 doctoral thesis she worked out the theory of possible two-photon absorption by atoms. Eugene Wigner later described the thesis as "a masterpiece of clarity and concreteness". At the time, the chances of experimentally verifying her thesis seemed remote, but the development of the laser permitted the first experimental verification in 1961 when two-photon-excited fluorescence was detected in a europium-doped crystal. To honor her fundamental contribution to this area, the unit for the two-photon absorption cross section is named the Goeppert Mayer (GM) unit. Her examiners were three future Nobel Prize winners: Max Born, James Franck and Adolf Otto Reinhold Windaus.

On January 19, 1930, Goeppert married Joseph Edward Mayer. The two had met when Mayer boarded with the Goepprt family. The couple moved to Mayer's home in the United States. He had been offered a position as associate professor of chemistry at Johns Hopkins University. They had two children, Maria Ann and Peter Conradt.

Strict rules against nepotism prevented Johns Hopkins University from hiring Goeppert Mayer as a faculty member, but she was given a job as an assistant in the Physics Department working with German correspondence. She received a very small salary, a place to work and access to the facilities. She taught some courses, and published an important paper on double beta decay in 1935.

The University of Chicago finally took her seriously enough to make her a professor of physics. Although she got her own office, the department still didn't pay her. When the Swedish academy announced in 1963 that she had won her profession's highest honor, the San Diego newspaper greeted her big day with the headline "S.D. Mother Wins Nobel Prize".

There was little interest in quantum mechanics at Johns Hopkins, but Goeppert Mayer worked with Karl Herzfeld, collaborating on a number of papers. She also returned to Göttingen in the summers of 1931, 1932 and 1933 to work with her former examiner Born, writing an article with him for the *Handbuch der Physik*. This ended when the NSDAP came to power in 1933, and many academics, including Born and Franck, lost their jobs. Goeppert Mayer and Herzfeld became involved in refugee relief efforts.

Mayer took up a position at Columbia University, where the chairman of the Physics Department, George Pegram, arranged for Goeppert Mayer to have an office, but she received no salary. She soon made good friends with Harold Urey and Enrico Fermi, who arrived at Columbia in 1939. Fermi asked her to investigate the valence shell of the undiscovered transuranic elements. Using the Thomas–Fermi model, she predicted that they would form a new series similar to the rare earth elements. This proved to be correct.

In December 1941, Goeppert Mayer took up her first paid professional position, teaching science part-time at Sarah Lawrence College. In the spring of 1942, with the United States embroiled in World War II, she joined the Manhattan Project. She accepted a part-time research post from Urey with Columbia University's Substitute Alloy Materials (SAM) Laboratory. The objective of this project was to find a means of separating the fissile uranium-235 isotope in natural uranium.

Through her friend Edward Teller, Goeppert Mayer was given a position at Columbia with the Opacity Project, which researched the properties of matter and radiation at extremely high temperatures with an eye to the development of the Teller's "Super" bomb, the wartime program for the development of thermonuclear weapons.

In February 1945, Joe was sent to the Pacific War, and Goeppert Mayer decided to leave her children in New York and join Teller's group at the Los Alamos Laboratory. Joe came back from the Pacific earlier than expected, and they returned to New York together in July 1945.

In February 1946, Joe became a professor in the Chemistry Department and the new Institute for Nuclear Studies at the University of Chicago, and Goeppert Mayer was able to become a voluntary associate professor of Physics at the school. When the nearby Argonne National Laboratory was founded on July 1, 1946, Goeppert Mayer was also offered a part-time position.

In 1960, Goeppert Mayer was appointed full professor of physics at the University of California at San Diego. Although she suffered from a stroke shortly after arriving there, she continued to teach and conduct research for a number of years. Goeppert Mayer died in San Diego, California, on February 20, 1972.

Rachel Louise Carson

RACHEL LOUISE CARSON

Rachel Louise Carson, born on May 27, 1907 in the rural river town of Springdale Pennsylvania. Her mother, a lover nature, shared this with Rachel. Rachel extended this love of nature and of the living world throughout her life and through every endeavor she engaged in.

Rachel expressed herself first as a writer and later became a student of marine biology. Carson graduated from Pennsylvania College for Women (now Chatham College) in 1929, and studied at the Woods Hole Marine Biological Laboratory. She received her MA in zoology from Johns Hopkins University in 1932.

She was hired by the U.S. Bureau of Fisheries to write radio scripts during the Depression and supplemented her income by writing feature articles on natural history for the Baltimore Sun. She began a fifteen-year career in federal service which culminated in her becoming Editor-in-Chief of all publications for the U.S. Fish and Wildlife Service in 1963.

She wrote pamphlets on conservation and natural resources and edited scientific articles, but in her free time turned her government research into lyric prose. She first wrote an article "Undersea" in 1937, for the Atlantic Monthly, and then in a book, *Under the Sea-wind in* 1941. In 1952 she published her prize-winning study of the ocean, *The Sea Around Us*, which was followed by *The Edge of the Sea* in 1955. These books constituted a biography of the ocean and made Carson famous as a naturalist and science writer for the public.

Carson resigned from government service in 1952 to devote herself to her writing.

She wrote several articles to teach people about the living world, including "Help Your Child to Wonder," in 1956 and "Our Ever-Changing Shore" in 1957, and planned another book on the ecology of life. Embedded within all of Carson's writing was the view that human beings were but one part of nature distinguished primarily by their power to alter it, in some cases irreversibly.

Disturbed by the profligate use of synthetic chemical pesticides after World War II, Carson reluctantly changed her focus in order to warn the public about the long-term effects of misusing pesticides. In *Silent Spring* in 1962, she challenged the practices of agricultural scientists and the government, and called for a change in the way humankind viewed the natural world.

Carson was attacked by the chemical industry and some in government as an alarmist, but spoke out to remind us we are subject to the same damage as the natural world. Testifying before Congress in 1963, Carson called for new policies to protect human health and the environment.

Rachel Carson died on April 14, in 1964 after a long battle against breast cancer. Her witness for the beauty and integrity of life continues to inspire new generations to protect the living world and all its creatures.

Dr. Rosalind Elsie Franklin

DR. ROSALIND ELSIE FRANKLIN

Rosalind Elsie Franklin was a British biophysicist and X-ray crystallographer who made critical contributions to the understanding of the fine molecular structures of DNA (deoxyribonucleic acid), RNA, viruses, coal, and graphite. Franklin is best known for her work on the X-ray diffraction images of DNA that led to the discovery of the DNA double helix. Franklin's scientific contributions to the discovery of the double helix are often overlooked.

After finishing her portion of the work on DNA, Franklin led pioneering work on the tobacco mosaic virus and the poliovirus. She died in 1958 at the age of 37 of ovarian cancer.

Franklin was born on July 22, 1902 in Notting Hill, London, into an affluent British Jewish family. Her father was Ellis Franklin a local merchant banker who taught at the city's Working Men's College, and her mother was Muriel Frances Waley.

From early childhood, Franklin showed exceptional scholastic abilities.

Franklin went to Newnham College, Cambridge, in 1938 and studied chemistry.

She spent a year in R.G.W. Norrish's lab without great success. Resigning from the Cold Spring Lab, Franklin fulfilled the requirements of the National Service Act by working as an Assistant Research Officer at the British Coal Utilization Research Association (BCURA)The BCURA was located on the Coombe Springs Estate, near Kingston upon the Thames.

She studied the porosity of coal, comparing its density to that of helium. Through this, she discovered the relationship between the fine constrictions in the pores in coals and the permeability of the pore space. By concluding that substances were expelled in order of molecular size as temperature increased, Franklin helped classify coals and accurately predict their performance for fuel purposes and in the production of wartime devices (i.e. gas masks). This work was the basis of her Ph.D. thesis *The physical chemistry of solid organic colloids with special reference to coal* for which Cambridge University awarded her a Ph.D. in 1945. It was also the basis of several papers.

Next Franklin got an appointment with Jacques Mering at the Laboratoire Central des Services Chimiques de l'Etat in Paris.

Mering taught her the practical aspects of applying X-ray crystallography to amorphous substances. Franklin published several papers on this work.

In January 1951, Franklin started working as a research associate at King's College London in the Medical Research Council's (MRC) Biophysics Unit.

Randall, the director, redirected her work to DNA fibers. He made this reassignment, even before she started working at King's, because of the pioneering work being done by Maurice Wilkins and Raymond Gosling – a Ph.D. student assigned to help Franklin.

Franklin, working with her student Raymond Gosling, started to apply her expertise in X-ray diffraction techniques to the structure of DNA. She used a new fine focus X-ray tube and micro camera ordered by Wilkins, but which she refined, adjusted and focused carefully. Drawing upon her physical chemistry background, Franklin also skillfully manipulated the critical hydration of her specimens.

Franklin and Gosling discovered that there were two forms of DNA. By the end of 1951 it was generally accepted at King's that the B form of DNA was a helix, but after she had recorded an asymmetrical image in May 1952, Franklin became unconvinced that the A form of DNA was helical in structure.

By January 1953, Franklin had reconciled her conflicting data, concluding that both DNA forms had two helices.

In mid-1956, while on a work-related trip to the United States, Franklin first began to suspect a health problem. An operation in September of the same year revealed two tumors in her abdomen. After this period and other periods of hospitalization, Franklin spent time convalescing with various friends and family members.

Franklin chose not to stay with her parents because her mother's uncontrollable grief and crying upset her too much. Even while undergoing cancer treatment, Franklin continued to work, and her group continued to produce results – seven papers in 1956 and six more in 1957. In 1957, the group was also working on the polio virus and had obtained funding from the Public Health Service of the National Institutes of Health in the United States for this.

At the end of 1957, Franklin again fell ill and she was admitted to the Royal Marsden Hospital. She returned to work in January 1958, and she was given a promotion to *Research Associate in Biophysics*. She fell ill again on March 30, and she died on April 16, 1958, in Chelsea, London.

Franklin was never nominated for a Nobel Prize. She had died in 1958 and was therefore ineligible for nomination to the Nobel Prize in 1962, which was subsequently awarded to Crick, Watson, and Wilkins in that year.

By Marcia Fountain-Blacklidge