How a great physicist taught science to children

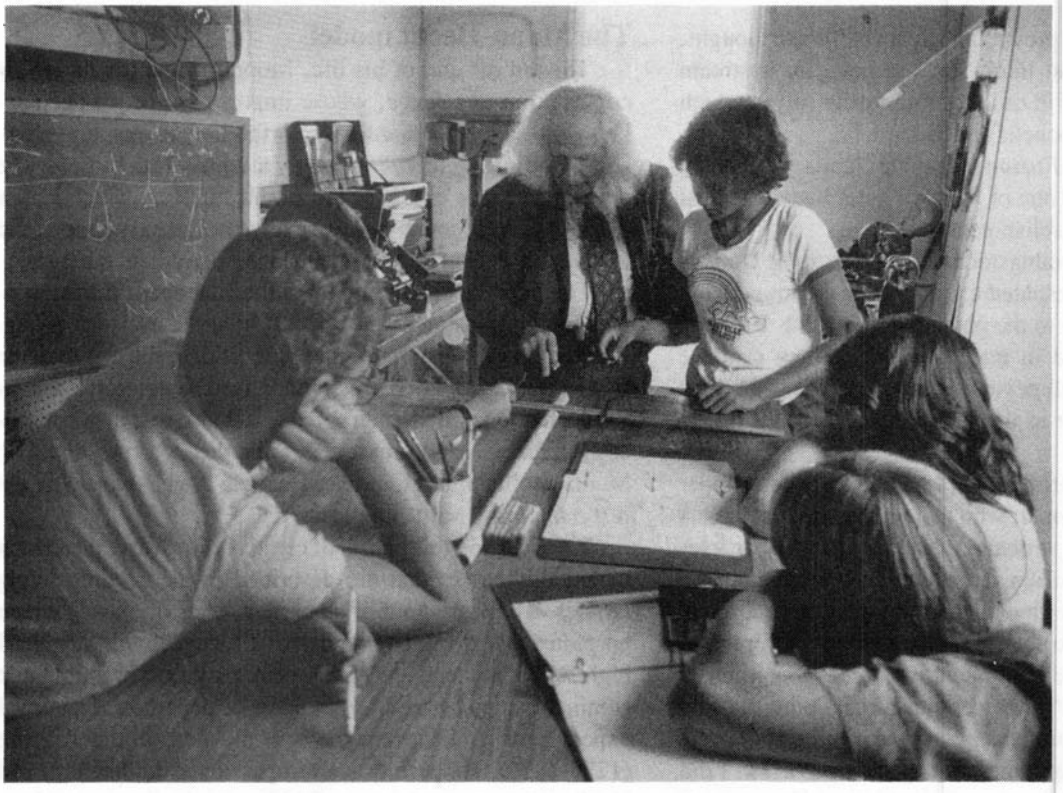
by Susan Welsh

The crisis in American science education is making headline news these days, with devastating statistics on students' test scores, teachers' lack of training, and the gross errors and methodological incompetence of textbooks. Anyone concerned with solving this problem can draw inspiration from the effort of the late Dr. Robert Moon, one of the great physicists of our time, to teach something about electromagnetism—and life—to a group of children ages 8-14, at summer camps in New York and Virginia during the summers of 1984, 1985, and 1986.

Dr. Moon (1911-89) was one of the pioneers in the development of nuclear energy. He was the first to build the scanning X-ray system that led to the CAT scanner, and the first to discover the correct cathode surface for a high-current electron gun. Before World War II, he developed the most advanced cyclotron then known, and during the war, he served on the Manhattan Project. He was a professor emeritus at the University of Chicago, a founder of the Fusion Energy Foundation, editor-in-chief of the *International Journal of Fusion Energy,* and a staunch collaborator of Lyndon LaRouche. (The FEF, *IJFE,* and the summer camp at which Moon taught, were all forcibly closed down during 1986-87, in an assault by the combined federal, state, and private "Get LaRouche" task force.)

One of Moon's collaborators, Dr. Jonathan Tennenbaum of the Fusion Energy Forum in Germany, described in an obituary for Dr. Moon, how the scientist shared his love of God's creation with everyone around him (*EIR,* Dec. 1, 1989):

"I shall never forget one night at a children's camp in Virginia, when Dr. Moon was taking some of his young friends on an exciting guided tour of the planets and stars using the camp's telescope. As the night went on, his pupils retired to bed, one by one. I woke up just before dawn, and glanced out the window: Lo and behold! There was Dr. Moon, alone, still standing at the telescope, absorbed in the study of some important phenomenon up there in the heavens."



Dr. Robert Moon works with children at a summer camp in Virginia in 1986. His approach was to have the students reproduce, "from scratch," some of the crucial experiments from the history of physics.

In an interview with *EIR* published Oct. 30, 1987, Moon described his experience growing up on a farm near Springfield, Missouri, in a way that conveys the love of discovery and productive labor which motivated him until the day he died, and which, more than anything else, he communicated to his students:

"When I was a boy, we had four cars and we lived on 10 acres, out in the country. We had a pig apiece and a cow apiece, each one of us four boys, my three brothers and I. That might not seem so exciting to some, but it was good training for us. We were busy from morning to night: Milk the cows, separate the cream, and so on, but we did it. . . .

"This was the sort of thing that I grew up with. There were automobiles to repair, batteries to rebuild, generators to rewind, a lathe to turn wood. I built my own lathe to do woodcutting. We had a lot of trees on the farm and we would cut them down and turn them into lamps and things like that. All of these things were a lot of fun.

"Of course, when I was growing up, electricity was first coming into general use. When I was still quite young, I became fascinated with the problem of understanding what made the front-door buzzer work. This raised one of the most fundamental laws of physics, Faraday's law of induction. It is this law which makes the application of electricity possible, even today.

"In 1917, at the age of six, I first came upon the idea of a transformer. My aunt had a doorbell buzzer which was connected to a battery—two dry cells in series—and I used it to help her change the battery. One day I saw a bell-ringing transformer in a shop window that was hooked up to a transformer. This was a completely new idea to me.

"I already understood Ohm's law, but I did not yet know about Faraday's law. . . . With my child's mind, I first tried to create the concept of a transformer. . . .

"Throughout my boyhood I was led to this kind of exploration, taking the simple things around me as a jumping-off point for fashioning my own experiments. Electricity was particularly exciting to me, because it was just taking the place of gas, gas lights."

'Navigating upstream'

Moon based his doctoral thesis on the theoretical work of the quantum physicist Louis de Broglie, one of those who battled against the acausal theory of physics promulgated by Niels Bohr, which is still hegemonic today. In an essay published in the *International Journal of Fusion Energy* (April 1985), titled "The Gifts of Louis de Broglie to Science," Moon described the "poetic" quality of the creative process, citing the view of de Broglie that "great physicists fight great battles."

"Ideas are buried," Moon wrote, "within the individual's spirit and burst forth when the individual's freedom is not suppressed by worldly materialism and dogmatism. Ideas do not come from conscious mentation or reading, since ideas are part of the individual's spiritual makeup and must be searched for from within in order to be discovered. Ideas

may flow contrary to the prevailing stream of human thought. The individual will most likely have to navigate upstream and avoid aimless drift, in order to find fertile soil in which to plant an idea for the benefit of mankind."

In an interview with *Fusion* magazine (January-February 1985), Moon described one of his own great battles against an ossified scientific establishment:

"When I was just a youngster of 19, I came to the University of Chicago and I presented a proposal on creating fusion energy in the laboratory to the physics department. But they weren't at all interested in nuclear energy. They said the energy is there but it will never come out; all has been done that can be done. As far as they were concerned, the books were closed.

"But there was one professor at Chicago, William Draper Harkins, a physical chemist, who had written several papers which I had read on the structure of nuclei, and the particles that should be in the nucleus, and so on. He took me on as a thesis student. 'We just have a small amount of equipment for the things you want to do,' he said, 'but it's very important to construct some of the equipment we don't have in order to do your thesis work.' So I went ahead and built the first Geiger counter on the campus. . . .

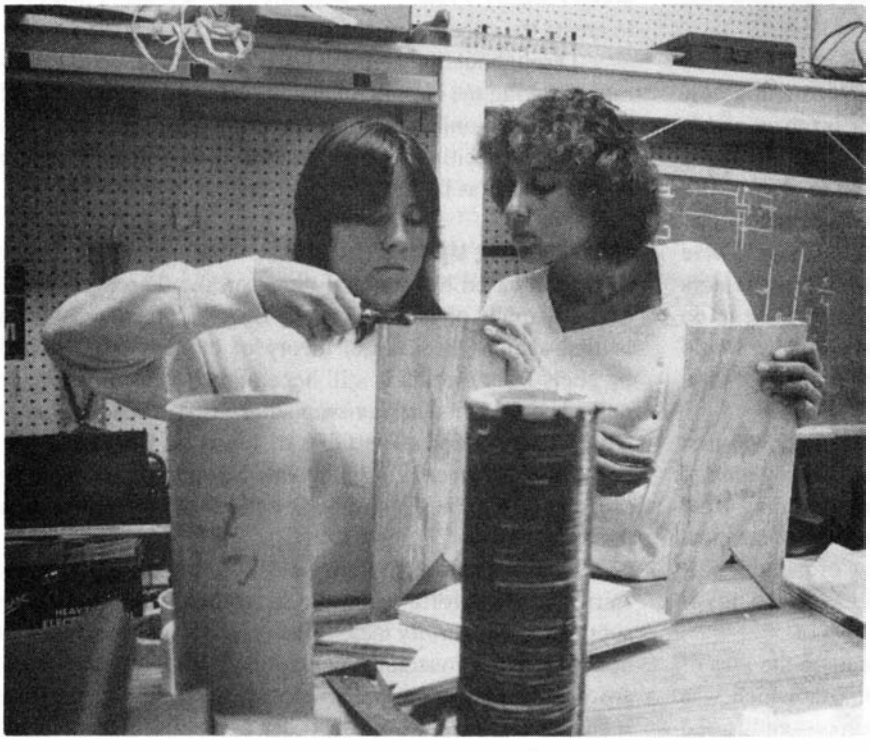
"While I built the equipment for the nuclear work, I did another thesis on the study of surface structure by means of slow electrons (less than 50 electron volts energy). Then I got involved in building the cyclotron. You know, we built the best cyclotron in the world, right in the middle of the Great Depression!"

The Moon-Hecht model

Toward the end of his life, Moon made a revolutionary contribution to science, whose import has not yet been acknowledged by the guardians of orthodoxy in quantum physics. In the spring of 1986, shortly after his 75th birthday, he developed a new model of the atomic nucleus, which makes it possible to account geometrically for the existence of the 92 naturally occurring elements in the periodical table.

The hypothesis is based upon the concept of the astronomer Johannes Kepler (1571-1630), that the universe is constructed according to harmonic proportions, starting with the five Platonic solids. If this is true for the solar system, as Kepler demonstrated, then perhaps it is also true in the microcosmic realm, Moon reasoned. (The theory is presented by Moon's collaborator Laurence Hecht in *21st Century Science & Technology*, May-June 1988.)

It was during this period of creative discovery, that Moon taught the classes that are described in the accompanying articles. They grew out of an earlier series of classes which he pioneered at the University of Chicago, with advanced high school students. With the younger group of children at summer camp, he took as his point of departure the crucial experiments in electromagnetism of André-Marie Ampère (1775-1836). Ampère was an impassioned Leibnizian, and his discoveries were a powerful blow to the dominant Newtonian conceptions of physics. He developed the concept that molecules are structured according to the vertices of the regular or nearly regular polygons—a concept which Moon's model takes much further.



Students construct the apparatus for Ampère's experiments. In the foreground is the solenoid—a piece of PVC pipe with copper wire coiled around it, which is needed to cancel out the effect of the Earth's magnetic field.