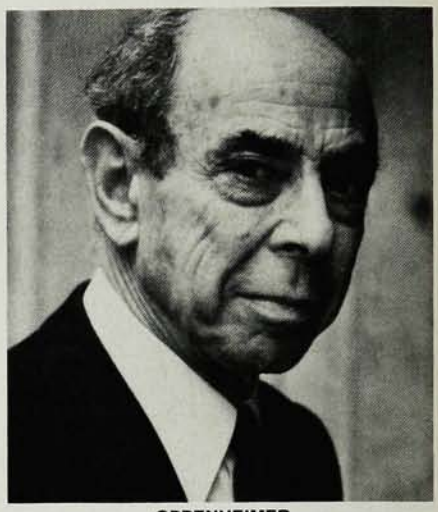
The University of Iowa has announced the following appointments: **John A. Goree,** formerly of Princeton University, has become an assistant professor of physics, with research emphasis in experimental plasma physics; and **Paul D. Kleiber,** formerly of the University of Iowa Laser Facility, has become an assistant professor of physics, with research emphasis in laser physics.

Ronald Ransome, formerly of the Max Planck Institut für Kernphysik, has become an assistant professor in the physics department at Rutgers University.

obituaries

Frank Oppenheimer



OPPENHEIMER

Frank Oppenheimer died on 3 February 1985 in Sausalito, California. Professionally a physicist, Oppenheimer was also a musician, a rancher and, not least, a teacher and an educator.

Oppenheimer was a graduate of Johns Hopkins; he worked at the Cavendish Laboratory in England and the Istituto di Arceti in Italy and received his PhD at Caltech in 1939. After spending 1939–40 at Stanford University, he went to work with Ernest O. Lawrence on the electromagnetic separation of uranium isotopes at Oak Ridge. He then came to the Los Alamos weapons laboratory in late 1943. There he became right-hand man to Kenneth T. Bainbridge, who was in charge of all preparation for the Trinity test site in the southern New Mexico desert. Oppenheimer had the primary responsibility for the instrumentation of that first nuclear explosion.

Reflections and discussions about the military and historical consequences of nuclear weaponry were never absent from the wartime centers of the Manhattan Project, as Alice Kimball Smith's history makes clear (A. K. Smith, *A Peril and a Hope: The Scientists' Movement in America* 1945–47, Chicago, 1965). At isolated Los Alamos they were muted, though I remember a good many. I was an administrative assistant to Robert Oppenheimer, and I later wrote the wartime history of the laboratory. What was latent at Los Alamos got strong expression after Hiroshima and Nagasaki. Frank Oppenheimer was involved in the beginning of the Association of Los Alamos Scientists, and somewhat later he joined in the national Federation of American Scientists. I think we all soon realized that we were plowing fresh ground, politically. There simply were no informed and intelligent party platforms on the subject, Left, Right or "Center." From then on, for many of us, the cause of nuclear pacificism preempted political energies. Not pacifists from the beginning, those who worked on the Manhattan Project knew what their work had done to two cities, and what upward of a millionfold enhancement of explosive power could mean for the institution of war. If that realization came too late, it has seemed to come far later to the big political world. Though we and others failed in those early efforts toward some system of international controls, the commitment has remained. With Oppenheimer it surely did.

After the war, Oppenheimer returned to Berkeley for a time and then in 1947 went to the University of Minnesota. There he undertook research that proved to be a landmark in the development of cosmic-ray physics. At that time there was still no firm knowledge of the nature or origin of the rays. The mean value of their upwardly skewed energy distribution was greater, by a factor of a thousand, than the greatest cyclotron energies, and no known astronomical process could produce such energies. Fermi first pointed out that atoms could reach such energies by equipartition with the stars; but whatever the mechanism of their acceleration, the crucial step was to catch the primary rays themselves at high altitudes. Oppenheimer chased balloons across the Minnesota countryside by car and plane and, later, at low altitudes, across the Caribbean—courtesy of the US Navy. His group and that of B. Peters (University of Rochester) collaborated; the one using cloud chambers, the other photo emulsions.

In 1948 they shared the discovery that primary rays were a sampling of the whole periodic table (P. Freier, E. J. Lofgren, E. P. Ney, F. Oppenheimer, H. L. Bradt, B. Peters, Phys. Rev. **74**, 213, 1948).

All this was interrupted in 1949, when Oppenheimer was called before the Un-American Activities Committee and asked to denounce as Reds some of his prewar political associates. He had been among those who were later known in intelligence circles by the deftly chosen label "premature antifascists." Having the power to compel testimony, the committee could bring an action for contempt of Congress against anyone who lacked a legal right of refusal. Oppenheimer was one of the first persons who courageously took the position that he would answer any question about his own past political activities, but he would not talk about those of his friends. In doing so he refused to claim any rights on grounds of self-incrimination. Although the committee brought no action against him, the University of Minnesota, ingloriously intimidated, fired him. And the political climate was such that for a long time no other university administration dared offer him a position.

Oppenheimer's talents stood him in good stead in his next career, that of a Colorado rancher. Already a good carpenter, plumber and mechanic, he and his family became hard-working members of a ranch community high in the Blanco Basin. In 1957 the teacher in their country elementary school left suddenly and Oppenheimer took over. The next year Pagosa Springs High School needed a science teacher and Oppenheimer took the job, promising to get (and getting) teaching credentials.

In 1959 he was invited to help staff a summer institute at the University of Colorado designed to introduce the PSSC physics course to high-school teachers; he was in charge of the laboratory. This led to further work at the University and to his becoming a consultant for the Jefferson County schools. When he was offered a full-time position in the physics department, he was back to teaching and research; his research program in particle physics utilized bubble-chamber films from the accelerator laboratories. For student laboratories Oppenheimer moved in a new direction: In a very large attic space, using standard industrial furniture, he undertook the design of what he called a library of experiments. Much of each experiment was predesigned and hard wired, but the design itself was aimed to give students flexibility in deciding how to use it. Helped by an NSF grant, he and his colleague Malcolm Correll radically transformed the whole year's course in

a little more than a year. The stodgy conventional relic of a lab was gone, and in its place was a matrix for a far more investigative way to learn physics.

Oppenheimer soon extended this way of teaching to science teaching for the public at large, for adults and for children. He spent some time looking at science museums here and abroad, took a leave of absence from Colorado and went to San Francisco to create the Exploratorium. For that, of course, he is now famous in the scientific community, to museum specialists and to a remarkably large public.

Exhibits in the Exploratorium are designed to reveal phenomena and extend our perceptions of them. The didactic mode, "explanation," is avoided in favor of asking questions of Nature. In its 15-year history, under Oppenheimer's leadership, the Exploratorium has attracted a wide public, and it has also linked itself with the schools: Teachers and children can use its exhibits in somewhat the way the physics lab in Boulder was intended, a way more persistent and systematic than that of the merely curious visitor. Perhaps in such liaisons between formal and informal education there can be fresh hope for evolving a society in which scientific understanding is not so narrowly and dangerously restricted as in our world today.

One basic mark of the Exploratorium's style is the shop where exhibits are first put together crudely, then tested, revised and tested again. The shop is a highly visible part of the museum and the visitors contribute to the museum's design as well, because their reactions are observed and recorded. What they bring with them, in terms of interest and preconception, determines what they will learn. The staff must be learners themselves: primarily about the exhibit's subject matter and its importance, but also about the visitors' ideas—how they match and mismatch the staff's own. In short, as a staff member one really becomes a teacher. That was Oppenheimer's greatest precept and example. (A special issue of *The Exploratorium* magazine, March 1985, was devoted mostly to Oppenheimer's own talks and writings.)

While contributing significantly to research physics, Oppenheimer's choices were increasingly toward a deepening commitment to education. He was himself a fine and reflective teacher, but his most profound and lasting achievement was surely the creative extension of our resources for science education, on the pattern of the Exploratorium.

DAVID HAWKINS
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