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Public Service and Human Contributions

by Glenn T. Seaborg

MUCH HAS BEEN SAID and written about Robert Oppenheimer by the many friends and students with whom he shared his life—his knowledge, wisdom and the wealth of his personal warmth and wide range of worldly interests. Thus I would like to begin with my personal recollections of him. I was fortunate enough to have known and worked with him over a long period of time—particularly in the early years of nuclear discovery and development when we shared some of the excitement of those historic days.

The early days

I first met Robert Oppenheimer when I went to the University of California as a graduate student in chemistry in 1934. Oppie had then just passed his thirtieth birthday and was an associate professor of physics, dividing his time between Berkeley and the California Institute of Technology in Pasadena. I must confess that he made a terrific impact on me—one which I never quite got over in the following thirty odd years of acquaintance with him. And I have the feeling that his memories of a gangling, young, naïve, would-be nuclear chemist may have continued to color his own view of me long after I pictured myself as having reached a moderate stage of maturity.

I am afraid that I may have manufactured occasions that made it necessary for me to consult with him regarding my research problems. In retrospect I do not see how these problems could have been of great intrinsic interest to him, but I cannot recall any occasion when he was at all unwilling to help. One particularly puzzling riddle, a real one in this case, concerned the results of the irradiation of various elements with fast neutrons in the MeV energy range that I was doing in the mid-1930's with David C. Grahame, also a graduate student at that time. The Japanese physicist Seishi Kikuchi and his coworkers had observed in such experiments the production of electrons in the MeV energy range, and they attributed these to some unusual direct interaction of the fast neutrons with orbital electrons. Grahame and I preferred the view that these electrons were the internal conversion products of gamma rays produced in nuclei that had been excited by the inelastic scattering of the neutrons, at that time an unobserved, or at least unproved, process. But this interpretation presented a problem because the experimental results suggested internal conversion coefficients much higher than had generally been observed up to that time. This is one of the riddles I presented to Oppie, and I believe that I succeeded in intriguing him although the explanation came some time later as a result of the recognition of the role of spin change in slowing down gamma-ray transitions and increasing their internal conversion.

I imagine I had one difficulty with Oppie that was common to all who sought his advice, that is, facing his tendency to answer your question even before you had fully stated it. And in this respect, I recall taking great pains in formulating my questions to him in a way that I could put the main thrust of my thoughts as early as possible into every sentence.

I particularly remember Oppie's role in physics-department seminars. Everyone turned to him for explanation of their experiments in nuclear physics, and his electric personality certainly contributed to our fascination and satisfaction with his performance. I remember particularly that I was present at the seminar in January 1939 when new results of Otto Hahn and Fritz Strassmann on the splitting of uranium with neutrons were excitedly discussed; I do not recall ever seeing Oppie so stimulated and so full of ideas. As it turned out, I was privileged to witness his first encounter with the phenomenon that was to play such an important role in

shaping the future course of events in his life.

As Viki Weisskopf wrote, the year 1939 changed many things, and Viki has given an illuminating account of Oppenheimer's marvelous leadership at Los Alamos. Although I spent the war years at the Metallurgical Laboratory at the University of Chicago, my contacts with Oppenheimer continued. He paid me visits on many of his trips to Chicago, and our discussions continued to impress me with his enduring interest in chemistry, an aspect of his character that has perhaps not been so well known. We discussed not only the problems attendant with the chemical purification of plutonium as required for its successful use as an explosive but also the various chemical methods under investigation for the separation of plutonium from uranium and fission products at Hanford, Washington.

The GAC

My closest association with him was at the time I served as a member of the Atomic Energy Commission's General Advisory Committee (GAC) during the first three-and-one-half years of its existence. The GAC played an important role in those formative years of the Commission, and Oppenheimer, as chairman of the GAC, was the architect of that role. The GAC, whose other members at that time were James B. Conant, Lee DuBridge, Fermi, Hood Worthington, Isidor I. Rabi, Peter Noël Rowe and Henry De Wolf Symth, had the responsibility of setting the initial course of the AEC's military program and guiding the first ventures in the peaceful uses of nuclear energy.

I recall how impressed I was with Oppie's leadership of the committee. During the three-and-a-half-years, we met in about twenty sessions of the GAC. These three-day-long meetings were usually held over the weekends when we had the time, or took the time, to leave our other duties. In a brilliant manner at the conclusion of each session, when the AEC commissioners came in to review our work, Oppie presented a masterful summary of the proceedings. I know that my fellow members of that GAC remember with me that this was pure Oppenheimer at his very best. I regret that tape recordings were not made of these eloquent summations of our deliberations, for I believe that these were better than the written record that followed and would provide fascinating historical material.

I believe that it is not generally appreciated how much of Oppenheimer's efforts in those early GAC meetings went toward strengthening the commission's and our nation's position in national defense. He devoted great effort to programs that strengthened the position of the Los Alamos Laboratory, and he emphasized the priority of plutonium production at Hanford.

Peaceful uses of the atom

During those early GAC days Oppie also showed his great desire to foster the peaceful role of the atom. Like most of us he wanted to see the early development of nuclear power. But, also like most of us at that time, he was somewhat overly pessimistic about the possibilities of rapid growth in this area. At least, judged by the current activity in nuclear power, his early report on the outlook for developing civilian nuclear power did not anticipate the possibilities being realized today.

During his leadership of the GAC, Oppenheimer spearheaded the move for strong AEC support of fundamental research. In no other era of human history had the world seen such a transfer of theory into application as in the events of the Manhattan Project. Perhaps better than any other person Oppenheimer, who had overseen so much of this project, saw this transfer take place. And to a man of his depth and philosophical insight the realization of the future implications of fundamental research had a most profound effect. He saw the dawn of a new age of science and knew that the government's relationship to science could never be the same. Therefore, he argued brilliantly in GAC proposals to ensure that the AEC would play a leading role in fundamental nuclear research. In one of his statements in support of nuclear research he made what AEC Chairman David Lilienthal termed "as brilliant, lively and accurate a statement as I believe I have ever heard."

In line with his case for AEC support of fundamental research Oppie advocated that the Commission support such research in the universities and other research establishments, thus helping initiate the incredible growth of science resulting from government-university coöperation.

Finally, regarding Oppenheimer's contributions on the GAC (and I have touched on only a few of them), he was a strong advocate of making fundamental scientific information available to all scientists and of distributing materials such as radioisotopes to scientists abroad, not only for medical investigation and therapy, but for use in basic research.

Oppie's contributions to his government extended far beyond his service during the war and his work on the GAC.

Nuclear detection system

While still at Los Alamos he was one of the first to recognize that a nuclear-test detection system should be established and so recommended while he was still with the Manhattan District. While chairman of the Committee on Atomic Energy of the Joint Research and Development Board, he was helpful on a number of occasions throughout the years 1948–50 to the program that was conducting research and development on techniques for detecing nuclear explosions. I had the privilege of serving with him on the panel that evaluated and confirmed the report by early scientific detection experts that the Soviets had, indeed, broken the US monopoly on nuclear weapons by testing a nuclear device of their own on 29 August 1949. He also served in a similar capacity to endorse the findings of the US detection system in 1951 that the Soviets had conducted their second and third nuclear tests.

He served his government in numerous other capacities. He served in 1945 on Secretary Henry L. Stimson's Scientific Panel of the War Department's Interim Committee and in 1946 on President Harry S. Truman's Evaluation Committee for Operation Crossroads. He served the Joint Research and Development Board from 1947 to 1952 in many capacities, perhaps the chief of which was as a member and chairman of its Committee on Atomic Energy. He was a member of the Naval Research Advisory Committee

from 1949 to 1952 and the Science Advisory Committee, Office of Defense Mobilization, from 1951 to 1954. He served on the Secretary of State's Panel on Disarmament in 1952 and 1953. And this enumeration of his services to his country is only a representative fraction of his total contributions.

We are all familiar with Oppenheimer's leading role in formulating the Acheson-Lilienthal Report of 1946 that called for the creation of an international authority to control all work in atomic energy. Much of the substance of this plan, which emphasized the peaceful potential of atomic energy, was incorporated in the proposal later presented to the United Nations by Bernard Baruch. Although the Baruch proposal was rejected, it set the tone for future thinking in international control and coöperation and anticipated many of the subsequent ideas and much of what we hope to achieve in the future. Twenty years later our current hopes for a nonproliferation treaty owe much to this original groundwork. Oppenheimer's contributions to the Baruch plan were indicative of his farsightedness and depth of understanding as well as his humanitarian outlook.

These are some of the contributions in the area of governmental public service that Robert Oppenheimer rendered to his country. But his public service contributions went far beyond this. He was tireless in his efforts to explain and interpret science, its meaning, its intellectual, cultural, humane, economic, political and sociological implications, to the broadest possible audience. He did this by means of speeches to a diverse spectrum of audiences, by the written word in a wide range of publications, by participation before Congressional Committees, by numerous appearances on radio and television, and by active memberships in many organizations and societies devoted to this cause.

His many contributions to his country were recognized by three presidents and the honors they bestowed upon him. The first was President Truman who in 1946 awarded him the Medal of Merit for his work at Los Alamos. The citation accompanying this award praised Oppenheimer for ". . . his great scientific experience and ability, his inexhaustible energy, his rare capacity as an organizer and executive, his initiative and resourcefulness, and his unswerving devotion to duty. . ."

The second president to honor him was President John F. Kennedy. This honor was in the form of an invitation to a White House dinner given in honor of Nobel Prize winners. President Kennedy had also decided, before his death, to present him with the Fermi Award.

Fermi Award

The third presidential honor he received was from President Lyndon B. Johnson in 1963. This was the occasion when the President presented Oppenheimer with the AEC's Enrico Fermi Award. In personally making the award at the White House President Johnson said in part: "Dr Oppenheimer, I am pleased that you are here today to receive formal recognition for your many contributions to theoretical physics and to the advancement of science in our nation. Your leadership in the development of an outstanding school of theoretical physics in the United States and your contributions to our basic knowledge make your achievements unique in the scientific world."

It seems to me that President Johnson's inclusion of a reference to Oppenheimer's role as a teacher was singularly appropriate. His role as an extraordinary and almost unique teacher must certainly be included among his public service and human contributions. Robert Oppenheimer will go down in the history of science for his founding of what has been called "the American school of theoretical physics."

Speaking of Oppenheimer's extraordinary talents as a teacher, Bethe wrote recently in *Science*: "His lectures were a great experience, for experimental as well as theoretical physicists. In addition to a superb literary style, he brought to them a degree of sophistication in physics previously unknown in the United States. Here was a man who obviously understood all the deep secrets of quantum mechanics and who yet made it clear that the most important questions were unanswered."

When Oppenheimer became director of the Institute for Advanced Study at Princeton in 1947, the physics department of the institute became the new international mecca of theoretical physics just as Copenhagen had served this role in the 1920's and 30's. Pauli, Dirac and Yukawa often came to Princeton during the Oppenheimer era at the institute, and Murray Gell-Mann, Marvin L. Goldberger, Geoffrey F. Chew, Francis E. Low, Yoichiro Nambu, Dyson, Pais, Tsung Dao Lee and Chen Ning Yang were among the many who worked there under Oppie's inspired leadership.

Although his greatest contribution to science was probably his role as an inspiring teacher, organizer and catalyst of the "new physics," Oppenheimer was a creative scientist who made many significant contributions to theoretical physics.

It is virtually impossible to summarize the additional "human" contributions of Robert Oppenheimer, just as it is almost impossible to separate them from his scientific contributions. Those scientists who knew him well and worked with him closely were equally impressed by the scope of his knowledge and interest—in languages, literature, the arts, music and the social and political problems of the world—as they were by his scientfic wisdom. Above all those who knew him read his writings, or heard him speak, were impressed by his fervent desire to see and relate an order and purpose in the entire spectrum of human existence and experience.

Oppenheimer was probably unique among scientists of our age in his effect on and high standing among other scientists. His magnetic, really electric, personality, his charismatic presence and his unique style commanded attention in a manner equalled by few scientists. His basically humanitarian outlook and his obvious concern for the overall welfare of humanity were widely recognized and appreciated throughout the world of science. And these qualities carried over to the world of nonscientists to an extent that was almost without parallel.

The passing of Robert Oppenheimer not only marks the passing of an era of physics but also portends an irreplaceable loss to the world of all scientists and nonscientists alike.

Perhaps the best way to show the

breadth and depth of his thinking would be to quote from some of his numerous writings and speeches, which exemplify so well his human and humanitarian qualities. I would, therefore, like to conclude with a few sections from some of Robert Oppenheimer's writings and speeches. The few passages I have chosen represent only a small sampling of his thoughts, but I think they may be significant on this occasion.

Speaking before a Japanese audience at the Bunkyo Public Hall of Tokyo, September 1960, he commented aptly enough on tradition:

"Tradition, of course, is to preserve, to refresh, to transmit, and to increase our insight into what men have done as men, in their art, their learning, their poetry, their religion, their politics, their science, feeling, thinking beings with our experiences, to cope with our sorrows, to limit and make noble our joys, to understand what is happening to us, to talk to one another, to relate one thing to another, to find the great themes which organize our experience and give it meaning. It is what makes us human."

In an address before the Tenth Anniversary Conference Congress for Cultural Freedom, in Berlin, June 1960, he again touched on tradition, this time introducing one of his favorite themes—the need for common understanding.

"I have been much concerned that in this world we have so largely lost the ability to talk with one another. In the great succession of deep discoveries, we have become removed from one another in tradition, and in a certain measure even in language. We have had neither the time nor the skill nor the dedication to tell one another what we have learned, nor to listen nor to hear, nor to welcome its enrichment of the common culture and the common understanding. Thus the public sector of our lives, what we have and hold in common, has suffered as have the illumination of the arts, the deepening of justice, and virtue, the ennobling of power and of our common discourse. We are less men for this. Our specialized traditions flourish; our private beauties thrive; but in those high undertakings where man derives strength and insight from the public excellence, we have been impoverished. We hunger for nobility: the rare words and acts that harmonize simplicity and truth. In this I see some connection with the great unresolved public problems: survival, liberty, fraternity."

In a broadcast talk "Prospects in the Arts and Sciences" for the Columbia University Bicentennial, 26 December 1954, Oppenheimer spoke of the common thread of the arts and sciences. "Both the man of science and the man of art live always at the edge of mystery, surrounded by it, both always, as the measure of their creation, have had to do with harmonization of what is new and what is familiar with the balance between novelty and synthesis, with the struggle to make partial order in total chaos. They can, in their work and in their lives, help themselves, help one another, and help all men. They can make the paths that connect the villages of arts and sciences with each other and with the world at large the multiple, varied, precious bonds of a true and world-wide community."

The theme of "community" was prevalent in many of his talks, as exemplified by this quote from his address "Science and Our Times," delivered to the Roosevelt University Founders and Friends Dinner in Chicago, 22 May 1956.

"Occasionally between the sciences, and more rarely between a science and other parts of our experience and knowledge, there is a correspondence, an analogy, a partial mapping of two sets of ideas and words. We learn then to translate from one language into another. Ours is thus a united world, united by countless bonds. Everything can be related to anything; everything cannot be related to everything. It may perhaps then be a beginning of wisdom to learn of the virtues, of the restraint and tolerance, and of the sense of fraternity that will be asked of us, if, in this largely new world, we are to live, not in chaos, but in community."

In the same talk he stresses the need for more learning.

"In a free world, if it is to remain free, we must maintain, with our lives if need be, but surely by our lives, the opportunity for a man to learn anything. We need to do more: We need to cherish man's curiosity, his understanding, his love, so that he may indeed learn what is new and hard and deep. We need to do this in a world in which the changes wrought by the applications of science, and the din of communication from remote and different places, complement the unhinging, unmooring effects of the explosive growth in knowledge itself."

For some closing thoughts I turn to the final paragraphs of Robert Oppenheimer's lecture at the University of Wisconsin, 10 May 1959—an address called "The Tree of Knowledge." Here he expresses his belief that though we live in a world of growing specialization we must also grow in our ability to communicate with our fellow man.

"Civilization, all we are, all we know, all we can do, rests on our power to tell each other about things. We do that in more ways than words; but if we do not do that, we are not human. That is why I have been willing to trouble you with an account of what seems to me a very real problem.

"We have a double duty; and I think this has its analogs for everybody. I say it, I cannot help it, as a man who hopes he will spend some part of his life always with physicists and in physics. We have a duty to the things which are necessarily limited, which we are close to and know well and love; they may be a discipline, they may be an art, they may be a community, but they will always have to be fairly small, to have human compass. We have another duty, which is to be open and welcoming to all our fellows who are not part of this community, but are still necessary and beautiful parts of the human community. And this double sense of faithfulness to that which is our own, and openness to all that is human, is perhaps one of the attitudes, which more even than reform in education, more than any political gimmickry, will help to see us through one of the most peculiar episodes in man's history." □

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These articles are edited versions of speeches given at the Oppenheimer Memorial Session of the APS Meeting held in Washington, D. C. on 24 April 1967. ***For a complete Oppenheimer bibliography see pages 52–3.***