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J. Robert Oppenheimer: Proteus Unbound

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Argument

J. Robert Oppenheimer was a complex person. His work in physics during the 1930s, at Los Alamos during the 1940s, and as governmental advisor in the immediate postwar period, gave him a deep sense of connection with communities that had distinctive purposes. But he found it difficult to conceive an overall creative vision for himself or to devise a compelling objective for the community he belonged to if one had not been formulated at the time he assumed its leadership. I analyze the reasons for his successes: the vision and demands of physics during the 1930s, the make-up of Los Alamos, and the challenges of the postwar atomic world. In each of these enterprises he assumed a distinctive role and came to represent a distinctive persona – but he could not integrate his activities into a coherent whole that might be a model for the intellectual in the new world he had helped to shape.

> The kind of person I admire most would be one who becomes extraordinarily good at doing lots of things but still maintains a tear-stained countenance.
>
> J. Robert Oppenheimer 1926

In Greek mythology Proteus was the old, prophetic, uncommunicative, shepherd of the seas' flocks who knew all things – past, present, and future. Those who wished to consult him first had to surprise him and bind him during his noonday slumber. Even when caught he would try to escape by assuming all sorts of shapes; but if caught he would then tell all he knew. Protean thus came to mean: variable, versatile, taking many forms.

In his Jefferson Lecture of the Humanities in 1973 Erik Erikson called Jefferson a *Protean* man. By the latter he meant a many sided man of universal stature; a man of many gifts, competent in each; a man of many appearances yet (in the case of Jefferson) centered in a true identity. Erikson noted that the appellation *Protean* could also designate a man of many disguises; a man of chameleonlike adaptation to passing scenes; a man of essential elusiveness. However, such designations in a man of exceptional stature must be seen in relation to the new identity emerging in his time. As part of a self-made man a Protean personality would convey the ability to make many things of oneself, and this in a semi-deliberate and rebellious fashion (Erikson 1974, 51–2).

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Like Jefferson, Oppenheimer can aptly be characterized as a *Protean* man, with both designations applying. But in contrast to Jefferson, whom Oppenheimer admired greatly, Oppenheimer was a man of many appearances. George Kennan, who got to know Oppenheimer after the war[1] and became his colleague at the Institute for Advanced Study in 1951, made some of the most perceptive observations of Oppenheimer's personality. He described him as

> in some ways very young, in others very old; part scientist, part poet; sometimes proud, sometimes humble; in some ways formidably competent in practical matters, in other ways woefully helpless: . . . a bundle of marvelous contradictions . . .. His mind was one of wholly exceptional power, subtlety, and speed of reaction . . .. The shattering quickness and critical power of his own mind made him . . . impatient of the ponderous, the obvious, and the platitudinous, in the discourse of others. But underneath this edgy impatience there lay one of the most sentimental of natures, an enormous thirst for friendship and affection, and a touching belief . . . in what he thought should be the fraternity of advanced scholarship . . . [a belief that] intellectual friendship was the deepest and finest form of friendship among men; and his attitude towards those whose intellectual qualities he most admired . . . was one of deep, humble devotion and solicitude. (Kennan 1972, 18)

Oppenheimer made many things of himself: creative physicist and influential teacher in an era that revolutionized the physical sciences, charismatic administrator of a wartime project that altered the course of world history, prominent adviser to the highest echelon of American policy makers in the postwar period. In each of these roles he became the personification of what others should aspire to. Yet for all these accomplishments he could not fashion a sense of identity for himself. A sense of identity means a sense of being at one with oneself as one grows and develops; and it means, at the same time, a sense of affinity with a community's sense of being at one with its future as well as its history – or mythology (Erikson 1974, 27). For a time, his work in physics during the 1930s, in Los Alamos during the 1940s, and his role as governmental advisor in the immediate postwar period, did give him a deep sense of connection with communities that had a distinctive purpose. But he found it difficult to integrate these disparate roles – perhaps because he found it difficult to conceive an overall creative vision for himself or to devise a compelling objective for

[1] Kennan first saw Oppenheimer in the fall of 1946 when Oppenheimer came to deliver a lecture at the National War College. In his *Memoirs* Kennan described that encounter as follows:

> He shuffled diffidently and almost apologetically out to the podium: a frail, stooped figure in a heavy brown tweed suit with trousers that were baggy and too long, big feet that turned outward, and a small head and face that caused him, at times, to look strangely like a young student. He then proceeded to speak for nearly an hour, without the use of notes – but to speak with such startling lucidity and such scrupulous subtlety and precision of expression that when he had finished, no one dared to ask a question – everyone was sure that somehow or other he answered every possible point. [But] curiously enough, no one could remember exactly what he had said. The fascination exerted by his personality, the virtuosity of the performance, and the extreme subtlety of expression had actually interfered with the receptivity of the audience to the substance of what he was saying. This was to dog him throughout his life whenever it fell to him to address any other than a scientifically specialized audience.

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the community he belonged to if one had not been formulated at the time he assumed its leadership; perhaps also because each of these activities had also been connected with a deep crisis – a deep rupture. My paper highlights three such ruptures. One relates to his choice to become a physicist; another, his decision to give up being a physicist; the third pertains to the revocation of his security clearance. All three have a bearing on his role as persona.

The Early Years

Robert Oppenheimer was born in New York on April 22, 1904, into a prosperous, emancipated Jewish family of German descent. His father, Julius, was a successful business man who had come to the United States in 1888 when he was seventeen to work in the cloth importing business of relatives. His mother, Ella Friedman, was an artist whose family had migrated from Germany to Baltimore in the 1840s. A younger brother died shortly after birth, and his brother Frank was born in 1912. The Oppenheimers lived in a large eleventh-floor apartment overlooking the Hudson River and also maintained a summer home in Bay Shore on Long Island. His lifelong friends, Paul Horgan and Jeffries Wyman, who frequently visited his home during the 1920s, described the household as very handsome (several van Goghs adorned the walls), very formal and elegant, but somewhat sad and melancholic. The tone was set by the mother who had a crippled right arm that was always encased in a gray silk glove. Horgan described her as highly neurotic, highly attenuated emotionally, a mournful person. John Edsall, another of Oppenheimer's friends during the 1920s, had the impression that Bob, as Robert was called by his friends until the late 1920s, was strongly attached to his mother, but not to his father. During Robert's youth, the Oppenheimers were active members of the Ethical Culture Society that Felix Adler had founded in 1876. It was therefore natural for the young Robert to be sent to the Ethical Culture School. He entered its second grade in September 1911 and graduated its high school in February 1921. For the precocious, dazzling, but insecure young Robert, the school was an ideal place to nurture his differences yet not cause him to feel like an outsider. One of his schoolmates remembered him at age fifteen, as still a little boy, . . . very frail, . . . very shy, and very brilliant. He outgrew his shyness, but the insecurity and a deep unhappiness remained. Paul Horgan, with whom he became good friends during a trip to New Mexico in the summer of 1922 before entering Harvard, recalled that "Robert had bouts of melancholy, deep, deep, depressions as a youngster" (Smith and Weiner 1980, 6).

Oppenheimer entered Harvard in 1922 with the intention of becoming a mining engineer. He majored in chemistry, but took and audited many other courses: physics (with Edwin Kemble and Percy Bridgman), mathematics (with George Birkhoff), philosophy (with Alfred North Whitehead), as well as courses in the humanities. A good friend described the diffident young Robert at Harvard as somewhat precious, narcissistic, arrogant, and completely blind to music. But even though he worked like

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a demon, he found time to cultivate his amity with Paul Horgan and with Francis Fergusson, a classmate from the Ethical Culture School who had also gone to Harvard, and to form new lasting friendships – with John Edsall, Jeffries Wyman, Frederick Bernheim and others. There was, however, no time for dating women.

His talents were such that he could have been anything he chose. His friends actually thought that he would become a humanist. Oppenheimer's contact with Percy Bridgman and with Edwin Kemble convinced him that he wanted to be a physicist. Physics offered him a safe, bounded arena in which he excelled, into which he could focus his energies, and in which he didn't have to confront his personal demons. The study and practice of physics required intense discipline, and Oppenheimer believed that through discipline, though not through discipline alone, one can achieve serenity and a detachment that preserves the world that it renounces. "I believe that through discipline we learn to preserve what is essential to our happiness in more and more adverse circumstances, and to abandon with simplicity what would else have seemed to us indispensable" (ibid., 156). Moreover, physics presented problems he could be *passionate* about: their solution indicated how the world is put together.

During his senior year he spent many hours each week in Bridgman's laboratory working on the problem of the effect of pressure on metallic conduction. That experience had made it clear to him that even though he was acquiring a deep appreciation and understanding of experimental practices, his genre, whatever it was, was not experimental science. Nevertheless, upon graduating from Harvard, he went off to Cambridge University to a disastrous experience working at the Cavendish.

His aspiration to be a physicist under the tutelage of Bridgman without great competence in the laboratory raised doubts in the minds of his teachers at Harvard. Bridgman in his letter of recommendation to Rutherford at the Cavendish acknowledged that Oppenheimer's weakness is on the experimental side, explaining that his type of mind was analytical, rather than physical, and that he is not at home in the manipulations of the laboratory. Yet it was clear to everyone at Harvard that Oppenheimer was an exceptional person. In his letter to Rutherford, Bridgman referred to Oppenheimer's perfectly prodigious power of assimilation. Though he felt unsure whether Oppenheimer would ever make any real contribution of any real character, Bridgman indicated that "if he does make good at all, I believe that he will be a very unusual success" (ibid., 77).

The year following his graduation from Harvard was one of deep emotional crisis. Oppenheimer went to the Cavendish hoping to work with Rutherford, but came under the tutelage of J. J. Thomson. "The business in the laboratory was really quite a sham . . .. I was living in a miserable hole," he reminisced to Thomas Kuhn (Kuhn 1963, 2). His experiment on the scattering of electrons on thin beryllium targets to measure the electrical conductivity in thin metallic films did not work, and Thomson, by now an old man, was not very helpful. Even though he was terribly excited by the new developments in physics, his failure as an experimentalist raised doubts about the appropriateness of a career in physics. John Edsall, who was working towards a Ph.D.

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in biochemistry at St. John's College at the time, remembered Oppenheimer talking to him at length about the papers of Heisenberg, Dirac, and Schrödinger and the meaning of these advances. Francis Fergusson and John Edsall noted how acutely troubled Robert was (see Smith and Weiner 1980 and Schweber 2000 for details). During a visit to Fergusson in Paris in the late fall of 1925, Oppenheimer revealed his despair over his inept performance in the laboratory and confided about unsatisfactory sexual ventures. The crisis seemed to have abated by itself and was overcome by the end of the summer. The nature of all the factors involved in the crisis in the winter of 1925 have not been disclosed. Undoubtedly Oppenheimer's frustration in his work at the Cavendish and his general unhappiness with the Cambridge culture, were catalysts in the breakdown. Another element was a confrontation with his sexual identity, questions of sexual polarity had arisen.[2] The latter issue is of relevance only in so far as it may point to another aspect of this exceedingly complex man, a feature that made cohesiveness and integrity of self more difficult. Although he never experienced a crisis of similar proportion as the one in Cambridge, Oppenheimer's delicate emotional balance was always precarious. As Isador Rabi later put it: In Oppenheimer the element of earthiness was feeble (Rabi, in Oppenheimer 1967, 3). Behind a facade of charm, wit, arrogance, and on occasion callousness, also lurked deep insecurities and, in particular, doubts about his creativity.

Becoming a Physicist: Oppenheimer and His School

After he recovered from his crisis, Oppenheimer determined to become a theorist. At Cambridge he published his first papers – both on quantum mechanics. They indicate that by mid–1926 he had not only mastered all the recent papers of Born, Jordan, Heisenberg, Dirac and Pauli, but had gone on to carve out an area of his own: problems involving the continuous spectrum.

A visit to Cambridge by Max Born led to an invitation to continue his studies at Göttingen. Oppenheimer accepted. At Göttingen he became a member of the intellectual community around Born, and blossomed. His close friendship with Paul Dirac and Isador Rabi dates from these days. He there continued working on the description of aperiodic phenomena in the new wave mechanics. He was one of the

[2] See in this connection the interviews of Alice Kinball Smith with Bernheim. A. K. Smith Papers. MIT Archives. Pais in his autobiography indicates that already in the early 1950s he was convinced that a "strong, latent homosexuality was an important ingredient in Robert's emotional makeup" (Pais 1997, 241). In Oppenheimer's FBI files, the following piece of extremely derogatory information was obtained during an interview with (name deleted) of the University of California at Berkeley: "It was further stated by (name deleted) that it was common knowledge on campus that prior to Oppenheimer's marriage he was possessed [sic!] with homosexual tendencies and at the time was having an affair with Harvey Hall, . . . a mathematics student at the University, who was an individual of homosexual tendencies and at the time was living with Robert Oppenheimer" (V. P. Kay to Mr. Ladd November 10, 1947. J. R. Oppenheimer, FBI security file [microform]. Wilmington, Del.: Scholarly Resources. Reel 1).

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first theorists to work on the quantum mechanical description of scattering phenomena – problems involving continuum wave functions that could not be tackled with the old quantum theory. With Born he wrote an important paper that laid the foundation for the quantum mechanical treatment of molecules, a problem he had already addressed in Cambridge in his paper on the quantum theory of vibrational and rotational degrees of freedom of molecules. In that paper Born and Oppenheimer formulated a quantum mechanical approach to describing physical phenomena that has become ever more prominent. Born and Oppenheimer recognized that in molecules the lighter electrons move much faster than the heavier nuclei. To describe the nuclear motion they therefore essentially integrated out the (high frequency) electronic motion and obtained an approximate, effective, wave mechanical description of the nuclear vibrations (Born and Oppenheimer 1927).

Oppenheimer obtained his Ph.D. in the spring of 1927 after less than a year's stay in Göttingen. He spent the following year as a National Research Fellow at Harvard and at the California Institute of Technology. At Cal Tech, discussions with Robert Millikan and Charles C. Lauritsen, who had just observed the extraction of electrons from metal surfaces by very strong electric fields, led to an extension of his previous treatment of the ionization of hydrogen atoms by electric fields. His theory of field emission was the first example of the phenomenon of barrier penetration in wave mechanics and antedated Condon and Gurney's and Gamow's explanation of decay in radioactive nuclei.[3] His work on cold field emission exhibited a feature that was to become very prominent in his work: close collaboration with his experimental colleagues.

While at Cal Tech, Oppenheimer visited Berkeley and decided that he would like to go there because it was a desert. "There was no theoretical physics and I thought it would be nice to start something." But he also recognized the danger of being isolated, and therefore kept a connection with Cal Tech, which he thought was "a place where I would be checked if I got too far off base." He accepted appointments at Berkeley and at Cal Tech that were to start after he had spent another year in Europe as a postdoctoral fellow (Kuhn 1963, 9–10).

When Oppenheimer first came to Berkeley and started giving graduate courses, his lectures left students bewildered. But after a few years all his courses – particularly his lectures on quantum mechanics and on electromagnetic theory – were models of clarity, emphasizing utility, but also conveying to the students the beauty of the subject matter. In his eulogy, Hans Bethe noted: "Probably the most important ingredient [Oppenheimer] brought to his teaching was his exquisite taste. He always knew what were the important problems, as shown by his choice of subjects. He truly lived with these problems, struggling for a solution, and he communicated his problems to his group" (Bethe, in Oppenheimer 1967, 13). It should also be noted that Oppenheimer was not only the center of his students' intellectual world, he was

[3] See Oppenheimer 1984, 173, for his recollection of these researches.

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also at the center of their social world. In his eulogy, Serber described Oppenheimer's interaction with his students:

> He met the group [which in the mid thirties consisted of a dozen graduate students and about half a dozen postdoctoral fellows] once a day in his office. A little before the appointed time the members straggled in and disposed themselves on the tables and about the walls. Oppie came in and discussed with one after another the status of the student's research problem while others listened and offered comments. All were exposed to a broad range of topics. Oppenheimer was interested in everything; one subject after another was introduced and coexisted with all the others. In an afternoon they might discuss electrodynamics, cosmic rays, astrophysics, and nuclear physics. (Serber, in Oppenheimer 1967; see also Serber 1998)

This form of cooperative investigation that made use of the collective knowledge of the group became the characteristic mode of distributed inquiry in research groups – but only much later. Oppenheimer had recognized the transformation that had taken place in theoretical physics, and in physics more generally, since the advent of quantum mechanics: physics had become much more of a cooperative enterprise. In a radio address on the occasion of Albert Einstein's sixtieth birthday in 1939, Oppenheimer spoke of this transformation:

> All discoveries in science grow from the work, patient and brilliant, of many workers. They would not be possible without this collaboration; they would not be possible without the constant technological developments that are necessary to new experiments and new scientific experience. One may even doubt whether in the end they can be possible except in a world which encourages scientific work, and treasures the knowledge and power which are its fruits.[4]

I submit that during the 1930s Oppenheimer was arguably the most imaginative and courageous theoretical physicist working in quantum field theory and high energy physics, the foundational frontiers of the discipline.[5] Furthermore, as Bethe asserted in his eulogy, "J. Robert Oppenheimer did more than any other man to make American theoretical physics great" (Bethe, in Oppenheimer 1967, 12). Moreover, he represented a new type of theoretical physicist, who by virtue of his mastery of the novel features that emerged from the synthesis of quantum mechanics and special relativity, could not only account for some of the puzzling experimental data generated by the newly built accelerators and by cosmic ray experiments – but who could also predict new ontologies: positrons and mesotrons.

Oppenheimer, this self-made man with a Protean personality, had fashioned himself, semi-deliberately, into this new kind of theoretical physicist. Together with

[4] Oppenheimer's remarks were reported in *Science* 1939 89(2311):335–336.

[5] Serber detailed the contribution of Oppenheimer and that of his students to particle physics during the 1930s in Serber 1983, 206–221.

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Bethe, Teller, Wigner, and others, he extended what it meant to be a theoretical physicist beyond the role fashioned by those working in more circumscribed fields such as atomic, molecular and solid state physics. The role played by them during World War II would be critical at the Radiation Lab at MIT, at the Met Lab at Chicago, and at Los Alamos.

The irony was that during the 1930s Oppenheimer was ahead of his time. Experiments were not accurate enough to corroborate his suspicions that the Dirac equation could not account for the spectrum of the hydrogen atom. Furthermore, a mistake in the calculations by one of his students, Sidney Dancoff, robbed him of the opportunity to address the divergence difficulties one encounters in the lowest order of perturbation theory in quantum electrodynamics and to overcome them by a procedure that later would be called mass and charge renormalization – when in fact he was clearly aware of the physics involved. Similarly, cosmic ray experiments were difficult to analyze and could not pinpoint the masses nor the spin of the observed mesotrons; astrophysical observations were such that claiming that a stellar object might be a neutron star would at best be considered an interesting suggestion and the state of theoretical astrophysics was such that claiming the possible existence of black holes would certainly have been considered a wild conjecture. The fact that many of his most insightful and daring productions could not be experimentally verified prevented him from obtaining confidence that he was a very creative physicist. But there is no doubt that during the 1930s theoretical physics was his first love, that it fully engaged his scientific efforts and that he was fully committed to these activities.

The 1930s were also tumultuous times. The Great Depression; the Nazi takeover of Germany; Hitler's pathological anti-semitism and expulsion of all civil servants of Jewish descent from governmental positions and the ensuing migration of German scholars to Great Britain, the United States, and elsewhere; the Spanish Civil War; the Stalinist purges in the Soviet Union; all eroded the safe haven that physics had provided Oppenheimer. His involvement with Jean Tatlock introduced him to political action and led him to actively support the cause of the Loyalist Spanish government. In 1940 he married Kitty Puening Harrison, who had been previously married to a Communist labor organizer, Joe Dallett, who had gone to fight in Spain and was killed there.

After the outbreak of World War II in September 1939 and particularly after the fall of France in June 1940, Oppenheimer felt that this was a time when the whole of western civilization was at stake. France, one of the great bastions of western civilization, having fallen, Oppenheimer committed himself to seeing that Britain and the United States won't fall as well. He publicly stated: "We have to defend western values against the Nazis. And because of the Molotov-von Ribbentrop pact we can have no truck with the Communists." When the opportunity presented itself to work on the uranium project Oppenheimer eagerly accepted. He worked on Lawrence's project that had as its goal the electromagnetic separation of U^{235} from U^{238} in naturally occurring uranium ores.

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Early in 1942 Oppenheimer was assigned the responsibility for the investigation of fast neutron fission and for the design of an atomic bomb. The concept of a fission bomb and its feasibility had first been analyzed by Frisch and Peierls and their associates in England. It became the focus of a thorough study by theorists working with Oppenheimer in Berkeley during the summer of 1942. Oppenheimer directed this workshop, which was concerned with the theoretical design of an atomic bomb and the estimation of its efficiency. The results obtained by this study group bolstered the conclusion that Peierls and Frisch had obtained and refined their estimate of the amount of U^{235} necessary and gave a better estimate of the efficiency of such a weapon. In the spring of 1943 the Los Alamos Laboratory was established to develop and fabricate an atomic bomb, with Oppenheimer as its director.

Los Alamos

When one reads the reminiscences of many of the physicists who had participated in the wartime project at Los Alamos, one has the sense that they look back upon that experience as if Los Alamos had been a utopia. They had believed that they were in a frantic race to save the western democracies. Their hope was that the atomic bomb would guarantee victory and secure a lasting peace. They knew they were involved in an enterprise which if successful would change the course of human affairs.[6]

Los Alamos was unique in its enormous concentration of first-rate people who constantly gave proof of what could be accomplished by their working together on very circumscribed goals. It was, in fact, a collaboration of unparalleled intensity. A cooperative task undertaken by outstanding people into which everyone threw himself completely and single-mindedly, and to which every one gave his ideas, his experience, and his energy fully, freely, and selflessly. The intensity resulted in the total effort being much greater than the sum of its parts. And everyone shared in the credit. Although the mood of exultation that Bethe and Rabi spoke of in their eulogies of Oppenheimer was not shared by everyone, after the Trinity test, the successful

[6] In his presentation to the Gray Board that was reviewing his security clearance in 1954, Oppenheimer noted that Los Alamos

> was a remarkable community, inspired by a high sense of mission, of duty and of destiny, coherent, dedicated and remarkably selfless. There was plenty in the life of Los Alamos to cause irritation . . . but I have never known a group more understanding and more devoted to a common purpose, more willing to lay aside personal convenience and prestige, more understanding in the role that they were playing in their country's history. Time and time again we had in the technical work almost paralyzing crises. Time and again the laboratory drew itself together and faced new problems and got on with the job. We worked by night and by day; and in the end the many jobs were done.

In the Reith lectures Oppenheimer delivered over the BBC in 1953, he recalled Los Alamos in more personal terms, in particular, his experiences:

> of the power and the comfort in even bleak undertakings, of common, concerted, co-operative life. Each one of us knows how much he has been transcended by the group of which he is a part; each one of us has felt the solace of other men's knowledge to stay his own ignorance, of other men's wisdom to stay his folly, of other men's courage to answer his doubts and weakness. (Oppenheimer 1989, 71)

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explosion of a plutonium bomb in the New Mexico desert in early July 1945, it became clear to everyone that without Oppenheimer's masterly direction, Los Alamos might not have produced atomic bombs in time to be used on Japan. This implied that the credit he received was justifiable, but also that he bore a greater responsibility for the consequences of the creation of these weapons. – and consequently, possibly a greater burden of guilt.

Though isolated – and perhaps because of its isolation – Los Alamos created that rare situation in the lives of individuals and communities when they feel in touch with much more than themselves. During the few years spent there, many of them – and in particular many of the physicists – felt whole. An atmosphere of wholeness permeated the entire enterprise, transmuting it into a kind of magic and enshrining it in the minds of those who had been there. Oppenheimer – who was largely responsible for creating this sense of wholeness and maintaining it until the project was successfully completed – personified the integration of the multifacetedness of the enterprise: the theoretical and the experimental, the mundane and the idealistic, the individual, the community. and the nation.

But attributing the success of Los Alamos solely to Oppenheimer is mistaken. Just as the answer "the conductor"[7] is usually given to the question "What makes for a great musical ensemble?" is committing the leader attribution error, the same is true for Los Alamos. The standard answer in the case of orchestras reflects the conventional view that the leader's behavior and style molds the team's processes so as to yield an off-scale team performance. The psychologist Richard Hackman who has studied the performance of many different kinds of teams – emergency rooms nursing and medical staffs, musical ensembles, athletic teams, airline cockpit crews, . . . – has come to the conclusion that to answer the question "What makes for a great ensemble?" requires focusing on *the conditions that support effective team performance, i.e. demands carefully analyzing the enabling conditions* and *not constraining the answer to state causalities* (Allmendinger et al. 1994; Hackman 1990). In Hackman's view, what made Los Alamos a success was that the following conditions were satisfied:

> 1) Its various divisions were populated by individuals who possessed an impressive mastery of the requisite technical skills. Recall that the laboratory was divided into seven divisions, each of which had definite tasks to perform. Each division was responsible for producing assessable results for which its members had collective responsibility.
> 2) There was a compelling purpose to the enterprise.
> 3) The divisions operated in a well defined organizational context. Furthermore, the structure of the divisions and of the groups within them was enabling: the process of carrying out its tasks enhanced the capability of the members to work together interdependently. Moreover, the group experience contributed to the growth and personal well-being of its members.

[7] Incidentally, that answer is most often also given by the members of orchestras themselves.

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> 4) A very supportive organizational context existed: essentially unlimited resources were channeled into the project. In addition, the ability to requisition the needed materials and manpower – by virtue of General Leslie R. Groves being in charge of the operation – made it possible to maintain a very demanding schedule and tempo for the project.

It is only because all these conditions were in place that Oppenheimer's leadership could eventually be so effective. "Eventually" because at the beginning it seems clear that Oppenheimer was unaware of the complexities that the operation entailed. Nor did those who knew him believe that he was temperamentally suited for the job of director of the laboratory. Robert Wilson, a nuclear physicist who had been trained at Lawrence's Radiation Laboratory and who knew Oppenheimer from Berkeley characterized him as an "eccentric, almost a professional eccentric when I knew him before 1940. . . . He just wasn't the kind of person that you would think would be an administrator." At first, Wilson disliked him at Los Alamos, for Oppenheimer was arrogant "a smart-aleck [who] didn't suffer fools gladly," but within a few months Wilson found that Oppenheimer had transformed himself into a superb administrator. "He had class and he had style" and noted that "when I was with him, I was a larger person . . .. I became very much of an Oppenheimer person and just idolized him. . . . I changed around completely" (Palevsky 2000, 134–5).

To highlight what was responsible for making Oppenheimer such an effective leader let me recall Bethe's eulogy at the memorial service for Oppenheimer that was held at the Institute for Advanced Study in the spring of 1967:

> Los Alamos might have succeeded without him, but certainly only with much greater strain, less enthusiasm, and less speed. As it was, it was an unforgettable experience for all the members of the laboratory. There were other wartime laboratories of high achievement . . .. But I never observed in any one of these other groups quite the spirit of belonging together, quite the urge to reminisce about the days of the laboratory, quite the feeling that this was really the great time of their lives.
>
> That this was true of Los Alamos was mainly due to Oppenheimer. He was a leader. It was clear to all of us, whenever he spoke, that he knew everything that was important to know about the technical problems of the laboratory, and he somehow had it well organized in his head. But he was not domineering, he never dictated what should be done. He brought out the best in all of us, like a good host with his guests. And clearly because he did his job very well, in a manner all could see, we all strove to do our job as best we could.
>
> One of the factors contributing to the success of the laboratory was its democratic organization. The governing board, where questions of general and technical laboratory policy were discussed, consisted of division leaders (about eight of them). The coordinating council included all the group leaders, about 50 in number, and kept all of them informed on the most important technical progress and problems of the various groups in the laboratory. All scientists having a B.A. degree were admitted to the colloquium in which specialized talks about laboratory problems were given. Each of these three assemblies met once a week. In this manner everybody in the laboratory felt

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> a part of the whole and felt that he should contribute to the success of the program. Very often a problem discussed in one of these meetings would intrigue a scientist in a completely different branch of the laboratory, and he would come up with unexpected solutions.
>
> This free interchange of information was entirely contrary to the organization of the Manhattan District as a whole . . .. Oppenheimer had to fight hard for free discussion among all qualified members of the laboratory. But the free flow of information and discussion, together with Oppenheimer's personality, kept morale at its highest throughout the war. Los Alamos has been an example for big accelerator laboratories ever since, and although they are concerned with very different scientific problems, Brookhaven and CERN and many other places have gained much of their spirit from wartime Los Alamos. (Bethe, in Oppenheimer 1967, 13–14)

The fact that whenever he spoke, Oppenheimer "knew everything that was important to know about the technical problems of the laboratory, and that somehow he had it well organized in his head" was surely a key attribute responsible for his success. It suggests again the analogy with the great orchestra. Oppenheimer was a great conductor. He knew intimately the parts played by all the divisions, and could coordinate all their actions. He set the tempo of the enterprise and maintained the sense of urgency. Similarly, he immediately saw the integrative value of the weekly Colloquium that Bethe had proposed in the early summer of 1943 and convinced Groves and Richard Tolman of its potential value for boosting the morale of the staff. The Colloquium became open to any staff member with a badge that allowed him or her to enter the technical area. Since all aspects of the work being carried out in the various divisions were presented and discussed at the Colloquium, everyone who attended had a general sense of the progress and status of the project. Since every one in attendance became privy to the scope and the objectives of the laboratory, the Colloquium fostered in each participant a sense of personal moral responsibility for the enterprise. It was one of the reasons that after the war the Los Alamos physicists were at the center of the efforts to ensure that nuclear developments would be under civilian control and this as a collective action under the aegis of the Federation of Atomic Scientists (Smith 1965).

Once again Oppenheimer, this self-made man with a Protean personality, had fashioned himself, semi-deliberately, into a remarkable, charismatic director of a project that was to alter world history. In the process, he became the model for how to direct the numerous research laboratories that were established after World War II.

The Postwar Years

After Hiroshima and Nagasaki almost everyone connected with Los Alamos had come to the conclusion that a nuclear war must never be waged. Perhaps because he was responsible for the bombs to be ready by the summer of 1945, Oppenheimer was

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deeply troubled by the obliteration of Hiroshima and Nagasaki. On August 17 he wrote Henry Stimson, the Secretary of War,

> The safety of this nation, as opposed to its ability to inflict damage on an enemy power – cannot lie wholly or entirely in its scientific or technical prowess. It can only be based on making future wars impossible. (Oppenheimer to Stimson, 17 August 1945. In Oppenheimer Papers)

How to use nuclear power effectively and safely, prevent the use of atomic energy as a weapon of war, and in the meantime curb the spread of nuclear bombs – weapons of sudden, overwhelming and horrifying destructiveness as revealed by the leveling of Hiroshima and Nagasaki – became the challenge that faced the newly founded United Nations Organization and its newly created International Atomic Energy Commission (IAEC). The IAEC was directly responsible to the Security Council, and had been asked by it to report on methods to effect the above goals. In early 1946 Secretary of State Byrnes appointed a committee headed by Undersecretary of State Dean Acheson to formulate the United States policy regarding atomic energy and to draft a plan that would be presented to the IAEC outlining the American position on these issues. The committee included Groves, Bush, Conant and John McCloy. To assist them an advisory panel was set up consisting of Harry Winne, a vice president of General Electric in charge of engineering, Chester Barnard, the president of the New Jersey Bell Telephone Company, Charles Thomas, vice president and director of research at Monsanto Chemical Company, Oppenheimer, with David Lilienthal, then the head of the Tennessee Valley Authority, as chair. The advisory panel was to draft recommendations to answer the question – Can a workable, feasible way be found to safeguard the world against the atomic bomb? – by formulating a position that would safeguard American interests yet have a good chance of being accepted by the Soviet Union (see Badash 1995). Oppenheimer became the principal architect of the Acheson-Lilienthal report that would have placed all atomic developments under an international agency – the Atomic Development Authority (ADA) – which would have exclusive control of all "dangerous" aspects of atomic energy. The report stipulated that national activity in these "dangerous" areas would be outlawed. The ADA would separate all U^{235} and plutonium, have control over all raw materials, and run all reactors. Participating nations would have to submit to a survey of uranium resources. The ADA would also promote the cooperative development of the atom's peaceful potentialities. The Acheson-Lilienthal proposal embodied Bohr's vision for international control of atomic energy, and Oppenheimer had been deeply influenced by Bohr during the latter's stay at Los Alamos.

But trouble developed after Truman and Byrnes appointed the seventy-five year old Bernard Baruch as the head of the US delegation to the UNO Atomic Energy Commission. Lilienthal thought the appointment disastrous by virtue of Baruch's age, "his unwillingness to work, his terrifying vanity." At his first meeting with Lilienthal Baruch spent most of the time telling him "how smart he is, how he doesn't need to

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study the facts, and how he will be in this thing to the end, that he isn't senile (he said it just about a half dozen times), and that he would outfox everybody" (Lilienthal 1964, 40).

Oppenheimer became deeply disturbed by Baruch's approach and particularly by his unwillingness to comprehend the technical reasons that had led to the formulation of the Acheson-Lilienthal plan. Until his encounter with Bernard Baruch, Oppenheimer's interactions with people like Bush, Conant, Groves, Stimson, Acheson, McCloy and Lilienthal had given him confidence that the destiny of the country was in the hands of people with integrity – disciplined men who had worked hard to understand the technical aspects of atomic energy and to appreciate the global implications of nuclear weapons. He might have differences with the viewpoints expressed by senators May, Johnson, and MacMahon over the military or civilian control of atomic energy and atomic weapons in peacetime, and with the position of James Byrnes over sharing atomic secrets with the Soviet Union – but he felt that they were dealing with him with integrity and respect and were open to exploring the consequences of the positions they were taking.

Baruch had recruited four associates who knew nothing about nuclear matters, and with their help reformulated the Acheson-Lilienthal plan. Baruch's proposal – which eventually won Truman's approval – embodied the outline of the Acheson-Lilienthal report, but not its spirit. It placed great emphasis on immediate punishment for violations and insisted that no veto power would exist when levying penalties for violations of the rules of the agreement. The central tenet of his plan, similar to the Acheson-Lilienthal one, was the assertion that once the international agency was operational, the world uranium deposits surveyed and assessed, the punishment for violations agreed upon, and the Security Council veto waived in nuclear issues, then all manufacture of atomic bombs by the United States would terminate and all existing atomic weapons would be dismantled. But Oppenheimer correctly inferred that Russians would see the "Baruch plan as a way to perpetuate the American monopoly in atomic energy and would not give up any of their sovereignty in favor of an international agency if the United States would be the only power having atomic weapons." (They indeed refused to consider the proposal when it was presented by Baruch to the UNO Atomic Energy Commission.) For a while Oppenheimer refused to join Baruch's delegation as a technical adviser.

Oppenheimer had tried in vain to have Baruch present a plan that at least would keep discussions going with the Russians. But Baruch was adamant that the position paper he would present to the IAEC incorporate his views regarding the veto and immediate punishment for violations. Oppenheimer became deeply despondent for he saw that no agreement would be reached with the Russians and predicted that:

> The American disposition will be to take plenty of time and not force the issue in a hurry; that then a 10–2 report will go the Security Council and Russia will exercise her veto and decline to go along. This will be construed by us as a demonstration of Russia's warlike intentions. And this will fit perfectly into the plans of a growing number who

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> want to put the country on a war footing, first psychologically, then actually. The Army directing the country's research; Red baiting; treating all labor organizations, CIO first, as Communist and therefore traitorous, etc. (Lilienthal 1964, 70)

On July 23, 1946 David Lilienthal met Oppenheimer in the evening and talked with him till 1:30 in the morning. The next day Lilienthal made the following entry in his Journal:

> O[ppenheimer] is in deep despair about the way things are going in New York. He sees no hope of an agreement; he doesn't feel that our plan [i.e. the Acheson-Lilienthal plan] is understood by the American delegation, that Baruch's preoccupation with punishment and veto has done a great deal of harm so that there is little or no discussion of the essentials of the plan. The whole business is quite undirected; he [Baruch] makes suggestions and quite uncritically they are accepted. There is no real discussion. The subcommittees are going through motions that induce what he feels is a wholly false sense of encouragement. (Lilienthal 1964, 69)

Lilienthal added: "[Oppenheimer] is really a tragic figure; with all his attractiveness, brilliance of mind." When they had parted early in the morning Oppenheimer looking so sad had said: "I am ready to go anywhere and to do anything, but I am bankrupt of further ideas. And I find that physics and the teaching of physics, which is my life, now seems irrelevant" (Lilienthal 1964, 69). Oppenheimer stopped doing physics, i.e. doing research as a vocation, from that time on and became primarily concerned with synoptic assessments. For the next few years he devoted much of his considerable energies and talents to becoming the most influential civilian adviser on atomic energy and atomic weapons within governmental circles – hoping that he might contribute to the formulation of some sort of *modus vivendi* with the Soviet Union.

Once again Oppenheimer, this self-made man with a Protean personality, had fashioned himself, semi-deliberately, into this new post-war role of scientist-statesman who owed his influence and status by virtue of his expertise in current scientific and technical matters. Oppenheimer not only adopted this new role in American political life and became a national public figure, he also became one of the senior statesmen of American physics after accepting the directorship of the Institute for Advanced Study in 1947. He might have believed that if a few wise people at the top had the right *ideas*, they could effect change. In both politics and physics he was a member of that elite, and perhaps assumed that therefore things would be fine. For a time, he may in fact have believed that only he had the pertinent insights and appropriate answers in matters of nuclear policy, and that only his participation could bring about a safe nuclear world. Perhaps his singular role at Los Alamos made him feel that he had a unique responsibility for finding solutions to the threat nuclear energy and nuclear weapons posed for humankind. But that role came to an abrupt end when his security clearance was revoked in December 1953.

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Hydrogen Bombs

Relations between the US and the Soviet Union deteriorated precipitously after the war. The failure to reach an agreement to place atomic energy under international control, the takeover of Czechoslovakia, the Berlin blockade, the victory of Mao Tse Dung over Chan Kai Chek on the Chinese mainland, the detection of the detonation of Joe 1, the first Soviet atomic bomb, in late August 1949, and the arrest of Klaus Fuchs in early January 1950, created an atmosphere that led Truman to order the AEC to go full speed ahead with the development of a hydrogen bomb, against the recommendation of the GAC.

After the detonation of Joe 1, the question whether the United States should intensify its effort to develop a "super" became the focus of intense debates within the US government. In the fall of 1949 Oppenheimer was opposed to a crash program to build a hydrogen bomb; and in this he was strongly influenced by James Bryant Conant, who in early October had written him that such a bomb would be built "over my dead body."

Oppenheimer believed that the atomic bomb had helped prevent further Soviet expansion into Western Europe, but it did not seem necessary to him to have more powerful weapons to deter Russian aggression even if the USSR had atomic bombs. By producing more A-bombs, refining their design to include tactical uses, and having a better delivery capability, he thought the US would be able to keep its military superiority over the USSR for the indefinite future. Moreover, when the GAC was confronted with the issue in the fall of 1949 it was uncertain whether a hydrogen bomb could be made. The method then proposed had been under theoretical development for seven years, and "in the end turned out to be unpromising, if not useless." Thus at their meeting of October 28–9, 1949, the GAC hoped that the development of fusion weapons could be avoided. Although recommending against a crash program, the GAC was not against the exploration of thermonuclear problems.

Truman's order to go ahead with a crash program for the development of an H-bomb also marked the adoption of the policy of immediate and massive retaliation as a deterrent against any Soviet aggression in any quarter of the globe. Since long-range bombers were to be the vehicles of delivery, the Strategic Air Command (SAC) commanded by General Curtis LeMay became the essential component of the policy. Oppenheimer on the other hand insisted on a greater emphasis on defensive strategies and helped write the conclusions of the 1951 Project Vista that asserted that small tactical atomic weapons could check any Soviet aggression in Western Europe. These differences of opinions between the Armed Forces, and SAC in particular, and an important segment of the scientific elite that was seen as being influenced by Oppenheimer led to a sharp confrontation. A famous article in the May 1953 *Fortune* magazine gave a blow by blow account of "The Hidden Struggle for the H-bomb: the Story of Dr. Oppenheimer's Persistent Campaign to Reverse US Military Policy" from the SAC point of view. The final sentence in the article concisely stated the

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differences between the scientific elite and the political and military elites: "There is a serious question of the propriety of scientists trying to settle grave national issues alone, inasmuch as they bear no responsibility for the successful execution of the war plans." Oppenheimer answered these charges in his July 1953 *Foreign Affairs* article. He there deplored the futility of the "rather rigid commitment to use [atomic bombs] in a very massive unremitting strategic assault on the enemy and of stockpiling a larger number of atomic weapons than the Russians since our twenty-thousandth bomb . . . will not in any deep strategic sense affect their two thousandth." Oppenheimer further emphasized the ineffectiveness of the policy since "relatively little [was being] done to secure our defences against the atom." Moreover, he foresaw a time when the "art of delivery and the art of defense will have much higher military relevance than supremacy in the atomic munitions field itself." But the main point Oppenheimer had to make was political rather than technical. Although he had witnessed a great deal of exchanges of opinions in and between many diverse and complex agencies of the government that contribute to the making of policy, the fact was that "a public opinion which is based on confidence that it knows the truth did not exist, for secrecy veiled the deliberations." Oppenheimer therefore recommended candor on the part of the government in order to strengthen the democratic process and the will of its citizens to confront the challenges to come.

As is well known, Oppenheimer's lack of enthusiasm during the early stages of the hydrogen bomb project, his support of explorations to ascertain whether the USSR would be willing to conclude an agreement that neither side test an H-bomb, and his emphasis on the development of tactical fission weapons, eventually led to the revocation of his clearance and his trial. A majority of both the Personnel Review Board and of the AEC commissioners who examined his appeal found that his personality was too complex to carry the responsibilities his scientific advisory position entailed. He had fabricated stories, i.e. lied, in 1943 in order to protect his friend, Haakon Chevalier, who had approached him with a proposition that he himself had considered treasonable, yet had dined with him in Paris in December 1953. The Gray Board found Oppenheimer's susceptibility to influence a threat to security. Although the Board did not doubt Oppenheimer's loyalty, it denied his appeal to have his security clearance reinstated because of his lack of enthusiastic support for the security program and for a crash program to develop a hydrogen bomb. The Board also expressed concern with "his highly persuasive influence in matters in which his convictions were not necessarily a reflection of technical judgment nor necessarily related to the strongest offensive military interests of this country." In arriving at this position the Board had accepted the contention that the only viable strategy was one based on massive retaliation with hydrogen bombs, in contrast to Oppenheimer's commitment to a more balanced, defensive strategy that relied on tactical atomic weapons and an air defense system (Oppenheimer 1970).

The loss of his clearance and the ensuing appeals trial constituted another deep crisis for Oppenheimer. His apathetic defense reflected the fact that he loved his

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country and could not understand how his loyalty could be doubted or his willingness to contribute to its strength and welfare could be questioned. That he was permitted to contribute to the unraveling of the destructive powers of the atom, but could not contribute in an official manner to the realization of the potentialities he believed the science of nuclear physics possessed – for peaceful applications, for communication, and for understanding among men – was undoubtedly one of the most disheartening experiences of his life.

The hurt and suffering he endured as a result of the revocation of his clearance was movingly conveyed in talks he gave in the fall of 1954. In an address delivered on the occasion of Columbia University's Bicentennial celebration, Oppenheimer painted a bleak and despairing overview of the world of the arts and sciences. Although he saw the arts and the sciences as flourishing, he stressed the diversity of language and techniques that separated "science from science and art from art, and all of one from all of the other." If each art and each science were thought of as a village then a "high altitude picture" would reveal innumerable villages with no paths between them. "Here and there passing near a village, sometimes through its heart, there [is] a superhighway, along which windy traffic moves at high speed. The superhighways [the mass media] seem to have little connection with the villages, starting anywhere and ending anywhere, and sometimes appearing almost by design to disrupt the quiet of the village."

In any village, i.e. in any science, there is harmony between practitioners. Each practitioner of that science, as a professional, is a member of a community where common understanding combines with common purpose and interest to bind men together both in freedom and co-operation. Their world and work is "objectively" communicable. But in their relations with a wider society, there is neither the sense of community nor of objective understanding. Even though the sciences developed out of the practical arts, the language and the knowledge of science have become so specialized that communication is possible only among initiates.

Only the artist retains as the "end of his work" communication with an audience which "must be man, and not a specialized set of experts among his fellows." Only the artist can speak to his fellow men in "intimacy, . . . directness and . . .depth." But the artist is bound to fail because "the traditions and the culture, the symbols and the history, the myths and the common experience, which it is his function to illuminate, to harmonize, and to portray, have been dissolved in a changing world." And in the new world "the unity of knowledge, the nature of human communities, the order of society, the order of ideas, the very notions of society and culture have changed and will not return to what they have been in the past . . .. The very difficulties it presents derive from the growth of understanding, in skill, and power." And if the growth in knowledge is responsible for the present evil, it is futile to seek to eradicate what has been learned. It is not only futile, "but in a deep sense, wicked. We need to recognize the change and learn what resources we have." It is a new, open world and the character of its openness stems from the irreversibility of knowledge.

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Salvation for the individual scientist lies in pursuing his vocation fruitfully. His place is thus not in the larger society but in the villages – in the communities of artists and scientists bound in freedom and co-operation by the common bond of creativity. The primary responsibility of the creative man is not the well being of the general society but the keeping of the gardens in his village – the true community – and to keep them flourishing in this great open, windy world.

With the loss of his security clearance, Oppenheimer's life changed. On the one hand a great responsibility had been lifted and he could now cultivate his wide interests and devote more time and energy to his duties as director of the Institute. There he tried to make paths between the various villages. But perhaps the greatest tragedy of Oppenheimer's life was not the ordeal he went through over the issue of his loyalty but his failure to make the Institute for Advanced Study a true intellectual community. Kennan observed that Oppenheimer was often discouraged, and in the end deeply disillusioned by the fact that

> the members of the faculty of the Institute were often not able to bring to each other, as a concomitant of the respect they entertained for each other's scholarly attainments, the sort of affection, and almost reverence, which he himself thought these qualities ought naturally to command. His fondest dream had been [Kennan thought] one of a certain rich and harmonious fellowship of the mind. He had hoped to create this at the Institute for Advanced Study; and it did come into being, to a certain extent, within the individual disciplines. But very little could be created from discipline to discipline; and the fact that this was so – the fact that mathematicians and historians continued to seek their own tables in the cafeteria, and that he himself remained so largely alone in his ability to bridge in a single inner world those wholly disparate workings of the human intellect – this was for him [Kennan was sure] a source of profound bewilderment and disappointment. (Kennan 1972, 19)

What emerges from my account of Oppenheimer's public life, is the absence of a life long project that could give coherence to the tasks he undertook. Giving up physics after the war took away the gratification that comes from the sense of mastery and accomplishment in work well done and the accompanying pride. On many occasions after the war Oppenheimer spoke of the fleeting, fragmented character of the new world he was living in. He could not mold the various pieces to mesh coherently and allow him to become the kind of person who is extraordinarily good at doing lots of things and is at one with himself.

Epilogue

In his eulogy for Franklin Roosevelt at the memorial service in Los Alamos in April 1945, Oppenheimer quoted a verse from the *Bhagavat Gita*: "Man is a creature whose substance is faith. What his faith is, he is."

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What was Oppenheimer's faith? Surely, the tenets of the Ethical Culture movement left their mark on him. I believe they helped mold his moral outlook and his sensitivity towards moral issues. They shaped his unusual consideration for others, his sense of *noblesse oblige* and what he believed were his responsibilities towards others. The Ethical Culture School also inculcated in him the belief that he should aspire to become a reformer, a leader, a person who will be supremely competent to change the world – and that the change he brought about would entail greater harmony with moral ideals. Change the world he did, and no one saw more clearly the global dangers engendered by the conquest of atomic energy, and no one was more profoundly aware of the dilemmas entailed by this new power over nature, which seemed to be out of proportion with man's moral strength. And no one was more passionate in his desire to be useful in averting the calamities that atomic weapons threatened to bring to mankind.

Similarly the tenets of Hinduism deeply influenced him. Already as an undergraduate at Harvard, Oppenheimer was conversant with the classical Sanskrit literature but at that time didn't know it in the original. In 1933 Oppenheimer began taking lessons from the Berkeley Sanskrit scholar Arthur W. Ryder who had translated the *Gita*, and studied the *Gita* with him. He later called the *Gita* the most beautiful philosophical song existing in any known tongue and quoted from it at singular, extraordinary moments. Thus, as is well known, upon witnessing the Trinity fireball in August 1945, Oppenheimer later claimed that the line from the *Gita* "I am become Death, the destroyer of worlds" burst in his consciousness. Undoubtedly, Oppenheimer's affinity to the *Gita* and its philosophy played a role in shaping his views and actions, but the *Gita* cannnot be *the* explanation for the role he played in the decisions to bomb Hiroshima and Nagasaki.[8] The views of key associates whom he respected – Bohr, Conant, Tolman, Groves, Rabi, . . . – those of his colleagues and friends in the Los Alamos community surely also affected him deeply.

His faith, to the extent that it can be characterized, was an amalgam of many things. It had components derived from his Ethical Culture upbringing with its emphasis on human welfare, from Christian thought with its emphasis on *caritas*, from the Gita and Hindu thought and its tenets of duty, from his readings of the Stoics and their notion of discipline, from Spinoza, from Bohr's notion of complementarity . . . He came to reject some of the platitudinous, universalistic tenets of Ethical Culture and became very much more concerned with the self-shaping, volitional aspect of

[8] In an article on Oppenheimer and the *Gita* James Hijiya suggested that Oppenheimer was deeply affected by three tenets of Hinduism: duty, fate, and faith. Hijiya submits that while at Los Alamos, Oppenheimer, following the dictates of duty in Hindu thought, believed that he had a job to do, that he should do it because it was *his* job to do as a scientist and that he should do it without any intent of self-aggrandizement. And perhaps Oppenheimer believed that following these principles would bring a measure of serenity into his tormented existence. In the Hindu ethical system, when one's obligation as a member of a caste and one's duties stemming from being in a certain stage in life conflict with universal duties obligatory for all human beings, the particular duties prevail. Hijiya adduces this tenet to explain Oppenheimer's role in the decisions to bomb Hiroshima and Nagasaki (Hijiya 2000).

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ethical conduct. He also came to include contextual factors and culture-specific values and motives in making sense of himself as a moral agent. Thus in a lecture delivered at the University of North Carolina in 1960, Oppenheimer asserted:

> It was one thing to say, along the banks of the Sea of Galilee, Love thy neighbor. It is a different thing to say it in today's world. Not that it is less true; but it has a different meaning in terms of practice and in terms of what men can manage. (Oppenheimer 1960, 13)

Oppenheimer's insistence on morality being context dependent helps explain why he never wavered in his belief that making the atomic bomb was right. Thus the following exchange took place in Geneva in 1964 following Oppenheimer's address entitled "L'Intime et le Comun" (Oppenheimer 1965)

> van Camp: If you had foreseen the present situation in the world, would have dared start the researches that led to the atomic bomb?
> JRO: My role was very more modest . . .. My role was to preside over an effort, to make, as soon as possible, something practical. But I would do it again.
> . . .
> Weisskopf: I would like to address Mr. Oppenheimer in a different fashion. Given what has happened these past twenty years, would you in the position you were in 1942, would you again accept to develop the bomb?
> RJO: To this I have answered yes . . .
> An assistant: Even after Hiroshima?
> RJO: Yes

In his lectures after the war, Oppenheimer often spoke of the break with tradition, of the feeling of novelty he was experiencing in the new world he was living in and of the vertigo brought about by the tempo of change. I would characterize him as almost postmodern during the last decade of his life.[9]

[9] Oppenheimer was a relativist, for he did not believe that one could recognize a detached or valid perspective from which to judge the morality of other societies. In a letter in 1951 to George Kennan, who found it difficult to understand his sense of morality, Oppenheimer explained: "it is not in our judgment of ourselves or our own actions that I would reject moralism: it is rather in our attitude toward the behavior of other peoples. What I question is our ability to put ourselves, as a nation, in the place of these other peoples and decide what is right or wrong in the light of their standards and traditions, as they see them, or even in the eyes of the Almighty. I regard the behavior of other societies as something the morality of which I would prefer not to have to determine. I think it is our business to study that behavior attentively, to measure the intensity of the emotional forces behind it, and to take careful account of the potency of its influence on international affairs; but I feel we would do better not to attempt to classify it as right or wrong, praiseworthy or reprehensible. We Americans have enough, it seems to me, with our consciences and with the necessity, now upon us, to reconcile an individualistic tradition with the centralizing pressures of advanced technology. It is for this that we are accountable as a body politic, not for the decisions and solutions arrived by others. Let us conduct our policies in such a way that they are in keeping with our own character and tradition. This means, of course, that the moral element, as we feel it, must be present" (Oppenheimer Papers. Library of Congress. Archives Division).

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He became very suspicious of statements that refer to totality and completeness and to the eternal and the immutable.

> only a malignant end can follow the systematic belief that all communities are one community; that all truth is one truth; that all experience is compatible with all other; that total knowledge is possible; that all that is potential can exist as actual. (Oppenheimer 1953, "An open house" in Oppenheimer 1984, 75–6)

He likewise became very distrustful of order which is hierarchical in the sense that it says that some things are more important than others – that some things are so important that you can derive everything else from them (Oppenheimer 1959, 39). As far as science was concerned

> No part of science follows, really from any other in any usable form. I suppose nothing in chemistry or in biology is in any kind of contradiction with the laws of physics, but they are not branches of physics. One is dealing with a wholly different order of nature.[10]

And he came to embrace the variety and diversity not only of the arts and the sciences, but of the cultures that populate our changing world. His concluding remarks in the Whidden Lectures delivered at McMaster University in 1962, evoke Darwin's last paragraph of the *Origin of Species*. Darwin's tangled bank "clothed with plants of many kind, with birds singing on the bushes" was proof of the wondrous workings of biological evolution resulting in the amazing diversity of living things. But it was from "the war of nature, from famine and death, that the most exalted objects we are capable of conceiving," namely the production of human beings, "directly follows." Similarly, for Oppenheimer "the increasingly tangled, increasingly wonderful and unexpected situation" that our social world presents is the result of cultural evolution. But it is we who must contribute "to the making of a world which is varied and cherishes variety, which is free and cherishes freedom, and which is freely changing to adapt to the inevitable needs of change of the twentieth century and all centuries to come, but a world which, with all its variety, freedom and change, is without nation states armed for war and above all, a world without war."

[10] Oppenheimer, *Tradition and Discovery*, a lecture delivered in 1960, in Oppenheimer 1984, 106. In another lecture from this same period he asserted: "There are no synapses, no gaps, no gulfs in the picture of the various orders and parts of nature; but they are not derivable from one another. They are branches, . . .each with its own order, each with its own concern, each with its own vocabulary" (Oppenheimer 1960, 15). The metaphor of a tree is invoked because it is a growing thing; it is a tree not a temple (ibid., 17).

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References

Allmendinger J., J. R. Hackman, and E. V. Lehman. 1994. *Life and Work in Symphony Orchestras: An Interim Report of Research Findings.* Cambridge, MA: Division of Research, Harvard Business School.

Badash, L. 1995. *Scientists and the Development of Nuclear Weapons: From Fission to the Limited Test Ban Treaty, 1939–1963*. Atlantic Highlands, N.J.: Humanities Press.

Born. M. and J. R. Oppenheimer. 1927. "Zur Quantentheorie der Molekülen." *Annalen der Physik*, 4th series 84:457–484.

Brown, L. M. and L. Hoddeson. 1983. *The Birth of Particle Physics*. Cambridge: Cambridge University Press.

Davis, N. P. 1968. *Lawrence and Oppenheimer.* New York: Simon and Schuster.

Erikson, E. H. 1974. *Dimensions of a New Identity.* New York: Norton.

Hackman J. R., ed. 1990. *Groups that Work (and those that don't): Creating Conditions for Effective Teamwork*. San Francisco: Jossey-Bass.

Hijiya, J. A. 2000. "The *Gita* of J. Robert Oppenheimer." *Proceedings of the American Philosophical Society* 144/2:123–167.

Kennan, G. 1967. "Oppenheimer." *Encounter* 28/4:55–6.

Kennan, G. F. 1972. *Memoirs 1950–1963*. Vol. 2. Boston: Little, Brown.

Kuhn, T. S. 1963. "Interview with J. Robert Oppenheimer by Thomas S. Kuhn, November 18, 1963." *Archive for the History of Quantum Physics*, AIP, NY.

Lilienthal, D. 1964. *The Journals of David E. Lilienthal: The Atomic Energy Years 1945–1950*. Vol. II. New York: Harper and Row.

Michelmore, P. 1969. *The Swift Years: The Robert Oppenheimer Story.* New York: Dodd, Mead.

Oppenheimer, J. R. *Oppenheimer Papers*. Library of Congress. Archives Division.

Oppenheimer, J. R. 1955. *The Open Mind*. New York: Simon and Schuster.

Oppenheimer, J. R. 1959. "Talk to Undergraduates." *Kansas Teacher* (February):18–20, 39–40.

Oppenheimer, J. R. 1960. *Some Reflections on Science and Culture.* Chapel Hill: University of North Carolina Press.

Oppenheimer, J. R. 1964. *The Flying Trapeze: Three Crises for Physicists.* New York: Oxford University Press.

Oppenheimer, J. R. et al. 1965. *Comment vivre demain?* Textes des conférences et des entretiens organisés par les Rencontres internationales de Genève 1964. Neuchâtel: La Baconnière.

Oppenheimer, J. R. 1967. *Oppenheimer.* New York: Scribner.

Oppenheimer, J. R. 1970. *In the Matter of J. Robert Oppenheimer: Transcript of Hearing before Personnel Security Board and Texts of Principal Documents and Letters. With a foreword by P. M. Stern*. Cambridge, Mass.: MIT Press.

Oppenheimer, J. R. 1984. *Uncommon Sense.* Edited by N. Metropolis, G. C. Rota, and D. Sharp. Boston: Birkhäuser.

Oppenheimer, J. R. 1989. *Atom and Void: Essays on Science and Community.* Princeton, N.J.: Princeton University Press. (This collection is a reprint of Oppenheimer 1954 and Oppenheimer 1964.)

Palevsky, M. 2000. *Atomic Fragments: A Daughter's Questions.* Berkeley, CA: University of California Press.

https://doi.org/10.1017/S0269889703000711 Published online by Cambridge University Press

Rhodes, R. 1987. *The Making of the Atomic Bomb.* New York: Simon and Schuster.
Rhodes, R. 1995. *Dark Sun*. New York: Simon and Schuster.
Rieff, P. 1969. *On Intellectuals: Theoretical Studies, Case Studies.* Garden City: Doubleday.
Schweber, S. S. 1993. *QED and the Men who Made It*. Princeton, N.J.: Princeton University Press.
Schweber, S. S. 2000. *In the Shadow of the Bomb.* Princeton, N.J.: Princeton University Press.
Serber, R. 1983. "Particle Physics in the 1930s: A View from Berkeley." In Brown and Hoddeson 1983, 206–221.
Serber, R. with R. P. Crease. 1998. *Peace and War: Reminiscences of a Life on the Frontiers of Science*. New York: Columbia University Press.
Smith, A. K. 1965. *A Peril and a Hope: The Scientists' Movement in America, 1945–1947*. Chicago: University of Chicago Press.
Smith, A. K. and C. Weiner, C., eds. 1980. *Robert Oppenheimer. Letters and Recollections*. Cambridge, MA: Harvard University Press.

https://doi.org/10.1017/S0269889703000711 Published online by Cambridge University Press