



EINSTEIN & OPPENHEIMER

THE MEANING OF GENIUS

Silvan S. Schweber

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For Snait

without whom it would not have been done

and

without whom it could not have been done

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Preface

In the light of the numerous publications connected with the centennial of Albert Einstein's *annus mirabilis* of 1905 and the several biographies of J. Robert Oppenheimer that have appeared in the past few years, one may well ask whether another book on Einstein and Oppenheimer is warranted.

A possible justification for the present volume is that it explores aspects of the lives and personalities of Einstein and of Oppenheimer that have received less attention: their views of individual and collective creativity, their link to Buddhist thought, their metaphysics, and in particular, how they coped with their lives after having climbed to summits that are unreachable to almost everyone else—this last, an aspect of their lives that is put into sharper relief by a comparative study.

One of my aims in the book was to banish the term *genius* when referring to these two extraordinary individuals by emphasizing how they created their science and made use of the cognitive and intellectual resources of their community; how they interacted with their colleagues and friends, and with the communities they were part of; how they

molded themselves after they had become “great men”; how they lived with their “greatness”; and how they saw each other’s greatness and interacted with one another. I refrained from using the attribution of “genius” because I wanted to stress the resources available to the individual and the role of the community. Calling Einstein a “genius” dwarfs the background against which his work was done—so that only the foreground, he himself, remains.

Both Einstein and Oppenheimer were singular human beings—off-scale as I am wont to say. But I am very conscious of the fact—and emphasize—that context and the vagaries of circumstances were factors in allowing them to become “great.” Einstein was born at the right time and was at the right place to be able to make his truly remarkable contributions to the development of physics. Einstein could achieve his particular greatness by arriving on the scene at the particular time that he did: it was precisely the time when the limitations and fissures of “classical” physics had become manifestly evident and that it had been concluded that Newtonian gravitational theory could not account for the anomaly in the precession of the perihelion of Mercury. It was Einstein’s creation of general relativity that makes him the extraordinary figure that he is in the pantheon of natural scientists. Any number of other people, individually and collectively, would have come up with the other outstanding contributions he made to the development of physics. Einstein did publish five remarkable papers during 1905, but they were the product of much prior research and rumination by him and by others—Heinrich Hertz, Hendrik Lorentz, Max Planck, and Henri Poincaré, in particular. And though perhaps in a somewhat different form, even general relativity would in time have been formulated by others. The fact is that there are crucial constraints of nature. Moreover, there is something to the “pre-established harmony between mathematics and physics” that Einstein believed in, howsoever that “harmony” is interpreted. A connection between geometry and gravitation would eventually have become established in other hands—but probably only later. In addition, it should also be remembered that Einstein had intense interactions with his friend Marcel Grossman and with David Hilbert in order to assimilate and

master the mathematical resources necessary to formulate his final version of general relativity.

I have had the privilege to come into contact with or study the lives of some of the outstanding members of the theoretical physics community, including Paul Dirac, Werner Heisenberg, Wolfgang Pauli, Hans Bethe, Rudolf Peierls, Lev Landau, Eugene Wigner, Edward Teller, Robert Oppenheimer, Freeman Dyson, Richard Feynman, Julian Schwinger, Sin-Itiro Tomonaga, Steven Weinberg, Jeffrey Goldstone, and David Gross. There is a great deal of contingency in what such people accomplish. Much depends on the problems faced by the community, the intellectual resources then available, the freedom—economic, professional, and political—to pursue their researches. It is my contention that some of them would have accomplished many of the things Einstein did—except perhaps for general relativity.

Keep also in mind how different the contexts were in the first two decades of the twentieth century and during the 1930–1970 period regarding the size of the community and the experimental data available. It is with that in mind that I believe that Oppenheimer, given his talents, could have made a singular contribution to the creation of quantum mechanics during the decisive year 1925–1926 had he arrived on the scene at that time. Because of the trench dysentery he contracted in 1921 on a trip to Germany while searching for mineral samples, he had to postpone entering Harvard for a year, and thus came into his own a year too late to make contributions to the genesis of quantum mechanics of the same importance, if not as those of Heisenberg, Erwin Schrödinger, Dirac, and Wolfgang Pauli, then perhaps those of Max Born and Pascual Jordan. Bear also in mind that quantum mechanics was the result of an intense collective and communal effort, while the general theory of relativity is the work of one person.

I believe that there are always people like Einstein about. I believe that Julian Schwinger, Richard Feynman, Murray Gell-Mann, Frank Yang, Steven Weinberg, Gerard 't Hooft, Kenneth Wilson, David Gross, Edward Witten, and Frank Wilczek are such people. The fact is that the range of phenomena they had to deal with was much more extensive

and the amount of reliable, accurate data they had to assimilate, comprehend, and explain was much greater than what Einstein had to confront with his gravitational theory. Also, their community was and is much, much larger, and the competition they faced much more intense. Put somewhat factitiously, Einstein's theory of general relativity accounted for two refractory pieces of data: the equality of the inertial and gravitational mass of an object and the advance of the perihelion of Mercury of 43 arcseconds per century. Einstein also made two predictions: the deflection of light passing near the sun and the redshift of light emitted on the surface of a heavy star. Of course, not to be forgotten and most important is the fact that under specified conditions, Newton's gravitational theory is a limiting case of general relativity, and therefore all the successes of that theory can be recovered from general relativity. But compare this with the phenomena and data accounted for by quantum mechanics, by the electroweak theory of Glashow, Salam, and Weinberg, and more generally by the standard model.

Given the size of the community, the selection process that operates in the choice of scientific fields that attracts gifted young people, and the cultural context, perhaps it is not possible for an individual at present to attain the "mythical" greatness status that Newton and Einstein were able to achieve. Should string theory be confirmed, I believe Witten would join their rank.

Schwinger, Feynman, Gell-Mann, Weinberg, and Wilson were lucky to be born at a time when their tradition and their culture at the local level inculcated in them a desire to emulate Einstein and others like him, and the culture and politics at the national level supported and valued their talents and strivings. There are many gifted young people like Lee and Yang in China today. Whether they will follow in Lee and Yang's path depends on the cultural, political, social, and economic values the Chinese government will promulgate, which in turn will determine the opportunities and channels such young people will have in order to develop their talents. Governmental Chinese policy will also determine whether there will be positions that will give such people the freedom to chart their own paths. Lev Landau did what he did because the only

channels open to him in the Soviet Union during the 1930s and 1940s were condensed matter and nuclear physics. If born elsewhere, who knows what he might have accomplished. It is this set of underlying suppositions that has molded my exposition in the book.

Oppenheimer's singular standing derives from his directorship of Los Alamos. He helped bring about a victorious end to the last "just war," and in the process the products of the laboratory he directed transformed the world. But this achievement was at a personal price that he never came to terms with, and I should add, at a collective price that humankind has not yet come to terms with. Oppenheimer was aware of the deep transformation that had been wrought by nuclear weapons from the moment of their creation and use. He was never at peace with himself in the various roles he assumed thereafter—as a citizen, as a scientist, as an adviser to the highest echelon of his government, and as an intellectual. Nor was he able to integrate these roles so as to render him effective and durable in the part he played in averting the catastrophes that the use of fission or fusion bombs would bring about. The task he faced after World War II was superhuman.

My intent in putting this book together was only coincidentally to offer further biographical materials regarding the life of Einstein and Oppenheimer. As I have stated, during the past decade there have been a number of excellent studies of Einstein: the biographical works of David Cassidy, Gerald Holton, Albrecht Fölsing, John Stachel, and Palle Yourgrau and the researches of Jean Eisenstadt, Don Howard, John Norton, Jürgen Renn, John Stachel, and others on the genesis of general relativity readily come to mind. In addition, 2005 has generated a rich assortment of more general books on Einstein addressed to a wide readership. Similarly, the impressive biographies of Oppenheimer by Jeremy Bernstein, Kai Bird and Martin Sherwin, David Cassidy, Abraham Pais and Robert Crease, and Charles Thorpe have given us accounts of his life that will be definitive for a long time to come. Also, Priscilla McMillan's careful, thorough, and sensitive depiction of Oppenheimer's "ruin," and the works by Barton Bernstein, Gregg Herken, and others have presented us with as detailed a report as is possible at the present

time of the complex story of Oppenheimer's involvement with the creation of nuclear weapons and the factors that led to the revocation of his security clearance.

I would also like to stress that this book should not be seen as an endeavor to compare Oppenheimer and Einstein, and certainly it is not to be interpreted as an attempt to diminish Einstein or elevate Oppenheimer, nor is it to be read as judging them. I have looked at their lives and their interactions in order to better understand them, both individually and in their context. As one of the reviewers of the manuscript indicated, a possible title for the book might have been *Einstein and Oppenheimer: The Scientific and Political Scene of Their Times*.

The book should be read as addressing the question: How did Einstein and Oppenheimer try to remain relevant after they had made their singular contributions? Though subtitled "The Meaning of Genius," the book is really about the meaning of greatness, of individuality, and of community. It does not address the questions: Why has Einstein become the mythic figure that he has? And: Why our fascination with Oppenheimer? Nonetheless, I hope that the book gives some insights into the distinctive character of their individuality to enable giving answers to these questions.

EINSTEIN AND OPPENHEIMER

Introduction

The real is not given us, but set as a task
(in the manner of a riddle).

—*Albert Einstein (1949a, 681), quoting Immanuel Kant*

On one of their walks together in the early 1950s, Albert Einstein told J. Robert Oppenheimer, “When it has once been given you to do something rather reasonable, forever afterward your work and life are a little strange” (Oppenheimer 1956b, 2). Einstein had not been modest as a young man, but as a man in his seventies he characterized what he had achieved as “something reasonable” rather than as “something great.” Both Einstein and Oppenheimer had done “great things”; both were “great”; both transformed our ideas concerning what human beings can be or do. In his essay on Chaim Weizmann, Isaiah Berlin noted that

Greatness is not a specifically moral attribute. It is not one of the private virtues. It does not belong to the realm of personal relations. A great man need not be morally good, or upright, or kind or sensitive, or delightful, or possess artistic or scientific talents. To call someone a great man is to claim that he has intentionally taken . . . a large step, one far beyond the normal capacities of normal men, in satisfying, or materially affecting, central human interests. (Berlin 1981, 32)

To deserve the attribution of “greatness,” Berlin required a thinker or artist to advance a society to an exceptional degree toward some intellectual or aesthetic goal, toward which it was already, in some sense, groping; or alternatively, to change its ways of thinking or feeling to a degree that would *not*, until the task had been performed, have been conceived as being within the powers of a single individual. Also, for Berlin, to be great, a thinker or artist need not have been a “genius.”

Similarly, in the realm of action, greatness, for Berlin, demanded that the individual seemed able, “almost alone and single-handed, to transform one form of life into another; or—what in the end comes to the same—permanently and radically alters the outlook and values of a significant body of human beings.” For this title to be truly deserved, the transformation that was effected had to have been such that those best qualified to judge considered it to be “antecedently improbable . . . something unlikely to occur without the intervention” of the person who for this very reason deserved to be described as great (Berlin 1981, 32–33).

Einstein surely was “great” by virtue of his extraordinary scientific accomplishments; Oppenheimer was deserving of the description by virtue of what he accomplished as a teacher in Berkeley during the 1930s and as director of the Los Alamos weapons laboratory during World War II. For both Einstein and Oppenheimer, science, and physics in particular, had a special meaning. Both were outstanding physicists, and becoming outstanding physicists was a necessary condition for their becoming “great” in Berlin’s sense.

Both Einstein and Oppenheimer became iconic figures at a certain stage of their lives. After the successful verification in 1919 of one of general relativity’s predictions—the bending of light in its passage near the sun—Einstein was hailed in the public sphere as a “genius,” “the greatest scientist of the world,” and “the most revolutionary innovator in physics” since Newton, a “universe maker” (Berlin 1981, 144–145). Myths were created about him.¹ In 1939, on the occasion of Einstein’s sixtieth birthday, Oppenheimer could state in a public address that “[Einstein’s] name is perhaps more widely known than that of any other living scientist; to many millions of people it has come to stand for sci-

ence itself, and for all we admire in the way of life and thought of the scientist” (Oppenheimer 1939, 335).²

As time went on, in addition to his scientific stature Einstein became acclaimed for his humanity, his humility, and his lack of pretension. He also was admired for his political stance during the Weimar period in Germany, for his fight against fascism during the 1930s, after World War II for his commitment to racial equality, for his stand against McCarthyism, for his campaigning for peace, and for his efforts to eliminate nuclear weapons. He became seen not only as a courageous guardian of democracy and an outspoken foe of militarism, but as the embodiment of reason and of ethical behavior. And his concerns with morality and with religion found resonance in the public sphere. Perhaps no more admiring summary of Einstein’s life, character, and accomplishments has been written than the *Biographical Memoir* by John Archibald Wheeler, himself an outstanding physicist who devoted a good part of his life to extending general relativity. This is what Wheeler said:

Of all the questions with which the great thinkers have occupied themselves in all lands and all centuries, none has ever claimed greater primacy than the origin of the universe, and no contributions to this issue ever made by any man anytime have proved themselves richer in illuminating power than those that Einstein made. (Wheeler 1980b, 97)

Oppenheimer, for his part, was the “boy-wonder” of the American physics community. During the 1930s he created an outstanding school of theoretical physics at the University of California in Berkeley. After 1945, having overseen the making of weaponry that terminated World War II, Oppenheimer quite suddenly rose to public eminence and recognition. This new prominence had not been presaged by events preceding the war. As Isidor Rabi noted in his eulogy for Oppenheimer in 1967:

[Before World War II] Oppenheimer’s reputation and influence were centered around the small and close circle of physicists. As the wartime director of Los Alamos Laboratory, he was bound to receive important public attention, but there were other directors of great laboratories, and other physicists, who shared equal esteem but did not become objects of