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5 / The Conscience of a Physicist

"My reawakening from being completely technically oriented came dramatically on July 16 as I experienced the test explosion of the first nuclear bomb. . . . That which had been an intellectual reality . . . had suddenly become a factual, an existential, reality. There is a very great difference."

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About thirty years ago, two graduate students from the Radiation Laboratory of the University of California at Berkeley were drinking coffee at the Student Union. Their conversation turned from nuclear physics, their usual obsession, to the war just breaking out in Europe. Very likely the left-wing discussion groups they had attended, or the anti-war demonstrations at Sather Gate, where they pushed their way at lunchtime, had an effect. They both agreed that the war in Europe was evil, that it would serve only to enrich the munition makers—the "Merchants of Death." They agreed that whatever might happen, and however justified the cause against Hitler might seem, the true course would be that of pacifism. They concluded with a friendly pact that come what may they would keep the faith, they would not get sucked into a futile, immoral war.

A scant year later, the two young men confronted each other at a different radiation laboratory. This one was just being formed at the Massachusetts Institute of Technology to develop the electronic device that would soon become known as military radar. Remembering that pact of a year earlier, they looked at each other sheepishly and simultaneously asked, "But what are you doing here?"

I was one of the young men and a good deal had happened to me in the intervening year. I had gone on to Princeton University as an instructor, and there I had been exposed to a completely different climate of opinion. At Berkeley, sentiment had not differed greatly from the more virulent isolationism of the Midwest. Princeton, however, was a bastion of British sympathy. Some members of the physics department who had come from Britain were beginning to return for active duty. Refugee members, with a direct experience of Nazism, were exploring methods of becoming directly involved with the war; indeed, one of the most notable of the faculty tried to enlist in the Army in order to carry a rifle. He was rejected. In this hostile atmosphere, I pressed my quasi-isolationist, quasi-religious, and, believe me, unpopular point of view. I made no converts. Meanwhile, as Nazi might proved more and more successful, I grew more and more uneasy. If Hitler indeed conquered the world, could I bear to stand by and watch it happen, could I bear to think what life might be like?

In a matter of months, I received a telegram from my professor at Berkeley, Ernest Lawrence. He had sent similar telegrams to other former students, requesting that we appear in Boston for an emergency meeting. I went. There a team of British scientists dramatically described the Battle of Britain. They told us how they had helped in the battle by using radio waves to sense enemy airplanes. Lawrence and other senior scientists were proposing the formation of a laboratory at MIT to put a major effort into supplementing what the British were doing. I was asked to become a member of the laboratory.

That night I did not sleep. The alternatives seemed frightening.

(I might add that thirty years later they still seem so.) It is one thing to take a philosophical position, such as pacifism, when only thoughts and statements, but not actions, are influenced. But it seemed to me that if ever the forces of darkness could be said to be lined up against the forces of light, it was at that time. There was no doubt that radar had already helped to win the Battle of Britain and that it would continue to play an important part in decisive air battles yet to come. Hence a technical person really could anticipate having a finite effect on the outcome of the war. That night, I chose against the purity of my immortal soul and in favor of a livable world. Rightly or wrongly, my conscience at the ready, I joined the new laboratory in the morning.

One dilemma of conscience resolved, another awaited me. When I returned to Princeton to make arrangements for my replacement as a teacher, Harry Smyth and Eugene Wigner drew me into a serious conversation. They described the studies, also just starting, at Columbia University concerning the application of the newly discovered fission of the nucleus to the development of a nuclear chain reactor. At that time, the end in view was not to be a bomb, but rather a new, and exceedingly intense, source of energy. Inasmuch as it was expected that the war would be a long one, such a powerful form of energy might be anticipated to have a serious, if not decisive, effect on the outcome. Smyth was persuasive in arguing that I, as a nuclear physicist, would be much more effective working with the cyclotron at Princeton on this new project than I ever could be working at MIT on a problem that was fundamentally electrical engineering. Well, in for a penny, in for a pound; I decided to work on nuclear energy.

I must confess that my decision to stay at Princeton was in some measure swayed by the consideration that I would be working on a basic source of energy that (I hoped) would become beneficial to everyone. At MIT, on the other hand, I would be involved directly in a nasty war, even though radar could then be construed as being wholly defensive. More thought about this, however, soon convinced me, perhaps wrongly, that any participa-

tion in war, offensive or defensive, served the same end, and that one could not distinguish between these two courses of action on moral grounds. Thirty years later, I have changed even that opinion. Obviously, there are differences in degree between an over-enthusiastic involvement in war and a lesser involvement that serves to protect family and friends.

The project at Princeton was moved to Chicago soon after Pearl Harbor. Just before that move, I learned of British measurements that indicated that a nuclear bomb could actually be built if a small quantity of U-235 could be separated from the more prevalent U-238. To my astonishment and horror, I invented a method (the isotron) of doing just that, and I was convinced that it would produce enough U-235 to make a bomb in about a year. Events in Europe had been going from bad to worse. Given the possibility that if we could produce a nuclear bomb, then the Germans could also produce one, it was not difficult for me then to take that next and most awful step. Thinking back to that time, it occurs to me that it would have been an excellent occasion for the conscience of a scientist to have been exercised. The idea of the isotope separator came to me in a flash of inspiration. But, at the same time, I fully realized the consequences of the idea were it to be successful. At just that moment of creation, I might have said to myself, "This is diabolical. To hell with it." Instead, I saw the isotron as a factor in reversing the tide of defeat and in stopping the carnage in Europe. I might just as well have spared myself that rationalization. New measurements showed that the early British measurements were wrong and that a bomb would actually require much greater amounts of U-235 than my method could possibly provide. Although I gave everything I had to the project at Princeton that was set up to develop the isotron, nevertheless I did not regret it when the project lost out in competition with other devices. Somehow, I felt that this failure relieved me (and my conscience) of a direct responsibility for a major contribution to the nuclear bomb. (Even so, my conscience still gives me an occasional twinge.)

With the closing of the Princeton project, my colleagues and I, by now hardened soldiers, moved *en masse* to Los Alamos to help with the development of methods for the assembly of a bomb from fissionable materials being made elsewhere. At Los Alamos, we worked frantically so that a weapon would be ready at the earliest moment. Once caught up in such a mass effort, one does not debate at every moment, Hamlet-fashion, its moral basis. The speed and interest of the technical developments, the fascinating interplay of brilliant personalities, the rapidly changing world situation outside our gates—all this worked only to involve us more deeply, more completely in what appeared to be an unquestionably good cause.

Occasionally, we did pause in the hot race to wonder where we were going—and why. It would be difficult to assemble a more sophisticated or more intellectually oriented international group than the one which the circumstances of war had brought together at Los Alamos. Niels Bohr, a great humanitarian as well as a great physicist, did most to inspire the introspective conversations that were held there, and kept them to a high moral level. Although I do not remember that he ever questioned whether we should be making a bomb or not, he did cause us to examine many of the serious consequences for a world that could continue to be divided. "Uncle Nick," as we fondly called him, could foresee many of the social and political changes that would be necessary for the world to survive. Perhaps, though, it was because he said these things so intensely, and ever so softly, and because we agreed ever so much with what he said that there was the verisimilitude of high moral purpose. Robert Oppenheimer, our leader in every respect, lent credence to that euphoric feeling with his poetic and political sensitivity. His wisdom and style in solving day-to-day problems of the Laboratory inspired confidence that postwar problems would be solved by equally great men—who would do it with the same wisdom and elegant style of expression and with the same obvious concern for humanity.

Perhaps even I, as a very young and insignificant member, con-

tributed to that moral atmosphere. Something like a year after Los Alamos had started, I called a meeting in the cyclotron laboratory (Building X), which was under my direction. I remember placing notices around Los Alamos that announced a seminar sententiously entitled "The Impact of the Gadget on Civilization." I am hazy now as to who came or just what was said, but my impression is that a large part of the "intellectual contingent" turned out, including Oppenheimer. Our rather small meeting room was completely filled. We were by then, I think, aware that the Germans probably would not be able to make a bomb, and that the Allies were almost certainly going to win the war. We also knew that the United Nations Organization was about to be established—the conference which was about to take place at Dumbarton Oaks was very much on our minds. The thought most expressed at our discussion was that the United Nations could be set up on a proper basis only in the knowledge of the reality of nuclear weapons; that the only way this reality could become manifest would be by actually exploding a bomb; that our responsibility for a stable peace required that we work as hard as possible to demonstrate a bomb before the opening of the charter meeting scheduled to be held in San Francisco in April of 1945. (We missed that date. Did our failure have any effect on the organization of the United Nations? Would it have been organized differently had we already exploded a bomb? I doubt it.) At that time, we were perhaps overly obsessed by what we regarded as the evil of military security. We feared that the military would keep nuclear energy a secret were the bomb not revealed by an actual explosion. It is significant that no one at that meeting in Building X even raised the possibility that what we were doing might be morally wrong. No one suggested that we should pack our bags and leave. Instead, with missionary zeal, we resumed our work.

I have often wondered why it was that the defeat of Germany in 1945 did not cause me to re-examine my involvement with the war and with nuclear bombs in particular. The thought never

occurred to me. Nor, to my knowledge, did any of my friends raise any such question on that occasion. Surely, it seems that among those hundreds of scientists at Los Alamos it might have been expected that at least one would have left. I regret now that I did not do so. It wasn't, I think, because of the rationalization concerning the United Nations. Perhaps events were moving just too incredibly fast. We were at the climax of the project—just on the verge of exploding the test bomb in the desert. Every faculty, every thought, every effort was directed toward making that a success. I think that to have asked us to pull back at that moment would have been as unrealistic and unfair as it would be to ask a pugilist to sense intellectually the exact moment his opponent has weakened to the point where eventually he will lose, and then to have the responsibility of stopping the fight just at that point. Things and events were happening on a scale of weeks: the death of Roosevelt, the fall of Germany, the 100-ton TNT test of May 7, the bomb test of July 16, each seemed to follow on the heels of the other. A person cannot react that fast. Then too, there was an absolutely Faustian fascination about whether the bomb would really work.

I learned that a decision was in the process of being made concerning the first use of the bomb, probably some time in July. I argued that Japanese scientists should be invited to observe a test demonstration. But pushing such a view was almost impossible because my duties at that time were in the desert where the test was about to be made. Still I had confidence that my point of view would be expressed somewhere by someone, and I also felt confident that such a decision would be in good hands. I was horrified (but not surprised) when, on August 6, the bomb was exploded in anger over Hiroshima.

My reawakening from being completely technically oriented came dramatically on July 16 as I experienced the test explosion of the first nuclear bomb. It literally dwarfed the great desert basin of the Jornado del Muerto and the mountains all around it. That which had been an intellectual reality to me for some three

years had suddenly become a factual, an existential reality. There is a very great difference. My technical work was done, the race was run, and the full awful magnitude of what we had done came over me. I determined at that moment that, having played even a small role in bringing it about, I would go all out in helping to make it become a positive factor for humanity. In this sentiment, I was by no means alone. Except for those scientists who were off to the Orient to help deliver a bomb, nearly everyone at Los Alamos began to consider intensely what could be done about the bomb. We wrote manifestos, we gave speeches, we made forays to Washington, we organized the Association of Los Alamos Scientists. Politics became our new business. When we learned of similar organizations at other laboratories, we amalgamated into the Federation of American Scientists. Part of the explanation of that eruption of idealism and activity, I believe, had to do with conscience unleashed after years of wartime suppression.

As soon as possible, I returned to university life, renouncing anything further to do with weapons work or, in fact, with any kind of work connected with secrecy. But even that kind of holier-than-thou course of action has since caused me considerable qualms. It was a kind of cop-out that is all too manifest in our youth today: good for my conscience, perhaps, but it immediately reduced my effectiveness to do something about nuclear energy. My expertise soon became outdated: I had to watch my more conservative friends, usually working from within the government, give the kind of advice and exert the kind of political pressure that is based upon understanding.

It seems to me that the efforts of scientists, of the kind generally characterized by what the Federation of American Scientists does, have been remarkably effective in bringing about conditions under which we may even be able to survive nuclear energy. Their campaign to bring about a general understanding of the atomic bomb has been reasonably successful. (It was our great initial fear that no one would face up to that danger and, indeed, at first, no one did.) The efforts of scientists led directly to civilian

control of nuclear energy. It could have been otherwise; the May-Johnson bill, intended to place nuclear energy in the hands of the military, might have become law instead of the McMahon bill. The vigorous response of the young scientists to the tocsin of "civilian control" dramatically blocked the May-Johnson bill and made possible the Atomic Energy Act of 1946 leading to the civilian Atomic Energy Commission. Similar efforts led eventually to the National Science Foundation. Scientists injected the issue of radioactive fallout into the election of 1956 and they kept after that issue until the test-ban agreement was consummated. But on the major issues, involving genuine disarmament, things have gone from bad to worse. Scientists themselves have been divided and, depending on their political beliefs, have perhaps contributed to the arms race more than they have tempered it—and, in every case, no doubt, strictly according to the dictates of conscience.

In spite of this, it appears to me that scientists have generally been pretty well motivated, that one can discern, dimly at times, conscience at work. How can the phenomenon of those eager young scientists of the first years of the FAS, frantically and effectively paying a political debt to society, be ascribed to anything but conscience?

It is easy for scientists to overrate their position in the political structure. In fact, the really important, and hence really moral, decisions have nearly all been made by men whose power of decision derived from their elected position. It was President Roosevelt's decision to start and then to continue the nuclear development. It was President Truman who decided to use the bomb against Japan, and it was he who decided that a hydrogen bomb would be developed. President Kennedy effected the partial nuclear test-ban agreement. President Nixon pledged this country against the use of biological weapons. If conscience has any reality, it was at this level that it was being exercised. We scientists can only propose possible projects, and I suppose a matter of conscience is involved in doing that. After a project has been authorized, scientists as well as many other kinds of workers must

face a moral choice in deciding to work on it, but, by then, the moral responsibility, except of the individual to himself, begins to get pretty thin. By now, there is a reasonably good understanding of alternatives by the public at large—enough so that the electorate now must also bear a major brunt of the responsibility for such technical developments as the anti-ballistic missile.

Those scientists who overemphasize moral responsibility for their work display, to my mind, a certain arrogance, as though they think of themselves as determining the course of society. We do have a moral responsibility to see to it that the politicians, the humanists, the public at large know enough about what we do so that we can all assume a proper role, moral and otherwise, in working out our problems. But how much time and what kind of emphasis we give to this kind of activity can be determined only by conscience.

Conscience. I have written this pilgrim's progress as though conscience were some kind of mechanism, like the sense of balance, that serves to keep one on a moral course. And pretty murky thinking it is for a hard-boiled physicist. Nevertheless, as I look at the decisions that have affected the country most deeply, it seems to me that they were made at a level and in such a manner that moral considerations tended to get lost or be reduced to shotgun principles like anti-communism. Personally, I shall continue to believe in that ephemeral heritage of my Quaker forebears and to hope that something like conscience will play a greater part in determining what we do and how we do it.