

Comment

Trinity

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“The whole world lit up.” That’s how Jack Aeby, who took the only color photograph of the event, remembers the explosion of the first atomic bomb, at Alamogordo, New Mexico, 60 years ago, at 5:30 in the morning, on Monday, 16 July 1945 (you can see the historic picture at <http://www.npr.org>).

Another observer had a similar thought. J. Robert Oppenheimer, the scientific head of the Manhattan Project that created the bomb and a student of Sanskrit literature, was suddenly reminded of a verse from the Bhagavad Gita:

If the radiance of a thousand suns
Were to burst at once into the sky
That would be like the splendor of the Mighty One.

Richard Feynman, standing twenty miles from Trinity, as the site of detonation was called, was nearly blinded by the flash. One and a half minutes later, the sound of the explosion reached his ears.

It was at about that moment that Oppenheimer, stationed far forward, recalled a second verse from the Gita:

I am become Death,
The shatterer of worlds.

Kenneth Bainbridge, the Harvard physicist who also worked on developing the atomic bomb, shared this sentiment but expressed it more prosaically. As Oppenheimer went around congratulating the assembled physicists on their success, Bainbridge shook his hand and looked him in the eye. “Now”, he said, “we’re all sons-of-bitches.”

It was Bainbridge who selected Alamogordo as the site for the test blast. He did not know that the place he had chosen was haunted ground. The Spanish settlers had a different name for it, commemorating a long-forgotten tragedy. Bernardo Gruber, a German peddler who traveled El Camino Real up from Mexico City to the Spanish outposts along the

Rio Grande, had a run-in there with the Spanish Inquisition in 1669 over the selling of magical charms. Gruber was imprisoned on a rancho near Sandia Pueblo (later Albuquerque) for two years. Somehow, he managed to escape, only to be killed by Apaches while fleeing back to Sonora. The lonely and desolate place on the trail south of Socorro where Gruber’s body was found came to be known as ‘Jornado del Muerte’ (The Dead Man’s Route). That was the spot that Bainbridge had chosen, and that Oppenheimer code-named Trinity.

The Allied atomic bomb project came about, as everybody knows, because Albert Einstein wrote a letter to US President Franklin Delano Roosevelt, warning him of rumored German efforts to develop a nuclear weapon, and urging that the US begin a crash program to do the same. Einstein actually only signed the letter, which was written by two Hungarian physicists, Eugene Wigner and Leo Szilard. In fact, the atomic age really began, as so much else in physics did, with Szilard, a nomadic theoretician with an engineer’s instinct for the practical. Six years earlier, as he crossed a London street, in a flash of insight he had realized that a self-sustaining nuclear chain reaction unleashing untold amounts of energy could be created from the right fissionable materials. Richard Rhodes, in his magnificent book, ‘The Making of the Atomic Bomb’ (New York: Simon and Schuster; 1988), describes the moment: “In London, where Southampton Row passes Russell Square, across from the British Museum in Bloomsbury, Leo Szilard waited irritably one gray Depression morning for the stoplight to change. A trace of rain had fallen during the night; Tuesday, 12 September 1933, dawned cool, humid and dull. Drizzling rain would begin again in early afternoon. When Szilard told the story later he never mentioned his destination that morning. He may have had none; he often walked to think. In any case another destination intervened. The stoplight changed to green. Szilard stepped off the curb. As he crossed the street time cracked open before him and he saw a way to the future, death into the world and all our woe, the shape of things to come.”

In the summer of 1939, Szilard and Wigner, alarmed by reports that Germany was about to embark on a project to produce just such a chain reaction, decided to visit Einstein, who was spending that July at a friend's house on Long Island. They succeeded in attracting his interest, but he would only agree to write to the Belgian ambassador, whom he knew. Later in the month, convinced that the letter must go to Roosevelt, they drafted it and decided to drive back out to Long Island. But Wigner was unable to make the trip and Szilard did not know how to drive a car, so they enlisted fellow Hungarian physicist Edward Teller to act as Szilard's chauffeur.

It was foggy that night, Szilard did not remember the way, and they became lost in a maze of streets on Long Island. Finally, Szilard said, "Maybe it's not meant to be. Maybe we should go home." Just then, they saw a young girl about 10 years of age, walking down the street. "Do you know where Dr Einstein is staying?", they asked her. "Sure", she said. "Do you want me to take you to him?" Einstein served them tea and then signed the letter Szilard had prepared.

Wigner, who told me this story when I was a student at Princeton almost forty years ago, said it was appropriate that a child, a messenger of the future, as he put it, had played so instrumental a role in ushering in the Atomic Age. I saw it differently. It seemed to me that the child, if she symbolized anything, symbolized innocence, and that the moment Wigner described was the last time physics would ever have that virtue.

It's been said by more than one person that because of the atomic bomb physicists have known original sin. What's meant by that, of course, is just this loss of innocence, a knowledge of not only good but evil. I think it's instructive, 60 years after Trinity, for biology, as we leave the Atomic Age and enter the Age of Genomics, to ask why that is so. The same thing has never been said of chemists, despite nerve gas and Bhopal and a long catalog of chemical horrors. My guess is that this is because chemistry has always had one foot firmly planted in the worlds of commerce and the military. It's always been seen as a practical science. Physics, especially atomic physics, was a 'pure' science, where the pursuit of knowledge for its own sake was the entire *raison d'être*. The employment of that science for the making of weapons of mass destruction gave atomic physicists enormous political influence and access to almost limitless research funding, but the price was that purity of mission. When, three weeks after Trinity, the two bombs were dropped on Hiroshima and Nagasaki, at least a quarter of a million people lost their lives to nuclear physics, and neither the world, nor physics, was ever the same again. Leaving aside the question of whether or not those bombs should ever have been dropped (and I'm of the opinion, reluctantly, that Truman's decision to do so saved hundreds of thousands, perhaps millions, of Japanese lives as well as Allied lives), it was suddenly, powerfully clear that Oppenheimer and Bainbridge were right about what physicists had become.

Biology now stands where physics stood in the days before Trinity. Like physics, it has long been thought of as a 'pure' science, whose applications, if any, were to the advancement of human health. But the spectre of bioterrorism and the ethical dilemmas posed by advances in genomics, reproductive biology, human genetics and genetic engineering may be presenting it with the Faustian bargain of influence and money in exchange for innocence and purity of purpose. I am not advocating abandoning these discoveries or the technologies they are creating. But if the lesson of Trinity is that the mistake the atomic physicists made was in not considering the full implications of what they were doing before undertaking it, so that the ethical dilemma caught them unawares, then I think there is something we should do.

My opinion of bioethics as a discipline is ambivalent, to say the least. On the one hand, many of its practitioners seem to me to be neo-Luddites whose lack of understanding of science is coupled with a socially conservative agenda. But a number are thoughtful, concerned people who raise important questions and realize the danger of simplistic answers. Every biology graduate program in the US that receives Federal funds is required to put its graduate students and postdocs through a course on the responsible conduct of research. Unfortunately, these courses, which tend to be taught by bored faculty and attended by even more bored students, usually focus on such subjects as plagiarism, intellectual property, and conflicts of interest. I think the requirement should be extended to cover basic elements of bioethics, such as the following. What subjects, if any, should be excluded from free inquiry? What duties does a researcher owe to the society that funds his or her science? What, if anything, should never be published because it might be too dangerous in the wrong hands? How does a scientist balance the obligations of self with those of the public? Who should make decisions about bioethical matters and on what grounds?

Many other topics could be covered, but you get the idea. To those who would argue that most students would find such material as boring as the plagiarism and intellectual property lectures, my response is that I have no interest in what they think. Anyone who finds these questions of no interest is never going to be a leader or opinion-shaper in the area of science and public policy anyway. But I'm hoping that a small number of young scientists will be interested enough to continue to think about these questions, to talk about them with their peers, and to play a role in shaping the way biology deals with the future that stretches before it. If they don't, such matters will be left entirely in the hands of politicians, religious leaders, and activists, and personally I don't trust any of them.

Oppenheimer looked at Trinity and thought that he had become Death. Bainbridge saw the same spectacle and had a similar, less poetic thought. They were right. They were right because nuclear physicists, in part because they were at war

but largely because the challenge was so seductive, thought more about what they could do than what would happen if they did it. It may be that such reflection would have changed little – that’s my guess, actually - but one thing I think would have changed: the role of physics in the nuclear age would have been more than just to service the appetite of the weapons industry it created. I want our bright young biologists to start thinking now about the ethical issues of what we can do and will be able to do in the future. I want them to participate in the dialogue with the politicians and the activists and the general public. I don’t want them to bury their heads in the sand and pretend that this is not their concern. Because if they don’t engage, and some day in the future, because of something we do, the whole world, figuratively, lights up, what then will we have become?

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refereed research

interactions

information