

Class Meeting 11

Discussion: **“Fathering the Unthinkable” – Ethical issues in science and engineering: The case of atomic physics and two physicists – Niels Bohr and Werner Heisenberg – (co-inventors of “the Copenhagen Interpretation” of intra-atomic organization) -- on opposing sides in WWII.**

The single most awesome manifestation of the power of modern science and technology -- the ultimate prototypical prime test case of ethical issues relating to science and society -- came with the creation of the atomic bomb. When the first one -- code named Trinity (see below) -- was successfully test-fired on desert sands outside Alamogordo, New Mexico. J. Robert Oppenheimer, physicist and project director publicly celebrated with colleagues. They were happy and proud to have been able to show that it was practically possible to unleash the hidden and unimaginably hugely explosive potential energy stored in atomic nuclei. Brigadier General T.F. Farrell witnessed the blast - "The effects could well be called unprecedented, magnificent, beautiful, stupendous, and terrifying. No man-made phenomenon of such tremendous power had ever occurred before. The lighting effects beggared description. The whole country was lighted by a searing light with the intensity many times that of the midday sun. It was golden, purple, violet, gray, and blue. It lighted every peak, crevasse and ridge of the nearby mountain range with a clarity and beauty that cannot be described but must be seen to be imagined..." More privately, Oppenheimer recalled an ominous passage in Hindu scripture, the Bhagavad-Gita: "I am become Death, the shatterer of worlds."



Photo is in public domain.

“Trinity” Atomic Bomb Test, July 16, 1945, Alamogordo NM. Fireball 16ms after detonation.

The light from the blast was seen all over New Mexico, and in parts of Arizona, Texas, and Mexico. Windows shattered 120 miles away in Silver City, New Mexico, and the shock wave was felt in Los Alamos, 230 miles away.

The yield of the first bomb was estimated to be equivalent to 20,000 tons of TNT - 2,000 B-29s worth of explosives. Today's big bombs yield megatons of TNT equivalents (around 1,200,000 tons for the B83 strategic bomb).

The present total global nuclear arsenal is about 30,000 nuclear warheads with a destructive capacity of 5 gigatons (5,000,000,000,000 tons) of TNT.

PREPARATION:

READ: 11-1 Frayn, Michael, *Copenhagen* (a play)

A copy of the text of the play is available for purchase from Amazon.

VIEW: 11-2 *Copenhagen*, a BBC television adaptation of Michael Frayn's play, adapted and directed by Howard Davies.

There is also an interesting BBC Documentary called *Copenhagen Fallout*, dealing with the same issues.

It is important to both view the film and read the script of the play! Pay particular attention to how Frayn elucidates the interplay of human factors (limitations of perception and vagaries of recollection) with social (e.g. ethical) and scientific ideas (e.g. relativity, uncertainty, complementarity).

WRITE: Reaction Paper #10

MIT OpenCourseWare
<http://ocw.mit.edu>

9.68 Affect: Neurobiological, Psychological and Sociocultural Counterparts of "Feelings"
Spring 2013

For information about citing these materials or our Terms of Use, visit: <http://ocw.mit.edu/terms>.