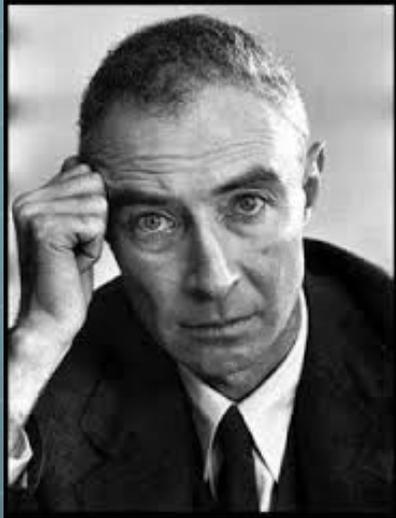


Atoms, Bombs and Morals

Robert Oppenheimer

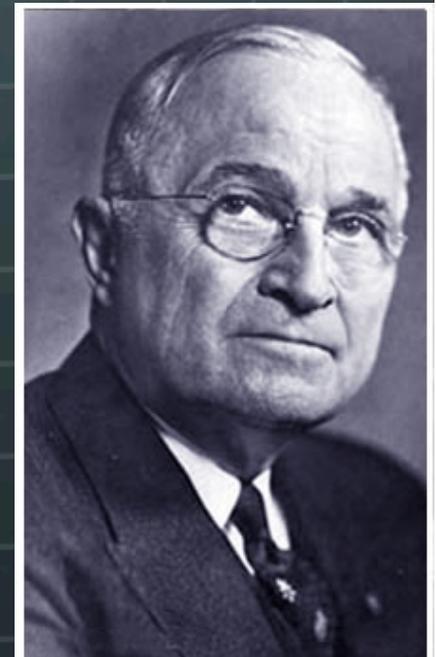
‘In some sort of crude sense, which no vulgarity, no humour, no overstatement can quite extinguish, the physicists have known sin.’



'Mr President, I have blood on my hands'

'Never mind, it'll all come out in the wash'.'

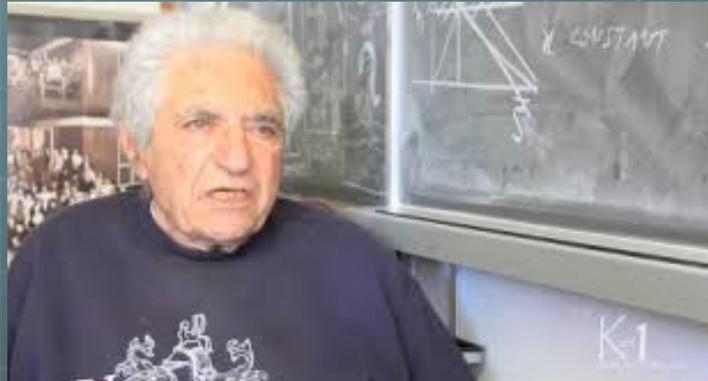
(After Oppenheimer left, Truman turned to an aide and said: 'Don't you bring that crybaby in here again. After all, all he did was make the bomb. I'm the guy who fired it off.')



So where does moral responsibility lie?



Jack Steinberger



(1988 Nobel Prize for Physics)

‘It is not for the physicist to decide upon issues of morality’

Two Parallel Trends

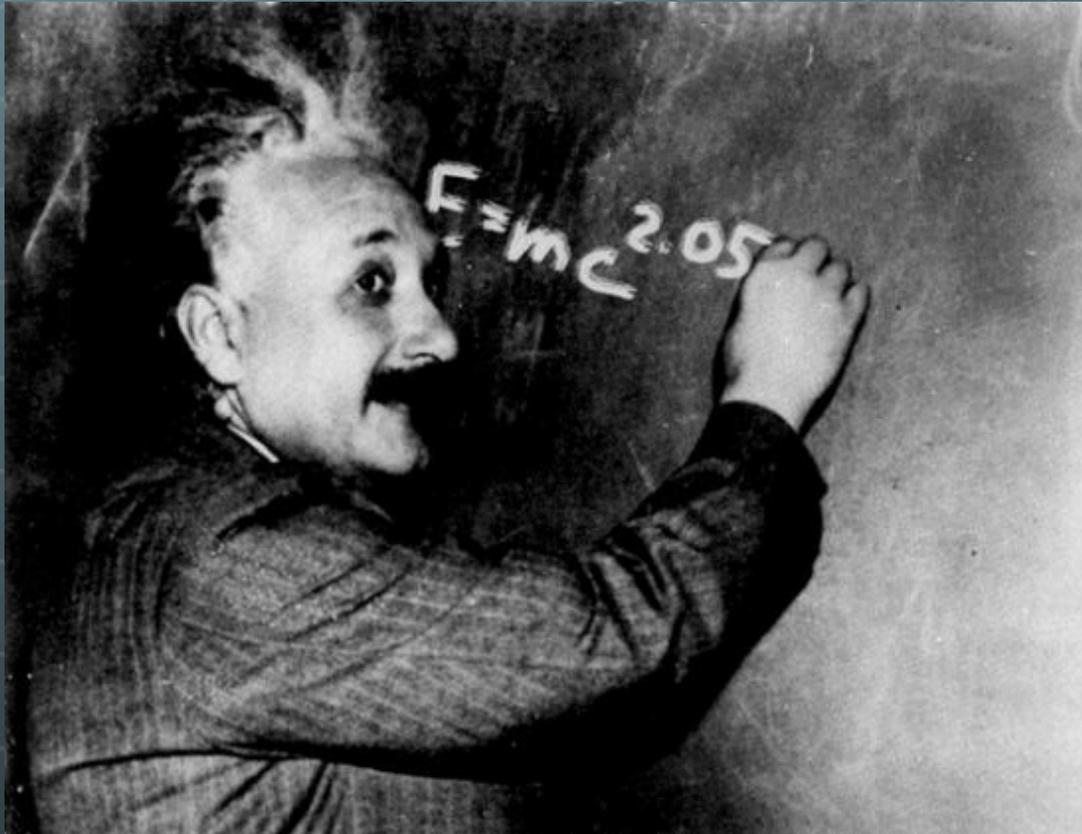
1. The advance of nuclear physics.

2. The capacity for evil.

Theory

Frederick Soddy (1904) 'if the energy contained within the atom could be tapped and controlled what an agent it could be in shaping the world's destiny! The man who put his hand on the lever by which a parsimonious nature regulates so jealously the output of this store of energy would possess a weapon by which he could destroy the earth if he chose.'

$$E = mc^2$$



1905

How much energy?

Francis Aston explained the implications of transmutation. If it were possible to transmute hydrogen into helium, around one per cent of the mass would be annihilated in the process. If, Aston surmised, the hydrogen in a glass of water was changed into helium, the energy liberated would drive the *Queen Mary* across the Atlantic at full speed – and back.

Dreamers

That perpetual struggle for existence, that perpetual struggle to live on the bare surplus of Nature's energies will cease to be the lot of Man. Man will step from the pinnacle of this civilization to the beginning of the next. ... I see the desert continents transformed, the poles no longer wildernesses of ice, the whole world once more Eden. I see the power of man reach out among the stars.

H. G. Wells, *The World Set Free* (1914)

The Scientific Imperative

'The discovery of a scientific process depends not on whether it is useful but whether it is possible'.

"When you see something that is technically sweet, you go ahead and do it"

J. Robert Oppenheimer

Moral Justification

There are those about us who say that research should be stopped by law, alleging that man's destructive powers are already large enough. So, no doubt, the more elderly and ape-like of our prehistoric ancestors objected to the innovation of cooked food and pointed out the grave dangers attending the newly discovered agency, fire.

Frederick Aston

DeGroot's Law

Morals
bend
to
accommodate
capability.

The Laws of War

Article XXV of the 1907 Hague Convention: 'The attack or bombardment, by whatever means, of towns, villages, dwellings, or buildings which are undefended is prohibited.'



World War I



Who would think that vault benign
God's last area free from vice,
Initiates the aerial mine,
With babes below as sacrifice?

The Laws of War

Hague Convention (1923): 'Aerial bombardment is legitimate only when directed at a military objective, that is to say, an object of which the destruction or injury would constitute a distinct military advantage to the belligerent.'

What is a military objective?

Guernica, 1937



The raid was a scientific experiment. Four waves of bombing followed in methodical order. First, 2,000-pound bombs knocked the buildings down. Then, 220-pound bombs made rubble. Then, incendiaries started fires. Finally, 22-pound shrapnel bombs kept the firemen at bay. Up in the air, bomber crews were isolated from the horror they caused – that was modern war. Down on the ground, however, carnage was inescapable. “From heaps of huddled clothes on the cobblestones blood begins to flow,” an observer wrote. “These were once live women and children.”

Meanwhile, physics marches on.

Eventually, the parallel lines of scientific progress and moral decline converge:

In 1940, Otto Frisch and Rudolf Peierls propose that an atomic bomb can be made from just 1 kg of fissile material.

Frisch-Peierls Memorandum (1940)

**As a weapon, the super-bomb
would be practically irresistible.
There is no material or structure
that could be expected to resist
the force of the explosion.**

Frisch-Peierls Memorandum

If one thinks of using the bomb for breaking through a line of fortifications, it should be kept in mind that the radioactive radiations will prevent anyone from approaching the affected territory for several days.

Frisch-Peierls Memorandum

Owing to the spread of radioactive substances with the wind, the bomb could probably not be used without killing large numbers of civilians, and this may make it unsuitable as a weapon for use by this country.

Frisch-Peierls Memorandum

We have no information that the same idea has also occurred to other scientists but ... it is quite conceivable that Germany is, in fact, developing this weapon.

Frisch-Peierls Memorandum

If one works on the assumption that Germany is, or will be, in the possession of this weapon, it must be realized that ... the most effective reply would be a counter-threat with a similar bomb. Therefore it seems to us important to start production as soon and as rapidly as possible, even if it is not intended to use the bomb as a means of attack.

Rationale

'Then my worries began. Should I be looking at this? By that time I had worked out a rationale for doing research on the possibility of the bomb. I convinced myself that the only way to stop the Germans from using it against us would be if we, too, had the bomb and threatened to retaliate.'

Joseph Rotblat (1939)

Moral Justification

‘We realised that, should atomic weapons be developed, no two nations would be able to live in peace with each other unless their military forces were controlled by a higher authority. We expected that these controls, if they were effective enough to abolish atomic warfare, would be effective enough to abolish also all other forms of war. This hope was almost as strong a spur to our endeavours as was our fear of becoming the victims of the enemy's atomic bombings.’

Eugene Wigner

New Best Friends



From Deterrent to Weapon

'No one who held a position of responsibility in the Manhattan Project could doubt that we were trying to perfect a weapon that, however repugnant it might be to us as human beings, could nonetheless save untold numbers of American lives.'

General Leslie Groves

Engineering

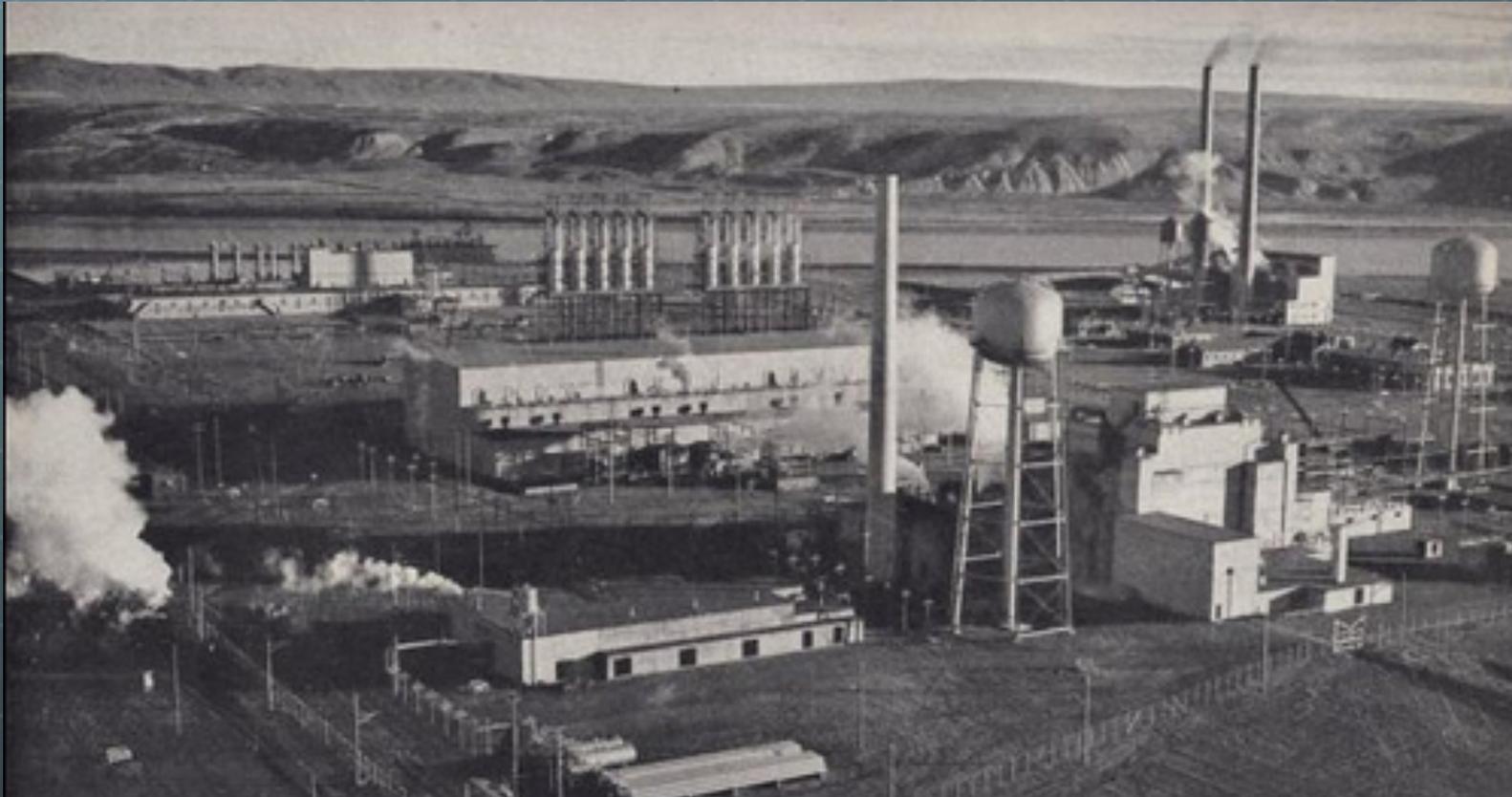
In 1939, Neils Bohr stated that the separation of U-235 from uranium ore was impossible unless a nation was willing to turn itself into a factory.

The Manhattan Project, including all the separation facilities, was built by the United States at a cost of around \$2 billion, an industrial conglomerate equal in size to the entire American auto industry.

Oak Ridge



Hanford



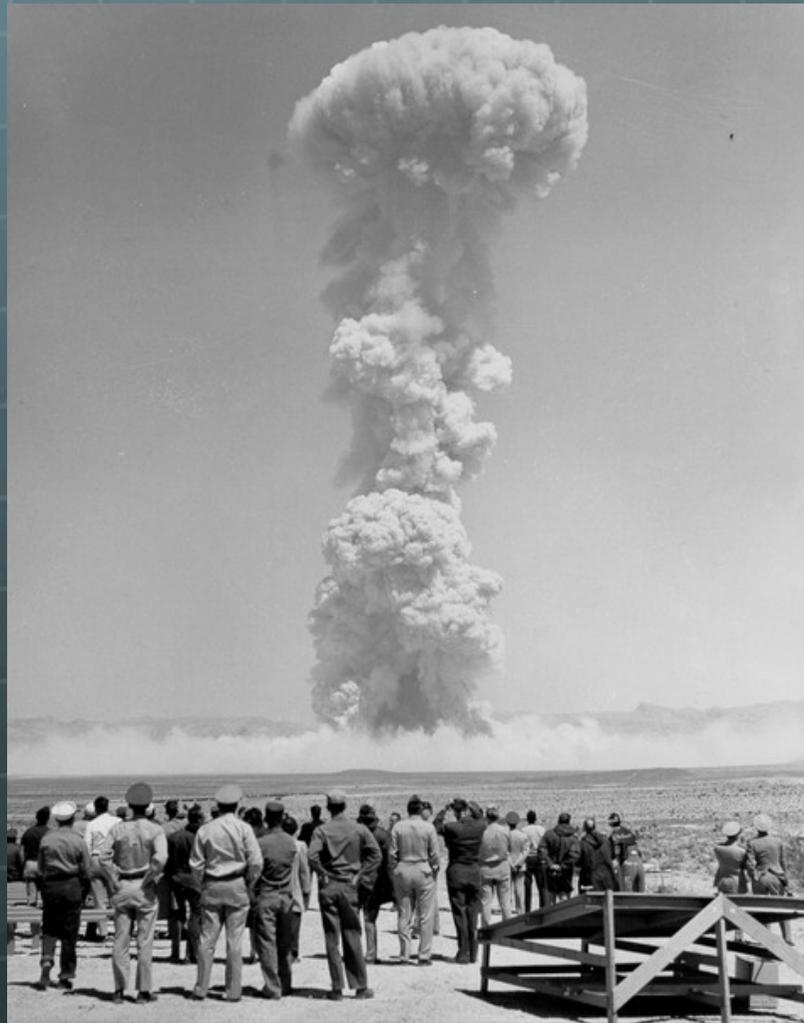
Los Alamos



Alamogordo: 16 July 1945

'This is not a pleasant weapon we have produced ... a city is henceforth not the place in which to live'.

'The war's over!'



'Some people claim to have wondered at the time about the future of mankind', Norris Bradbury remarked. 'I didn't. We were at war and the damn thing worked.'

**'Now I am become Death, the
destroyer of worlds.'**



A final thought from John Gray's *Straw Dogs*:

“Today, for the mass of humanity, science and technology embody 'miracle, mystery, and authority'. Science promises that the most ancient human fantasies will at last be realised. Sickness and ageing will be abolished; scarcity and poverty will be no more; the species will become immortal. Like Christianity in the past, the modern cult of science lives on the hope of miracles. But to think that science can transform the human lot is to believe in magic. ... Even as it enables poverty to be diminished and sickness to be alleviated, science will be used to refine tyranny and perfect the art of war.”