

**OPENING STATEMENT FOR ROUNDTABLE AT 60th TRINITY SYMPOSIUM
July 14, 2005**

Thank you very much for your kind introductions to this session. We have assembled around this table some of the individuals who observed the Trinity explosion early in the morning on July 16, 1945 or who accompanied the nuclear attack on Japan. Scientists who worked on the development of nuclear weapons are often asked whether they had qualms about their work because of the unprecedented power of nuclear weapons. The people you see here were in their early 20's at the time of Trinity. They were working hard and schedules were extremely tight. They were motivated to counter the expansion of Nazism and Fascism in Europe and to respond to the Japanese attack on Pearl Harbor. People on both sides of the conflict were dying by the hundreds of thousands.

Under these circumstances, not many of the participants in Trinity entertained profound thoughts on the basic revolution in military affairs which the advent of nuclear weapons would generate. Indeed many senior individuals directing the work on the bomb had divergent responses to the vexing questions facing them: should a demonstration of the awesome power of nuclear weapons precede their use against Japan? Would one bomb have been enough to induce Japan to surrender or was surrender so imminent that use of the bomb would not be necessary? The answers to these questions are still debated today but in this session we should accept history "as is" and focus on the future. The frame of mind of most young people at Los Alamos is well represented by the words of Richard Feynman, when he was celebrating the successful Trinity explosion, "You see what happened to me – what happened to the rest of us – is we *started* for a good reason, then you're working very hard to accomplish something and it's a pleasure, it's excitement. And you stop thinking, you know, you just stop."

My participation in military problems was at the California Institute of Technology, on improving the accuracy of anti-aircraft fire by measuring the shockwaves from supersonic bullets traveling past their intended target. The director of Los Alamos, J. Robert Oppenheimer, asked the great physicist Luis Alvarez to devise instruments to measure the energy released both during the test explosion to be unleashed at Alamogordo, and during the actual operational use of the weapons. Alvarez read our reports on measuring shockwaves and asked me to adapt the devices developed at Caltech for the purposes assigned to him by Oppenheimer. This was done, but during the Trinity test, because of bad weather, we were unable to release the measuring device from the B-29 airplane in which we were traveling at a range of several miles from the test explosion. We made sketches of the mushroom cloud and estimated its height. After landing I was asked about my "profound thoughts" in response to this momentous historical event. I replied truthfully, "I fell asleep immediately."

The shockwave measuring devices were dropped by parachute both over Hiroshima and Nagasaki from a plane separate from the one that dropped the bomb. It was these devices from which yielded the precise values of the explosive power of the two bombs which destroyed Hiroshima and Nagasaki. The Japanese later recovered the devices, and one of them is exhibited in the Peace Museum in Hiroshima.

You may be interested in the following event associated with the parachute drop over Nagasaki. A group of physicists working at the University of California Radiation Laboratory (now the Lawrence Berkeley National Laboratory) wrote a letter (appended) which they taped to the battery case attached to the shockwave measuring devices descending over Nagasaki. The letter was addressed to Prof. R. Sagane, a physicist who worked at the Berkeley Laboratory before the war. The letter explained the nature and power of the new weapon in general terms, easy for a physicist to comprehend. The Japanese did recover the letter and it was delivered to the Japanese High Command. Japan surrendered the next day. It's not known to me whether this form of communicating with the enemy affected the decision to surrender.

Let me turn to the sequel to Trinity; the next lecture will outline the attempts to control nuclear weapons as well as their historical evolution. Today the world has an inventory of about 30,000 nuclear weapons, about one-half of the Cold War peak. Each of these weapons possesses an average explosive power larger by a factor of about 20 than those which destroyed Hiroshima and Nagasaki, taking about 250,000 lives. But the good news is that no nuclear weapon has again been used in hostilities, notwithstanding that 100 or so wars have been fought since 1945.

But this good news has its bad side effects. The group assembled here has seen real nuclear weapons explode; today's decision-makers have not. While they have been exposed through the literature and briefings to the awesome physical realities of nuclear weapons and the destruction and suffering they cause, nuclear weapons have to many of them primarily become symbols of strength and prestige, and tools for diplomatic bargaining. Some decision makers are even searching for new missions where conjectured circumstances might give advantages to nuclear weapons over conventional munitions. But such efforts endanger the now 60 year old taboo against actual use of nuclear weapons.

The awesome physical facts pertaining to nuclear weapons are real. Whatever the means of delivery, nuclear weapons can multiply the destructive power that can be carried by a weapon of a given size and weight by a factor of about a million, a factor so large that it is hard for any person to comprehend. In consequence, nuclear weapons allow fewer people to kill and injure more and more other humans, and to exact enormous economic damage. This leads to the ultimate danger that sub-national terrorist groups might acquire nuclear weapons and detonate them in populated areas.

The advent of nuclear weapons invariably changes the relations among nations. In some sense, they are becoming "the great equalizer" between powerful and less powerful states. The United States must recognize that our overwhelming military strength and

demonstrated willingness to use that strength provides an incentive for lesser states to acquire nuclear weapons. In the words of a Deputy Indian Minister of Defense “Never negotiate with the United States unless you have a nuclear weapon. Categorizing some of the world’s states as “rogues” or even “evil” is no substitute for an even-handed international non-proliferation policy.

Throughout human history proliferation of any new technology for either peace or war – be it fire, gun powder, steel fabrication, electronics, or whatever – has never been stopped, but in response to Trinity we must stop the proliferation of nuclear weapons. But how can we accomplish this? Treaties and other international agreements have been very successful in slowing proliferation, but in the long run each sovereign state on this globe must be persuaded that its National Security is better served without possessing nuclear weapons than with them. It also requires each state now possessing nuclear weapons to examine critically whether their stockpiles of these weapons and of the critical materials to make them are truly consistent with their National Security – not to meet short range contingencies but to serve the long range true security of the nation.

But above all the emergence of nuclear weapons underscores the need to emphasize non-violent means for settling international conflicts.

Ignoring the physical reality of nuclear weapons demonstrated at Trinity or replacing or distorting scientific facts by policy or ideology results in grave peril to the nation.

**Letter drafted by Luis W. Alvarez addressed to Prof. Ryokioshi Sagane,
University of Tokyo**

Headquarters
Atomic bomb command
August 9, 1945

To: Prof. R. Sagane
From: Three of your former scientific colleagues
during your stay in the United States.

We are sending this as a personal message to urge that you use your influence as a reputable nuclear physicist, to convince the Japanese General Staff of the terrible consequences which will be suffered by your people if you continue in this war.

You have known for several years that an atomic bomb could be built if a nation were willing to pay the enormous cost of preparing the necessary material. Now that you have seen that we have constructed the production plants, there can be no doubt in your mind, that all the output of these factories, working 24 hours a day, will be exploded in your homeland.

Within the space of three weeks, we have proof-fired one bomb in the American desert, exploded one in Hiroshima and delivered the third this morning.

We implore you to confirm these facts to your leaders, and to do your utmost to stop the destruction and waste of life which can only result in the total immolation of all your cities if continued. As scientists, we deplore the use to which a beautiful discovery has been put, but we can assure you that unless Japan surrenders at once, this rain of atomic bombs will increase manifold in fury.

Philip Morrison, Bob Serber