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Legacy of the Manhattan Project
The Creativity Factor

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Creativity reveals itself in many forms. On one level we have the man whose hearing is less good than previously, but he resists all entreaty from his children and grandchildren to acquire a hearing aid. Eventually he does so. When asked by a friend whether his children are now happy, he replies that he has not told them. He just sits and listens. He has changed his will three times. Creativity in science is not confined to scientists. The Congress has played a vital role in nurturing science and creativity in science, since WWII. New Mexico Senators have traditionally played leadership roles. General Groves demonstrated extraordinary creativity in choosing Oppenheimer to head the Los Alamos project. He was perhaps somewhat less creative when, upon complaining to Oppenheimer about the avalanche of new babies and being told that the problem was not in the portfolio of the Laboratory Director, he barked; "shorten the lunch hour."

On the far end of the scale is the Manhattan Project which required extraordinary creativity. This requirement arose for obvious reasons such as the need to deduce, by calculation and intuition, the nuclear, chemical, metallurgical behavior, and high density energy transport, of materials at temperatures and pressures far beyond that achievable in the Laboratory. But creativity was also key to assembling independently-minded, genius category, world experts, from diverse disciplines, background and experience,

who needed to work collaboratively and seamlessly towards a common purpose. An important legacy of the Manhattan Project is that it demonstrated the power of a "critical mass" of creativity, as well as of a critical mass of fissionable isotope.

A few months ago, Priscilla Duffield, Oppenheimer's war-time secretary, presented a lecture on her Los Alamos experience. She was asked what was her greatest challenge. Her immediate response was "To limit access to Oppenheimer." Such was the stress factor induced by the driving forces of creativity and urgency. Major legacies of the Manhattan Project are, of course, the National Laboratories, which today continue to inform and invigorate the scientific enterprise, and have served as a model for similar institutions elsewhere.

An obvious immediate legacy of the Manhattan Project for creativity was that by hastening the end of WWII it permitted redirecting creativity from war-time goals to peaceful pursuits, as well as limiting casualties on both sides and in occupied China where there was great distress as a result of hunger and disease.

I believe that most would now agree and recently released Japanese archives ~~achieves~~ seem to confirm that the abrupt end of WWII avoided complete destruction of Japanese culture. That should rank as one of the great legacies of the Manhattan Project.

A more quantifiable legacy which greatly impacts science came from the dramatic demonstration of the harnessing of nuclear energy. This helped convince the public of the value of science, which we now can see is indispensable to global energy security, environmental security and economic security. When I started in physics there

was little federal support for research in this field, and pursuit of science generally was considered a luxury. The Manhattan Project catalyzed a fountain of creativity in essentially all areas of science. It was a breeding ground for new thinking in science and new initiatives. I am most familiar with one of the initiatives which is a direct legacy of the Manhattan Project. It is a good example. It was originally called the Los Alamos Meson Physics Facility and has transmuted into LANSCE. It owes its birth and survival to creativity. The goal was to invent and build a proton accelerator of unprecedented capability, for basic science and national security. Nagle, Knapp, and Hagerman and their colleagues invented such an accelerator. Along the way their invention was key to more efficient production of high energy x-rays, and makes possible more effective treatment many thousands of patients each year. Such are the fruits of scientific creativity.

LANSCE welcomes graduate students. Many stay on after completing their thesis. One of them was Chris Morris. Recently he invented a capability to take moving pictures of the behavior of materials subject to high-explosives driven shock waves. It is called proton radiography. This is now a unique capability for materials science, and national security. Last year LANSCE hosted 1600 visitors, 600 reserved beam time, from institutions inside and outside the US, thus promoting science and international good will, which today is more essential than ever.

The past 61 years are the longest period in modern history (300 years) absent war between the major world powers. May I suggest that this reality and the successful conclusion of the Cold War qualify as legacies of the Manhattan Project.

I recall Dr. Bradbury's testimony at a hearing of the House-Senate Joint Committee on Atomic Energy. He was asked what savings he had achieved during the past year. His reply was "Congressman, the purpose of a National Laboratory is not to save money. It is to spend money wisely and cost-effectively." That philosophy was honored during the cold war. But few things last forever.

Immediately following the end of the Cold War there appeared a worrisome editorial in the Bulletin of the Atomic Scientist. Hans Bethe, George Cowan, Nick Metropolis and I wrote a rebuttal. The following brief excerpts bear the unmistakable hallmark of Hans Bethe and relate to the theme of this symposium.

> "The demise of the Cold War provides unique opportunities for improving the quality of life throughout the world. It also provides opportunity for destroying some national treasures which may be critical to accomplishing the above goal.
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> "Admiral Watkins and others have correctly, in our opinion, identified the national laboratories as national treasures. However, voices are now heard suggesting, even demanding, that Los Alamos be henceforth devoted to weapons work, and nothing else. There was no such restriction on Los Alamos, even at the

height of the Cold War. It was understood then, and also during World War II, that major advances in technology require understanding and pursuit of the science that underlies the technology. It was also understood that even science which is not directly related to a specific technology can contribute greatly to that technology and vice-versa.

"This country faces many problems on the way to becoming again pre-eminent in civilian technology. Creative technology is the key to economic competitiveness. Many of the technological problems are of long range. These cannot be solved by industry alone, because industry must look at the bottom line every year. Multidisciplinary laboratories are required which do not need to make an annual profit.

"We have learned from our Los Alamos experience that the major key to progress in science and technology is highly gifted and dedicated people, together with an environment which fosters cross-fertilization, involving a broad spectrum of sciences and technologies, of ideas and concepts and skills; and also dreams and aspirations. Such an environment cannot, for long, exist in a single purpose, narrowly focused, institution."