Book Review

The 'secret' of the hydrogen bomb

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The Physical Principles of Thermonuclear Explosive Devices
by Dr. Friedwardt Winterberg

Fusion Energy Foundation
New York, 1981
$9.95 145 pages

Dr. Friedwardt Winterberg has worked for some 30 years in the controlled nuclear fusion and weapons research communities. He was the first to propose electron-beam pellet fusion, ion-beam pellet fusion, impact fusion, magnetic isolation of electron beam and ion beam diodes for particle-beam fusion, and particle-beam superpinch fusion. He was also among the first to publish papers on the use of fusion and microexplosions for space propulsion, on an electromagnetic rail gun powered by a hydrogen bomb, on the staging of pellet targets, and on autocatalytic drivers for thermonuclear shock waves.

His book, which thoroughly explains thermonuclear explosive devices from the H-bomb, to beam weapons, to the currently ballyhooed neutron bomb, was written out of a passionate commitment to harnessing thermonuclear fusion as a cheap, clean, and plentiful energy source.

Over the years, Winterberg's commitment to achieving fusion energy has led him to inquire into many areas that are officially circumscribed by military secrecy classification. Since he does not hold a Q clearance, the rating required of scientists and other personnel involved in research in areas related to thermonuclear bomb production, he has had to reconstruct a great deal of the thinking that has gone into bomb design. This book is an outcome of that research.

In his introduction, Winterberg says: "It is not the *secret* of the H-bomb that protects us from thermonuclear annihilation but, rather, the correct political decision by our leaders. To cover up their own political inability it is, of course, understandable that governments try to make their people believe it is secrets that protect them. I hope that the publication of this book will not only contribute in demystifying the whole business of secrets, but also make the public aware that a belief in security by secrets is dangerous wishful thinking."

By classifying fusion weapons research—the principles of which can be easily pieced together from the public literature—the government, Winterberg says, is delaying progress in inertial confinement fusion, which is now close to breakthrough. "If secrecy persists," he says, "errors are likely to be made that will cost the taxpayers millions of dollars. The resulting failure could retard progress toward controlled fusion by many years . . . [and] could lead to the very energy war fought with thermonuclear weapons that the government wants to avoid."

One striking example of the chill government classification casts on fusion research can be seen in the exchange of letters Winterberg recently released to *Fusion* magazine. Writing on behalf of the Desert Research Institute of the University of Nevada at Reno, Nevada, where he is a research professor and scientific assistant to the president, Winterberg proposed to the Department of Energy's Office of Inertial Fusion a project to test a new idea in fusion fuel-pellet compression. The idea, using the soft X-rays from an underground fission explosion for pellet compression, would be much less costly and more efficient than the present methods using laser or particle accelerators.

The reply to the Winterberg proposal from G. H. Canavan, the director of the Office of Inertial Fusion is very brief: because "certain categories of information" are classified, Canavan wrote, "we cannot comment on the contents of your letter." Hence, no research will be done in this promising fusion area.

It is important to distinguish Winterberg's book from various antinuclear attacks on the U.S. weapons program. In recent years there have been a number of attempts to embarrass the U.S. government by pointing out just how ineffectual the security classification system really is. For example, in the 1979 *Progressive* magazine case, the government sued an antinuclear magazine to prevent the publication of an article on how the H-bomb works. The government lost its case, largely because of materials published by the Fusion Energy Foundation and Winterberg, and an FEF amicus curiae brief that made it clear that the so-called secrets of the H-bomb had been in the public literature since Bernhard Riemann's 1859 paper on shock waves.

Winterberg's intent in providing an explanation of how the H-bomb works is not to confound the U.S. security system, but to show that classification of scientific ideas is self-defeating because of the very nature of scientific discovery. Winterberg emphasizes that the conclusions he has arrived at in order to design targets for inertial confinement fusion research are based on well-known physical principles that are not and can not be

classified. Probably the most significant of these principles arises from the above mentioned classic 1859 paper by mathematical-physicist Bernhard Riemann that laid the basis for subsequent intense research into the production and propagation of shock waves.

The book itself is written in a pedagogical fashion; in fact, it almost reads like a good mystery novel. Winterberg proposes an initial hypothesis for designing a workable fusion microexplosion target or a primitive hydrogen bomb. As the work progresses, he refines this initial hypothesis and transforms it, until a highly efficient design emerges.

Winterberg then traces the steps necessary to arrive at a workable design from the first considerations of ignition conditions and the physics of the radiation-particle energy mix of various trigger mechanisms. The problems inherent in ignition lead to the discussion of "boosters" and "spark plugs," somewhat esoteric ingredients in the design of a workable fusion device, but central ideas in practice.

The question then becomes one of optimization, and the key ideas revolve around the geometrical focusing of energy. Using some old ideas from the problem of reflected and focused shock waves, Winterberg derives a number of interesting configurations for bombs as well as inertial confinement fusion targets. The central concepts of focused shock waves come from the German hydrodynamicists Prandtl and Meyer in papers published in the first decade of this century. Thus, the essential secret that is still classified is based on *scientific knowledge at least 70 years old.*

Winterberg then applies these considerations to the key questions of yield and energy spectrum. The design of the cruise missile, tactical nuclear weapons, and the neutron bomb all depend on relatively recent developments in weapons research dealing with the ability to create small-yield (less than 100 kilotons) devices with energy outputs tailored toward more radiation energy output and less blast wave (and radioactivity) output. The physical principles and design considerations used in these weapons are extensively discussed in Winterberg's book, along with new ideas of his own concerning the peaceful application of these weapons in fusion research and civil engineering.

I found the most intriguing section of the book to be the last several chapters, which contain material on pulsed power generation, ignition of fusion reactions using chemical explosives, use of magnetic fields to enhance fusion ignition, and thermonuclear "microexplosions" for use in inertial confinement fusion.

Unfortunately, not more than a few readers, those with access to classified information, will know exactly how good Dr. Winterberg's design may really be. I share his hope that the artificial barriers to achieving controlled fusion energy will soon be removed.

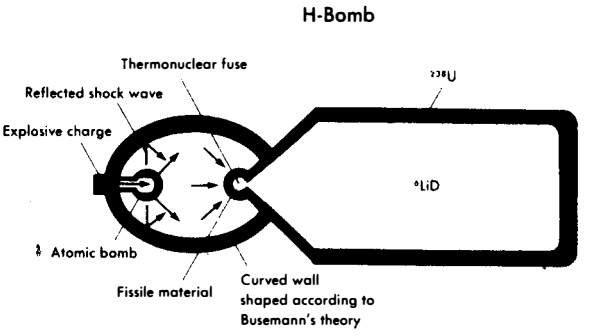

Figure 11. Design of dry H-bomb that I proposed in 1952. In this concept, ignition is accomplished using a Prandtl-Meyer ellipsoid with a thermonuclear exponential horn and a cylinder.

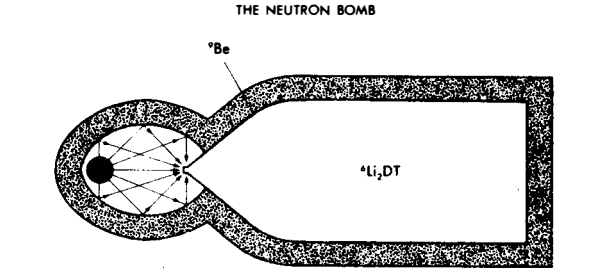

Figure 14. In the neutron bomb, the thermonuclear fuel is $^{6}Li_2DT$, replacing the ^{6}LiD of the ordinary H-bomb. The ^{9}Be shell serves as a neutron-multiplying reflector so that most of the energy goes into neutrons, with little blast effect.

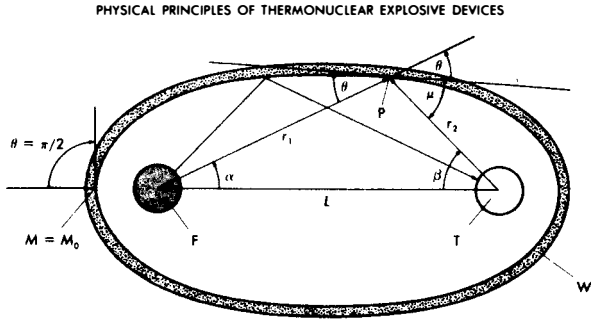

Figure 4. In the Prandtl-Meyer ellipsoid shock wave focusing principle, only one fission bomb F is used to induce a spherical implosion onto the thermonuclear explosive T by shock wave reflection from the wall inside the ellipsoidlike cavity. P is the point where the incoming wave intersects with the wall; M is the Mach number of the hypersonic flow associated with the diverging wave at P; θ is the angle between the wall slope and the incoming ray; r_1 and r_2 are the rays of the shock wave.

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