A Brief Revisionist Note on the History of the Nuclear Age

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This brief note is written specifically as background to the paper *The Shadow of the Bomb: a study of degree-level nuclear physics textbooks* (Cottey 2010). An adequate understanding of the problematic aspects of the nuclear physics textbooks and of the culture which creates them does require some knowledge of the history of the nuclear age in its technological, political and psychological dimensions. This note is revisionist, relative to the treatments that are to be found in degree-level nuclear physics textbooks, in that it attends especially to the military applications. I hope that it and the references therein will be useful to readers not already acquainted with nuclear history and to those acquainted only with a 'received interpretation'.

When nuclear fission (the splitting of certain heavy nuclei with the release of a very large amount of energy) was discovered at the end of 1938, it was recognised immediately by physicists that such splittings might be amplified in a runaway chain reaction, thus creating a fission bomb (informally known as an atomic bomb) thousands of times more powerful than the largest conventional bomb. After a slow start, the USA (with involvement of some of its allies and of refugee scientists) created a crash program (the Manhattan Project) to research this speculative possibility. As the possibility turned out to be real, the project became extremely large. An essential stage on the way to creating fission bombs was the design and construction of nuclear reactors (in which the chain reaction is controlled, so that energy and neutrons are released in large but controlled amounts). These were required for relevant researches and for the production of plutonium (an alternative fission explosive, with some advantages over uranium235). One bomb of each kind was exploded by the USA (with some involvement of other allies), destroying the Japanese cities of Hiroshima and Nagasaki.

Even before the end of the Second World War another war, the Cold War, was brewing. The development and use of two fission bombs was followed quickly by two more gigantic amplifications of human destructive ability. A nuclear arms race began with the production of large numbers of such weapons. And shortly thereafter, fusion weapons (also called thermonuclear weapons and informally known as hydrogen bombs, or H-bombs) were developed and deployed. Fusion means the joining together of certain light nuclei (principally hydrogen), a reaction which, like fission, produces a very large amount of energy. Fusion weapons were quickly developed with yields (euphemistic term!) hundreds of times greater even than those of fission weapons. *Nuclear Arms Race: technology and society* (Craig and Jungerman 1986) provides a valuable overview of the history of the technology and politics of nuclear weapons to the 1980s. Since then the overall scale of the arsenals has been reduced. *Nuclear Notebook: Worldwide deployments of nuclear weapons* (Norris and Kristensen (2009) is the latest overview in a long series of updates in the Bulletin of the Atomic Scientists on nuclear weapon arsenals. This report begins

> As of the end of 2009, we estimate that there are approximately 23,360 nuclear weapons located at some 111 sites in 14 countries. Nearly one-half of these weapons are active or operationally deployed.

Nuclear physics has vital applications that are overtly military and applications that are not overtly military. The latter group of applications nevertheless has military connections. Two of these connections are especially important …

- most nuclear reactor designs produce an important nuclear weapon fuel, Plutonium, in large quantities
- nuclear-powered submarines (which may also be armed with long-range nuclear missiles), with their unique ability to cruise discreetly underwater for very long periods, have from near the beginning of the nuclear age decisively affected geo-political nuclear strategy.

By contrast with the under-reported significance of nuclear reactors as submarine power units, which receives little attention, nuclear power stations are hyped. Seventy years into the nuclear age, they supply only a small fraction of the world's electricity and a smaller fraction of its energy. If there were no controlled nuclear power, submarines powered by nuclear reactors would not exist and geo-political military strategy would be significantly different. On the other hand, the world's energy resources would be, at most, little poorer (and arguably richer as alternative energy supplies and efficiency would have received more intensive development).

The disparity between under-reporting and hype is even more marked in the case of nuclear fusion. The actually existing fusion weapons receive little attention while controlled nuclear fusion is much bruited. Yet despite very large R&D investments over more than half a century the goal of economic fusion power is forever claimed to be a few decades away.

One more feature of nuclear physics and engineering should be noted. The early military programs created a large number of highly skilled nuclear scientists and engineers. The repulsive nature of what they had created, under pressures of war (including the Cold War), fed into a strong desire to put their skills to constructive use. The resulting enthusiasm for nuclear energy, especially for controlled fusion, overwhelmed the critical approach which is supposed to be a hallmark of science.

References

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