NUCLEAR PHYSICS

Superbomb Is Possible

Known basic reactions point to the possibility of a "hydrogen bomb" hundreds of times more violent than the present atomic bomb.

By WATSON DAVIS

➤ AN ATOMIC SUPERBOMB, a thousand times as violent as the present plutonium bombs, is definitely within the realm of possibility.

It would be made principally from the double-weight variety of the lightest chemical element, hydrogen. This isotope was discovered in America in 1931 and is called heavy hydrogen or deuterium (symbol D).

This is the "hydrogen bomb" that certain high officials in past months have vaguely, and possibly inadvisably, hinted may be made.

What, if anything, is being done by the U. S. Atomic Energy Commission about the construction of a deuterium superbomb is so far a secret, but the factual and theoretical basis of the hope for a new and more powerful bomb is no secret to anyone who can read the literature of physics and chemistry, even that earlier than 1940.

Basic Reactions

The basic reactions that point out the possibility of the superbomb are these: When two hearts or nuclei of heavy hydrogen (deuterons) come together there may be formed an ordinary hydrogen atom and a hydrogen atom of mass three (called tritium). Or the same coming together of D and D may also form a helium atom of mass three and a neutron. The important thing is that in each of these cases a sizable quantity of nuclear energy, due to conversion of mass into energy, is released. This amounts to 3,300,000 electron volts in each reaction.

You can find these reactions set forth in scientific articles published in 1935 in the *Proceedings of the Royal Society of London* and in *die Naturwissenschaften* (Germany).

The atomic energy released may appear at first sight to be small compared with that provided by the fission of the uranium or plutonium atom (which happens in the existing atomic bomb) which is 200,000,000 electron volts. But due to the fact that deuterium weighs only two, compared with uranium's 235, the energy available is very closely the same on a weight basis.

How to get the chain reaction started and kept going is a problem. In one sense it could be simpler for the heavy hydrogen bomb than the uranium-plutonium bomb. Neutrons, the neutral particles which are fundamental building blocks of atoms, are necessary to trigger and continue the fission of uranium or plutonium. No specially produced particles of this sort are necessary in the case of the superbomb. It is a matter of getting two deuterons together with enough speed and punch. The problems of doing this have not been worked out, so far as the literature shows.

Certainly the superbomb will require very careful attention to producing a high level of agitation of the atoms and a very speedy transfer of the energy and agitation to other atoms. It must all happen in a fraction of a microsecond. How big the bomb can be is also a question. The suggestion that it can be a thousand times or so the violence of the present fission bombs is based on the idea that it has no limits of size beyond which it must explode. There is a critical mass of the fission bomb beyond which it will explode and below which it won't. The superbomb size limitation is probably the amount of material that will react in the short time.

Since the energy-releasing reactions of deuterium bombardment were known long before the discovery of the fission of uranium in 1939, it is assumed that scientists must have thought of making deuterium bombs long before the uranium bombs were conceived. But the invention of the fission bombs may have solved the problem of getting a deuterium bomb started.

The trigger of a deuterium bomb might very well be the explosion of a fission bomb.

Combined Bomb

Because in one of the two D-D reactions a neutron is produced, it may prove practical to make a sort of combined deuterium-plutonium bomb, using the neutrons of the D-D reactions to fission plutonium.

For this reason, any competent chemist could tell you that the material of the superbomb might be a solid consisting of a chemical combination of plutonium and deuterium.

One dream of scientists has been the operation here on earth of the cycle of nuclear changes that maintains the heat of the sun. Dr. H. Bethe, now of Cornell and one of the world-renowned atomic physicists, has advanced a theory, now generally accepted, that carbon transforms into helium by six steps through nitrogen and oxygen with release of nuclear energy. Presumably this takes place only at very high temperatures and pressures. But this subatomic process of the sun which has been talked about freely (see Smyth report) is quite different from the D-D reaction and should not be confused with it. Dr. Bethe did publish in 1938 a study of the nuclear energy within the deuteron (*Physical Review*), which bears on the superbomb.

Scientific journals show that there is a continuing intense research upon the effects of deuterium bombarded with deuterium. For instance in the *Physical Review* for April 15, 1948, Dr. E. J. Konopinski of Indiana University and Dr. E. Teller of the University of Chicago go into the theory of angular distribution of the products of smacking deuterons into deuterons. Both are closely identified with U. S. atomic research.

The discoverer of the neutron, Dr. J. Chadwick of Britain's Cambridge University, headed a team studying deuterons in 1937, while groups at Massachusetts Institute of Technology, Rice Institute, State University of Iowa and elsewhere in the U. S. A. published reports in the years 1935 to 1940.

Many Uncertainties

Besides the prime question of whether the superbomb will act as expected, there are other uncertainties: Will the scientists cooperate in fashioning a new and more dangerous superweapon? Will enough money and facilities be devoted to the problem by the government? Will some other nation get the superbomb first?

There may be only a few scientists in the world capable of working out the theory and practice of the superbomb.

Even if more powerful bombs are not

PIPE BENDING MACHINE—Here is shown a 50-inch diameter pipe bend which is the largest one-piece bend ever made. The apparatus, developed at the Jersey City Works of The M. W. Kellogg Co., will mean longer life, reduced maintenance and superior performance for piping systems of process units.

needed, research should continue on nuclear energy from deuterium. Power plants of the future might be run on this atomic fuel. The production of a continuing (chain) reaction that won't explode should be as possible with heavy hydrogen as with uranium. And there is probably more heavy hydrogen than uranium on earth.

Science News Letter, July 17, 1948

NUCLEAR PHYSICS

Control of Atomic Bomb

If it is taken from the hands of civilians and given to the military it will create great uneasiness here and abroad. It will be an important political issue.

➤ A PRIME political question in this year of politics is:

Who shall control the atomic bomb, civilians or military?

The peace of the world may depend upon its answer.

The decision to put the bomb securely in the hands of the U. S. Atomic Energy Commission, composed of civilians, seemed to have been made by the passage of the McMahon Act two years ago.

But by providing only two-year terms for the atomic energy commissioners, Congress has served notice of the possibility of changes to come.

There is a quiet drive underway to put the military service back into the driver's seat on atomic energy. Latest manifestation is a plan sponsored by the McGraw-Hill Publishing Co. through its $15-per-year monthly magazine, *Nucleonics*. This divorces military activities and production from the AEC, and actually leaves only research in the hands of the AEC.

If atomic bombs were ordinary weapons it might not be very important just where the U. S. A. stock is kept and who controls it. But atomic bombs are extraordinary, devastating weapons. They are unlike machine guns, ordinary bombs or 16-inch guns. One can wipe out a city.

The rest of the world is afraid of America's atomic bombs. There is a measure of reassurance in the fact that the armed forces of the U. S. cannot use atomic bombs until they are turned over to them by the AEC on presidential order.

No angry general or admiral can order an atomic bomb dropped on his own authority, as he might order a border guard to fire upon attackers. The dropping of an atomic bomb would be the equivalent of a declaration of war and that is the job of Congress on the recommendation of the President.

There is still high fear on the part of many that, given the bombs and a more aggravated international situation, some high military officials may be tempted to start a preventive war. Some have openly urged this.

As it is now close cooperation of the military services with the Atomic Energy Commission provides for development and testing of atomic weapons, as was done at Eniwetok.

The loyalty investigations of AEC employees (as well as all government employees) with attention being paid to the most insubstantial gossip of "guilt by association" have done great damage to the quality of the scientists at work on the atomic energy program. The scientists themselves say that our second or third team is in the atomic energy game today.

Peaceful use of atomic energy has developed much more slowly than most scientists and laymen had hoped it would. Not even pilot plants for atomic power are underway, so far as known. This is added discouragement.

If the atomic bombs themselves are turned over to the men in uniform, it will be a new and ominous danger signal of a new war. This will be the case even if it should be done, secretly or openly, by Presidential order, without new legislation or change in atomic energy control.

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Losses of *vitamin C* value occur in plants that grow too much to foliage.

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