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.

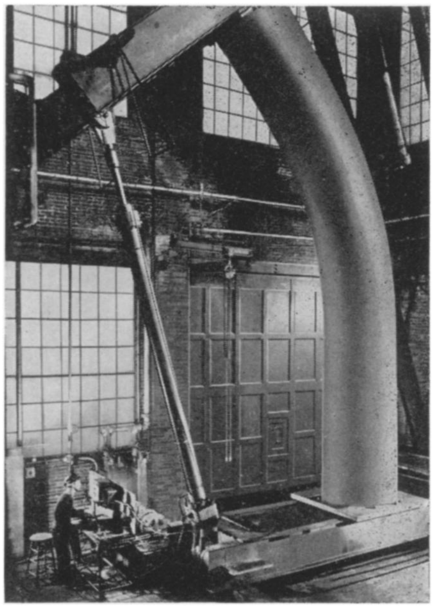
The discoverer of the neutron, Dr. J. Chadwick of Britain's Cambridge University, headed a team studying deuterons in 1937, while groups at Massachusetts Institute of Technology, Rice Institute, State University of Iowa and elsewhere in the U. S. A. published reports in the years 1935 to 1940.

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.