PHYSICS

Probe Fusion Elements

Predict many more H-bomb blasts will be detonated to test the fusion of different combinations of light elements, with the conversion of mass into energy.

By WATSON DAVIS

➤ MANY MORE H-bomb explosions will occur in the Pacific in coming months.

Aside from any military or political reasons, we must know about the phenomenon of fusion, the transmutation of light elements, with release of atomic energy, the conversion of mass into energy. This requires scientific experimentation.

What is being done on a grand scale is comparable historically to the exploration of radioactivity that took place about the turn of the century, or the development of uranium fission and the whole A-bomb program at the beginning of World War II.

There is not just one kind of superbomb — whether you call it hydrogen bomb, thermonuclear weapon, or fusion bomb. There probably are a dozen or so, each materially different. Then there is always the question as to how small and how large each of them may be made. And how they can be made to explode most efficiently.

The essential ingredients in a fusion bomb are: 1. Light chemical elements, part of whose mass is converted into energy. 2. A detonating or igniting charge, which is presumably a plutonium fission A-bomb, which is no small explosion in itself.

The igniting A-bomb would provide the high temperatures of a million degrees or more that are needed to fuse the hydrogen or other elements so that they transform into other elements with conversion of a small amount of their mass into energy.

Probably an A-bomb is the only practical way now known of setting off an H-bomb. But some of the tests now under way may include an attempt to ignite an H-bomb with another source of very high temperature, a fine metallic wire exploded by a jolt of high voltage electricity.

The material in a fusion superbomb is basically some sort of hydrogen, either the double-weight deuterium or the triple-weight tritium. This is the chemical stuff, the lightest element. Theoretically it could be converted into the next heaviest element, helium, with a large yield of energy from the mass or matter lost in the process. This is the kind of reaction that is believed to keep the stars stoked. It happens in the H-bomb in very short fractions of a second, and it has to happen before the atoms involved are flung far apart by the energy that such atomic interactions create.

The first of the U. S. H-bombs, whose explosion in November, 1952, is now being witnessed by the world in officially released motion pictures (see SNL, April 10, p. 227), was presumably primarily a rather simple hydrogen bomb. It probably utilized a D-D reaction, a combination of two atoms of deuterium or heavy hydrogen. It may have been a D-T reaction, in which a deuterium atom coalesced with an atom of tritium or triple-weight hydrogen. Both of these reactions, theoretically, should work.

Certainly one of them did in the now famous first H-bomb shot of 1952 Operation Ivy, which has become psychologically "poison ivy" to many.

The first H-bomb of 1954 (March 1) was about twice as large as the calculated estimate. It has aroused people by its tremendous size and the meteorological accident of "fall-out" of its radioactive material upon Japanese fishermen inside the danger area.

Too little is reported about the March 26 and April 6 bombs to do much speculating, but the March 1 bomb probably contained light element ingredients other than the hydrogens of the earlier H-bomb. That is what probably gave the March 1 bomb its extra "umph." It was an experiment. This test should have been made for scientific reasons, simply to know about the facts of matter and energy, even if it served no military or political purpose.

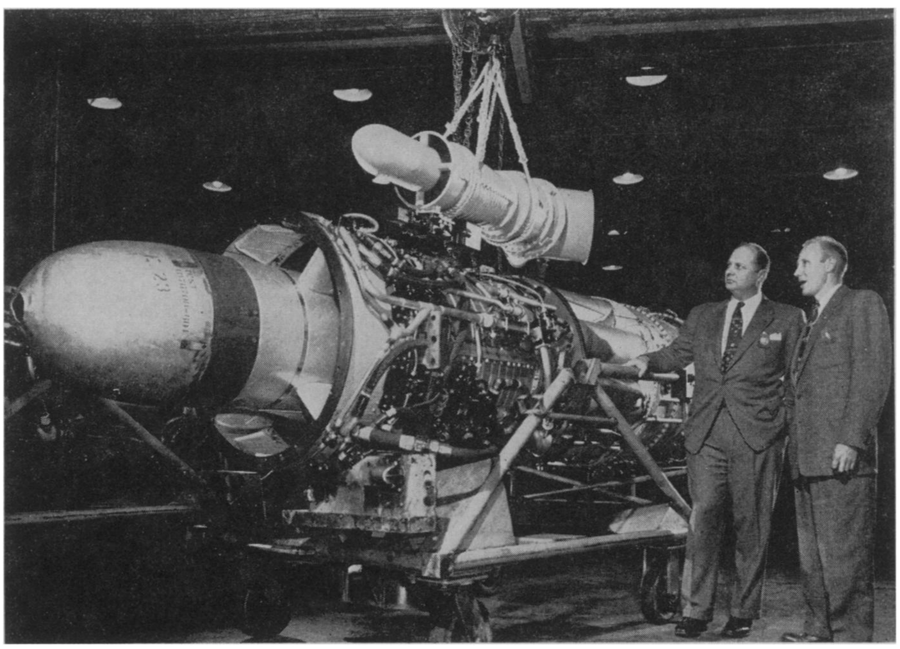
The best guess at an added light element is lithium. This is a light metal, atomic number 3 in the list of chemical elements. Lithium is relatively plentiful in the earth's crust, and it was used in its metallic form during the war to produce hydrogen for inflating weather and radio balloons.

Even before 1939 when the discovery of the fission of uranium made obvious the eventual building of an atomic bomb, the reactions between the light elements were known both by calculation and observation. In 1950 this reporter detailed such possibilities. (See SNL, Feb. 11, 1950, p. 83.)

For instance, there was a decrease in mass when an atom of lithium isotope 6 and an atom of deuterium or heavy hydrogen reacted. This is translatable into energy by Einstein's famous mass-energy equivalence, $E = mc^2$, or energy equals mass times the velocity of light squared. Similarly, it was known that there was energy in the lost mass of the coming together of the various hydrogens with the other sort of lithium (weight 7), beryllium, boron, and even carbon and nitrogen.

The lack was a means of getting them together so that they would react. That was not available until the A-bomb was achieved. The fission of the A-bomb brought the needed temperature that slammed the light elements together. That is the reason that the H-bomb has to have an A-bomb at its heart.

There are so many possible combinations of the light elements to try that we can expect many more H-bomb tests.



JET FOR HELICOPTERS—A mock-up model of the new gas turbine engine, XT-58, being developed for helicopters by General Electric is shown here, compared for size with a jet engine that powers the Sabre Jet interceptor.