GENERAL SCIENCE

Predict Harnessing H-Bomb

U. S., British and Russian scientists are seeking way to get energy from controlled fusion, which India's representative at Geneva predicted will be accomplished within 20 years.

See Front Cover

By WATSON and HELEN DAVIS

➤MINING the world's oceans for heavy hydrogen, a virtually inexhaustible power supply, was foreseen by scientists in Geneva, following the prediction by Dr. Homi J. Bhabha that energy may be obtained within 20 years from controlled fusion of the light elements.

Dr. Bhabha, chairman of India's Atomic Energy Commission, is president of the International Conference on Peaceful Uses of Atomic Energy.

When such an authority as Dr. Bhabha is confident that H-bomb reactions can be harnessed, oceans may be tapped for their heavy hydrogen, or deuterium, even sooner than within two decades.

Other elements besides hydrogen, for instance lithium, can be fused with release of energy, although Dr. Bhabha did not hint at this in his presidential address opening the Geneva Conference.

It is known that lithium stocks are already speculative on stock exchanges around the world.

The raw materials for fusion are plentiful compared with the scarce and heavy uranium and thorium out of which fissionable materials, for bombs or power reactors, are made.

Within a few days after Dr. Bhabha's prediction, the heads of atomic programs in Both United States and Britain revealed that scientists in their countries were working on peaceful uses of the fusion reaction.

Adm. Lewis L. Strauss, chairman of the U. S. Atomic Energy Commission, said that the U. S. is engaged in a moderate program of very long-range research to develop power from thermo-nuclear fusion. This program does not jeopardize progress in the fission reactor field, he said.

When asked by SCIENCE SERVICE whether lithium figures in thermonuclear reactions, Adm. Strauss refused to answer.

Sir John Cockroft, director of Britain's Atomic Energy Research Establishment at Harwell, disclosed that British scientists were also working on the problem of harnessing fusion reactions.

It is presumed the Russians are likewise tackling the task of thermonuclear control. Thus, the three leaders in the atomic field are evidently also vying for first position in making the energy released by fusion available for productive use.

Dr. Bhabha's announcement confirmed speculation over several years on the possibility of triggering the hydrogen reaction without exploding an atomic, or fission, bomb.

Originally it was thought the extremely high heat of a uranium or plutonium bomb was necessary to ignite the fusion bomb. Now it is believed some other devices, such as wires exploded by a jolt of high-voltage electricity or sun-like temperatures produced by shock waves, might do the trick. (See SNL, July 30, p. 76, and Aug. 6, p. 84).

Produce Atomic Fuel

➤ AN ATOMIC POWER REACTOR will make money on the atomic fuel it produces in generating power, engineers from the Oak Ridge National Laboratory told the conference.

The U. S.-designed power plant, now in experimental form, uses a fluid fuel, consisting of uranyl sulfate in heavy water, and also thorium oxide slurry in heavy water in another part of the device, called a homogenous reactor.

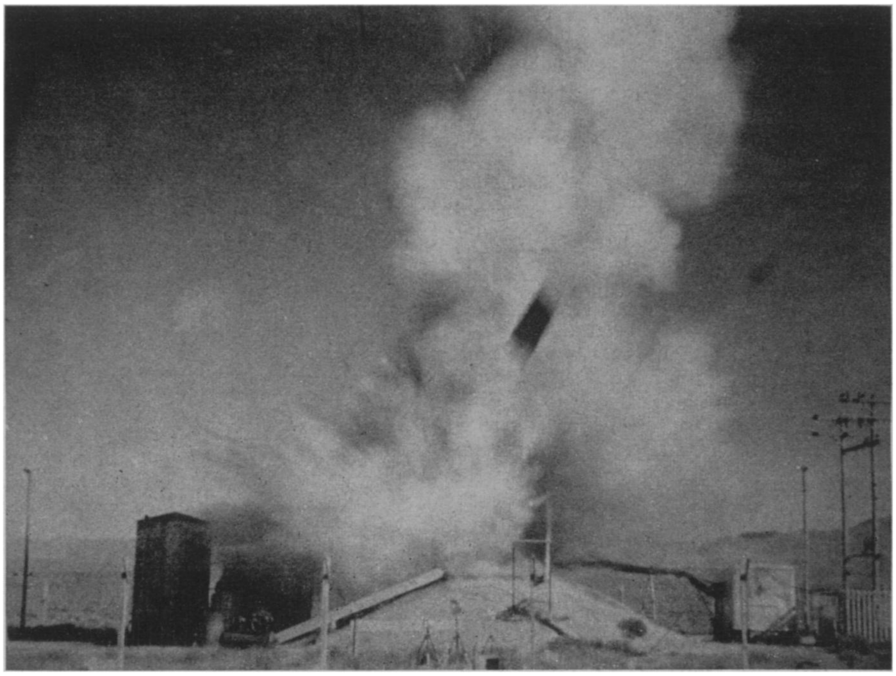
Neutrons from fissioning uranium change the thorium into uranium isotope 233, the atomic fuel. Due to thorium's low relative cost, the atomic materials produced is worth more than the uranium put into the plant.

The fuel cost for operating a large power plant of this sort would be low provided the cost of separating spent materials from produced fissionable materials is cheap. If this could be done wholesale from five or more 100,000 kilowatt plants, fuel processing should be less than one-tenth cent per kilowatt hour, R. B. Briggs and J. A. Swartout estimated.

A major attraction at the Geneva Atoms-for-Peace conference is a "swimming pool" reactor, designed primarily for research purposes. The exhibit reactor, which is shown in the photograph on the cover of this week's SCIENCE NEWS LETTER, can operate at a continuous power level of 10 kilowatts. Radiation from the core appears as a bluish-green glow.

"Runaway" Reactor

➤ FEAR of the consequences if a "runaway" atomic power plant should blow up in a densely inhabited area was reduced when Dr. J. R. Dietrich of Chicago's Argonne National Laboratory told the conference the results of such an explosion, which was allowed to happen at Los Alamos in 1953.



"RUNAWAY" REACTOR—This photograph, made by a high-speed camera at the height of the explosion of the "Supo" reactor, shows the large amount of debris blown into the air. Most of the fuel element fragments fell to earth within 200 feet of the reactor. There was no dangerous fall-out at distances greater than a few hundred feet.

Within a radius of 350 feet from the site of the explosion, chunks of melted and twisted metal were found afterwards. These added up to the amount of metallic fuel plus the thin-walled steel tank that contained it.

"No large fraction of the reactor core material left the site in the form of airborne material," the Argonne Laboratory scientist stated.

Although X-ray type radiation momentarily surged out from the exploding reactor in such quantity that it registered 400 milliroentgens per hour on a recording instrument half a mile away, the total amount of radiation received at the measuring point was less than one-fortieth that figure. A milliroentgen is one-thousandth the unit of quantity of X-rays.

Although duration of exposure to these rays is measured in roentgens per hour, the ray's effects on the body add up. Total radiation of from 400 to 600 roentgens is within the limits likely to cause death. Thus the peak dosage of the explosion, at the distance of half a mile, measured only one-thousandth of the lethal dose.

Blowing up of the "Supo" reactor at Los Alamos in 1953 came as the climax of a series of tests designed to learn more about what happens when an atomic power plant runs too hot.

After the fuel elements had become warped and partly melted at the end of the series, it was decided to arrange conditions so that heat would build up as rapidly as possible, with all controls removed. This would simulate the worst conditions in the case of a runaway reactor.

The resulting explosion sounded to scientists at the control station, half a mile away, like that of one to two pounds of 40% dynamite exploding at the same distance, it was reported. The blow-up was reported to have effects "comparable to those which could be caused by a moderate amount of chemical explosive."

Einstein and Fermi

➤ THE NAMES of two great scientists who died within the past year, Albert Einstein and Enrico Fermi, have been immortalized by christening chemical elements 99 einsteinium and 100 fermium.

Dr. Albert Ghiorso of the University of California at Berkeley revealed both elements were first discovered in debris from the October, 1952, H-bomb explosion by Dr. Glenn Seaborg, also of the University of California.

A group of scientists led by Dr. Seaborg later made einsteinium and fermium in a cyclotron and in nuclear reactors at Berkeley, Argonne National Laboratory and Los Alamos.

The symbol for element 99, einsteinium, is plain E. That for 100 is Fm.

Now all discovered elements are named, since 101 was previously named mendelevium after the Russian, D. Mendeleeff, who announced the periodic system of the elements in 1869. This name pleased the Russians who placed it on the giant periodic table of the USSR exhibit at the International Conference on the Peaceful Uses of Atomic Energy in Geneva.

The Russians are expected to replace their labels for 99, athenium, and for 100, centurium, with the announced U. S. names.

Naming the new elements was delayed by secrecy imposed by the creation in the thermonuclear reaction when uranium 238 added 17 neutrons in one jump, becoming einsteinium 255, which changed to fermium 255 by electron loss.

The elements were found in H-bomb dust picked up about 200 miles from Eniwetok.

Subsequently both 99 and 100 have been made in the cyclotron by bombardment with nitrogen 14, and in a reactor by successive neutron irradiation of plutonium.

Dr. Ghiorso predicted sufficient quantities of element 99 to be visible microscopically would be available within a year, since one form has a half life of one year. Within four years, the discovery of elements 102, 103, and 104 will probably be made as a result of bombardment of heavy elements with heavy particles. Dr. Ghiorso reported atoms with 152 or more neutrons change themselves spontaneously at a terrifically enhanced rate, as fermium does.

The christening announcement will be made formally in the *Physical Review*, dated Aug. 1, which will appear Sept. 1.

Predict Heavy Atoms

➤ ATOMIC HEARTS twice as heavy as any now known can be made by "fattening" lighter elements with neutrons, Dr. John A. Wheeler of Princeton University, Princeton, N. J., predicted at the conference.

"Massive" doses of neutrons would be needed to make the "superheavy" nuclei, which would be the heaviest form of matter on earth. Such atomic hearts would be unstable and break up into smaller fragments, but would live long enough to be studied in the laboratory.

Nuclear reactors are presently the best source of neutrons in quantity.

The heaviest nucleus known is element No. 101 in the series counted by atomic number. It has an atomic mass of 256. An element's atomic number is equal to the total number of positive charges on the nucleus, from one for hydrogen to 101 for element 101. An element's mass is considered concentrated in the nucleus, made up of protons and neutrons, collectively called nucleons.

Dr. Wheeler based his suggestion of "nuclei with masses two or more times heavier than the heaviest nucleus now known" on estimated limits of nuclear stability. That is the limit to the number of neutrons a nucleus may contain without becoming unstable. This limit varies for different elements.

Certain elements, such as uranium and plutonium of atomic bomb fame, split into two fragments of nearly equal mass after absorbing bombarding neutrons. This is nuclear fission.

In outlining what is known about the physics of fission, Dr. Wheeler pointed out that the Russians Flerov aid Petrjak were the first to discover the spontaneous fission of uranium in 1940. It was, he said, "one more reminder of the international character of fission physics, as of every other branch of science."

To get some idea of what goes on inside the nucleus, physicists have made simplified pictures of atomic cores, then tried to make predictions based on these models. One likens the nucleus to an "onion," another likens it to a "water drop."

"An improved analysis," Dr. Wheeler said, "combines the two points of view."

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