PHYSICS

Background of Atomic Bomb

It is well for the world to have the simple facts about the atomic bomb and something of its history in order to understand the Bikini demonstration.

By WATSON DAVIS

➤ WHILE THE attention of the world is focused on Bikini atoll in the Pacific awaiting the explosion of the fourth atomic bomb in history, here are the facts and background of the release of atomic energy and the bomb itself:

The atomic bomb, such as used at Bikini, is the most concentrated blast of energy that man has ever set loose.

It is not only the most powerful type of bomb in history, but its explosion is different from the conventional high explosives such as TNT. High explosives of the old sort have air, water and solid blast effects, but the atomic bomb has pressures of millions of atmospheres and adds to these radiation blast. It also produces clouds of radioactive substances more formidable than the most deadly poison gases.

Temperatures at the center of the atomic bomb explosion—which is all over in less than a millionth of a second—are so high, some 10,000,000,000 degrees Fahrenheit, that it is as though a star had been brought to earth. Nothing else in the world is quite so hot and so bright.

The energy of the atomic bomb comes from the actual conversion of matter into energy. The amount of energy released can be computed accurately by the famous law of equivalence of matter and energy that Dr. Albert Einstein, of relativity fame, developed in 1905. This formula is E equals m times c squared, where c is the velocity of light, and E stands for energy and m is mass.

Weight Military Secret

The actual weight of the active stuff in the atomic bomb is still a military secret. It is maybe about 60 pounds, which could be carried in a suitcase. If it were possible to convert 60 pounds of any kind of matter completely into energy, it would provide more energy than was generated by the whole electric power industry in the United States during the approximately four years of the war period, something like 680 billion kilowatt hours of energy.

Actually only a very small fraction of this total mass is changed into energy in the fission of the split atoms in the atomic bomb elements, whether it be uranium 235 or plutonium. The energy produced is still ample and terrifying. If all the atoms undergo fission in a 60-pound bomb, the energy released would be equal to that of the explosion of 550,000 tons of TNT. Yet if all the material in the active elements in the bomb could be gathered up and weighed after the explosion, you would still have almost 60 pounds.

Although immense energy is released from the atomic bomb, it is not as large as that involved in some of the natural occurrences on the face of the earth, such as great earthquakes. The earthquake in April off the coast of Alaska on the floor of the ocean that sent a tidal wave of destructive proportions to Hawaii undoubtedly involved much more energy. Destructive tidal waves from the underwater atomic bomb tests are not expected.

Power Localized

The great power of the atomic bomb explosion is relatively localized. The zone of total destruction is a circle of about two miles in diameter. People and structures a dozen miles away are relatively safe except for some possible effects and radioactive substances that might be blown upon them by winds in the wrong direction.

The Bikini tests are designed to make careful observations of many effects not accurately known, but because of the military nature of the tests much of the important and significant data will not be announced to the public.

Sealed Cans To Be Used

One of the most useful of the test instruments used in the Bikini tests is a sealed can such as is used to transport gasoline. The amount of collapse in this simple device gives an accurate measure of air pressure or air blast caused by the atomic bomb explosion.

The extraordinary radiation produced by the atomic bomb explosion is perhaps more remarkable than the great destruction caused. The heat produced is so intense that steel is vaporized and vanishes into the air.

In addition to burns, the victims of an atomic bomb suffer true radiation sickness similar to to that seen in patients who get sick following massive doses of X-rays and radium. Some severely radiated die in a short time. In others a fever is caused, the victim feels sick and has loss of appetite, gums bleed, teeth are loosened so that they could be removed with the fingers, gold fillings become radioactive and at least temporary baldness is suffered.

There was fear at first that the whole area exposed to the bomb would be made dangerously radioactive, but this does not seem to be the case. In the Japanese and New Mexico explosions, practically all the radioactive products of the explosions were carried upward in the ascending columns of hot air and dis-

Joint Army-Navy Task Force One Photograph

BIKINI REHEARSAL—But this is not an atomic bomb. It is a TNT underwater explosion performed as a preliminary test at the Naval Mine Warfare Test Station, Patuxent River, Md., to provide data for underwater atomic explosions at Bikini Atoll.

persed harmlessly over a wide area.

Extensive investigation will be made at Bikini of both radiation effects and radioactivity.

The details of the manufacture of the atomic bomb are secret, but the Smyth report gives a general idea of how it is put together. The bomb must be larger than a certain "critical size" in order to blow up. The number of neutrons produced by the first fissions of the atoms must be sufficient to get into other atoms and produce further fission. It must do this before the bomb flies apart. The time that elapses between the beginning and the end of this nuclear chain reaction is extraordinarily brief. This very, very short time—less than a millionth of a second—is the reason for most of the technical difficulties of making an atomic bomb.

Neutrons Reflected Back

The bomb is evidently surrounded by an envelope of pure graphite or a similar substance that reflects many neutrons back into the bomb instead of letting them escape outward where they would not hit the hearts of atoms in the bomb. This layer is called a tamper. In addition to being a neutron reflector, it also helps to delay the expansion of the reacting material.

Because there are enough neutrons from cosmic rays or sources inside the bomb to set up a chain reaction, it is necessary to keep the bomb in separate pieces, each below the critical size, until it is desired to produce the detonation. When the bomb is to be set off, these separate pieces must be brought together just as fast as possible. Evidently the method of assembling the bomb at the instant when an explosion is desired is to shoot one part as a projectile in a gun against a second part as a target. Doing this successfully is not as simple as it sounds, of course, and much of the "know-how" of the atomic bomb itself is concerned with this problem.

History of Atomic Bomb

When atomic bombs are exploded at Bikini, more historic dates will be added to the chronology of science's achievement of atomic power.

The story of the release of atomic energy really begins with many discoveries, experiments and theories in nuclear physics in the 1930's, but the immediate start of the researches which resulted so spectacularly was in January, 1939, when two Germans, O. Hahn (awarded the Nobel prize in 1945) and F. Strassmann proved that an isotope of barium was produced by neutron bombardment of uranium. The neutron is a fundamental particle of matter without electrical charge and with a mass about equal to that of the proton or nucleus of the hydrogen atom.

Two refugees from Germany, O. R. Frisch and Lise Meitner, suggested that the absorption of a neutron by a uranium nucleus sometimes caused that nucleus to split into approximately equal parts with the conversion of some of the mass, by Einstein's 1905 formulation, into enormous quantities of energy, a process called fission.

These reports were brought to the January 26, 1939, conference on theoretical physics at Washington, D. C., jointly sponsored by The George Washington University and the Carnegie Institution of Washington, with Niels Bohr of Denmark, Enrico Fermi and others discussing the problem. Experimental confirmation of uranium fission in several laboratories followed and the suggested likelihood of emission of neutrons in the process was demonstrated. This indicated the possibility of a chain reaction releasing energy explosively.

On December 2, 1942, the first self-maintaining nuclear chain reaction was initiated at an uranium-graphite pile at Stagg Field Stadium, Chicago. On July 16, 1945, 5:30 a.m., the first atomic explosion created by man blasted the New Mexico desert. On August 6, 1945, the first atomic bomb used in warfare was dropped on Hiroshima, Japan.

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GENERAL SCIENCE

Seeds and Insects To Be Tested in Atomic Blast

➤ IN ADDITION to testing warships, the atomic bomb blast at Bikini will be turned upon seeds, molds, insects, and diseases of plants and animals.

A collection of these test materials, carefully nursed by U. S. Department of Agriculture scientists, are now en route.

Plants with new hereditary strains may result from the atomic bomb explosions. X-rays are known to change the hereditary mechanisms of seeds and resulting plants, and scientists expect some such hereditary changes from the alpha and gamma radiation from the bomb.

Among the materials to be exposed at 25 locations in the bombed area are: cereals, forage crop seeds, vegetable seeds, flower seeds, cotton seed, smut spores, snap beans, micro-organisms, various cultures for treatment of animal diseases, beetles, weevils, moths, mosquito eggs, termites, bedbugs, several kinds of ticks and mites.

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