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Uranium-235: Can It Win the War?

by MURRAY TEIGH BLOOM

In guarded laboratories all over the world, quiet men of science are engaged in a grim race. The prize? A weapon which alone might win the war

IMAGINE a substance with explosive power so great that a 10-pound bomb could blast a hole 25 miles in diameter and more than a mile deep and wreck every structure within 100 miles. Think of a magic metal with so much potential energy that a five-pound piece of only 10 per cent purity could be used to drive battleships and submarines back and forth across the oceans without refueling for months.

It's not at all beyond the realm of possibility, either!

As a result of work being conducted in carefully guarded laboratories all over the world, there is every likelihood that cheap, almost inexhaustible atomic power will be achieved in the lifetimes of most of us—thanks to a heavy metal known as Uranium-235. There are those who believe that U-235 will play an important and perhaps decisive role in this war.

As a matter of fact, the world was given a one-day fright in February, 1941, when carefully manufactured rumors emerged from Germany that the Third Reich's scientists had finally perfected a uranium atomic-energy bomb, theoretically two million times as powerful as an ordinary bomb of equal weight. Of course, this was a bald mixture of wishful thinking and Nazi bogey-man tactics. If they had such a weapon, not a single word would have been necessary. An English city razed to the ground would have done the trick.

More than 10 years ago William O. Stapledon, an imaginative Briton, foresaw such an event. Only Stapledon laid the scene on a lonely English beach—and set the date for 1980. Not until then, he prophesied, would physicists finally solve the problem of atomic power.

At that time, a picked group of great international scientists (goes the story) would watch a certain young physicist train his atomic gun at a small uninhabited island nearby. There would be a cataclysmic explosion—and the island would disappear. Then the physicist would offer his secret to his colleagues "for the benefit of humanity."

In Stapledon's version—published in 1931 in *Last and First Men*—the scientists made their discovery as their countries were about to enter on the Third World War. But Stapledon was too conservative.

Today, in the midst of the Second World War, we are on the verge of the Atomic Age.

AMERICAN scientists engaged in the secret work of isolating sufficient U-235 have minor fits when you bring up the possibilities of the metal's terrific explosive properties. To them and to Dr. Vannevar Bush, head of the Office of Scientific Research and Development—through which American scientists are mobilized for total warfare—the value of U-235 lies in its great industrial potential. They admit, though, that once sufficient amounts of the substance were isolated it could be used, very effectively, as the deadliest explosive in history. So behind closed doors the fabulous research continues.

Fortunately, it is one field where we have definite numerical superiority over the Nazis. For we possess a relatively large number—35—of cyclotrons, the key instruments in the creation of atomic power. These machines, usually called atom smashers, generate terrifically energetic invisible particles called neutrons which, when hurled at a uranium target, smash it. The breaking up of the uranium atom creates atomic energy.

Germany is believed to have had five cyclotrons when war broke out, and it captured six more in conquered countries. In Tokyo old Dr. Nishina works with Japan's sole cyclotron. Though American physicists consider him one of their most dangerous competitors for the secret of Uranium-235, the Germans offer a greater threat. More than 200 Teutonic scientists are giving the problem their full attention, German immortality assured him who discovers how to produce U-235 in quantity.

American physicists doubt if the problem can be solved inside of a decade. But the Germans are badly in need of a new, powerful weapon. Since it could be used as a terrible explosive and as a fuel for submarines, planes and tanks, U-235 would be their answer.

There are tremendous problems in the way, of course, but war breeds scientific miracles. Didn't Fritz Haber, in the nick of time, discover the nitrogen fixation process that enabled Germany to continue the First World War with cheap artificial nitrates for explosives? Today Germany prays for another miracle like Haber's.

Lise Meitner might have accomplished that miracle for Germany—but not for a Germany ruled by Nazis. For like Haber before her, Lise Meitner is "non-Aryan."

For 20 years this plain, 61-year-old spinster had been a vital part of a research team respected the world over for its solid accomplishments in atomic physics.

In the spring of 1938 Dr. Lise Meitner and Dr. Otto Hahn, director of the Kaiser Wilhelm Institute in Berlin, began to bombard ordinary uranium atoms with neutrons. The heavy metal uranium has been known for 150 years but till 1938 its practical uses had been confined to coloring porcelain and glass and as a minor constituent in alloy steel. Neutrons? They're the electrically neutral fragments of matter which form the building blocks of our universe.


Dr. Lise Meitner

This business of atom smashing had been going on for a decade without making red-hot front page stories. By employing very high and very expensive electrical voltages, scientists had been able to bombard small pieces off the atomic core of the metal which was subjected to this terrific punishment. When the atom was chipped in that way, a considerable amount of energy was released in the process, but not nearly enough to compensate for the amount of power you had to use for the splitting. It was like putting 20 nickels into a slot machine and getting four back.

But one day Fraulein Meitner and Herr Hahn, using "slow speed" neutrons in their bombardment of uranium, got some crazy results. Instead of getting a heavy element resembling uranium, they got traces of something entirely different: barium.

This barium business didn't make sense. But just then that was a comparatively minor matter for Lise Meitner. A German racial court had decreed that she was "non-Aryan." From then on life would be unbearable for her in Nazi Germany. She would go to Sweden.

Shortly after eight on a January evening in 1939, the Stockholm Express pulled out of Berlin with the lonely old lady. As the train hurled past the town of Eberswalde, Fraulein Meitner allowed herself a little smile. The palatial country home of Goering was nearby.


Niles Bohr

She recalled the hesitant offer of her colleague Hahn to go to Goering and ask him to make an exception in the case of Lise Meitner. But what use was the Fraulein Doktor to a Germany preparing for vengeance? All she could do was help smash uranium atoms, which anyone with half a brain could see was no help to the German war machine.

She took out her battered notebook. This barium nonsense, now. The only possible explanation was utterly fantastic. Somehow they had split uranium—not chipped it, but really split it—into two uneven pieces of barium and krypton. It had never happened before in history. Everyone knew there just wasn't enough power on earth to split an atom in half, let alone the uranium atom, the heaviest of all.

So she went over her figures again and again. No, you couldn't get around the incredible conclusion of the cold figures: in splitting the uranium atom they had released in atomic binding energy 200,000,000 electron volts per atom, an energy yield five million times greater than that released in the burning of coal. She, Lise Meitner, had hit upon the answer sought by every able physicist since the turn of the century.

At fog-bound Sassnitz, the last stop in German territory, she was led off into a small room in the station where a Customs matron ordered her to undress and be searched. Ten marks and no more must go out. No notes. No military secrets. But it was late and the matron wasn't wide-awake. Somehow the little notebook, containing the basic clue to a new world's destiny, passed muster.

They boarded the ferry. She couldn't sleep. She stood on the deck for the long Baltic voyage and went over her figures again and again. No, it was no mistake. She was certain. It wasn't dawn yet when the ferry docked at Trelleborg, Sweden.

Thus it was that when Fraulein Meitner arrived in Stockholm, she telegraphed the historic news to a scientist friend in Denmark who in turn cabled the news to Professor Niels Bohr, then working with Albert Einstein at Princeton. With Enrico Fermi, who had left Fascist Italy to continue his atom-smashing work at Columbia University, Bohr checked Lise Meitner's figures on Columbia's great atom smasher—and found she was correct to the last volt. Elsewhere the experiment gave identical results.

Thanks to an obscure German racial court, the secret was no longer a German secret.

LATER THE scientists discovered that to get a continuous supply of energy you had to have a certain type of uranium—now known as Uranium-235. However, in every 140 pounds of ordinary uranium, there is but one pound of pure U-235. The process of isolating this precious substance is painfully slow and today all the U-235 in America could be placed on a dime with lots of room left over. The present goal is mass production of U-235.

The metal needs only a continuous stream of water to release its energy. The water would be turned into steam and steam would run powerful turbines. The brake? Simply stop the water flow.

The sources of the substance, carnotite and pitchblende, are located mainly in Allied territory, although some amounts are found in Germany itself. Great rich veins of pitchblende, which also reduces to radium, are found in the Great Bear Lake district of Canada's northwest and in the Belgian Congo. Carnotite is found in Colorado.

Obviously the discovery of a practical means of obtaining large quantities of U-235 would almost revolutionize American industry and transportation. The coal industry would become a gigantic museum piece. The national energy bill of some three billion dollars a year would be cut to a fraction of that. Autos would have permanent in-built fuel supplies . . . but do your own imagining. The sky's the limit if we can get enough U-235—and if we get it before the Nazis do.

Many American scientists think the problem will be well on its way toward solution with the huge 4,900-ton atom smasher which is now being built by Dr. Ernest O. Lawrence and his associates at the University of California. It will be capable of hurling a stream of 200,000,000 electron volts. It will probably be capable of transmuting any element, including uranium. If U-235 could be made of the more common U-238 we would have the answer. Sometime in 1943 the super-cyclotron should be ready for the historic test.

Meanwhile some of the keenest American minds continue their work on the great problem, fully aware that success means almost certain death. The radiations of U-235 will probably kill them unless a protective non-bulky shield is discovered to protect them from the rays. Early X-ray pioneers died that way, too.

And meanwhile, in Stockholm, quiet Lise Meitner, who set the spark to a scientific revolution that will certainly change man's history, continues her experiments, too.

At 61, death is a minor matter.

—*Suggestions for further reading*

WHY SMASH ATOMS?
by Arthur K. Solomon *$2.50*
Harvard University Press, Cambridge, Mass.

ATOMS IN ACTION
by George R. Harrison *$3.50*
William Morrow & Company, New York

WORLD AND THE ATOM *$2.75*
by Christian Moller and Ebbe Rasmussen
D. Van Nostrand Co., Inc., New York