

PHYSICS

# Atomic Energy Released

## Millions of Electron-Volts Given off When Uranium Is Split by Bombardment With Low-Energy Neutrons

By WATSON DAVIS  
and ROBERT D. POTTER

See Front Cover

IS THE WORLD standing on the brink of the release of atomic power?

This question is paramount in scientific circles, following confirmation in several laboratories of the extraordinary release of atomic energy from the splitting of the uranium atom. Perhaps these experiments are more important than even the discovery of radioactivity itself.

First of all, the physicists are anxious that there be no public alarm over the possibility of the world being blown to bits by their experiments. Writers and dramatists (H. G. Wells' scientific fantasies, the play *Wings Over Europe*, and J. B. Priestley's current novel *Doomsday Men*) have over-emphasized this idea.

### Heavy Element Split

What is the new experiment that is so exciting?

Uranium, heaviest of stable elements and a sort of granddaddy among the radioactive elements that slowly disintegrate spontaneously, has been split with great release of energy. And the atom-splitting agency is the neutron, the electrically neutral particle discovered only seven years ago, itself a part of the hearts of atoms.

Bombard uranium with neutrons, even those with only a fraction of an electron-volt of energy, and its nucleus will split and give off millions upon millions of electron-volts of energy, up to 100,000,000 volts in actual experiments and some 200,000,000 volts theoretically.

Of course, it is not nearly so simple as this sounds, for there is the matter of producing the neutrons and arranging it so they hit frequently enough to make the process efficient, which it is not as yet.

But the energy release is astoundingly high, nevertheless, since the greatest release of atomic energy hitherto achieved consisted of 20,000,000 electron-volt gamma rays, obtained when deuterons, hearts of heavy hydrogen atoms, are smashed into lithium, a light metal. Incidentally,

neutrons are given off at the same time and it is these neutrons that can be used to split uranium.

Neutrons slide into the nuclei of elements easily and for that reason the energy-releasing bombardment, to be efficient, would probably need to be performed upon very pure substances, such as seldom exist now. This is probably the reason why the effect was not discovered accidentally, perhaps through a laboratory explosion.

This latest chapter of physics began in its immediate phases with researches in Berlin by Prof. Otto Hahn. He observed the strange action of uranium under neutron bombardment but could not quite account for it. Dr. Liese Meitner, long associated with Prof. Hahn, and Dr. R. Frisch of Copenhagen, suggested the idea of uranium splitting into other elements, which although unheard of previously proved to be the

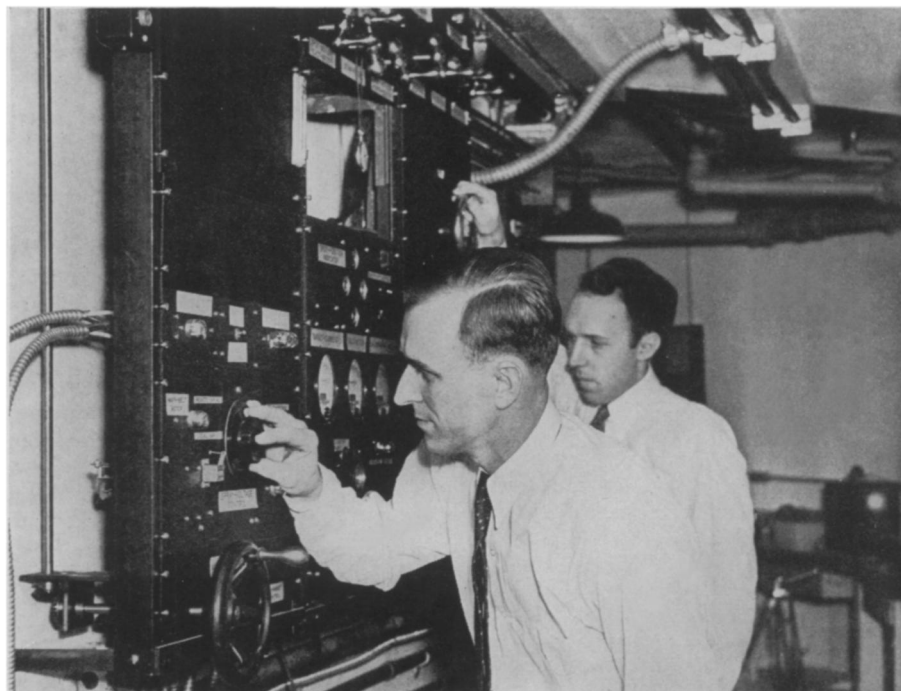
case. Ironically, Dr. Meitner is now an intellectual refugee from Germany temporarily working in Stockholm.

This work, just reported in *Die Naturwissenschaften*, German science journal, became known first by private communication from Prof. Hahn and later through publication. The Hahn-Meitner-Strassmann paper was the sensation of the theoretical physics conference under auspices of the Carnegie Institution of Washington and George Washington University.

Atom smashers were rushed into service to confirm or deny the German work. Long distance telephones provided prompt communication. At least four independent confirmations have been obtained.

It was learned subsequently to the Washington conference that the experiment was confirmed in Copenhagen at Prof. Niels Bohr's laboratory about Jan. 15. Prof. Bohr, world famed Nobelist, is himself in America visiting Princeton University.

Columbia University, whose research



AT THE CONTROLS

Drs. R. C. Meyer and Richard B. Roberts of the Carnegie Institution of Washington, setting the controls of the electrostatic generator with which they demonstrated the release of atomic energy from uranium.

team consists of Prof. John Dunning, Dr. E. T. Booth, Dr. G. N. Glasoe, H. L. Anderson, Prof. S. G. Slack, Prof. George B. Pegram, and Prof. Enrico Fermi, confirmed uranium's energetic splitting on Jan. 25. (Prof. Dunning and Dr. Booth are shown at work, in the cover illustration).

The Carnegie Institution of Washington's Department of Terrestrial Magnetism, directed by Dr. John A. Fleming, got into action with their new atom smasher as soon as they heard of the Berlin experiments and in a historic midnight experimental conference on Saturday, Jan. 28, demonstrated to Prof. Bohr and Prof. Enrico Fermi, Italian Nobelist now at Columbia University, pioneer in neutron bombardment of uranium, the reality of the energy's release. The Carnegie research crew consisted of Drs. Richard B. Roberts, R. C. Meyer, N. P. Heydenburg, L. R. Hafsted, and M. A. Tuve, assisted by a Carnegie associate, Dr. Gregory Breit of the University of Wisconsin.

On Saturday morning (Jan. 28) the Johns Hopkins University, in experiments conducted by Dr. R. D. Fowler, confirmed the discovery also.

#### Other Elements Bombarded

Convinced of the reality of the energy release from uranium, there will be a great rush to complete science's current mystery problem. Neutrons will be turned—are being turned at this moment—upon other heavy elements.

Crucial point of the original Hahn experiments, Prof. Fermi said, is the careful chemical tests on the products resulting from the bombardment of uranium with neutrons. These products had previously been considered to be isotopes of radium but when Dr. Hahn, one of the world's best physical chemists, sought to detect the presence of radium in them he was unable to do so. Instead, he found only isotopes of barium.

Thinking his method might have been in error he intentionally placed a known radioactive compound, mesothorium, in his mixture of supposed radium isotopes and found that while the mesothorium followed the usual separation the radium isotopes did not. Thus he had to conclude that his bombardment of uranium with neutrons split the uranium into two parts about half as massive; into barium and probably into krypton also.

Prof. Fermi, in explaining his own original work, said he had tested the supposed trans-uranium elements to see that they were not mistakenly some of

the six or seven elements just below uranium in the periodic table of the chemical elements. The idea of checking them against such relatively light elements as barium, only half as massive as uranium, never occurred to him or to any one who has worked in this field before Dr. Hahn.

Dr. Hahn in his report amplifies this point by indicating that the experiments are contrary to all previously known experience of physics.

#### Wild Speculations Feared

Now that scientists have confirmed the discovery of how to release enormous stores of energy bound within uranium atoms, they are fearful lest the public become worried about a "revolution" in civilization as a result of their researches.

They fear that there may be forecasts of the near possibility of running giant ocean liners across the Atlantic on the energy contained within the atoms of a glass of water. Or of using "atomotors" as energy sources instead of steam and hydro-electric plants. Or the suggested possibility that the atomic energy may be used as some super-explosive, or as a military weapon.

Scientists who have exploded uranium and released its tremendous supply of atomic energy report that the present research is comparable with experiments, a few years ago, on the transmutation of the elements.

For centuries, alchemists had dreamed of transmuting base metals into gold. Enormous wealth—it was imagined—would be at hand for the discoverer of transmutation. Dire forecasts of the effects of transmutation's discovery, picturing a revolution in the world's financial pattern, were made.

But transmutation of the elements has now been achieved for every one of the 92 known chemical elements except two. Yet there has been no revolution in the money marts of the world as a result. It has only become increasingly clear how infinitely difficult it would be to produce enough transmutation, in any element, to fill the pans of a tiny chemical balance. Transmutation's biggest result has been simply the wonderful intellectual impetus which it has provided for physical discovery.

In quite the same way, the dream of releasing large amounts of energy locked inside atoms has been in the minds of men for many years. It is highly probable that the current realization of this dream will have no more effect on the power resources of the world



#### AT THE MUZZLE

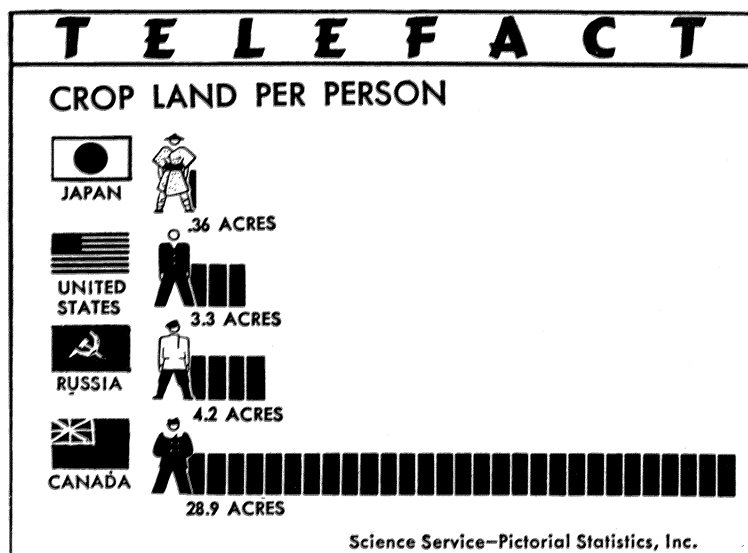
*Dr. Richard B. Roberts of the Carnegie Institution of Washington makes an adjustment at the "business end" of the giant electrostatic generator with which the neutrons were created to split uranium atoms and release 200,000,000 electron-volts of atomic energy.*

than has the discovery of transmutation on the world's financial exchanges.

It takes only a quick calculation to show that even in the most favorable case it requires expenditure of about 3,000,000,000 electron volts of energy to release 200,000,000 electron volts of energy from a uranium atom.

This optimum case is based on the assumption that the three billion volts of energy will create one neutron which can slip into a uranium atom and release two hundred million volts of energy. In actual fact, neutrons are so easily absorbed by all atomic nuclei that many of the neutrons produced (each at the cost of three billion volts energy) will only go into atoms other than uranium.

Thus the process is only a little over six per cent efficient for the most favorable case and, in (*Turn to Page 93*)



Laboratory tests have shown that by regulating the "interpolated" learning, it was possible to make people forget anywhere from 5 to 90 per cent of what they had previously learned.

The student will remember his tomorrow's lesson better if he goes directly to sleep after learning it than he will if he goes out tonight to a party or to an entertaining show.

The influence of surroundings is also shown, Dr. McGeoch pointed out, in the greater ease which many people experience in working at their familiar desk, and in the difficulty of working as well in a strange office.

We do not forget everything we learn, he said, because somehow these two factors, new learning and new surroundings, are prevented from having their full effect.

We usually remember anything which has been well learned, especially when we try to recall it in a familiar setting.

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reality, is much less efficient on the average.

Finally, scientists point out, the release of atomic energy from uranium need arouse few fears about explosions in nature set off by these physical researches. The very heavy elements in which such an energy release can be secured occur only in very small amounts in the earth's crust and they are greatly contaminated with other elements which do not yield atomic energy. This means that the release of atomic energy can only be achieved by direct intent, in the laboratory, and then only with considerable ingenuity of experiment.

Besides the astounding amount of energy liberated from the uranium atoms, the following appear to be the important consequences of the newest researches:

1. For the first time something other than atomic particles or radiation (alpha and beta particles, positrons, neutrons and gamma rays) has emerged from atom smashing. Uranium seems to be split into two parts, which may prove to be the elements barium and krypton, whose atomic masses add up approximately to that of uranium.

2. The supposed existence of the trans-uranium elements, those numbered 93, 94, 95, 96, heavier than uranium, is called into question. These superheavy elements may be merely forms of barium.

3. The radioactive "time clock" method of determining the age of the earth may be proved wrong if uranium can split up in the strange new manner.

4. Science has a new atomic mechan-

ism that may account for the tremendous energy that keeps the stars shining through the ages.

*Science News Letter, February 11, 1939*

### PSYCHOLOGY

## Psychology of a Sissy Urged as Scientific Study

THE SISSY is nominated for psychological study by Dr. Joseph Chassell, psychiatrist at Sheppard and Enoch Pratt Hospital, Towson, Md.

No one really understands the sissy, Dr. Chassell points out in *Psychiatry*, although many an American boy is entirely preoccupied with the task of proving that he is not one.

Just what is a sissy? The term is well understood even in nursery school, and yet it would be hard to define it.

It does not mean "girlish," for girls can be sissies, too, or they can demonstrate that they are not. And a boy may even be effeminate without rating as a sissy.

Cries of "Sissy! Sissy!" accompanied by a gesture with the two forefingers familiar to all disdaining juveniles, is alternated with the chant, "Just a little baby!"

And yet mere youth does not make a sissy, either. It is a certain kind of immaturity. Boys may demonstrate while they are yet in rompers that sissiness is not for them. And the most unsophisticated, innocent, naive lad may be far removed from the sissy class.

Even the mother's darling with long curls and Lord Fauntleroy collar, Dr. Chassell said, may be recognized by the brotherhood as actually no sissy.

No, it seems to be not so much any of these things as an intangible feeling that they do not belong in the group of other boys. They are not in the gang.

The sissy seems to have a misapprehension of the world as a place where terrible things are always happening and where one must become some vague sort of superman in order to succeed.

Other humans are not seen as persons, he suggested, but as potentially friendly or hostile fairy-book creatures.

The sissy's idea of masculinity, he said, is a caricature built up with the aid of stories of the Wild West, Indian fighting, gangsters, and Buck Rogers. From this view of manhood is born a deep desire to turn away from it into mother's arms, which in its turn must be repressed.

When psychologists have made the study of the sissy, they should tackle next the sissifying mother, Dr. Chassell urged.

*Science News Letter, February 11, 1939*