PHYSICS

What About Atomic Power? Facts and Fancy Separated

Uranium Can Be Split to Release Energy But It Would Take 75,000 Years to Make Pound of It

IS ATOMIC power at hand? Here is the way *not* to write the story of this possibility but the flood of reports which have swept the country telling of the isolation of a rare isotope of uranium with mass 235 and the possible implications of this discovery for releasing atomic power, make it highly desirable that some one sit down, take off the gloves, separate fact from fancy and give a fair picture of what is happening. Here are the facts. Fantasy may come later.

1. Over a year ago, when it was first discovered that uranium atoms could be split by bombardment with neutrons, neutral atomic particles, and made to release a large measure of the atomic energy, Prof. Niels Bohr, Danish Nobelist, and Dr. John A. Wheeler of Princeton forecast that atoms of uranium 235 would probably be split by very weakly energetic, "slow" neutrons. Only high energy neutrons, they predicted, would be successful in splitting the common form of uranium with mass 238. (*See SNL,* Mar. 11, 1939)

2. Occasion for the recent spectacular retelling of the story of uranium fission, which has been reported again and again since late in January, 1939, was the confirmation of the Bohr prediction on uranium 235 by Dr. A. O. Nier of the University of Minnesota and Drs. E. T. Booth, J. R. Dunning and A. V. Grosse of Columbia University.

Isolated by Nier

3. Dr. Nier made possible this confirmation by isolating, in an instrument known as a mass spectrometer, the tiny sample of uranium 235 which was only a few millionths of a gram of material. Other scientists, including Drs. K. H. Kingdon and H. C. Pollock of the laboratories of the General Electric Company, have been effecting similar concentrations of uranium 235 and uranium 238, its heavy common isotope. Prof. J. W. Beams, using a gold-plated centrifuge at the University of Virginia, has been working on the problem but is having the material he has isolated checked in a mass spectrometer to determine its atomic weight. He has just told Science Service he has no specific report to make until this mass spectrometer test is concluded.

4. The isolation of the uranium 235 isotope is extremely slow, tedious and costly in time and effort. Figures discussed by Drs. Kingdon and Pollock reveal that even for the much more abundant uranium isotope of mass 238 it takes three hours of operation to produce one and eight-tenths of a microgram, where a microgram is a millionth of a gram and a gram is less than one four-hundredth of a pound.

Very Slow Work

Simple computation shows that at this rate it will take scientists some 70,000 days (over 191 years) to make a single gram of concentrated uranium 238 and over 400 times as long — over 75,000 years—to make a pound of this material. The rare isotope of uranium of mass 235, occurring in only one part in 139 in comparison with uranium 238, would take still longer for its production.

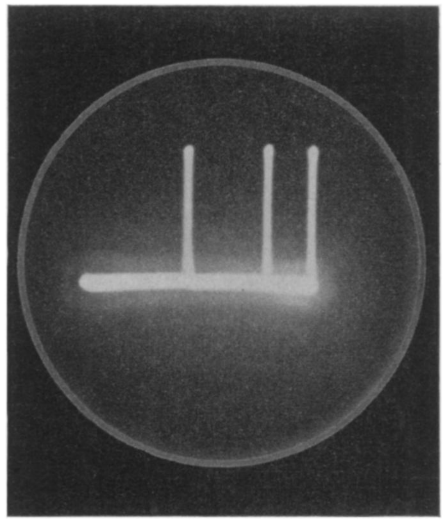
5. It has been indicated that a chain reaction occurs in uranium fission with neutrons. This fact was announced from Paris by the co-Nobelist scientist Prof. J. Joliot and his colleague Dr. H. von Halban. This important fact has not yet been confirmed, conclusively, in America. (*See SNL,* Feb. 10, 1940)

So much for the facts about uranium's fission which, unembellished, are seemingly prosaic. Much better reading —and the cause of the widespread use of the recent story—is the speculation about the future of the possible release of atomic energy from uranium.

Taking off from fact into fancy one can cite the following:

1. The separation methods of isolating uranium 235 are bound to improve so that while it may take over 75,000 years to concentrate a pound of uranium 235 today it may be done far quicker in the future. Perhaps the scientists' wish for a five-pound chunk of the stuff can be realized within our times.

The war in the north has stopped construction of a thermal diffusion apparatus which promised, by theory, to speed the concentration of the rare uranium 235 isotope by a factor of 11,000 times. The thermal diffusion method offered the possibility of obtaining a gram of uranium 235 within three years whereas best American production reported has been a gram in 33,000 years. The thermal diffusion tubes described by Prof. Wilhelm Krasny-Ergen of the University of Stockholm (*Nature*) are easy and cheap to make. A whole series run in tandem or separately could greatly increase the yield of rare uranium 235 still further.



URANIUM FISSION

When the energy of a splitting uranium atom is detected and put into an oscillograph, electrical pulses can be seen which closely resemble those shown here.

2. It may not be necessary to have pure uranium 235 (U-235) to find practical uses. True, the U-235 works best with the weak neutrons but uranium 238, much more common, splits with fast, high-energy neutron bombardment. It can be recalled that the discovery of uranium fission was obtained with uranium oxide — a commonplace chemical compound widely spread throughout the earth.

3. The energy liberated from uranium by fission is enormous and weight for weight it is at least 5,000,000 times as effective as coal.

Chain Reaction Possible

4. If the chain reaction of having one uranium atom split and liberate the neutrons which will split another one near by and so on, can be controlled, then a compact power source for military purposes could be achieved despite whatever the cost might be. Things which are

uneconomical in a peacetime sense become practical for military services if they can perform tasks not possible, or carried out as easily, in any other way. No price can be put on such developments that might save the life of a nation which owned the discovery, any more than one can put a price on a surgical operation which saves a man's life.

5. Is Germany pressing the utilization of the discovery of uranium fission? The answer is probably yes, for it has been pointed out since the first announcement of the sensational find that Germany was the home of the original discovery, and that German scientists have had a six months' and more start on their research. (*See SNL,* Feb. 11, 1939)

This drive is going on in all nations and does not require the special large cyclotron atom smashers which dominate the American scientific scene.

The whole virtue of uranium fission for any possible practical applications is that it does not require huge heavy cyclotrons to set off the fissions and release the energy. A little bit of radium mixed in a flask with beryllium and embedded in a block of paraffin is the entire "source" that is required. This radium-beryllium mixture is a source of neutrons and with these to bombard uranium the uranium splitting and its own chain reaction do the rest.

Those five points are the fancy which may or may not come true within our times. There are others, like the uranium bomb, which go beyond fancy into the fantastic.

Probably the sanest forecast of the future is that uranium atomic power will be so valuable when and if it comes, that it will be used only for the most special purposes for which it is characteristically adapted and which it can do better than anything else.

Uranium fission will probably have its greatest benefits as a ready-at-hand, compact source of neutrons which are highly sought-after in medicine and biological experiments and in nuclear physics. Every university may yet have its own neutron source. (*See SNL,* Mar. 2, 1940.)

Science News Letter, May 18, 1940

PHYSICS

Will Atomic Power Release Come As Gigantic Explosion?

WHEN the power within the uranium atom is released, as scientists hope that it will be by atom-smashing, will it come as a gigantic explosion?

This possibility has some scientists worried. They do not believe the whole earth will explode, but they do fear that the experimenter and his laboratory might disappear in the disaster of a successful experiment.

A particular variety of the heaviest chemical element, uranium of mass 235, has been shown to split and release enormous energy when attacked by a relatively slow and unenergetic atomic particle, called a neutron. In this atomic smash, more neutrons are produced. These are capable of producing more uranium splitting if they score hits on the right kind of uranium atomic centers. And so the explosions might continue, just as they do when powder or TNT explodes, one atom setting off another.

There is plenty of uranium in the earth's crust.

Even neutron bombardment of a fairly rich piece of uranium ore does not cause an explosion or release of appreciable atomic power because the uranium atoms are so diluted with other atoms around them. The attacking neutrons will spend themselves futilely colliding with unresponsive common atoms.

In hope of getting away from this limitation, attempts are being made to concentrate uranium 235 in very pure form, which is a long and tedious job.

If this can be done, another barrier to too dangerous explosions may exist. Strangely the explosiveness is caused by relatively slow neutrons of low energy. If the neutrons are too powerful, with energies of about 10,000,000 electron-volts, the fission is a dud. A mere capture with release of trivial energy takes place. If an explosion of pure uranium 235 does begin, it may produce enough of the high energy neutrons to bring about these dud reactions and damp out the incipient cataclysm.

In working with uranium, the scientists are like soldiers who know too little about the artillery they are hoping to fire, afraid that it may go off prematurely and fearful that it may not fire at all when they try to pull the trigger.

Science News Letter, May 18, 1940

GENERAL SCIENCE

Excerpts From Address By President Roosevelt

The Eighth American Scientific Congress was formally opened on the evening of Friday, May 10 with an address by President Franklin D. Roosevelt. The assembled delegates from twenty-one Republics of the three Americas were the audience.

". . . This hemisphere is now almost the only part of the earth in which such a gathering can take place. Elsewhere war or politics has compelled teachers and scholars to leave their great calling and to become the agents of destruction. . . .

"In our search and in our teaching we are a part of a great adventure—an exciting adventure—which gives to us a larger satisfaction even than did the adventure of settling the Americas give to our Founding Fathers. We feel that we are building human progress by conquering disease and poverty and discomfort, and by improving science and culture, removing one by one the cruelty, the crudity and the barbarism of less civilized eras.

"In contrast, in other parts of the world, teachers and scholars are not permitted to search for truth lest the truth when made known might not suit the designs of their masters. Too often they are not allowed to teach the truth as they see it, for truth might make men free. . . .

"You who are scientists may be told that you are responsible because of the processes of invention for the annihilation of time and space, but I assure you that it is not the scientists of the world who are responsible, because the objectives which you have had have looked toward closer and more peaceful relations between all nations through the spirit of cooperation and the interchange of knowledge.

"What has come about has been caused solely by those who would use, and are using, your inventions of peace in a wholly different cause—those who seek to dominate hundreds of millions of people in vast continental areas—those who, if successful in that aim will, we must now admit, enlarge their wild dream to encompass every human being and every mile of the earth's surface.

Science News Letter, May 18, 1940

Chinese in the fourteenth century recorded their observations of sunspots.

The "life expectancy" of *automobiles*—like that of humans—is lengthening and cars are now used on the average more than nine years.