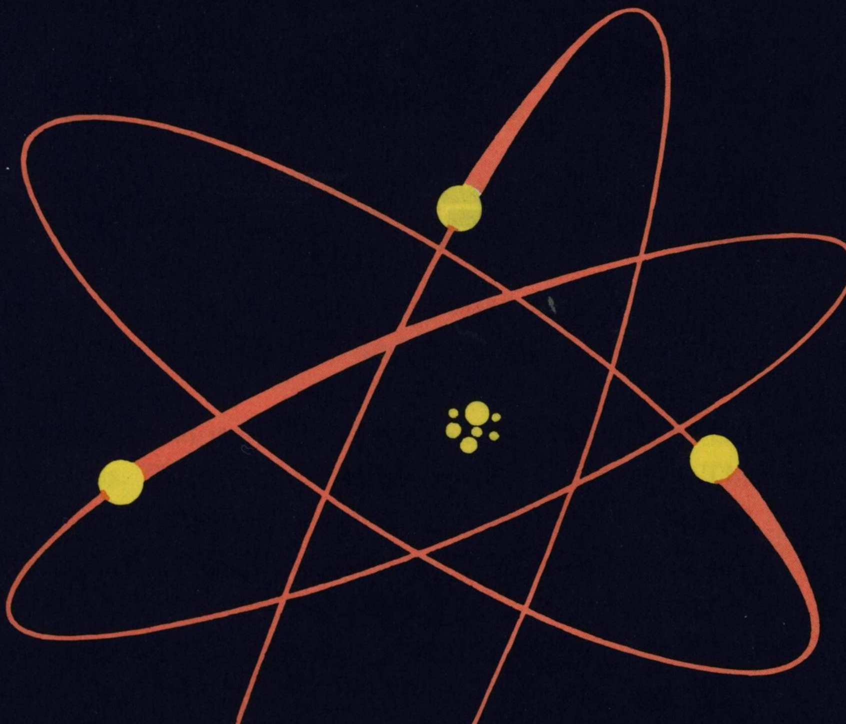
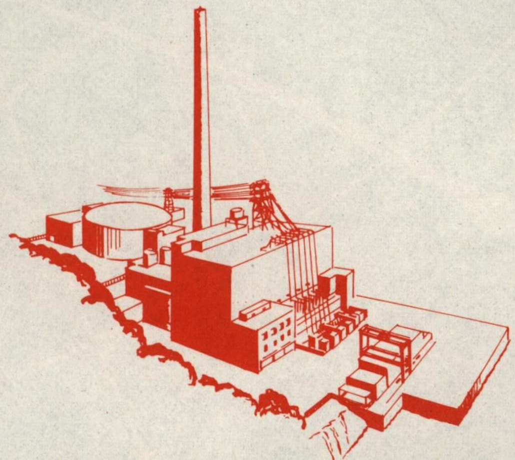


ATOMIC ENERGY

ATOMIC ENERGY



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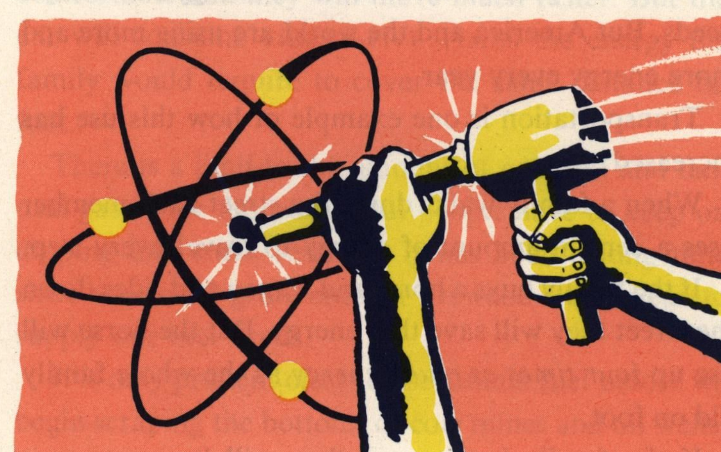
THE *why* OF ATOMIC ENERGY

Man has learned to split certain atoms and obtain heat from them.

Splitting atoms is a complicated process. But it is not magic. Men understand it now. They call it nuclear fission.

When atoms split they release energy in several forms. The most easily observed of these is heat. This heat is similar to that produced by burning firewood, coal or oil. In this sense, atoms are a newly discovered fuel.



FAMILY	HORSE	AUTO
3 miles per hour	**4 miles per hour**	**35 miles per hour**
1 fuel unit per mile	**4 fuel units per mile**	**35 fuel units per mile**
3 FUEL UNITS PER HOUR	**16 FUEL UNITS PER HOUR**	**1,225 FUEL UNITS PER HOUR**

There are substantial sources of energy for today's needs. But America and the world are using more and more energy every year.

Transportation is one example of how this use has increased:

When a family walks down the street each member uses a certain amount of energy to travel every step.

If the family buys a horse and wagon and rides down the street they will save that energy. But the horse will use up *four times as much energy* as the whole family did on foot.

If the family buys a car they will be even more

comfortable and they will move much faster. But the car will consume THIRTY-FIVE TIMES the energy the family would require to cover the same distance on foot.

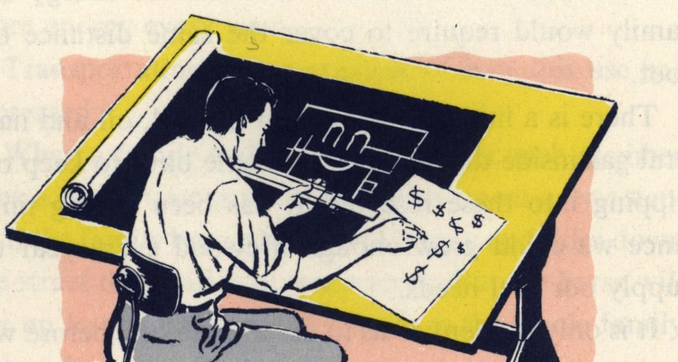
There is a limit to the amount of coal, oil and natural gas inside the world. But people have to keep on dipping into these reserves. It has been a long time since we could grow enough firewood every year to supply our fuel needs.

It is only prudent of us to use atomic fuel before we begin scraping the bottoms of coal mines and oil wells.

The steam engine succeeded in competition with animal power because it could do a better job at a lower cost. It seems sure atomic fuels will succeed in competition with other fuels for the same reason.

Engineers hope to find a way to produce heat with atomic fission more cheaply than with coal, oil or natural gas *even at their present prices*. Since coal, oil and natural gas cost more in some places than in others, atomic fuel is likely to be attractive first of all in the expensive fuel areas.

As coal, oil and natural gas begin to become scarce, their prices will rise. This will help atomic fuels in the competition. And engineers are learning more and more about how to lower the cost of using atomic fuel.

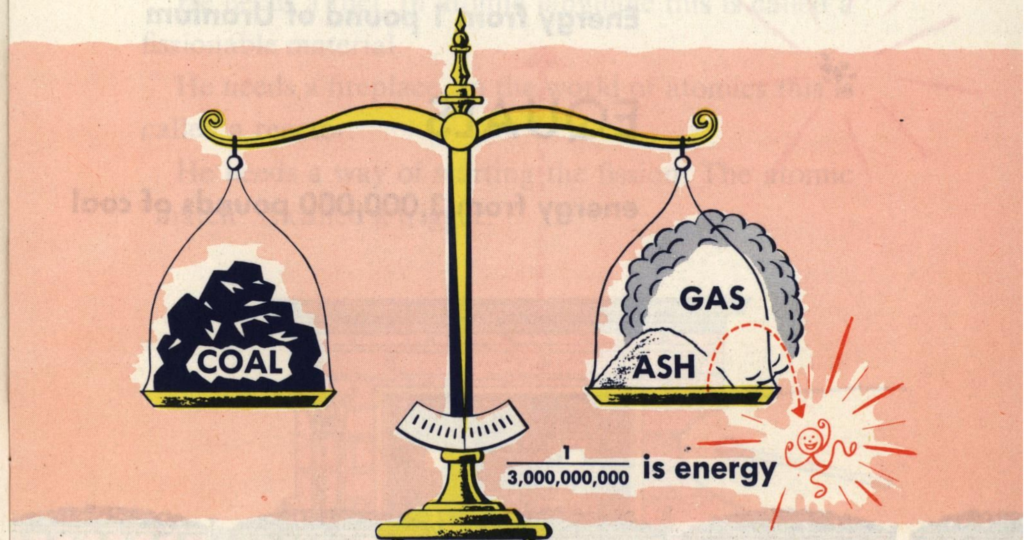


The heat from an atomic "fire" is the same as the heat from a fire supplied with ordinary fuel. The difference is in the fuel, not the use to which the heat is put.

When man burns a pound of coal, it appears that nothing is lost. The gas from the coal and the leftover ashes seem to weigh a full pound.

In truth, the ashes and gas *do not* weigh a full pound. If the scale were accurate enough, it would show that one-third of a billionth of the pound was missing. This fraction, $\frac{1}{3,000,000,000}$, is changed to energy.

Man is using the fringes of the atom's energy when he burns a fuel like coal.

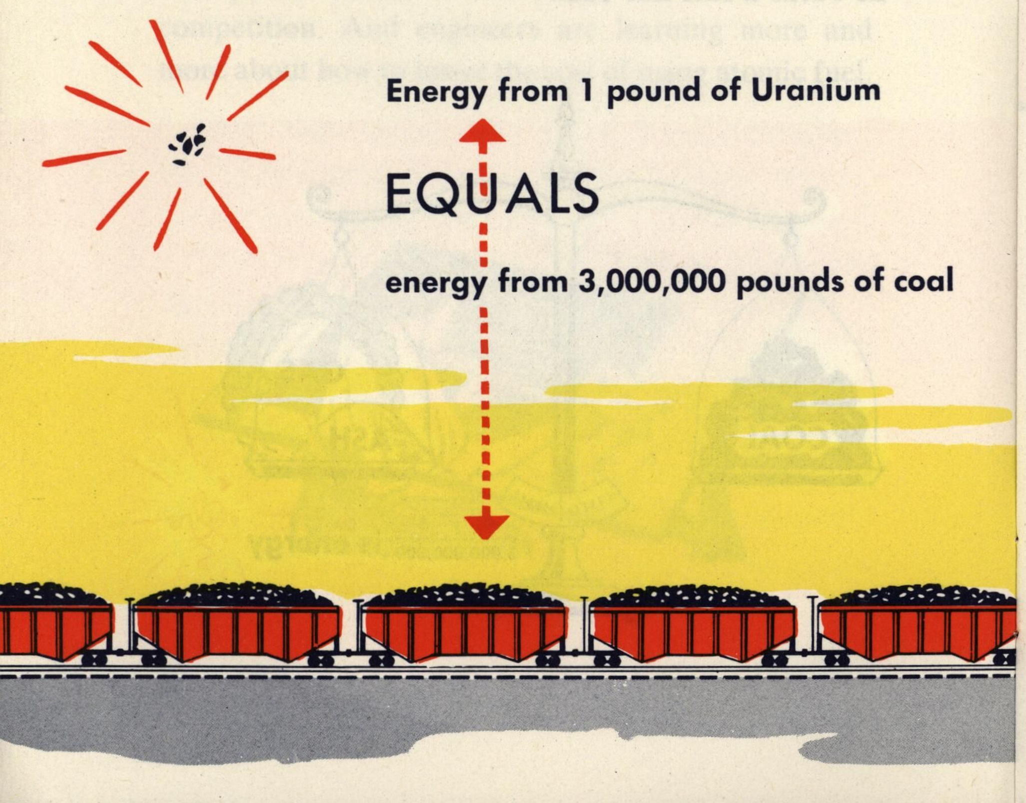


When man fissions a pound of uranium, however, one-thousandth of the pound is changed to energy. This fraction, $\frac{1}{1,000}$, is three million times larger than the fraction of coal that is changed to energy.

This means that a pound of uranium can produce as much heat as 3,000,000 pounds of coal.

By reorganizing the central parts of the atom instead of the atom's fringes, man is drawing on the forces of creation.

This is the potential of atomic energy.



THE *how* OF ATOMIC ENERGY

To build a satisfactory fire, man needs three things.

He needs a fuel. This can be firewood, coal, oil or any of many things that burn.

He needs a fireplace or some similar arrangement. The fireplace keeps the fire from spreading. It lets man use the heat of the fire the way he wants to use it.

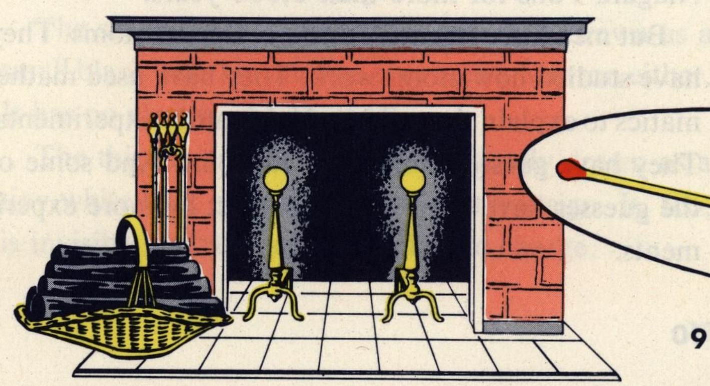
He needs a convenient way of starting the fire. Some fuels can be started with a single spark. Others require kindling.

To get heat from the atom, man needs the same three things.

He needs a fuel. In atomic language this is called a fissionable material.

He needs a fireplace. In the world of atomics this is called a reactor.

He needs a way of starting the fission. The atomic "match" is called a trigger.



6,000,000,000,000,000,000,000

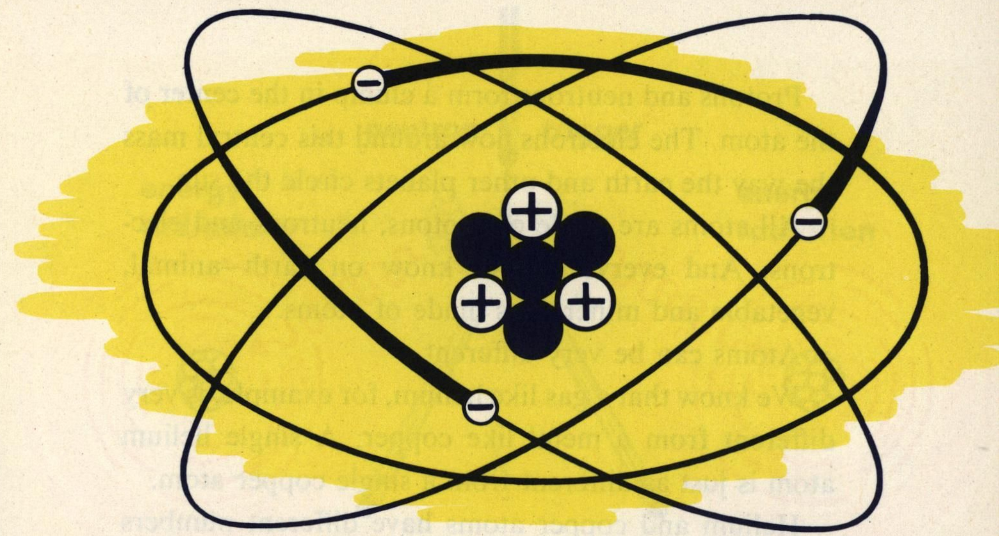
ATOMS

Atoms are very small. No one has ever seen an atom. They are so tiny it is even hard to imagine them.

In an ordinary drop of water there are six sextillion atoms.

Six sextillion is 6,000,000,000,000,000,000,000. That many water drops would be enough to supply Niagara Falls for more than 2,000 years.

But men have learned quite a bit about atoms. They have studied how atoms work. They have used mathematics to explain the results of laboratory experiments. They have guessed things about atoms. And some of the guesses have been proved correct by more experiments.



Atoms seem to be mostly made up of three things.

The first is a proton. It is generally drawn as a small white ball. No one knows what it really looks like. It has a positive electric charge.

The second is a neutron. It is generally drawn as a small black ball. No one has ever seen a neutron either. It has no electric charge at all.

The third is an electron. It is generally drawn as a tiny white ball, sometimes with a minus sign. It, too, is invisible. It has a negative electric charge.

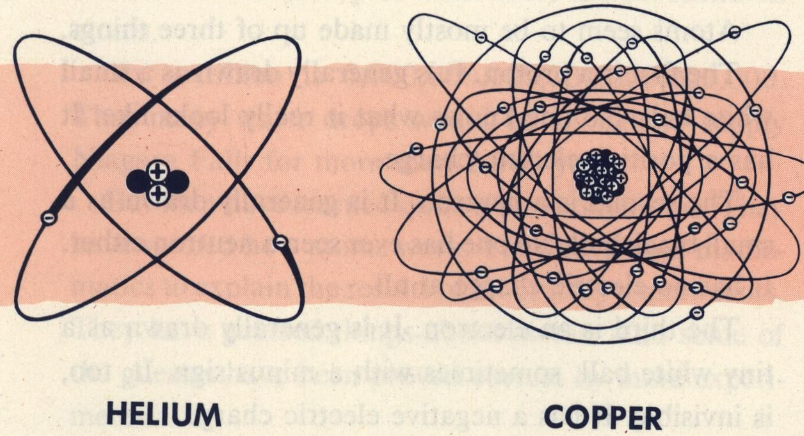
Protons and neutrons form a clump in the center of the atom. The electrons flow around this central mass the way the earth and other planets circle the sun.

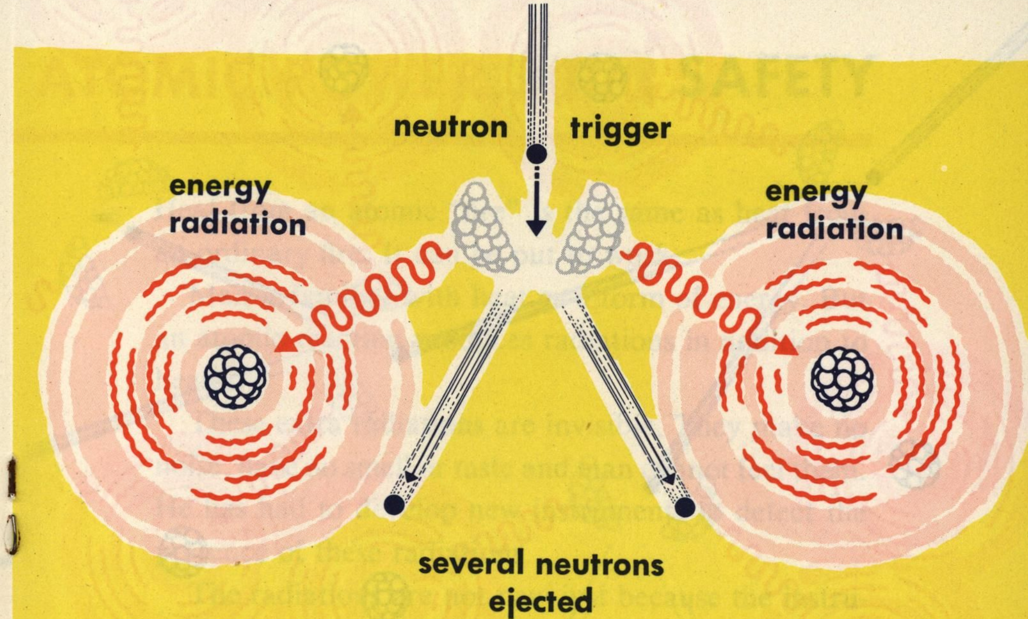
All atoms are made of protons, neutrons and electrons. And everything we know on earth—animal, vegetable and mineral—is made of atoms.

Atoms can be very different.

We know that a gas like helium, for example, is very different from a metal like copper. A single helium atom is just as different from a single copper atom.

Helium and copper atoms have different numbers of protons, neutrons and electrons. The copper atom is heavier. It has more protons, neutrons and electrons.



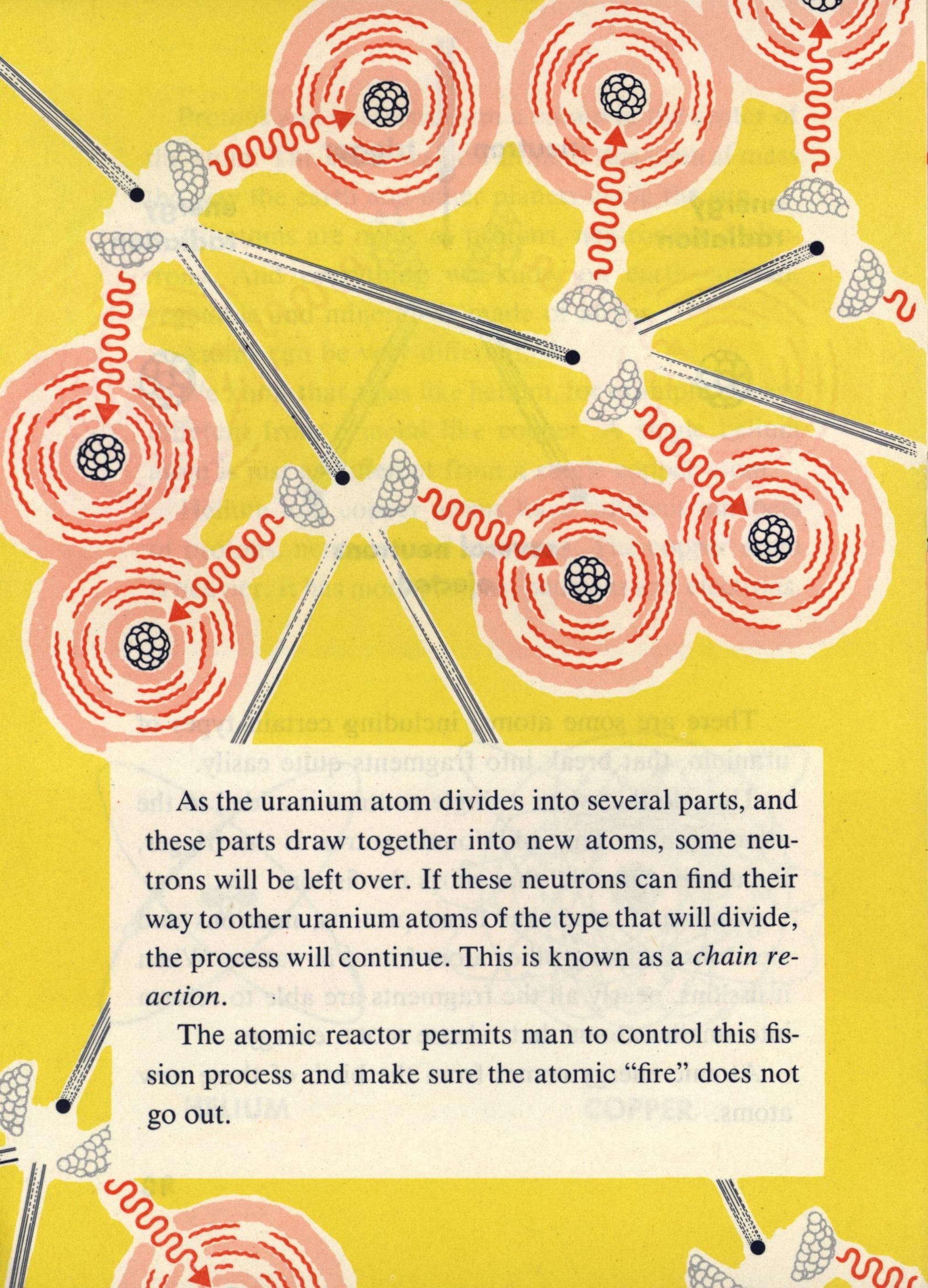


There are some atoms, including certain types of uranium, that break into fragments quite easily.

They do this when a single neutron is added to the atom's center. This additional neutron is the trigger, the atomic "match" that starts the fission.

A uranium atom has more protons, neutrons and electrons than any other atom found in nature. When it fissions, nearly all the fragments are able to reform into smaller atoms that release MORE energy.

Atomic energy comes from the birth of these new atoms.



As the uranium atom divides into several parts, and these parts draw together into new atoms, some neutrons will be left over. If these neutrons can find their way to other uranium atoms of the type that will divide, the process will continue. This is known as a *chain reaction*.

The atomic reactor permits man to control this fission process and make sure the atomic "fire" does not go out.

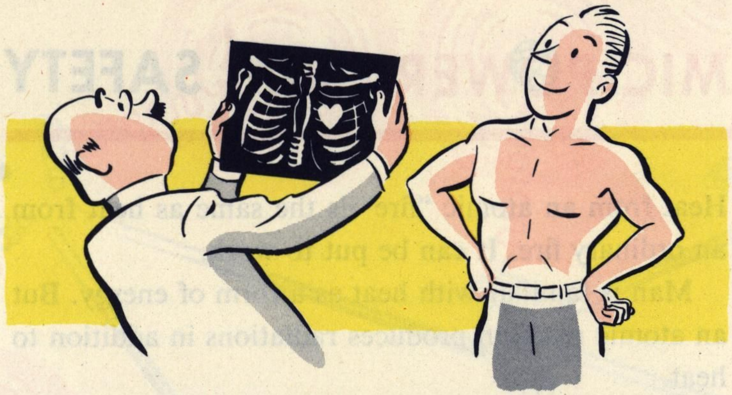
ATOMIC POWER...*and* SAFETY

Heat from an atomic "fire" is the same as heat from an ordinary fire. It can be put to work.

Man is familiar with heat as a form of energy. But an atomic reaction produces radiations in addition to heat.

These extra radiations are invisible. They make no noise, have no smell or taste and man cannot feel them. He has had to develop new instruments to detect the presence of these radiations.

The radiations are not new just because the instruments are new. The world has contained atomic radiations as long as it has contained the radiations of light and warmth. All are parts of nature's activity.



Several forms of invisible radiation have already been put to use by man. The physician's X-rays, for example, permit him to see where he could not see before.

X-rays are measured in roentgens (pronounced *rent'-gens*). This is a measure of quantity, like a pound of coffee or a quart of milk. The process of taking a typical chest X-ray can radiate the owner of the chest with as much as a whole roentgen of X-rays.

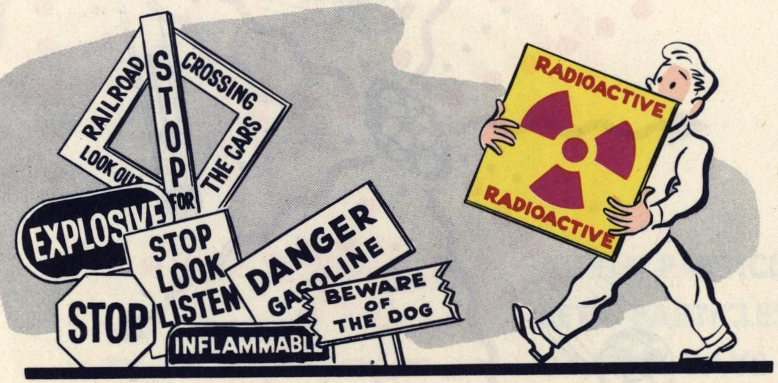
Some of the radiations from an atomic reaction are very much like X-rays. Other radiations resemble solid particles. It is possible, however, to measure all types of atomic radiation in terms of roentgens.

The point where harmless radiation becomes dangerous is difficult to fix. One individual may find sudden exposure to 200 roentgens too much. Another may be able to take an equally rapid exposure to 600 roentgens and still survive.

Generally speaking, man will suffer if the cells of his body are destroyed by the radiation more rapidly than his body can replace them.

When men work at trades where they are constantly exposed to radiation, it must be kept at a very low level.

With careful planning and ordinary caution, it is possible to keep radiation at this low level. From the point of safety, peacetime use of atomic energy only means that another warning sign has been added to man's collection.

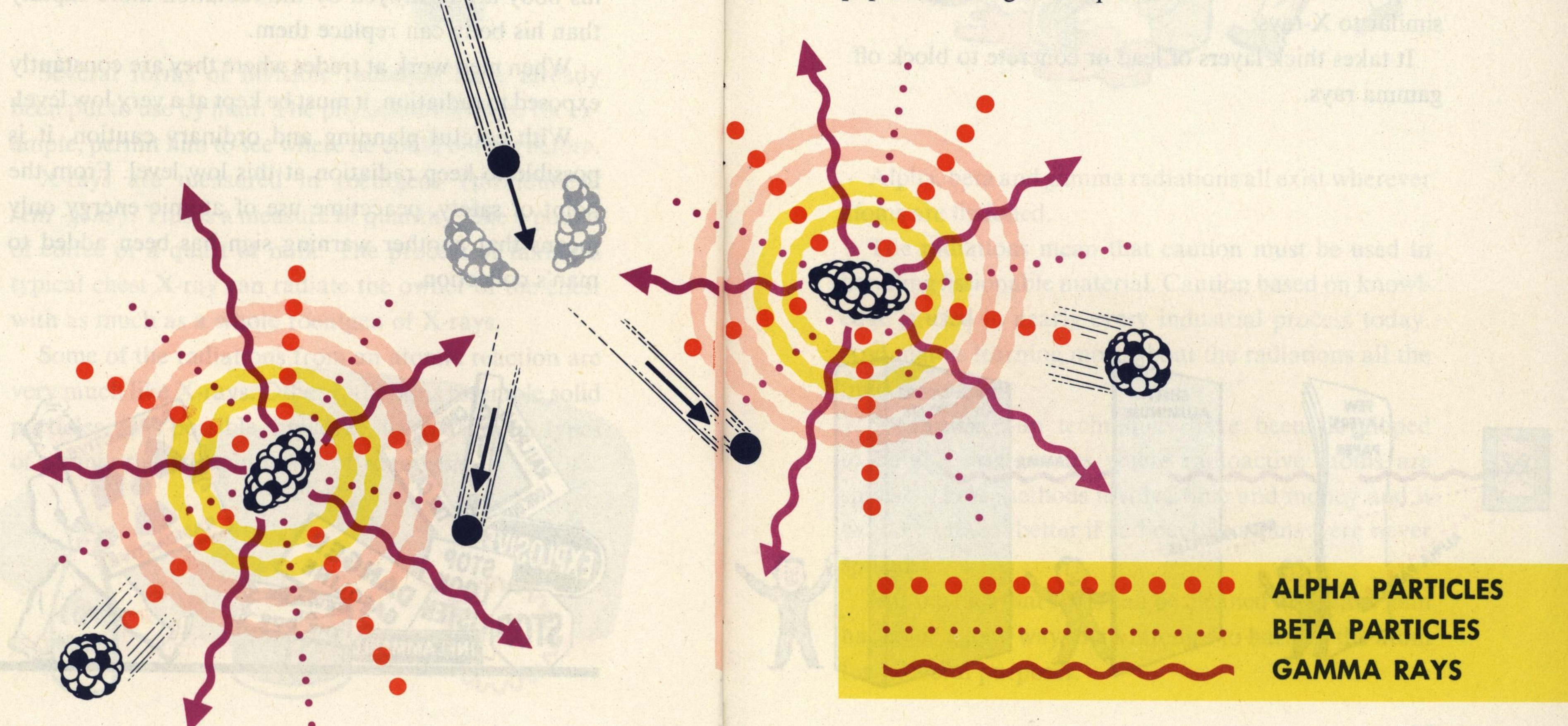


The radiations are made up of the particles and rays shrugged off by the central part of the atom as it settles into shape after fissioning. An atom involved in this shrugging process is said to be *radioactive*.

The three major forms of radiation have been named for the first three letters of the Greek alphabet: *alpha, beta* and *gamma*.

Alpha radiations are really particles. These bits of matter consist of two protons and two neutrons shaped in a clump like the central part of a helium atom.

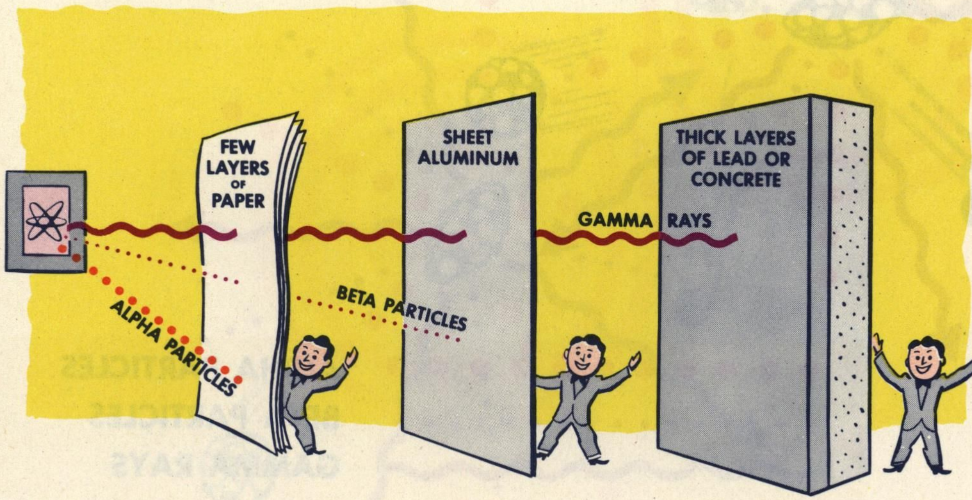
While the alpha particle starts out at 6,000 miles a second, it does not weigh enough to travel very far. It only goes two inches through the air. A few layers of paper are enough to stop it.



Beta radiation is made up of electrons emitted from the central part of a radioactive atom. These particles can travel several feet in open air. But they do not penetrate materials easily. A thin sheet of aluminum is enough to stop them.

Gamma radiation is the most difficult to contain. This radiation is made up of waves of energy quite similar to X-rays.

It takes thick layers of lead or concrete to block off gamma rays.



Alpha, beta and gamma radiations all exist wherever atoms are fissioned.

The radiations mean that caution must be used in handling fissionable material. Caution based on knowledge is used in nearly every industrial process today. And man is learning more about the radiations all the time.

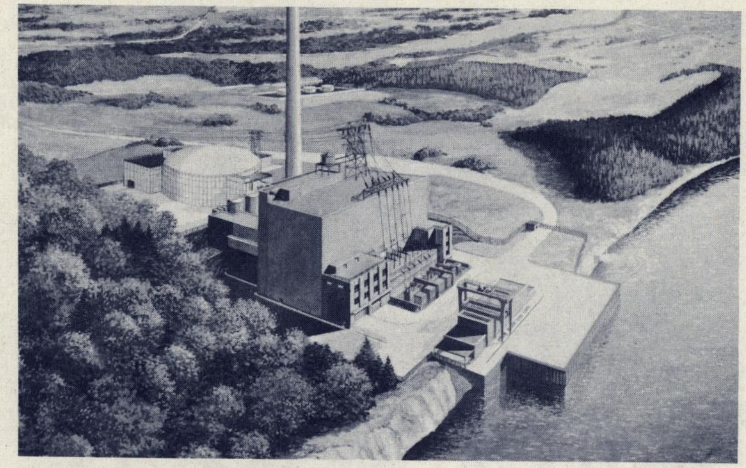
Special mop-up techniques have been developed to handle emergencies where radioactive atoms are spilled. These methods involve time and money and it would be much better if radioactive atoms were never spilled.

But the fact that spills can be cleaned up means man has come a long way in his attempt to harness the atom for peaceful purposes.

Man did not abandon hope of controlling electricity when he learned it was the secret of lightning's destructive power. If he had, he would have deprived himself of a very useful form of energy.

The same thing is true of the atom. Atomic energy is associated with radiations. But it is worth man's trouble to control those radiations and put the energy to useful work.

In competent hands, the atom can help supply man's energy needs...*and safely!*



A $90,000,000 atomic power plant to generate electricity for New York City and Westchester County is being built at Indian Point on the Hudson River

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ENERGY IS OUR BUSINESS