

ALL YOU NEED TO KNOW ABOUT THE CANDU NUCLEAR REACTOR

CANDU stands for CANada Deuterium Uranium. Unpacked, that means this is a Canadian-designed reactor using heavy water (deuterium oxide) as the moderator and natural uranium (oxide) as the fuel.

Deuterium is an isotope of hydrogen. Deuterium differs from hydrogen this way: the hydrogen atom consists of a proton (the nucleus) and an electron whizzing round it. The deuterium atom has a nucleus consisting of a proton and a neutron. Chemically, it behaves much like hydrogen. Hydrogen combines with oxygen to form water (H_2O). Deuterium combines with oxygen to form heavy water (D_2O). It's heavy because of the extra neutron in the deuterium atom.

What's heavy water like?

Much like ordinary tapwater, but it costs more than Scotch.

Why so expensive?

Because it's hard to get and there's a big demand for it. Heavy water occurs naturally in ordinary water. But on an average there's only one molecule of heavy water among 7,000 molecules of H_2O .

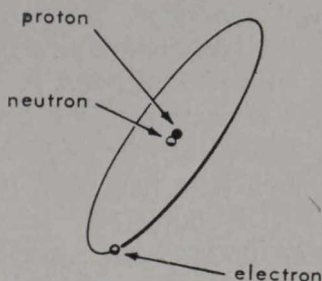
How do you get at it?

Theoretically you ought to be able to boil off the H_2O . Heavy water boils a degree or so hotter than H_2O (it freezes at 40 degrees Fahrenheit). But the

process used industrially is much more complex. Canada has several heavy water plants and India is planning four. One will be at the RAPP site.

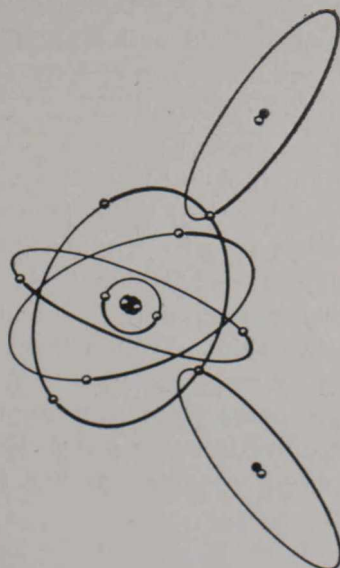
What's a moderator?

It's anything that slows down or moderates the fast neutrons given off by nuclear fission.



And fission?

Fission is the splitting of an atom of a radioactive material, in the present case uranium-235. As the atoms of uranium break up they emit neutrons which normally would fly off into space. The moderator intercepts them.



What for?

The object of a nuclear power plant is to exploit the heat which is a by-product of fission. But under natural conditions uranium disintegrates too slowly to provide a source of heat of any consequence. To get significant amounts of heat, we step up the rate of fission. This is done by bombarding the uranium with neutrons. The impact triggers further fission.

How do we do that?

That's the function of the moderator. In a CANDU nuclear reactor, neutrons flying off uranium fuel bundles encounter the neutrons of the deuterium atoms in heavy water. Like repels like, so the marauding neutrons carom off the deuterium atoms, in the process getting slowed down. All this goes on inside a vessel holding hundreds of fuel bundles side by side with heavy water in between. Chances are a ricocheting neutron will bump into a neighbouring fuel bundle and set off more fission. That liberates more neutrons, which go careering out into the heavy water and suffer the same fate. Pretty soon you have a chain reaction. The breakdown of uranium, normally a process lasting aeons, is accelerated astronomically. As this happens, heat is also released from the fuel bundles and—presto!—you have a nuclear power source.

The core of a CANDU reactor is a vessel called a calan-