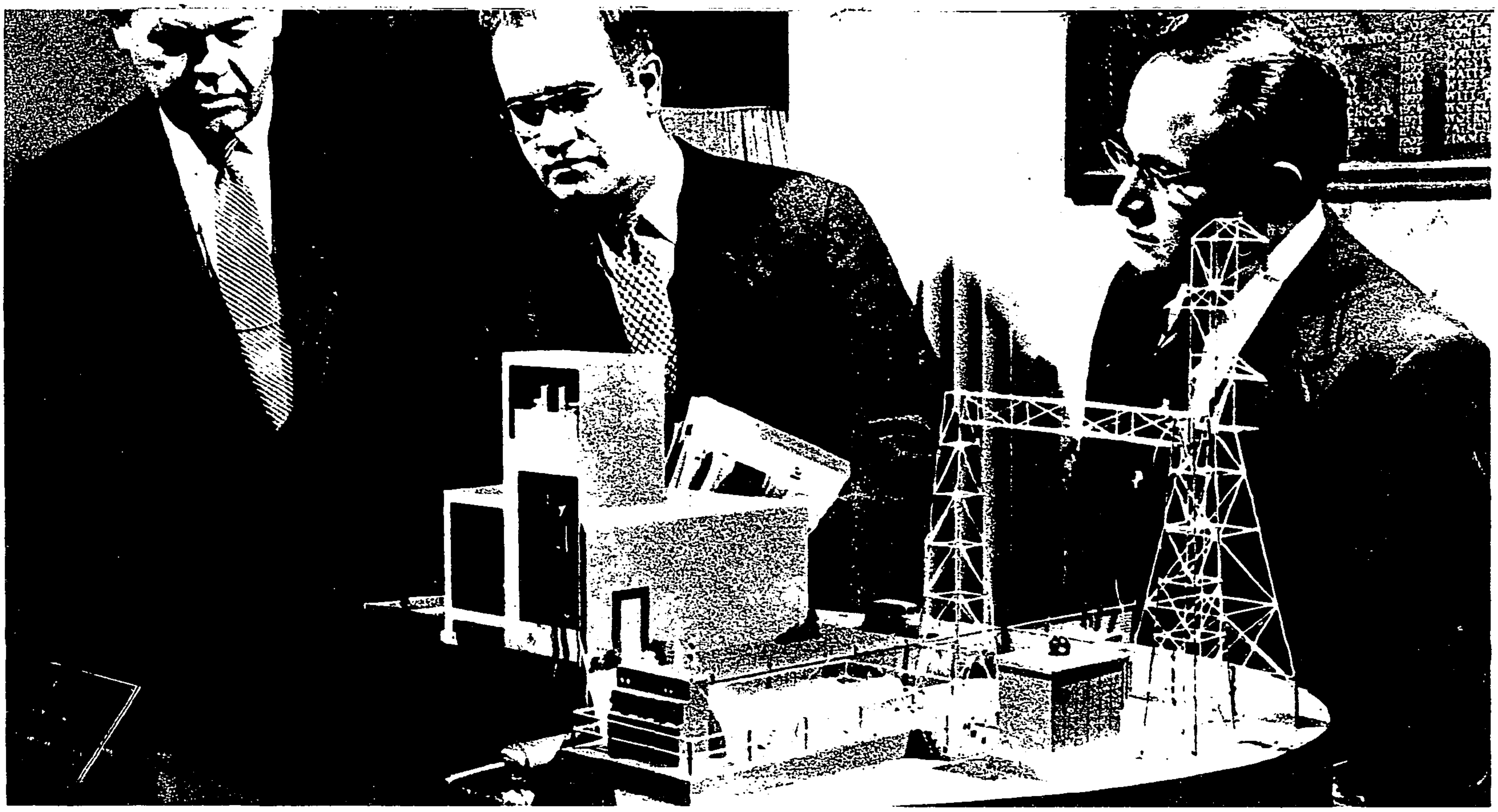

Design for commercial atomic power—A model prepared by North American Aviation, Inc., is shown at a recent meeting of the National Industrial Conference Board.

Forecast of the Age of Atomic Power

Atom-run plants here and abroad approach reality as President Eisenhower proposes an international pool of atomic materials for peace.

By LEONARD ENGEL

AUGUST 6, 1945, the day the atom bomb fell, on Hiroshima, is usually thought of as the beginning of the atomic age. The atomic era will soon, however, have another, more auspicious, day to count as birthday.

The Atomic Energy Commission has announced plans for the first atomic power plant in the United States. In England an atomic power plant is already under construction by the British Atomic Energy Commission. And if the peaceful international atomic agency called for by President Eisenhower materializes, additional plants could soon afterward be under construction in other countries.

Electricity has been obtained at one time or another in the past few years, in amounts ranging from token to substantial, from a number of atomic piles, such as experimental land-based submarine reactors. But the new American and British plants—barring the unlikely possibility of the Russians completing a similar unit even sooner—will be the first real atomic power plants, the first expressly designed as electric generating stations. Atomic power will thus be an indisputable reality within three or four years. The approach of the atomic power era raises anew a host of intriguing questions. What will this age be like? How will atomic power affect our lives? What is "different" about power from the atom, and how is it obtained?

IN the eight years since Hiroshima, innumerable and completely contradictory predictions have been made about atomic power. It would be here in no time at all; it would not come for a generation. The atom would swiftly displace traditional sources of energy for everything from automobiles and waffle irons to battleships and factories; it would not displace traditional sources of energy at all, but merely serve as a supplementary source where older sources of energy are unavailable.

Atomic power is, in fact, coming along faster than the pessimists expected. For reasons that will become clear, atomic automobiles and some of the other more lurid imaginings of the science-fictioneers are doubtful developments. Over the years, however, atomic power is certain to work a profound transformation in ways of life. Each new source of energy that has been mastered by man—water power, coal, petroleum—has proved to be a revolutionary force. Atomic energy can be no less.

People have a way of putting new discoveries and inventions to unexpected uses. Nevertheless, the outlines of what atomic power promises are already clear.

To begin with, power from the atom will assure the world of ample fuel supplies for centuries to come; world reserves of atomic fuel are at least twenty times as great as reserves of coal. Power plants as large as, or larger than, the greatest in existence today will be possible, not just where water power or coal deposits permit, but anywhere in the world. Undeveloped and technically advanced regions will both benefit; the former will find, in atomic power, a short-cut to the twentieth century, and the latter, a means of exploiting new resources.

Both directly and as a result of the requirements of the atomic power plant itself, atomic power will also open up new branches of chemistry and metallurgy. And it will extend the application of those extraordinary by-products of the atomic reactor, radioisotopes, from the research laboratory to industry.

Atomic power promises to have such wide effects indeed that the United States cannot afford not to press ahead with its development. Military and political as well as economic strength will, in the coming era, depend more than ever on continuing technological advance; the race will be to those that don't stand still. "It would be a major setback to the position of this country in the world," the Atomic Energy Commission observed early this year in a statement on the development of atomic power, "to allow its present leadership in nuclear power development to pass out of its hands."

A CONVENIENT starting point for examining the atomic power age in some detail is a brief glance at what the first atomic power plants will look like and at what this still unfamiliar force called atomic energy is. As yet, the A. E. C. has given no details of our first atomic power plant. The commission has announced only that it will be built by the Westinghouse Electric Corporation under the direction of Rear Admiral Hyman G. Rickover, the atomic submarine expert, who has been borrowed from the Navy for the job; that the plant will cost "many tens of millions of dollars" and will have generating capacity of at least 60,000 kilowatts (enough for a city of 75,000 inhabitants). But more than two dozen (Continued on Page 38)

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reactors have been built or are under construction in various parts of the world, exclusive of Russia. Thus the general characteristics of the reactor, the heart of the atomic power plant, are well known.

Some atomic power plants of special type may be entirely enclosed—reactor, generating equipment and all—in a mammoth gas-tight steel shell a block or more in diameter, like the experimental land-based submarine engine which General Electric is constructing at West Milton, N. Y. This extra safety precaution, however, will usually be unnecessary.

IN most plants, there will be several interconnected buildings, placed out in the open. Most of the buildings will house the familiar elements of a coal-fired power plant—boilers, turbines and generators—and will be of standard modern industrial design. To one side, one will also see the huge banks of transformers and forest of cables and insulators characteristic of all power plants, and the high-tension lines marching away across the countryside atop towering pylons.

One building—not necessarily the largest, but with a central location—will be a windowless structure several stories in height. This is the building that will make the atomic power plant unique.

Inside the windowless building will be a massive concrete box with walls many feet thick and a gallery along one face. The box is the radiation shield; it contains the reactor and its accessories. The reactor will be operated by remote control from an instrument panel along the gallery. Special machinery hidden in the far wall or the top of the radiation shield will insert new fuel into the reactor or perform other tasks as required. A traveling crane, riding on rails high above the shield is ready to take the reactor out, if it should ever have to be replaced.

The most striking features of the atomic power plant will be its cleanliness and silence (except for the muted whine of the dynamos in the generator building). Since a few hundred pounds of atomic fuel will suffice to operate an atomic power plant for months, there will be no docks or railroad sidings, no great loaders or unsightly storage dumps for handling and storing mountains of fuel. Nor will there be controversies with local authorities over smoke or fly ash; the atomic power plant will probably have no smokestacks at all, as the stacks in present reactor buildings serve essentially for the disposal of heat, which atomic power plants will retain and utilize. A few lonely technicians will constitute the plant's entire personnel.

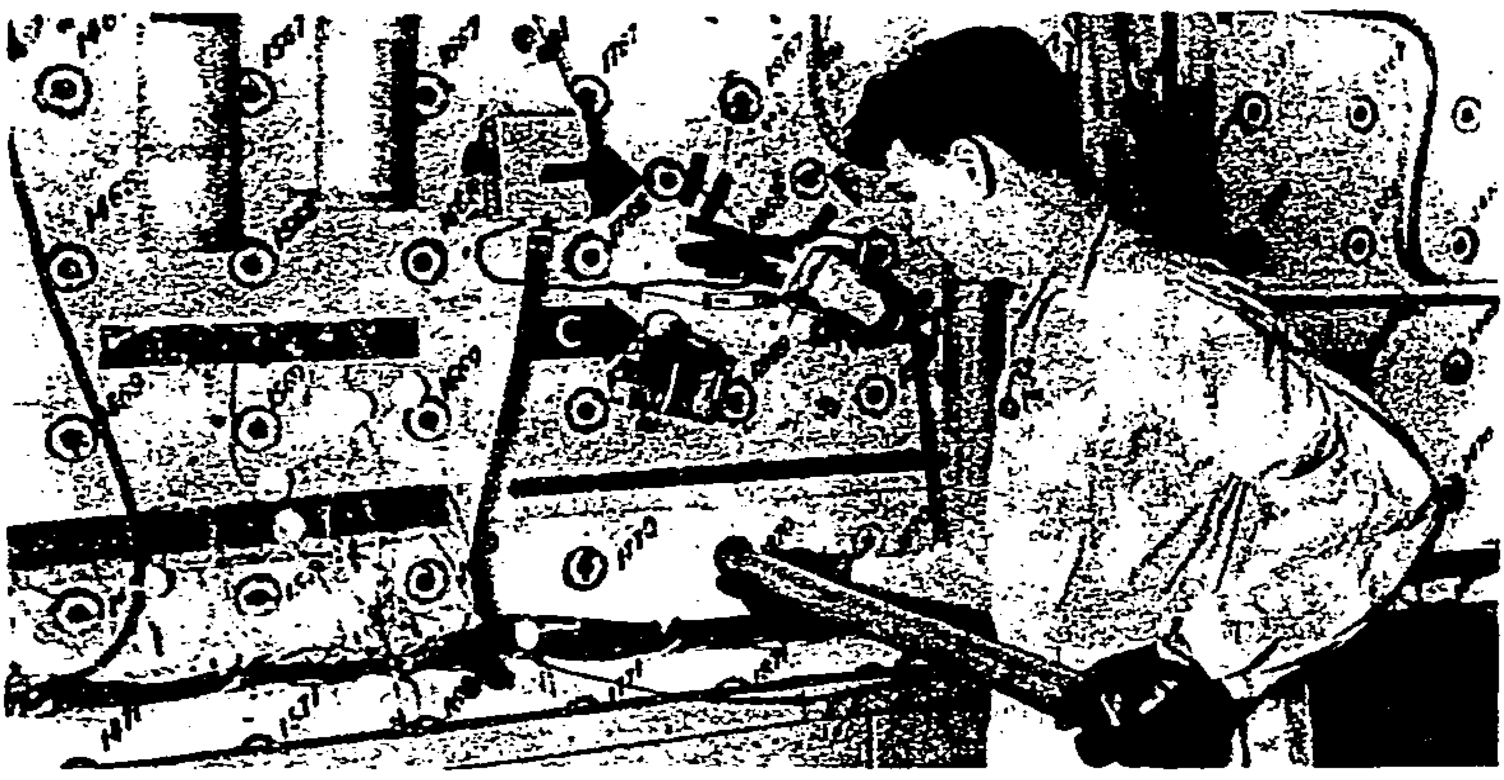
In principle the atomic power plant will generate electricity in very much the same way as a conventional power plant. Generators will be turned by turbines. Boilers will raise steam to drive the turbines. In place of the coal furnaces that fire the boilers in a conventional plant, however, the atomic plant will have heat from its reactor, brought to the boilers by means of devices known as heat exchangers.

The heat of an atomic reactor is the product of silent and unseen, but remarkable, activity inside it. Atomic energy can be released by two distinct processes. One is the fusion of light atoms, the process employed in the hydrogen bomb. Nuclear fusion takes place, for practical purposes, only at the temperature of exploding atomic bombs and has nothing to do with atomic power. Atomic power plants will utilize the other atomic-energy process, the fission or splitting of uranium 235 and of certain other heavy elements.

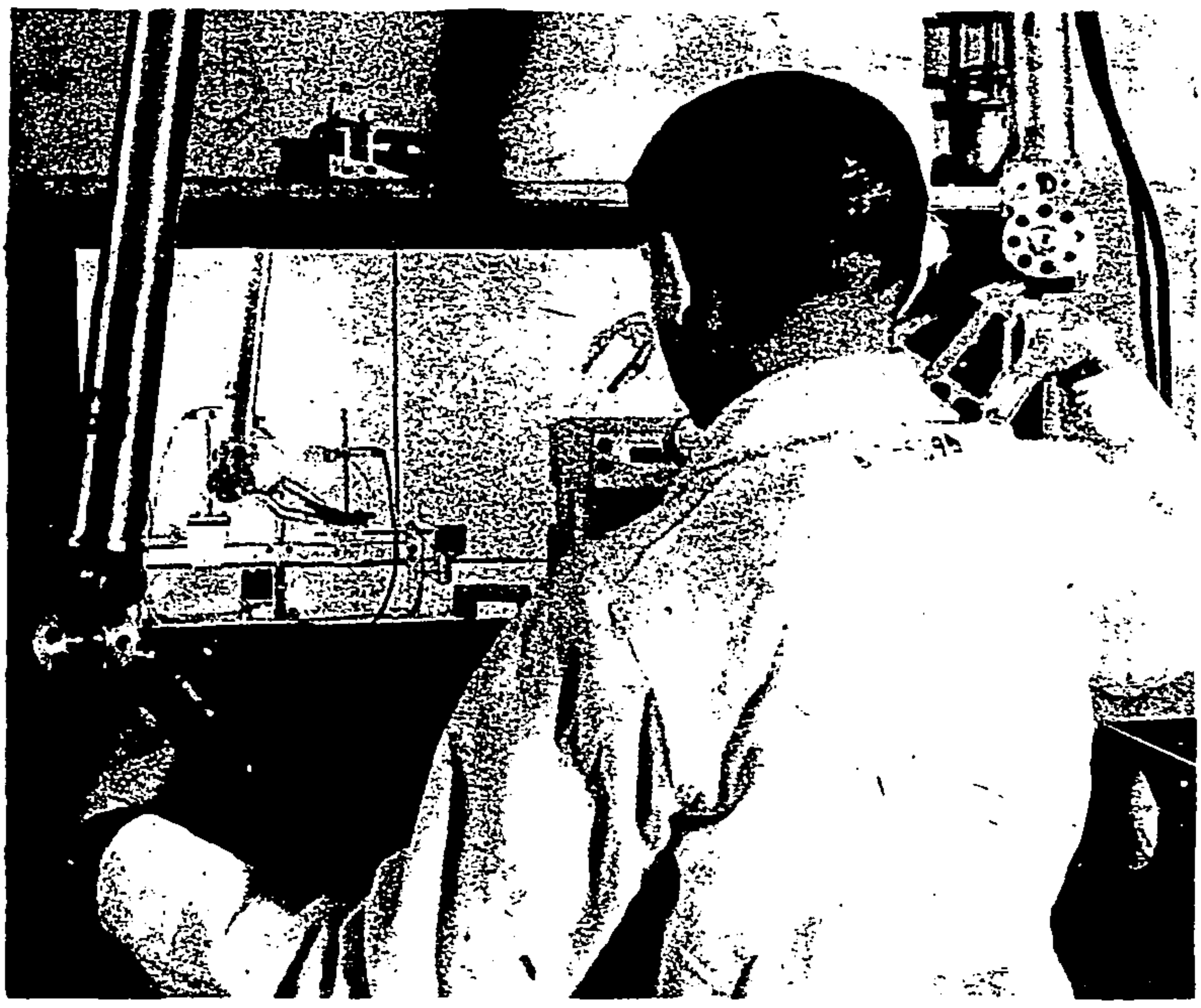
When a certain minimum amount of a fissionable material is placed in a reactor, atoms of the fissionable material split into fragments that fly apart with tremendous force. Some of the fragments (specifically, particles called neutrons) keep the reaction going by causing other fissionable nuclei to split; they also fulfill other roles in special reactors like the plutonium piles at Hanford, Wash.

BUT most of the fragments merely collide violently with near-by atoms. In colliding, they generate enormous quantities of heat. All atomic piles generate heat. In the first ones the heat had to be thrown away (that is, eliminated through a cooling system) because of the practical difficulty of utilizing it in any way at that time.

The concrete shielding and other special features required to protect the world at large and the plant and its personnel from radiation will make the first atomic power plants cost, according to various engineering study groups, from two to five times as much to build as comparable conventional power plants. (The massive shielding will also rule out atomic autos and other very small portable atomic units). But savings in fuel



LOADING—A technician stokes a present-day reactor with a uranium slug.



REMOTE CONTROL—Operating a pair of mechanical hands from outside a reactor.

should offset at least part of the extra cost of the plants.

During the past several years, the experts have debated the comparative cost of atomic fuel. It now promises to be, in time, a remarkably cheap as well as remarkably convenient fuel.

RECENT developments, for example, have made uranium 235 cheaper, in terms of useful energy, than aviation gasoline and comparable to coal priced at $10 a ton. New production shortcuts and more efficient reactors, declares Dean John R. Dunning of the Columbia University School of Engineering, the first man to demonstrate atomic fission in the United States, could cut the cost of fissionable material to the equivalent of "$2 a ton or even 20 cents a ton for coal." With fuel costs that low, even extremely expensive power plants would be economically feasible.

But the place of atomic power will not be determined solely by its comparative cost, however great or little that may prove. Inventions establish themselves primarily through advantages of utility; cost is generally secondary.

For instance, people buy automobiles in preference to horses, though autos have always been much more expensive than horses, because even a poor automobile can do easily what is manifestly impossible for any horse.

What makes atomic power exciting and important is that it will do with relative ease things that are managed awkwardly at best with conventional sources of power, or cannot be managed with them at all.

One is continued expansion of the world energy supply. During the last twelve months the world used up about 1/700th of its known reserves of coal and oil. (Water power forms only a small part of the world's energy reserve.) This sounds like a comfortably small portion of man's patrimony of energy. The real position is altogether different.

According to expert Dr. Karl Cohen of the Walter Kidde Nuclear Laboratories, world energy consumption is rising rapidly—so rapidly, in fact, that our reserves of coal and oil would be gone in considerably less than 100 years if we had to depend on oil and coal alone.

As a matter of fact, fuel is already a critical problem in many regions once counted rich in fuel, as well as in traditionally fuel-poor areas like Italy and Southeast Asia.

In Belgium, coal is being brought up from twelve-inch seams 5,000 feet inside the earth, at a cost of $15 a ton at the mine-head—more than double the price of coal in the United States, despite the lower wages of Belgian miners. Britain will have an annual fuel deficit of 20 million tons by 1965. Even in the United States there are areas without adequate local fuel supplies or where the better deposits (in some of the Southern coalfields, for example) are beginning to be worked out.

Atomic energy puts a world fuel crisis far into the future. An estimate prepared for the A. E. C. places the recoverable world reserve of U-235 and U-238, the common form of uranium, which can be converted into atomic fuel, at 25 million tons—a quantity equivalent in energy to twenty times the world reserve of coal and oil. Thorium, a heavy element that can also be converted into atomic fuel, is even more abundant.

THE largest coal-burning power plants have a generating capacity of about 200,000 kilowatts; larger ones are barred by the mechanical difficulty of handling the enormous volume of coal they would require (over 100 tons an hour). Hydroelectric plants may be very much larger; the generators at Grand Coulee have a combined capacity of 2,600,000 kilowatts. But there are few rivers with volume and fall of water enough for hydro plants of even a quarter that size.

Atomic power plants escape both the size limitations of the coal plant and the geographical limitations of the hydro station. Nuclear engineering specialists say they can be built as large as one pleases. And they can be located wherever desired.

Atomic plants can be used to supply electricity to inaccessible areas, such as Far Northern outposts or remote mines. One potential site, suggested by Chairman W. Sterling Cole of the Joint Congres- (Continued on Page 41)

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sional Committee on Atomic Energy, is Thule Air Base in Greenland. Others are some of the distant places where uranium itself is mined, and where fuel must be shipped in or bulky unrefined ores shipped out at great cost.

Even more important, atomic power will touch off new industrial expansion in settled parts of the globe. Americans are widely familiar with the part played by Grand Coulee and Bonneville dams in the Pacific Northwest and TVA in the Tennessee Valley. The big dams brought in a complex of basic industries dependent upon abundant electricity—aluminum, fertilizers, atomic electricity. The basic industries attracted processors, fabricators and a host of other ancillary plants and services.

ATOMIC power will write a similar story in still wider areas. To regions that have never been able to get into the twentieth century for lack of fuel, atomic power will bring not only aluminum and fertilizer, but all the goods and services of modern technology. To better endowed parts of the world it will bring new materials and new industrial processes whose exploitation awaits only a new source of power—for instance, the tough, extraordinarily corrosion-resistant new metal, zirconium (developed for the atomic reactor itself), or perhaps large-scale desalting of sea water.

Up to now we have considered atomic energy only as a means of generating electricity. The special properties of atomic fuel, however, also open up a realm of hardly explored possibilities.

An example are radioisotopes, the radioactive materials resulting from atomic fission or produced by exposing selected materials to the radiation of the atomic pile. These "tagged" materials are widely used in laboratories for studying all sorts of complex natural phenomena. Their use in industry is just beginning.

ANOTHER example is the ability of the atomic pile to deliver higher temperatures than can be obtained in any existing furnace. At present no one knows what will be done with such super-hot furnaces, but industry has always found important uses for the hottest heats furnaces can deliver.

In a way, the super-hot furnace aptly sums up the whole atomic power story. No one can foresee precisely what ingenious employments will be found for it as the development of atomic power moves forward and as we here in the United States (as seems likely) prepare to bring the resources of private industry and Government both to bear on it. But atomic fission was one of the greatest achievements in the long history of science. It cannot but prove one of the most fruitful.