NEW USES FOR ATOMIC WASTE PRODUCTS

ATOMIC waste products produced in reactors by the fission or rupture of atoms of uranium or plutonium, are the nuclear scientist's nightmare. They are highly radioactive, therefore dangerous, and their disposal raises a serious problem. Some specialists have suggested that these materials be sunk into blocks of concrete and dropped into the deepest parts of the ocean. Others have even put forward the somewhat far-fetched idea of sending them out into space by rocket.

But this can hardly be the right approach to the problem. The question is not so much how to get rid of atomic waste products as to find a way of putting them to good use. The possibility of using them in industry was envisaged as early as 1951 by physicists at Stanford University in the United States. The idea was enlarged upon by Sir John Cockroft during last year's British Conference on Radiology, with special emphasis on the polymerization of plastics.

Polyethylene is one of the most widely used among plastics, and it has been shown that gamma rays emitted by atomic waste products are powerful agents of polymerization. Sir John Cockroft has calculated that only 100 curies of radioactivity are necessary to produce one ton of polyethylene from ethylene. This is very little, when one considers that by 1965, two tons of radioactive waste—that is, millions and millions of curies—will be produced in the United Kingdom alone. And the process would be extremely economical. Sir John Cockcroft has predicted that the cost of the energy involved in the production of one pound of plastic would amount to only one penny.

Meanwhile, research on other forms of polymerization is being pursued in Britain, while in France two physicists, Michel Magat and Auguste Chapiro, have succeeded in producing what they call "grafts" of plastics. They subject two different materials to gamma rays and thus obtain a third type of plastic through copolymerization.

In the 19th century, when electricity was invented, it was found to be a very effective agent for initiating certain reactions. Later, as intense sources of artificial light came to be developed, it was discovered that light too could induce chemical changes. And today, nuclear energy provides a powerful medium for producing new chemical substances. Thus, after thermo-chemistry, electrochemistry and photo-chemistry, the science of radio-chemistry is being born.

The tremendous field which this new science is opening up has barely been explored to date. Scarcely a month passes without some new discovery being made. One of the most interesting was recently described in an article by Professor Harteck in *Nucleonics*. It explains how fertilizers can now be produced from air in an atomic reactor.

The process is quite simple: when air is passed through an atomic pile, a large proportion of the energy resulting from the fission of uranium is converted into chemical energy, so that the nitrogen of the air combines with the oxygen of the air to produce nitric oxide, from which nitrate is manufactured. The fertilizer produced by this process has a low radioactive content and can safely be used and even stored for long periods.

Quite recently, radioactive "waste" recovered from atomic piles is being put to large-scale use in British hospitals for treatment of deep-seated cancer. The Royal Marsden Hospital, London, uses a source of radioactivity consisting of cæsium produced from the fission products of the atomic piles at Windscale Works in Cumberland, and has installed it in a specially designed therapy apparatus at Sutton in Surrey, for treatment of patients almost immediately.

Although the cæsium itself, in the form of a salt of the element, is only the size of about four lumps of sugar, it has an activity of more than 1,200 curies. One may indeed hope that cæsium units will in the not distant future make the best type of radiative treatment available for fighting the cancer.

CHEMICAL ELEMENTS BEYOND 92*

ESSENTIALLY all the elements heavier than uranium, element 92, are non-existent in nature. Such elements may have existed at the birth of the earth, but they were all highly radioactive; as a consequence, they decayed, turning into lighter elements and became extinct.

In 1940, Dr. E. M. McMillan and Dr. P. H. Abelson, using the Berkeley 60-inch cyclotron, created element 93. This was followed a year

* From a lecture by Dr. Glenn T. Seaborg at the Radiation Laboratory of the University of California, Berkeley.