The following points are important. There is no known practical limitation to the temperature at which energy can be produced by a fission chain reaction. Indeed there is reason to believe that in the explosion of the atomic bombs temperatures perhaps as high as 1,000,000°C. may have been obtained. A practical limitation is imposed only for machines designed to operate at a steady level by the refractory properties of the materials used. In this respect, the choice of the materials is quite critical because not only their ability to stand high temperatures must be taken into account but also one must consider the adverse effect that adding foreign materials in the reaction system has on the nuclear reaction itself. This adverse effect is due to the fact that most materials absorb neutrons sometimes more and sometimes less. Any material that has to be added as a coolant to remove heat from the pile or as a lining for the pipes through which a cooling fluid is conducted determines a loss of neutrons. When this loss is so large that the reproduction factor drops below 1 the reaction stops.

COULD LARGE AMOUNTS OF ENERGY BE RELEASED?

It has been mentioned that the essential fuel in piles of the Hanford type is U^{235} which represents only .7 per cent of the total weight of natural uranium.

The content in fission energy of uranium is roughly 3,000,000 times that of an equal weight of coal. If only .7 per cent of the uranium is utilized, the practical uranium to coal ratio will be about 20,000. These figures point to the great importance of devising methods for the complete utilization of the energy of uranium.

The demand for a practical solution of this problem may not be very pressing in the immediate future since there still are fairly large uranium deposits which can be mined at relatively low cost. If we conceive, however, a development in which large amounts of atomic energy would be produced by U^{235}, the rich deposits of uranium would rapidly be exhausted and further production would have to use very poor ores with a consequent increase of several orders of magnitude in the cost of the primary material. In this case, the importance of a complete utilization of the energy stored in uranium would naturally become much greater. It is clear on the other hand the energy value of one pound of uranium is so great that even an enormous increase of cost of this material may not interfere with its economical use as a source of power. Indeed 3 million tons of coal, equivalent in energy content to one ton of uranium, cost about 8 million dollars. Consequently, as far as cost of the raw materials, uranium and coal would become equivalent for a price of uranium of 4,000 dollars per pound. Before the war the cost of uranium was about 2 dollars per pound so that an increase of the order of a thousand times the pre-war price would not be necessarily uneconomical.

We might conceive that 20 or 30 years from now the general scheme of atomic energy production may be perhaps about as follows. There will be large central installations in which very great amounts of power will be produced and transformed into electrical energy or steam for local power consumption. Besides producing directly power, these large units may also produce some amount of plutonium which will be extracted and distributed to small installations in which plutonium and not uranium will be used as the primary fuel. This plan would have the advantage of permitting wide use of relatively small power units thereby reducing very greatly the difficulties of distribution.