and weight 239 as indicated in the second reaction. The transformation of uranium into neptunium takes place in a time of the order of one half hour. Also Np^{239} which is thereby formed is unstable and spontaneously emits an electron transforming in a few days into the final reaction product Pu^{239} as indicated by the last equation. If we examine the overall balance of a chain reaction of this type, it is clear therefore that U^{235} will gradually be destroyed to keep the reaction going; whereas U^{238} will slowly be transformed into Pu^{239}.

CONTROL OF A PILE

In order to operate a chain reacting pile at a steady level the reproduction factor must be equal to one. If it is larger than one the intensity increases, if it is smaller the intensity drops. For this reason the operator must have means to adjust the reproduction factor to any desired value in the vicinity of one. This usually is achieved by means of organs called control rods. They are rods made of some material having a strong absorption for neutrons which the operator can insert into the pile at a depth that can be accurately adjusted. The number of neutrons absorbed by the rods and thereby removed from the reaction will depend on how deep the rod reaches into the pile. Consequently, the reproduction factor will also depend upon the position of the rod and will have its largest value when the rod is outside and its smallest value when the rod is completely inside. Conditions are usually adjusted in such a way that the reproduction factor is equal to 1 when the rod is in some intermediate position called "critical position" and it takes values larger than 1 if the rod is pulled further out than the critical position and smaller than 1 if the rod is pushed further in. If the operator wishes to increase the rate of reaction, the rod is pulled out so that the reproduction factor exceeds 1 by some small amount and the number of neutrons gradually increases. If the operator wants to reduce the rate of reaction, all he has to do is to insert the rods somewhat further than the critical position. The reproduction factor will then be less than 1 and the rate of reaction will gradually decrease. If he wants to keep the power at a steady level, he will place the rods at the critical position.

It is clear from this that the problem of controlling the rate of reaction in the pile can be solved in a very simple way. Experiment actually has shown that the controlling problem can be solved very easily also in practice. Indeed, to keep a pile, whether capable of producing a large or small amount of power, running at a steady level is an art that can be completely mastered in a few hours. It is also easily possible to keep the intensity of the pile steady at any desired level by moving the rods with mechanical devices operated automatically. In this case all the operator has to do is watch the control panel.

HIGH TEMPERATURE PILES

The chief technical difficulty which stands at present in the way of production of atomic energy for practical uses is the following. In all the reacting units that have been constructed until now the energy is produced at a very low temperature. This undoubtedly is due to a great extent to the fact that the primary purpose for which the piles have been constructed during the war was not production of useful power but the production of plutonium. For this reason no effort was made in the direction of constructing a pile with materials capable of standing a very high temperature since such development undoubtedly would have retarded very considerably the achievement of the essential objectives.