25, this corresponds to the fission of about 42 metric tons of uranium or thorium per year. Forty tons per day is given (*2*) as the rate corresponding to twenty times the world's present energy consumption. Thus, the energy wasted in volcanism is about 6% of the world's current consumption.

The geographic distribution of volcanic energy is generally complementary to that of fossil fuels, and has already led to competitive electric power generation from fumaroles in a few places. The Italian installations at Larderello have been recently described by Schnell (*3*). About 3000 metric tons of natural steam per hour are currently used there in the production of approximately 2×10^9 kw-hr of electricity per year. Large scale use of volcanic energy might eventually be of value in locally stabilizing the earth's crust and increasing property values in volcanic regions.

The development of volcanic energy resources might prove an attractive alternative to fission reactor development in several regions such as Italy, Japan, Mexico, Alaska, and Hawaii during the next several decades.

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Criticality Study on TREAT Reactor-Cause of Excess Boron Impurity in Graphite

Criticality calculations for the TREAT reactor, assuming no slots and no test hole, and using a modified Fermi-Age Theory which allows for epithermal absorption and fission, indicated a critical radius of 59 cm. At the time of startup, TREAT became critical at a radius of 67.8 cm. The discrepancy between the calculated and measured values was found to be due to boron impurity in the graphite in excess of 1.0 ppm allowed in the original specification. The results of spectrochemical and chemical tests on 50 random samples indicated an average boron impurity in the core of 7.6 ppm with an average deviation of 1.6.

An effort was made to determine the origin of this boron impurity in order to ascertain if the value of 7.6 ppm was representative of the core, and also in order possibly to prevent the recurrence of this kind of graphite contamination. The reason for the excess of boron, determined by the Metallurgy Division, is as follows:

The fuel tubes used in the TREAT reactor were baked in borated (nominally 2 w/o boron) stainless steel separators, covered with loose graphite powder. Impurity tests of graphite samples were made in a repeated experiment simulating baking operations. After cooling, analysis was made of the graphite samples which were in contact with the borated steel surface and at distances 1½ and 3 in. away from the borated steel surface. The corresponding contents of boron impurities were 20, 5, and 4 ppm, respectively. This seemed to indicate that at the baking temperature, some of the boron atoms that were not in stable solution in the steel, migrated from it, and were transferred to the graphite in the fuel element (*1*).

REFERENCE

1. For more details, see H. P. Iskenderian, Post-criticality analysis of the TREAT reactor. ANL-6115 (1960).

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Errata

Volume 7, Number 2, February 1960, in the article by Jeffery Lewins entitled, "The Use of the Generation Time in Reactor Kinetics," pp. 122–126:

p. 126, eq. (15): for a_i read $s^* a_i$

p. 126 eq. (18): for t^{**} read t^*