Only a small fraction of these protons will be able to participate in reactions (b) and (c) to any considerable extent because of the potential barrier that they have to penetrate. Let us assume that this fraction is .1, representing the protons of 3 MeV and more. Actually, this number cannot be calculated at present because the fission spectrum is not well known. The above appears to be a safe estimate. The proton will remain effective for reactions (b) and (c) only until it loses about 1 MeV energy by collisions. This gives them an effective range of less than 10 cm in air or about 1.3×10^{-2} cm in water. If the cross section of reaction (b) or (c) is σ, the number of reactions will be

$$N = 1.4 \times 10^{17} \times 13 \times 10^{-2} \times .33 \times 10^{23}\sigma = .6 \times 10^{38}\sigma$$

in case (b), the number of O^{16} atoms per cm^3 being $.3 \times 10^{23}$. For σ we can assume about $10^{-28} cm^2$ in this case which gives $N = 6 \times 10^9$ F^{17}/sec. This is a strong positron activity which has to be reckoned with when the leak detecting apparatus is designed. However, it is very much smaller than the activity due to O^{19} of which about $N = 5 \times 10^{11}$ are formed in a second.

The situation is similar with respect to reaction (c). The number of the O^{18} nuclei which participate in (c) is 500 times smaller than that of the O^{16} nuclei participating in (b). On the other hand, the cross section for (c) may be $10^{-25} cm^2$ (this is about the highest cross section known for a nuclear reaction of this type) so that, conceivably, $N = 10^{10}$ F^{18} nuclei may be formed per second. This, again, is more important for the design of leak detecting counters than for the total radioactivity in front of the pile. Only if O^{19} should not emit γ rays would (b) become the largest source of radioactivity in pure water. The half life of F^{17} is 64 sec and thus has a larger probability of disinte-