

grating in the front pipings than the  $F^{18}$  the half life of which is 6700 sec. Actually, the total radiation is very small, both from (b) and (c) so that, if  $O^{19}$  is really free from  $\gamma$  rays, the impurities in the water may contribute fully as much radiation as  $F^{17}$  or  $F^{18}$  do.

It is, probably unnecessary to mention that, while the radioactivity due to  $O^{19}$  can be estimated reasonably accurately, the amount of  $F^{17}$  and  $F^{18}$  may be twice greater or more than ten times smaller than given above.

#### Impurities.

The most important impurities in water are, apparently, Fe,  $SiO_2$ , Ca, Mg, Na, K,  $SO_4$ ,  $NO_3$ , Cl, Br,  $CO_3$ . To these  $PO_4$ , may be added which is used as an inhibitor. In a good water source these are present only to the extent of a few parts per million. The radioactive nuclei which may be formed from these elements are  $Fe^{56}$  (harmless),  $Fe^{59}$ ,  $Si^{31}$  (no  $\gamma$ , harmless),  $Ca^{41}$ ,  $Ca^{45}$ ,  $Ca^{49}$ ,  $Mg^{27}$ ,  $Na^{24}$ ,  $K^{42}$  (probably no  $\gamma$ ),  $S^{35}$  (probably no  $\gamma$ ),  $S^{37}$  (hardly to be expected to amount to anything),  $N^{16}$ ,  $Cl^{36}$ ,  $Cl^{38}$ ,  $Br^{80}$ ,  $Br^{82}$ ,  $Cl^{14}$  (harmless),  $P^{32}$  (no  $\gamma$ , harmless). The following table gives N and A for the case that the element in question is present to 1 ppm (i.e., the p assumed in the table is the abundance of the relevant isotope). The table gives, therefore, a sort of "danger coefficients" for outside the pile (N) and for the exit manifold (A). However, in the former case, allowance should be made for the life time of the radioactive nucleus. This will decrease the danger both if it is very long and also if it is very short. In the former case, most of the disintegration will occur after the water is well mixed with river and perhaps sea water. In the latter case, most of the disintegration will occur in the neighborhood of the plant, partly already in the conduit to the river where proper precautions can be taken against the effects of it.