SUMMARY

This thesis deals with the design, construction and systems analysis of detection equipment for measuring the ^3H level in environmental water. The practical use of these analyses is illustrated by several hydrological applications.

The effective volume of a proportional gas counter is smaller than the total volume because of a distortion of the electric field near both ends. A mathematical analysis of the electrostatic field has yielded optimum counter dimensions in this respect. A method for measuring gas multiplication is given, that only requires some series of measurements of muon induced counting rates at various counter gas pressures, counter voltages and discriminator settings. The major background component of the counter system we constructed is muon induced radiation in the shielding. This can only be reduced by installing the counter further underground (chapter 2).

The use of high-density polyethylene vials in liquid scintillation measurements of environmental ^3H is necessary to attain a low background. Using these vials, the application of an external standard for quenching corrections proved to be unreliable for long measuring times. It is rendered superfluous by a careful sample preparation. Contrary to the proportional counter, the interaction of external radiation with the sample causes only half of the background for ^3H counting (chapter 3).

The lower detection limit and the accuracy of ^3H determinations have been improved by the electrolytic enrichment of the sample water. The chance variations of the applied enrichment factor of ten are within the accuracy of the liquid scintillation counter (8 °/oo) (chapter 4). The lower ^3H detection limits of the equipment, including a tenfold enrichment and a 1000 minutes measuring time, are 0.3 TU for the proportional gas counter and 1.5 TU for the liquid scintillation counter.

^3H targets and radioluminous watches are shown to pose a serious threat to environmental ^3H laboratories (chapter 5).

The ^3H level variations in precipitation, due to the thermonuclear bomb tests, are compared to the observed ^3H level in soil moisture and ground water. From this, semi-quantitative conclusions are drawn about infiltration rates. Furthermore, estimates are made of the relative contributions from various sources to the runoff of some rivers.