Isotope Techniques for Hydrology. Technical Reports Series No. 23. Published by International Atomic Energy Agency, Vienna, Austria, 1964. Distributed by International Publications, Inc., 317 East 34th Street, New York, N. Y. 10016. 38 pages. $1.00

The titled document is the report of a panel on isotope applications in hydrology, convened under the auspices of the International Atomic Energy Agency. The document covers, in some detail, the isotopes that have been used in in hydrology, and then specifically discusses some aspects of surface- and ground-water applications. Mention of activation analysis is made, although essentially no space is spent in indicating its real potentialities. This is unfortunate since herein probably lies one of the major contributions of the nuclear discipline to water supply and quality analysis.

The discussion of experience with isotopes and those isotopes with desirable characteristics is well presented in the space provided. In most cases the isotopes are discussed in connection with a ground-water dating or tracing application. Such discussion of isotope characteristics is easily related to the later consideration of use in surface-water studies.

The emphasis on water dating tends to be overdone in the amount of discussion presented, particularly in view of its relative minor importance to the overall field of ground-water hydrology. The issue of how important dating is to hydrology apparently is disposed of in one statement on page 9: "Dating of ground water is a technique which *can give information* on recharge rates . . ." The discussion then turns directly to dating, with no further consideration of the applicability to ground-water hydrology. As is the case with so many dating proponents, the way to calculate a recharge rate (a volume of fluid per time) from a dating (just time) without a myriad of unrealistic assumptions is not given. Further, the carefully thought out and published paper by Skibitzke[1] in 1958 was not considered. In that paper the fallacies are explicitly pointed out for the extensive use of dating and tracers in hydrology for the usual proposed applications.

The reviewed document gives helpful information on the behavior and interactions of tracers in soils. Such information can be expected to contribute to better use of tracers in the future for studying the advanced phases of ground-water research—such as hydrodynamic dispersion characteristics and porosity distributions in heterogeneous porous media. The present types of uses as reported can not, in general, be expected to quantitatively contribute such knowledge for the reasons pointed out by Skibitzke as early as 1958.

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[1]HERBERT E. SKIBITZKE, "The use of Radioactive Tracers in Hydrologic Field Studies of Ground Water Motion," *Extrait des Comptes Rendus et Raports—Assemblée Générale de Toronto 1957.* **Tome II,** 243.

Radioisotopes in Hydrology. Published by International Atomic Energy Agency, Vienna, Austria, 1963. Distributed by International Publications, Inc., 317 East 34th Street, New York, N. Y. 10016. 459 pages. $9.00.

This book contains the proceedings of the International Symposium on Radioisotopes in Hydrology, held in Tokyo, Japan, 5-9 March 1963, under the sponsorship of the International Atomic Energy Agency in cooperation with the Japanese Government. Twenty-seven papers (21 in English and 6 in French) are included in the volume; each is followed by an abbreviated discussion which occurred at the Conference. Each paper is preceded by an abstract in the four languages of the conference: English, French, Russian, and Spanish.

The purpose of the conference was to present and discuss investigative methods and uses of radioactive tracers in hydrologic studies. Papers presented fitted well into the conference theme. The technical and semitechnical reports are grouped into five areas of isotope applications: mixing process and discharge measurement in rivers and lakes; sediment and bed load transport; speed and direction of ground-water flow; in-well ground-water-velocity measurement devices; and characteristics of specific isotopes for ground-water tracing.

The conference was quite effective in bringing together people in varied disciplines from many countries to let them become aware of the results, types of investigations and, most importantly, the problems being encountered in using radioactive tracers in hydrology. Although no formal conclusions are presented, several general conclusions and trends are evident from the papers and from the ensuing discussion:

1. The major limitation of using isotopes for measuring discharge in large rivers or canals is the uncertainty of complete mixing. This limitation can be minimized only through injecting tracers across the entire flow, as contrasted to point injection, and by using a spatial concentration integration to determine the true diluted tracer concentration downstream.

2. The use of radioactive tracing for studying sediment transport seems to have potential. The major detail work reported is that in the United Kingdom, using reactor-irridiated sand in flume studies of transport. Rather high activities, which are needed to detect longer time and distance particle transport, may be a limitation in long-range studies.

3. The utilization of radioactive tracers in ground-water hydrology is moving into a new stage of development on the way toward assuming a mature position among ground-water investigative methods. This change is evident, particularly as noted in pages 175-237, by the absence of the more glamorous claims of the past, and the presentation of careful evaluations of those useful hydrologic tracer methods.

A number of papers in the publication emphasize what is slowly coming to light, that tracers at this time have limited application in quantitatively describing in detail a ground-water flow system. Although tracer tests may provide useful information on water (or waste) movement rates and approximate paths between injection and sampling points for an existing flow system, they provide limited information on the details of the system (hydrologic parameters, such as permeability and potential distributions) which are needed for a complete analysis of flow. There are few instances where flow analysis is desired for a system that is not to be exploited in some manner, recharge or pumping, by man. Data from tracer tests conducted prior to the fact may be of little value in the case where the system is subsequently altered appreciably through human efforts or natural phenomena. On the other hand, if such techniques can be employed to yield accurate