Tritium and Carbon-14 in the Tree Rings

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The data on the atmospheric carbon-14 and tritium in recent years can be expected to furnish new information on the circulation problems of geophysics.

There are several data on the concentration of carbon-14 in the atmospheric carbon dioxide and of tritium in the rain water[1-3]. This note presents the results of measurements of the concentration of carbon-14 and tritium in the tree rings of recent years. The purpose of the measurements was to obtain the annual mean concentration of the atmospheric carbon-14 and of the tritium in the rain water.

1) T. A. Rafter and G. J. Fergusson, U. N. Conference on the Peaceful Uses of Atomic Energy, **18**, 526 (1958).
2) F.Begeman and W. F. Libby, AFOSR Report Number: Tn-56-561, ASTIA Document Number AD 110381 (1956).
3) H. v. Buttlar and W. F. Libby, *J. Inorg. & Nuclear Chem.*, **1**, 75 (1955).

TABLE I. TRITIUM AND CARBON-14 CONCENTRATION IN TREE RINGS

Interval of growth of tree ring	Trritium concentration, $T/H \times 10^{18}$		Carbon-14 concentration**	
	Pine; grown in Hiroshima*	Paulownia; grown in Tokyo	Pine; grown in Hiroshima*	Paulownia; grown in Tokyo
Aug. 1953~Sept. 1954	92.2±6.2		0.975±0.009	
Aug. 1954~Sept. 1955	54.5±4.2	96.3±8.1	0.967±0.009	1.032±0.012
Aug. 1955~Sept. 1956	80.7±8.9		1.006±0.008	
Aug. 1956~Sept. 1957	67.3±2.6	65.6±2.2	1.060±0.009	1.024±0.012
Aug. 1957~Sept. 1958	138.7±3.9		1.101±0.008	1.153±0.012
Aug. 1958~Sept. 1959	304.4±3.0	261 ±3	1.192±0.012	1.196±0.013
Aug. 1959~Sept. 1960	138.7±2.8*	111 ±2.8	1.221±0.013-	1.187±0.013

* This tree was cut down in April 1960, therefore the last tree ring corresponds to the period between Aug. 1959 and April 1960.

** The data are normalized to the concentration of Carbon-14 of the hypothetical modern wood which would not have been affected by industrial effect and nuclear tests.

The tree ring samples were previously dried in a vacuum desiccator at 110°C for several hours. The hydrogen in the tree ring was collected as water by combustion of the gas evolved by strong heating of the dried sample. The water obtained (100~150 ml.) was purified and electrolyzed in order of enrich the tritium. After the reduction of the volume of the water to about one hundredth, the deuterium content of the concentrate was measured by buoyancy method. The tritium disintegration rate was measured by an external quenched Geiger-Counter filled with hydrogen and propane. The preparation of hydrogen from the water and the operation of the counter were done in the similar manner to those developed by Östlund[4].

In Table I the measured tritium concentrations of the tree rings are shown together with the carbon-14 concentrations in the same tree rings. The carbon-14 concentrations were measured in the same manner as described in the previous paper[5]. The concentration of carbon-14 and tritium in the tree ring may be regarded as an annual mean value of the carbon-14 concentration in the atmosphere and that of the tritium concentration in the rain water respectively. The data on the carbon-14 presented here and in previous paper show a tendency of decrease after 1960 and seem to have a maximum value at the beginning of 1960.

The annual mean concentration of tritium in the rain water descreases after 1959 with the half life of about one year. Since the tritium in the troposphere has short mean life[2], the amount of tritium in the troposphere may be proportional to the amount of supply of tritium to the troposphere from the stratosphere. The observed decrease of tritium after 1959 and the annual variation of carbon-14 after 1959 suggest a stratospheric residence time of 1~2 years for these nuclides.

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4) H. G. Östlund, IAEA Tritium Symposium, Vienna, 1961, Paper TTS/17.

5) K. Kigoshi and T. Tomikura, This Bulletin, 33, 1576 (1960).