National Science Foundation grants allow continuance of radioactive elements measurement

February 12, 1971

A grant of $178,000 has been made to UCSD to underwrite measurements of the level of certain radioactive elements in the environment throughout the world.

The National Science Foundation award assures continuation for two years of a project initiated at the Scripps Institution of Oceanography more than a decade ago, involving studies of tritium and radiocarbon in the world's oceans.

Dr. Hans Suess, a professor in the UCSD chemistry department, and the project's principal investigator, said these studies can throw light on certain problems in oceanography which remain unsolved.

"There is the question, for example, of how long it takes the surface layers of the ocean to mix with the deep layers," Suess said. "Answers to this puzzle would be useful in dealing with marine pollution. If an oil tanker collides with another vessel, as happened recently in San Francisco Bay, or a shipment of acid is dumped accidentally in the ocean, we need to know how long it will take the oil or acid to reach the depths. Is it three years, or five, or twenty? Nobody really knows for sure."

Suess said the tritium laboratory at UCSD is the only research center in the world which makes regular determinations of tritium in ocean waters. The laboratory receives samples from points throughout the globe including 12 island stations in the Pacific, one on the Caspian Sea, and from ships at sea. UCSD's "library" of ocean-water samples is probably the largest and most varied in the world.

Tritium is the heaviest isotope of the hydrogen element, and the only hydrogen isotope which is radioactive. It is present in very small amounts in nature, but also occurs as a man-made product in the form of fallout from hydrogen bombs.

"Tritium is really a form of water," Suess explained. "It is found everywhere on earth where water is found. For all practical purposes, tritium is hydrogen, just like ordinary water. And as all human beings are about 90 percent water, tritium is present in the human organism, as well as in other animate matter and in plants."

Natural tritium in the atmosphere first was discovered in 1948 by Dr. Willard Libby of UCLA. Most of the tritium found in natural waters of the earth is deposited by rain. Naturally produced tritium is believed to result from the bombardment of nitrogen in the atmosphere by cosmic rays. In recent years, however, bomb tests have complicated the problem of measuring the level of tritium in earth's waters.

One objective of Suess' project is, therefore, to assess the degree to which the world's waters have been polluted by radioactive debris resulting from bomb tests.

"When people started shooting off hydrogen bombs," he said, "the level of tritium in water, especially in rainwater and snow but also in river and ocean water, increased considerably over what it had been before the bombs. There's now about 10 times more tritium in the natural environment than was put there by nature, worldwide. There's much less of it in the southern hemisphere then in the northern, where the tritium level is something like 100 times normal. It's a beautiful example of how an artificial product can contaminate the whole world."

The first device to produce "man-made" tritium pollution in the atmosphere was the so-called "Greenhouse" experiment on a Pacific atoll in 1952. A large number of U.S. and Russian bombs were tested in the early 1960's, releasing a substantial amount of tritium into the upper atmosphere. These tests ceased when the U.S.Russian bomb moratorium went into effect, hence since October, 1963 no appreciable amount of tritium has come from such sources.

"To the surprise of many scientists," said Suess, "tritium from bombs remains in the uppermost layers of the atmosphere, and comes down relatively slowly. It takes years for it to descend, in some cases perhaps up to 12 years - the half-life of tritium. As a rule, it descends in spring and early summer. And, of course, it does not come down from the stratosphere in rain or snow because there are no rain or snow falls up that high. It descends mainly through mixing of the upper and lower air levels, coming down with bomb debris. Then, at lower levels, it mixes with rain or snow, and shows up in fog and in clouds. Finally the rain water goes into the rivers and oceans. The surface waters of earth's oceans now contain six to eight times more tritium than they did before the bomb tests."

Suess said there is little cause for alarm, however, because tritium is relatively harmless when dispersed in the form of rain.

"It is a very soft, very weak radioactivity which nobody has so far considered harmful, even at the highest level ever encountered in nature," he explained.

Though UCSD's tritium laboratory is the only one devoted principally to such measurements on a routine basis, several other labs throughout the world also make tritium determinations. The most unusual of these is one maintained by the U.S. Internal Revenue Service, said Suess, to measure the level of tritium in whisky.

"Not, as you might suspect, to protect the consumer, but to verify the ages of whisky. If a given whisky is labelled with a date more than 10 years old, and tests indicate a high level of tritium, the IRS knows the bottler is making a fraudulent claim regarding the whisky's age. Because a 'high' level would indicate that the whisky was made since the bomb tests."

Tritium also can be used to check wine vintages, Suess said. Wines of known vintage years are useful to the scientist because their water content can be checked for tritium levels. Water samples in the UCSD "library" go back only to 1958, Suess explained, hence wines from vintages prior to 1958 can be used to determine the level of tritium deposited in earth's waters in those earlier years.

Some "radiant dial" wristwatches emit tritium radiations in "unbelievable amounts," Suess said, because of the special paint used to make their dials glow in the dark. Such watches are rigidly banned from the UCSD tritium laboratories.

"Just one such watch could contaminate our labs for many years," he said.

Suess' project also surveys the distribution of artificial radiocarbon in the surface waters of the Pacific. In addition, Suess and his colleagues work with other UCSD investigators in measuring cosmic-ray produced radiocarbon in meteorites and in lunar samples brought back to earth by Apollo astronauts.

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