The "Lost" Mercury at Oak Ridge

A year after a scientist is disciplined for checking privately on mercury pollution, vast spills from a bomb plant are confirmed

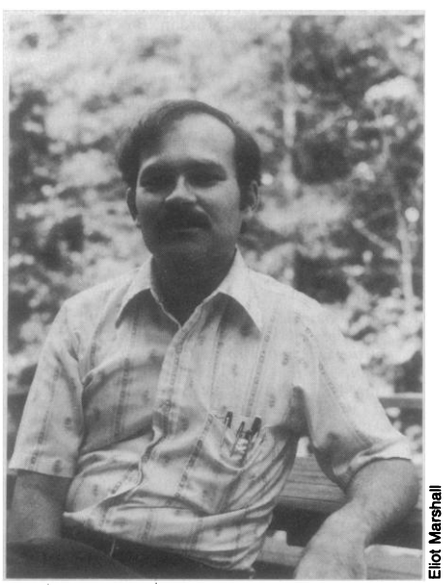
The worst moment in his career, biologist Stephen Gough recalls, was on 12 April 1982 when he learned that his division chief wanted him and his brother to surrender "all the samples, all the field notes, all the analysis sheets" on the vegetation they had collected one Saturday as they walked around the edges of the government facility where Stephen was working. The Goughs complied, for they had aroused higher ups in the bureaucracy and stumbled onto a toxic residue problem of enormous proportions for Stephen's employer, the Oak Ridge National Laboratory (ORNL) of Oak Ridge, Tennessee.

ORNL, a research institution, is one of three federal operations at the site managed for the Department of Energy (DOE) by Union Carbide. The others are the Y-12 hydrogen bomb plant and the K-25 gaseous diffusion uranium fuel plant. Each has its own environmental monitoring staff, linked fraternally with ORNL.

On 5 December 1981, the Saturday when the Goughs went sample collecting, they picked up bits of moss, liverwort, and sycamore roots near a stream that runs under the Y-12 plant. As it turned out, they had begun to document the highest levels of mercury contamination ever recorded in the United States. Tennessee Representatives Albert Gore, Jr. (D), and Marilyn Lloyd (D) plan to hold a day-long inquiry into the affair on 11 July in Oak Ridge, particularly to investigate a report that the Y-12 plant has lost 2.4 million pounds of mercury.

The Goughs did their sample collecting on free time while Stephen's brother Larry was making a family visit on his way home from a business convention in Atlanta. (Larry works for a division of the U.S. Geological Survey (USGS) that analyzes trace metals in the environment.) They hoped to gather enough data to justify a joint ORNL-Geological Survey research project. It is hard to get new projects funded, Stephen explains, and the Oak Ridge environs seemed a fertile source of data. He had learned there were high levels of mercury in the stream from working on an environmental study at ORNL in 1978.

In addition to mercury, the Goughs hoped to look for traces of other toxic heavy metals reported in the area—arsenic, cadmium, and lead. But their plans were cut short. Stephen Gough says that the director of environmental sciences at ORNL, Stanley Auerbach, confiscated all the research materials. "My brother called me that day [12 April]" Gough says, "and told me that his division chief had been contacted by Auerbach and instructed to return all the samples [then at the Geological Survey] to Oak Ridge." Auerbach insisted that no cover letter accompany the package, probably because DOE wanted "no official record that the sampling and analysis took place," according to Gough.



Eliot Marshall

Stephen Gough

Reprimanded after finding mercury in moss

Gough was angry, but says "I didn't have the guts to call Auerbach." Instead, he talked with an intermediate supervisor, W. Van Winkle, who confirmed that Auerbach had intervened. Today Gough tends to stress the irony of the situation rather than his outrage. The research which Gough was prevented from doing is being done nevertheless, but with more flap and fanfare than if Gough had been allowed to carry on as he had planned.

Gough was reprimanded for insubordination. He left Oak Ridge under a cloud in June 1982, his research unfinished. Auerbach's staff at ORNL picked up the work and carried out a quick study in May 1982. Gough suggests, however, that it was done only to protect the management should word of the problem leak out.

Auerbach said in a telephone interview that he disciplined Gough because the junior scientist took on a study for which he was not qualified, and because Gough involved another federal agency without clearance. Auerbach adds that ORNL staff experts are "acclaimed nationally and internationally for their work on environmental aspects of mercury pollution," but none was consulted by Gough. This led Auerbach to fear that Gough's inexpert work might injure the laboratory's scientific reputation. As it happens, the senior experts have never carried out a thorough mercury study at Oak Ridge, and, in fact, the only known request for such a study, made in 1977, was turned down by DOE. The quick study of May 1982, intended as a follow-up to Gough's work, did not find that he had exaggerated the problem. On the contrary, it reported even higher levels of contamination.

Auerbach confirms that Gough was warned in January 1982 that he might be forced to leave ORNL, but insists that the warning was prompted by budget distress and that it came 3 months before the lab learned of Gough's mercury project. However, as soon as Auerbach did learn of the unauthorized sampling, he stopped the project.

When a USGS supervisor sought permission to record the samples in the spring of 1982, Auerbach refused. He says he asked to have the material returned immediately because it had been collected without consent. He also asked that the findings be kept out of the official records. "No cover letter was requested since USGS was not involved in the sampling, nor did they wish to be," Auerbach says. Asked if he specifically requested no cover letter, he replied: "It is pretty hard to recall a telephone conversation." But he does recall that the USGS official "was happy to get rid of the samples as soon as he could." They were returned as requested—that is, with no traces entered in the file.

After Gough's departure, the local press coaxed out data confirming his early findings and revealing that the Y-12 plant may have lost as many as 2.4 million pounds of mercury since 1953. That was the conclusion of a classified Union Carbide report written in 1977, released only in May 1983 because the *Appalachian Observer* heard about it and filed a Freedom of Information request.

The process that used mercury at Y-12 was shut down in 1963. Yet mercury continues to leak into the little stream known as the East Fork of Poplar Creek, fed by springs under the Y-12 plant. The current rate of leakage, according to James Alexander, a spokesman for DOE, is about 2 ounces a day. He says that staff geologists speculate that hundreds of thousands of pounds of mercury may be lodged in sumps, sewers, and in shale cavities beneath the plant. Whenever it rains heavily, some of the old mercury is stirred and moved into the stream. Yet laboratory officials think that no serious damage has been done to the environment and they say that no human health problems have been reported. There are high levels of mercury in creek sediments and nearby vegetation, and some of the fish close to the Y-12 plant have been found to contain a little over twice the level of mercury accepted by the Food and Drug Administration (FDA) [1 part per million (ppm) is deemed safe]. Oak Ridge officials argue that there is no reason for alarm; this situation has existed for nearly 30 years with no apparent ill effects.

The revelations about the 2.4 million pounds of lost mercury, however, have created a mood of restrained frenzy among health and environmental officials in the area. After insisting for years that it could manage its own environmental problems, DOE conceded recently that perhaps there was a role for state and federal health agencies as well. Under intense pressure, DOE agreed on 26 May to a memorandum of understanding with the state of Tennessee and the regional office of the Environmental Protection Agency, promising to take some remedial action on mercury. The first meeting of a joint study group created by the memo took place on 23 June in Knoxville. One of the two coordinators, state water quality enforcement official Barry Sulkin, says that as far as he is concerned, the DOE's decades-long record of pollution monitoring is less than adequate. He wants to rebuild from the ground up. A comprehensive review is now beginning. Although no sponsor has stepped forward, all eyes have turned to DOE. Sulkin says, "The study will be done, and it will be funded."

Some townspeople are understandably edgy, for mercury in the methylated form is known to affect the central nervous system. In the notorious Minamata scandal in Japan during the 1960's, people died and were paralyzed after consuming methyl mercury dumped into drinking water supplies.

DOE officials have assured Oak Ridgers that their predicament is entirely different because the Y-12 leaks involved only elemental mercury, a form relatively insoluble in water. It is converted slowly by natural processes to methylated mercury, but DOE maintains that the quantities must be small. It seems that none of the mercury has reached the town's drinking water, for these supplies are taken from an area upstream of the Y-12 plant. Downstream, according to DOE, the mercury will sink 300 to 1000 feet into the earth and then be trapped by shale before reaching deep ground water.

Alexander, DOE's spokesman, says that there are some immediate problems requiring more study. DOE would like to know the extent of mercury contamination in vegetable gardens filled with silt taken from the stream bed. DOE hopes to learn whether there is any significant level of mercury in the flesh and milk of cows grazing near the creek. And a few wells near the edge of town are being monitored. Fish in another creek and in the Clinch River (farther downstream) have been found to contain slightly higher than normal amounts of mercury, but not more than the FDA "guideline" level of 1 ppm for commercial fishing.

One of DOE's biggest challenges now is to reestablish its credibility. State water quality official Sulkin says that he has learned from working on this case for 10 months that DOE tends to be too optimistic. For example, Sulkin was surprised by DOE's response when he first learned of the mercury problem in the fall of 1982. He had just been assigned to the region and asked Oak Ridge officials to come to a meeting to discuss pollution. While the DOE representatives confirmed that some fish in the creek were showing unacceptably high levels of mercury, they minimized the finding by saying that Oak Ridge is a town of scientists and engineers who are too busy and too well-off to go fishing for dinner. They calculated that a person would have to eat 159 large bluegills a year to be at risk. Finally, they argued, anyone who did go fishing would not take fish from one of the least promising of local streams and lakes—the East Fork of Poplar Creek. Its fish are too scrawny.

Courtesy of DOE

Mercury poured into Y-12's process pipes (1950's)

In the rush to make H-bomb fuel, DOE says, incoming supplies were not carefully logged.

Sulkin brushed aside these arguments and got approval from the state health commissioner to post the creek as unfit for fishing in December 1982. Since then it has been learned that people occasionally eat turtles taken from these waters. Sulkin is confident that he took the right step, particularly because he does not regard the FDA guideline as sacrosanct. "Up until 1977 the standard was 0.5 ppm," he says. "Then they changed it to 1 ppm for the tuna fish lobby."

Sulkin learned to be skeptical of DOE's data on mercury leaks as well. "We began asking where all the mercury

Keyworth Calls for Bold Push in Space

Taking a sharp new tack on the civilian space program, presidential science adviser George A. Keyworth has suggested that the United States consider an ambitious new space initiative in the spirit of the Apollo moon landings—for example, the construction of a manned orbital transfer vehicle to shuttle between low Earth orbit and geosynchronous orbit; a lunar colony; or even a manned expedition to Mars.

Coming from Keyworth, such words are startling indeed. He has been a vocal skeptic of the National Aeronautics and Space Administration's (NASA's) plans for a much less ambitious step, a manned space station (*Science*, 10 September 1982, p. 1018). Moreover, 2 years ago he was defending the White House's attempt to downgrade NASA's unmanned planetary program (much less any *manned* expeditions) on the grounds that a new series of probes would offer less scientific return than, say, space astrophysics (*Science*, 18 December 1981, p. 1322).

However, in a recent interview with *Science*, Keyworth explained his new approach as a matter of national pride. There is now a broad public awareness that the country's future depends on science and technology, he says. Perhaps a new space endeavor could be an appropriate way of sustaining that awareness.

"I think the country would take a major thrust in space very seriously," he says. "We've shown that the shuttle works, and is reliable. We know we have the technology to build a space station. [In fact], most advocates of a space station readily acknowledge that it is only an intermediate step in a more ambitious long-range goal of exploring the solar system. Why, then, can't we be forthright and lay those ideas out on the table? Do we want to tell the American people that we have bold objectives in space? Or do we want to sneak up on it?"

Keyworth maintains that this is perfectly consistent with his previous stance. "I simply said that I would not wax enthusiastic about a large new endeavor until NASA defines what it expects to achieve," he says. In particular, he still wants NASA to fully exploit the capabilities of the shuttle/spacelab combination before it rushes to build a new, permanent laboratory in orbit.

However, his new approach amounts to shifting the emphasis from space station as laboratory to space station as transportation hub. "If you see the space station as the intermediate platform for extended missions [such as a lunar colony or a Mars mission]," he says, "well, it's difficult for me to imagine doing that without a manned station."

Keyworth says his proposals grew out of personal meditations on the national spirit and the space program. He has not yet discussed them with President Reagan, although he does point out that Reagan has long been enthusiastic about space. Nor do his proposals have anything to do with the President's call last 23 March for a space-based, "Star Wars" missle defense. "Stars Wars grew out of strategic considerations," he says. "The two ideas are related only by being in space."

Be that as it may, it is not at all clear what effect Keyworth's ideas will have on official Administration space policy. Of course, Keyworth will now have a tough time opposing NASA's space station in next fall's budget negotiations, if he is still so inclined. And NASA, meanwhile, will doubtless be delighted to start drawing up plans for orbital transfer vehicles, lunar colonies, and Mars missions. But would an Apollo-style initiative necessarily make for a healthy space program?

A nation that can afford the current defense budget can certainly afford a few hundred billion dollars for, say, a manned trip to Mars. But would that trip be purchased at the cost of a more balanced program of space science and near-earth applications? Would it leave NASA in possession of a massively expensive set of hardware that is useless for anything else? Experience with Apollo and the space shuttle is not encouraging. The debate should be interesting.—**M. MITCHELL WALDROP**

was coming from," he recalls. "In October they told us there had been a leak of 100,000 pounds in 1966, and half of it was recovered. That was all." Then Sulkin began hearing rumors that an inventory of all mercury leaks was being declassified. He requested a copy during the winter. Just before DOE released the report in response to a newspaper request on 17 May, an official called Sulkin to warn him to brace himself, for "the number would be large." Indeed it was: not only were 2.4 million pounds of mercury unaccounted for, but 475,000 were thought to have gone down Poplar Creek. Sulkin now says, "There are a lot of other chemicals in that creek—PCBs, acids, organic solvents, plutonium." He wants to look into all of them.

One question the congressional inquiry may wish to examine is why it took so long for this pollution to come to light. The official in charge of environmental monitoring at the Y-12 plant, James White, says that he was most concerned with radionuclides and mercury vapors in the workplace and less with the effects on biota outside. The workers' safety was his first priority. White says that the water in the creek meets federal drinking water standards for mercury, and "there isn't any standard for mercury in soil." As for fish, "We did only a small amount of sampling" in the part of the creek near the Y-12 plant, for "as far as we knew it wasn't fished at all." Most samples were taken further downstream near the Clinch River. More fishing goes on there, and mercury levels are also lower.

The research staff at ORNL does not look into local problems such as this unless invited to do so by peers at the Y-12 or K-25 plants, Auerbach explains. However, the managers of Y-12 did ask for some broad advice on pollution in the mid-1970's. Jerry Elwood, an environmental scientist at ORNL, took a preliminary look at the creeks and recommended in 1977 that an in-depth study be funded to learn the extent of mercury pollution. DOE's chief of environmental protection at Oak Ridge, Jerry Wing, wrote back thanking Elwood for his recommendation and informing him that his paper was being classified "business confidential." The issue lay dormant until December 1981, when Gough began collecting samples on his own.

The early information suggests that the town of Oak Ridge is stuck with a major waste cleanup problem but not one that clearly threatens public health. Sulkin says, however, "We're only one-third through." He has not yet tackled pollution from K-25 and ORNL.

—**ELIOT MARSHALL**