IS GLOBAL WARMING REAL?

Art Lachenbruch of USGS searches for answers by taking temperature of Earth's upper crust

BY MARION SOFTKY

For people who want to know if the earth is really warming up, Art Lachenbruch has a simple suggestion: Ask it.

A senior scientist with the U.S. Geological Survey in Menlo Park, Dr. Lachenbruch has been asking. And the earth has been telling him it is getting warmer — at least in Alaska.

He and colleagues from the geological survey have been helicoptering to abandoned oil wells in northern Alaska. By dropping thermometers through the frozen ground in more than 35 inactive wells, they have substantiated weather records that indicate the Alaskan Arctic is getting warmer.

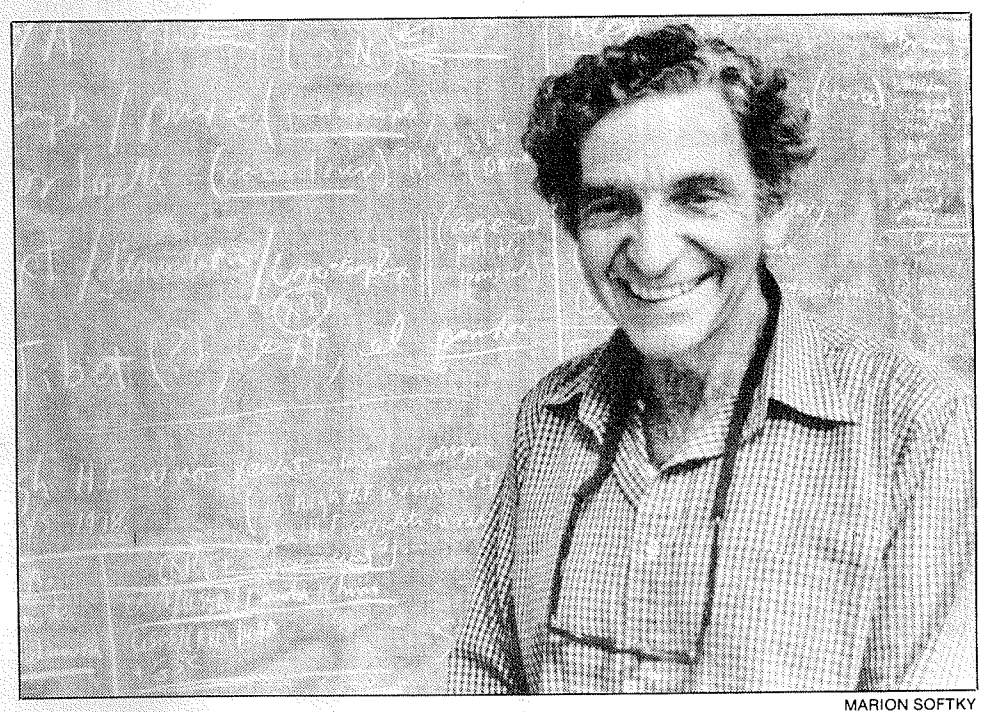
"The temperature in oil wells showed that in general the surface of the solid earth has warmed up some 2-4 degrees centigrade in the 20th century," Dr. Lachenbruch says in an interview in his Menlo Park office.

"That does not mean the whole earth is doing that," he cautions quickly. "We have to ask the rest of the earth what it is doing."

Taking the temperature of the upper 200 meters of the Earth's crust can give a measure — independent of air temperature — of whether the Earth is warming as a result of the dramatic increase of "greenhouse" gases, says Dr. Lachenbruch.

"We're suggesting there's another data set to look at to see if the earth is warming," he says.

The dangers of global warming have been widely discussed. Greenhouse gases, such as carbon dioxide — a product of man's increasing burning of fossil fuels — trap heat in the atmosphere and may lead to a general warming of the climate. The potentially disastrous results range from melting the polar ice caps and flooding coastal cities, to droughts, floods and other unpredictable effects on local climates.



MARION SOFTKY

***GEOLOGICAL JARGON** fills the blackboard of Art Lachenbruch's Menlo Park office. The man who once blew the whistle on the Alaska pipeline is taking aim at global warming. He believes taking the temperature of the earth just below the surface could confirm whether the climate is really warming up.*

Although President Bush is not convinced global warming is a problem, a committee from the National Academy of Sciences has estimated the earth will warm between 1.5 and 4.5 degrees C over the next century. For comparison, the earth has not been more than 2 degrees C warmer than at present during the 10,000 years of human civilization, reports Stephen H. Schneider in *World Monitor* magazine; the last ice age was only 5 degrees colder.

In the course of more than 40 years of engineering studies of the permafrost — the frozen soil and rock and water that extend up to 600 meters below the surface in the frozen Arctic — scientists from the geological survey have made many measurements of how heat flows through the earth. Near the surface, ground temperatures respond to air temperatures; at deeper levels, the earth's temperatures reflect heat flowing from the molten core.

Dr. Lachenbruch notes a number of advantages to getting temperature information from the earth rather than the air. Temperatures in the earth are steadier. "The earth preserves the trends but filters out the noise," he says.

In areas such as rock or permafrost, where water is not moving, the heating or cooling on the surface propagates slowly downward, creating memory of past temperatures. The top 10 to 20 meters show temperature variations from summer to winter, Dr. Lachenbruch says; the next 100 to 200 meters show the climate history of the last century or two — long before weather records were kept.

"We can ask the earth about its memory of temperatures during the last few centuries," says Dr. Lachenbruch. "We can do this almost any place where water isn't flowing through the rocks too fast."

Scientists from around the world who study heat flow in the earth's crust are going back to their records. They are looking to see if the data from the top few hundred meters that they ignored will support or counter the findings of Dr. Lachenbruch and his colleagues in Alaska.

New information on this body of data may become public this December in San Francisco when the American Geophysical Union is planning a special session on the subject.

Always the careful scientist, Dr. Lachenbruch is reluctant to conclude positively that the earth as a whole is warming.

Does he believe it? "I think it's extremely likely," he replies cautiously. "I think there's very little doubt that greenhouse gases have increased dramatically in the last half of the 20th century, and that effect will clearly cause heat to accumulate in the earth."

Should the United States be taking preventive action? After a pause, he concludes, "My gut feeling is a sense of disappointment that our political leadership hasn't given stronger support to international efforts to curb emission of greenhouse gases."

How Lachenbruch changed pipeline construction, quake theory

BY MARION SOFTKY

Some of Art Lachenbruch's most notable achievements have been "asides" to his main research.

He blew the whistle on the Alaska pipeline and caused its redesign at huge cost. He has cast new light on the structure and mechanics of the San Andreas earthquake fault. Now he's calling for a new line of research to confirm or debunk global warming.

Yet, Dr. Lachenbruch is not a climatologist or pipeline engineer. He is a geophysicist and mathematician whose primary interest is heat flow in the earth. He studies how heat drives landscapes, continents, earthquakes, volcanoes, and the ocean floor.

"The climate thing was an aside. The pipeline thing was an aside that seemed timely," he says. "That's the beauty of this kind of science. The methods are so general."

What, for example, do the San Andreas Fault and the Alaska pipeline have in common?

"The San Andreas is potentially a long linear heat source, and that's what a pipeline in permafrost is," he says. "If you take the San Andreas away and substitute a heated pipeline, the problems are not all that different."

His involvement with the Alaska pipeline began more than 20 years ago with a conversation with Menlo Park geologist Irv Tailleur.

They were talking about the pipeline then being planned to carry oil across Alaska from the Arctic to Valdez. In the course of the conversation, Dr. Lachenbruch learned two things that spelled potential disaster. The oil in the pipeline came from 10,000 feet below the earth and was 60 degrees C (140 F). And the oil companies planned to bury the pipeline in permafrost — the upper layer of ground in the Arctic that never thaws.

Some quick calculations and dozens of phone calls later, the directors of the Geological Survey and the Council of Environmental Quality confronted the oil companies in a public hearing in Alaska. Thanks to Dr. Lachenbruch's long weekend, they produced calculations showing that hot oil would melt the permafrost supporting the pipeline and probably cause it to break.

Permafrost is a wonderful foundation as long as it's frozen, Dr. Lachenbruch explains; but when it melts and turns to water, it loses its structural strength.

"Next morning I had all those guys down in my office, and it lasted for two years," he chuckles.

The upshot was that the permit was held up and the pipeline redesigned. Now, more than half the pipeline, where it traverses permafrost, is elevated. It successfully carries more than a million gallons of hot oil a day 800 miles across Alaska.

Dr. Lachenbruch later received a special medal from the Department of the Interior citing him for being the first to see the need for the thermal analysis and conducting a study of "great national importance."

"This was an initiative out of Menlo Park. It was not part of the system, but interested geologists advising their superiors of a potential problem," Dr. Lachenbruch muses 20 years later.

He advises: "We all should try to stay alert to the applications of things we do. You never know when you're going to find answers."

It was Dr. Lachenbruch's love of landforms and mathematics that led him from a dismal performance in high school to a distinguished scientific career. During 47 years with the U.S. Geological Survey, he has become a member of the National Academy of Sciences, the nation's top scientific body, and received numerous awards. Last December in San Francisco he was honored with the Walter H. Bucher Medal, the top award of the American Geophysical Union.

In his dark and cluttered Menlo Park office, Dr. Lachenbruch, a resident of Los Altos Hills and former member of its Planning Commission, is quiet and unassuming. He speaks — slowly, carefully and with frequent pauses — about

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