contributions by other known methane sources — ruminant animals such as cattle, which produce methane as a by-product of digestion; stagnant water bodies such as rice paddies and swamps; and leakage from natural gas pipelines.

The debate is certain to continue. Greenberg, speaking for the NCAR group, says that they are confident in their figures but adds that any estimate of global methane production by termites is undermined by the lack of good termite population figures, and by the difficulty of determining how much total carbon the insects consume. Conrad, for instance, told SCIENCE NEWS that the reason his calculations differ so notably from those of the NCAR group is that they used different figures in computing the amount of biomass eaten by the termites each year. The equation is complicated further because different termite species and termites in different ecological systems do not necessarily produce equal quantities of gas.

The controversy is of practical interest because the implications of the rising methane concentrations will be better understood when the sources for the gas are identified. The problem also highlights the difficulties inherent in any effort to extrapolate a local measurement to a global scale. Not only is agreement lacking over sources of the gas, but no one knows for sure what happens to methane once it is produced.

As the NCAR group suggests, methane may enter the atmosphere as soon as it escapes from the termite mounds or other sources. Or, as some other researchers, including Seiler and Conrad, believe, it may be taken up by other micro-organisms, such as those that so densely populate the soils.

In related research, the German scientists took measurements of methane uptake by soils in the same geographic region where they conducted their termite studies. They estimate that the annual methane consumption in the tropics and subtropics is 21 million tons, exceeding their estimate of the methane emitted by the termites and "indicating that these areas may act as a net sink of atmospheric methane." —*C. Simon*

Integrated optics: On a hot trail

Modern integrated electronics can do many things that would have seemed magical only a few decades ago. However, integrated optics are hot on their trail and may soon provide more versatile and lower-power alternatives. An example of such a development, representing worldwide efforts at optical signal processing, is an optical analog-to-digital converter developed at the Lincoln Laboratory of the Massachusetts Institute of Technology in Lexington, Mass., by R. A. Becker and F. J. Leonberger. Their paper on the subject presented this week at the meeting in New Orleans of the Optical Society of America was intended to show, among other things, that "optics can do some things you can't do with silica."

An analog signal is a continuous signal that mimics the shape of something — it may be the acoustical wave produced by a person's voice or the variation of light and dark across a picture. For most kinds of present day computer processing, analog signals, which naturally arise in many data gathering procedures, must be converted to digital signals, sequences of numbers. The converter works by repeated fast sampling of the passing analog signal. It then measures at intervals whatever quality of the analog signal is changing, usually either the amplitude or the frequency of an electromagnetic wave, and puts out a sequence of numbers representing the values it measures as it samples again and again. The computer does whatever calculating it has to do with these numbers and then the signal is converted back to analog.

Thus the smoothly varying analog signal is converted to what amounts to a series of steps. The faster the sampling rate, the narrower the steps, and the more faithfully the analog signal is coded. The optical converter samples much faster than silicon ones can, Becker and Leonberger say, at rates of 100 million to even a billion samples a second. Furthermore, its optical properties have a periodicity that matches that of the Gray code, a widely used digitizing method. In the Gray code each decimal number is translated to a series of 1s and 0s. The decimal is arranged so that a change of one unit in the decimal number changes only a single 1 or 0 in the digital code and does it in a cyclic way as the digital numbers rise or fall. The operative element in the optical converter, an array of Mach-Zehnder interferometers, cycles in the same way, facilitating the coding procedure.

The Mach-Zehnder interferometer takes an incoming laser light pulse, splits it in two and sends the parts down two paths in an electro-optic material. Electrodes bracket both paths. A potential difference across the electrodes causes the material to change the speed of the light through it. One path is biased to slow the light, the other to speed it. The incoming analog signal controls these biases. When the light pulse is reunited at the end of the interferometer, the pulse difference between the two halves represents the data sample. Very short laser pulses make high sampling rates possible.

The interferometers can be fabricated in an integrated way out of titanium-doped lithium niobiate. Work is underway on developing a fully integrated converter and optical readout components as well.

—*D.E. Thomsen*

Clark nominated for Interior job

President Reagan's quick and surprising nomination of White House National Security Adviser William P. Clark as Department of Interior secretary to replace James Watt (SN: 10/15/83, p. 247) has sent Senate staff and many environmental groups digging into Clark's past record on environmental issues. Much attention is focussing on Clark's rulings when he was a justice of California's Supreme Court from 1973 to 1981.

Reagan's announcement last week, just three days after Watt's resignation, described Clark as "a God-fearing westerner, a fourth-generation rancher, a person I trust." Whether or not those qualifications are sufficient for the job and whether Clark intends to continue Watt's policies will be the subject of confirmation hearings before the Senate Energy and Natural Resources Committee. Sen. James A. McClure (R-Idaho), committee chairman, said he saw no difficulty in confirming Clark, and said confirmation may come before Congress recesses on Nov. 17.

However, several senators, including Sen. Dale Bumpers (D-Ark.), expect to question Clark closely because of Clark's apparent inexperience in dealing with environmental matters. Groups like the National Audubon Society are hoping that the hearings will also be a forum for looking at the Reagan administration's environmental policies and for getting an idea of what direction the Interior Department may take in the next year.

Although some groups like the Wilderness Society have already condemned the Clark nomination, others like the National Wildlife Federation and the Sierra Club are awaiting meetings with Clark to get a better sense of where he stands on particular issues. One important concern is whether Clark will consider replacing some Interior Department officials dedicated to carrying out Watt's policies. Another worry is access. A National Audubon Society representative says, "We will again try to open some of the doors that have been closed at the Interior Department."

Based on Clark's California record—for instance, he favored limiting government land-use restrictions—most environmentalists are not optimistic about a change in policy, but they are hoping Clark will listen and show more flexibility than his predecessor.

One issue Clark would face immediately is the administration's long-delayed acid rain policy. The present cabinet debate seems to center on the great cost of measures to reduce sulfur dioxide emissions versus the apparent benefits of "saving a few fish" and the issue's potential for dividing the country because of strong regional differences. A decision may not be made until late November. —*I. Peterson*