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Petroleum From Decay? Maybe Not, Study Says

By NICHOLAS WADE

Long-dead plant matter may not be the world's only source of hydrocarbons. Twelve miles or more beneath its surface, in hellish temperatures and under pressures 50,000 times that at sea level, the earth itself may be generating methane, say researchers who have squeezed common rock and water together to reproduce these conditions.

The discovery bears on a longstanding argument about the source of petroleum and whether deposits are generated by rotting vegetation or by inorganic processes. "If the answer turns out to be inorganic, this has huge implications for the ecology and economy of our planet as well as for the chemistry of other planets," said the physicist Dr. Freeman Dyson, of the Institute for Advanced Study at Princeton, in a written comment, adding that the new work showed how to do experiments that will tackle the question. Most experts agree that commercially significant oil and gas deposits are biological in origin.

The finding was made at the Geophysical Laboratory of the Carnegie Institution of Washington, a leader in studying geology at high pressures, and is being reported today in The Proceedings of the National Academy of Sciences. It was conducted by a team led by Dr. Henry Scott, now at Indiana University.

Dr. Scott said the work was inspired by the writings of Dr. Thomas Gold, a maverick astrophysicist who spun off a stream of brilliant ideas, many of them correct, before his death in June. In the still undecided category remains Dr. Gold's thesis that hydrocarbons are an abundant natural constituent of the earth that constantly seep to the surface; petroleum deposits only seem to be biological in origin, he suggested, because they are contaminated with materials made by a subsurface kingdom of chemical-eating microbes.

Several aspects of Dr. Gold's thesis have been corroborated, including the discovery of the subsurface microbes as well as certain sources of methane gas that are clearly not biological.

To check another aspect of Dr. Gold's thesis, Dr. Scott took marble and water, with iron oxide as a catalyst, and put them in a diamond anvil cell, a device for studying materials at extremely high pressures. He found that at pressures corresponding to those some 12 miles beneath the earth's surface, the water disintegrated, and its hydrogen atoms joined the carbon atoms in the marble rock to form methane.

"This work suggests that natural gas, which people in the West have assumed is primarily biological in origin, may not be so much so," said Dr. Dudley Herschbach, a Nobel-Prize-winning chemist at Harvard and a co-author of the study. "I think all of this will lead people to take Tom Gold more seriously than many were inclined to."

Dr. Barbara Sherwood Lollar, a geologist at the University of Toronto, said the finding that methane can be generated in the earth's mantle was important and "a missing piece of the story." Dr. Lollar studies deep subsurface microbes on behalf of NASA, which is interested in the possibility of microbial life

beneath the surface of Mars and other planets.

Dr. Lollar has developed an isotope-based method for testing whether hydrocarbons have been made inorganically or through the heating of organic matter. Some of the hydrocarbon emissions tested were inorganic, but most were of biological origin.

Inorganic methane generation is much more of a worldwide phenomenon than had been supposed, she said, but the quantities produced are probably diffuse, compared with the rich deposits of biologically generated hydrocarbons.

Dr. Scott and his colleagues say their finding about the generation of methane "has broad implications for the hydrocarbon budget of the planet."

The researchers plan to see if more complex hydrocarbons, like ethane and butane, can be generated at the higher pressures deeper in the earth.

Their data was analyzed by scientists the Lawrence Livermore National Laboratory which, because of its work on the thermodynamics of nuclear weapons, is familiar with the intense pressures and temperatures found deep in the earth.