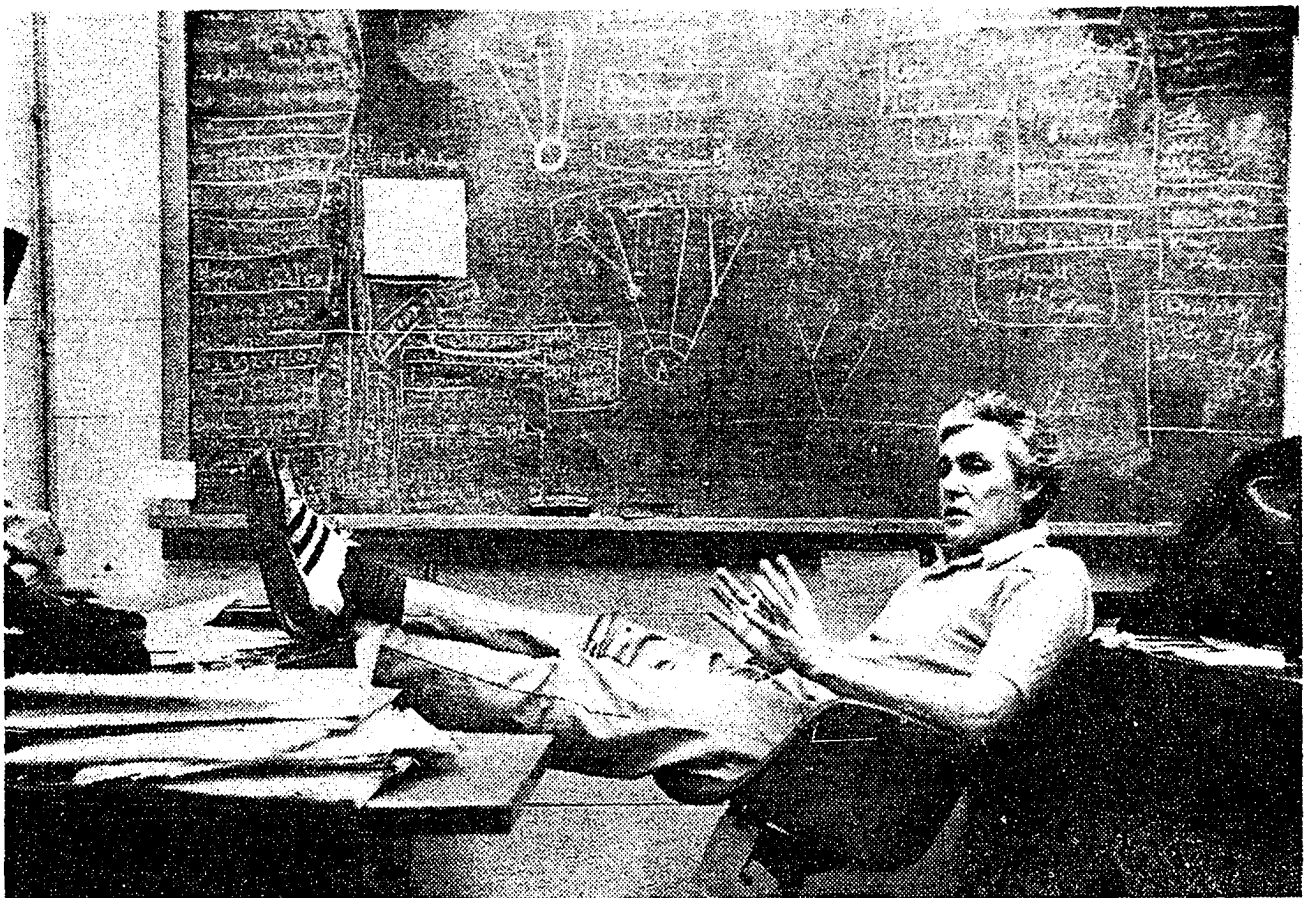

The New York Times/Phil Greer

Dr. Carl R. Woese, leader of research team, in his office at the University of Illinois. Photo at right shows the newly discovered microorganism: top, a chain of two organisms, each one-thousandth-of-a-millimeter long; center, a cross section of the chain; bottom, an organism dividing into four cells.

Scientists Discover a Form of Life That Predates Higher Organisms

By RICHARD D. LYONS
Special to The New York Times

URBANA, Ill., Nov. 2—Scientists studying the evolution of primitive organisms reported today the existence of a separate form of life that is hard to find in nature. They described it as a "third kingdom" of living material, composed of ancestral cells that abhor oxygen, digest carbon dioxide and produce methane.

The research group working here at the University of Illinois reported that this third form of life on earth was genetically distinct from the higher organisms that evolved from it—bacteria and, finally, the plant and animal world. Bacteria, are more primitive than plant and animal life, and are believed to have evolved about 3.4 billion years ago. Until today's report, they were considered the oldest form of life.

The methane-producing organisms are believed to have evolved 3.5 billion to 4 billion years ago. They have yet to be named but are being referred to informally as either archaebacteria or methanogens.

"We have shown that they are genetically distinct from the higher organisms," said Dr. Carl R. Woese, the leader of the group investigating the evolution of microorganisms.

The genetic tracking efforts of the scientific group, which spanned five years, were made public today by two of the Federal agencies that supported the research, the National Aeronautics and Space Administration and the National Science Foundation.

The work is described in detail in the October and November issues of the Proceedings of the National Academy of Sciences.

Asked for their evaluation of the results of the team at the University of Illinois, two other scientists familiar with the genetics of microbiology described the reports as "important" and "exciting," adding that it would further what is known of the basic processes of evolution.

Dr. Woese and his colleagues conclude that before the emergence on the earth of bacteria, usually regarded as the simplest form of life as we know it, at least one and perhaps several earlier forms of primitive organisms had evolved from the primordial ooze that developed after the

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SCIENTISTS DISCOVER DISTINCT LIFE FORM

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crust of the earth had been solidified from a gaseous cloud.

Dr. Woese, whose name is pronounced "woes," said in an interview that the practical value of the research probably was nil.

But he added that, if the efforts of his group were confirmed by other researchers, the findings would enhance man's knowledge of his genetic heritage and perhaps explain some of the mysteries of evolution and puzzles of the solar system.

One flight of fancy advanced by Dr. Woese, with an accompanying smile, is that the presence of this class of organisms might explain why life evolved here and not on the earth's sister planet, Venus.

The rationale goes as follows: Clouds of carbon dioxide originally enveloped both planets, but methanogens developed on earth and digested much of the cloud and in turn produced the hydrocarbons that developed into higher forms of life. But on Venus, according to this line of speculation, the lack of methanogens allowed the carbon dioxide to accumulate to the point that the so-called "greenhouse effect" took over the Venusian surface, in turn making it too hot for life to evolve.

Dr. Woese, a slightly built biophysicist who has an unruly shock of graying hair, expounded on the research of his group in a three-hour interview in his sparsely furnished office here. Nearby rooms are filled with such gadgets as electron microscopes and X-ray machines that are the basic tools used in deciphering the genetics of microorganisms.

"For years I've wanted to understand how life evolved," he said, "and five years ago my colleagues and I set about looking into the geneology of organisms."

Dr. Woese, who is 49 years old, said that only in the last 10 years had it been feasible to explore the genetics of such rudimentary organisms. Elaborating, he cited the existence of only an elementary knowledge of molecular genetics a decade ago, the development of more powerful electron microscopes, and the discovery of more sophisticated techniques for examining the molecular structures of microrganisms.

At first the group examined DNA of bacteria, that is, the deoxyribonucleic acid molecules that contain the coded information needed for the function and development of the cell. The team also studied bacterial ribosomal RNA, the ribonucleic acid that is a major constituent of the ribosomes. These are the units within cells where the messages from the genes are received and read in order to make the appropriate proteins.

The ribosomal RNA's are believed to be extremely old and represent parts of the ancestral replicating systems of both primitive and advanced organisms.

Examining the parts of either an animal cell or a plant cell is relatively easy as compared with a bacterial cell, which is perhaps 1,000 times smaller. Also, the bacterial cell does not have a clearly defined structure that the higher forms of life possess.

According to Dr. Woese, the early research on the evolution of microorganisms focused on their structural differences, rather than their genetic differences.

By examining ever simpler forms of bacteria, the University of Illinois scientists arrived at what then were believed to be the simplest forms, which the scientists have now found not to be bacteria at all.

"The methanogens themselves are not new to science," Dr. Woese said. He noted that 10 different forms had been examined in the course of the research here and that their total number was unknown because "scientists have just begun to isolate them in earnest and there could be millions of them."

To be examined, the methanogens must be cultured under extremely difficult conditions since they will not exist in the presence of oxygen.

Various forms of methanogens have been found in mud at the bottoms of San Francisco Bay and the Black Sea, in deposits in Carioco Bay off the coast of Venezuela, and in deep, hot spring waters such as those at Yellowstone National Park.

They generally are found in what are called anaerobic niches, or areas free of the presence of oxygen, which are relatively uncommon on the earth's surface.

The technique used here cultured the methanogens in the presence of radioactive phosporous, which in turn made the RNA radioactive. The radioactive RNA then was separated from the genes through the use of acrylamide gel electrophoresis.

The RNA then was digested with enzymes into smaller pieces and their molecular sequences, or messages as they are called, were compared with the RNA messages of either higher or lower organisms.

"Somewhere along the line in evolution a mistake is made and a mutation results," Dr. Woese said, adding that by studying these mutations it was possible to compare the ages of different RNA's.

By deciphering the mutations of the genetic material, the scientists were able to identify methanogens as being distinctly different from bacteria.

Dr. Woese credited the name "methanogen" as having been coined by a colleague on the project, Dr. Ralph S. Wolfe, a professor of microbiology.

Other collaborators included Linda J. Magrum, a research assistant; William E. Balch, a graduate student, and Dr. George E. Fox, the senior author of the paper in the October issue of the proceedings, who is now an assistant professor of biophysical sciences at the University of Houston.

Asked for comment about the University of Illinois work, Dr. Sol Spiegelman, now a professor of genetics at Columbia University, said that "the research results look O.K."

"Dr. Woese is a substantial scientist of international reputation who has contributed a number of ingenious ideas to science," he added.

Dr. Cyril Ponnamperuma, director of the laboratory of chemical evolution at the University of Maryland who has reported on extraterrestrial organic molecules, described the work as "very exciting, even fantastic."

"It fits into the general idea of evolution under nonoxygen conditions," he said.