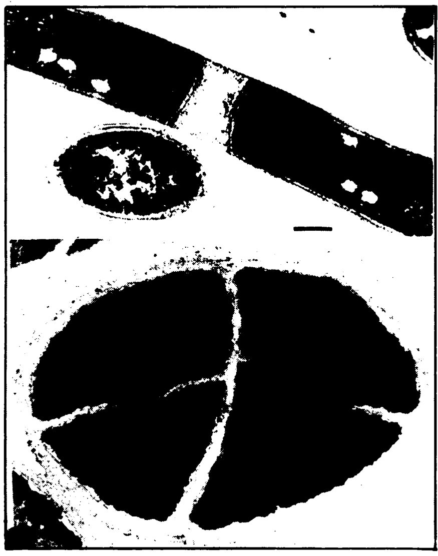


J.G. Zeikus, Univ. of Wis.

Candidates for a third evolutionary line: One species (top) forms a chain of two organisms (also seen in cross section); another species about to undergo division.

from changes that occur once and are then copied into all descendants.

The "page" which Woese chose to examine in the volume of macromolecules that characterize an organism is the RNA found in ribosomes. Because ribosomes are an essential part of the machinery for converting genetic information into protein, they are common to all organisms from methanogens to humans. "Every self-replicating system has it," Woese says. He explains that the sequence of nucleotide "letters" in ribosomal RNA seems to be tightly controlled. Misspellings crop up less frequently than in genes, for example.

In tackling the phylogeny of bacteria, Woese asked other researchers to suggest groups of microorganisms for his study. He says, "I ask them, 'What's a peculiar bacteria by the criteria you're using?'" Ralph S. Wolfe, a microbiologist at the University of Illinois, suggested the methane producers.

Woese and colleagues have now compared one type of ribosomal RNA isolated from 12 different methane-producing bacteria and 60 other bacteria (which Woese suggests calling eubacteria or true bacteria). The sequences of those groups bear little resemblance, the researchers conclude. Some "words" that occur among the methane producers never occur in other bacteria. Other sequences of nucleotides found in almost all bacteria were never detected in methanogens.

But is is comparisons with the higher life forms that lead the researchers to propose that the methane producers are not just very distant bacterial relatives. "They are just as close genealogically to higher forms as to bacteria," Woese says. So far the researchers have done only a broad screening of higher life forms. They have examined one animal, one plant, one yeast and one slime mold, Woese told SCIENCE NEWS.

Although the genealogy is the clearest indication that the methane-producing bacteria are a distinct evolutionary group, other differences separate them from typical bacteria. Wolfe has found at least three coenzymes (the nonprotein portion of enzymes) that are unique to methanogens. Some other common components have not been detected in those microorganisms. Almost all cell walls contain peptidoglycan, but the walls of the methane-producing bacteria do not. Finally, bacteria and higher organisms have the exact same sequence of bases in one region of transfer RNA, the cell component that carries specific amino acids to a forming protein chain. Methane-producing bacteria are the first major group of organisms in which that unique nucleotide sequence has not been found. All these differences contribute to the researchers' belief that methanogens form a systematic group distinct from other bacteria.

The idea that methane-producing bacteria provide a glimpse of ancestral life has two supporting arguments, Woese says. The first is the genealogic evidence that branches within the methanogen group split long ago—at least as far back as when the blue-green algae split from bacteria. Yet the biochemistry of all the methane-producing organisms is similar, as if those organisms simply have evolved slowly. "There is a constant kind of biochemistry across a deep, ancient division," Woese says. From this he infers that earlier life forms, before methanogens, bacteria and plants and animals split, relied on similar chemical reactions.

Conditions of the primitive earth provide the other basis of support for Woese's suggestion that methane-producing bacteria are the common ancestor. "Their requirements for growth are like the primitive atmosphere," he points out. "They can't stand oxygen and they live off CO_2."

The researchers suggest that the methanogens may even have played a pivotal role in the earth's physical evolution. Methane-producing organisms might have digested much of the cloud of carbon dioxide that once enveloped the planet, making possible evolution of higher life forms, Woese speculates.

Reports of the work by Woese, Wolfe, George E. Fox, Linda J. Magrum and William E. Balch will appear in the October and November PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

There are no fossil records to corroborate the proposed genealogy; methanogens may have been forming before there were rocks on earth. Therefore, scientists have only their analyses of the record within cells' genes and protein. As they examine more genealogies, Woese says, biologists may uncover yet other distinct evolutionary lines of life. □

Planetoid between Saturn and Uranus

It's almost certainly not a comet. It would be misleading to call it an asteroid. Nor is it a moon in orbit around a planet. But whatever it is, it's out there circling the sun between the orbits of Saturn and Uranus.

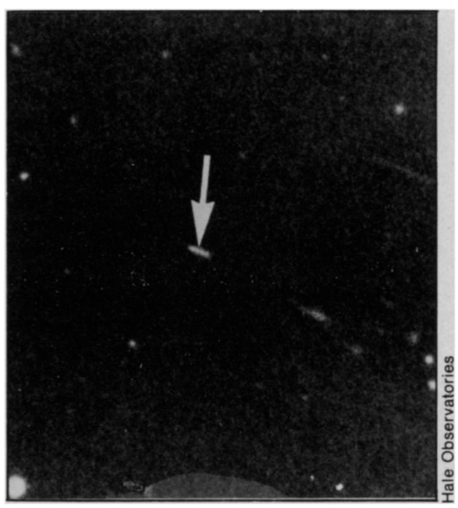
It was discovered by Hale Observatories astronomer Charles Kowal, who has been credited in the past with discoveries ranging from supernovae to the 13th and possible 14th moons of Jupiter. He first spotted the object in a photographic plate taken on Oct. 18 with the 48-inch Schmidt telescope on Palomar Mountain, then found it again in a plate from Oct. 19. Next it was located by University of Arizona astronomer Tom Gehrels, looking back at plates made on Oct. 11 and 12, after which California Institute of Technology graduate student Richard Green photographed it on Nov. 3 and 4.

The combined observations span a period of less than three weeks, making it difficult to be certain of the orbital elements (although at magnitude 18 or 19, says Kowal, the object is bright enough that it should be relatively easy to find in past plates). However, Kowal says, the object seems to take from 60 to 120 years to circle the sun, in a circular or slightly eccentric path with an inclination of 3 to 5 degrees. Its brightness implies that, if it has a surface like that of earth's moon, it is about 300 miles across, Kowal says; a darker surface like a carbonaceous chondrite would mean that it is larger, while an icy, more reflective surface would make it smaller. Photometric observations are likely to be made in the near future.

The object's image on the plates is too sharp, and its orbit too shallowly inclined, for it to be a comet. It should not be considered an asteroid, according to Kowal, since that implies a location between Mars and Jupiter and perhaps restricts the list of source mechanisms.

But what is one to call it? A planetoid? "That would be a nice name for it," says Kowal, "if only we could revive it." □

"Object-Kowal"—but what is it really?



Hale Observatories