

## **Kill the Prokaryote! (by Michelle Furlong, Clayton State University)**

The act of using the terms prokaryote and eukaryote is one of the most fundamental dichotomies in the biological sciences; however, the use of the term prokaryote has caused some controversy in recent years. Was this term ever relevant? Should scientists continue to use this term when it does not accurately define what we currently know about the evolutionary history of life? Let's take a closer look at the history and controversy of the term prokaryote.

The first documented use of the terms "procaryote" and "eucaryote" are believed to be from Edouard Chatton in 1937 where he referred to these as the "singular prescience". Prior to the introduction of the term prokaryote the term monera was used to describe the bacteria. Archaea had yet to be discovered, thus the terms monera and prokaryote simply referred to cells without organelles or bacteria and blue-green algae. The terms appear to be neglected from the literature until 1962 when Roger Stanier and C.B. van Niel published *The Concept of a Bacterium*. This paper was an attempt to make some sense of a group of organisms that "cannot be readily and satisfactorily defined in biological terms." After this publication the terms became universally accepted by biologists and quickly entrenched in biologists minds.

The term prokaryote had a false assumption in that considered the prokaryotes a monophyletic group. At the time in which the term was assigned there was no clear evidence that prokaryotic cells were indeed polyphyletic. In 1977 Carl Woese, George Fox, Ralph Wolf, and William Balch discovered the archaeobacteria. Woese pioneered the use of the rRNA genes and constructed the tree of life, which showed three lines of decent and thus proving that the prokaryotes were not monophyletic. In 1990 Woese referred to these three lines of decent as the three domains of life; eubacteria, archaea and the eukarya. Woese argued the prokaryote/eukaryote dichotomy, 'Can you understand why I have such distaste for the prokaryote-eukaryote dichotomy? This is not the unifying principle that we all once believed it to be. Quite the opposite: it is a wall, not a bridge. ..Biological thinking, teaching, experimentation, and funding have all been structured in a false and counterproductive and dichotomous way.' Despite this the terms prokaryote and eukaryote continued to appear in biological literature.

Should we continue to use the term prokaryote? This question continues to be debated heavily. Biologists who are in favor of retiring the term have many good reasons. The most obvious reason is that the term assumes that prokaryotes are actually monophyletic, which is well documented to be false. The second reason is that it assumes that prokaryotes gave rise to eukaryotes, which contradicts our current understanding of the tree of life. Another reason is that the definition as stated--*organisms containing no nucleus*-- is negative. It tells you what these cells are not, but does not attempt to provide any description of what these cells have in common. Finally, the term is not based on scientific results, but simply antiquated speculation. Biologists in favor of using it suggest that it is still a convenient way to classify the bacteria and archaea since they are united in some sense by their tiny size and lack of a nuclear membrane. Recently Norman Pace from the University of Colorado has called on all microbiologists to stop using the term in 2009 stating that, 'The retirement of prokaryote from the lexicon of biology will be slow because it is now so deeply entrenched. Consequently, that retirement process needs to be catalysed. Microbiologists are in the best position to understand the issues and to participate in modernization. This is because their organisms span the three domains, and the phylogenetic perspective is referentially necessary and an obvious utility...One catalytic step that any microbiologist can contribute, however, is simply to stop using the term 'prokaryote'. It will be interesting to observe how this challenge is addressed in future microbiology textbooks.

### References:

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