

Pace Answer to Whitman

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At issue, here, is the scientific validity of the procaryote concept. Professor Whitman embraces the term and concept of procaryote that was introduced into microbiology by R.Y. Stanier and his colleagues in the early 1960s. The procaryote concept was a specific hypothesis that postulated: (1) there are fundamentally two kinds of cells, procaryotes and eucaryotes; and (2) procaryotes are defined by their particular cellular organization, one distinct from that of eucaryotes. Professor Whitman believes that the Stanier definition needs to be modernized, more specific in the definition of "procaryote." His "modern concept" of procaryote includes two phylogenetic groups of organisms, bacteria and archaea, because both lack the eucaryotic cell structure.

The procaryote hypothesis, with no specific definition of procaryote and no experimental test, was incorporated into the common wisdom of biology. When the experimental test came, with the discovery of archaea in 1977, the validity of the procaryote hypothesis was disproved. "Procaryotes" were determined molecularly to consist of two kinds of organisms, the traditional bacteria (taxon Bacteria) and archaea (formally, Archaea), which are not specifically related. Eucaryotes (Eucarya) constitute a monophyletic group, but there is no phylogenetic grouping that corresponds to procaryotes. Moreover, it was discovered that bacteria and archaea do not share the same cellular organization, when looked at more carefully in the light of the molecular evidence.

Professor Whitman's rationale for the grouping of non-eucaryotes, his defense of procaryote, is not convincing. Indeed, he is forced to conclude that: "... examination of the distinct and shared characters between the Archaea and Bacteria provides

compelling evidence for two domains.” That is true. Then why try to conflate them conceptually?

Professor Whitman stumbles in his use of the rRNA tree of life to illustrate his modern concept of procaryote. He shows an unrooted three-domain tree, and brackets Bacteria and Archaea to illustrate his taxon procaryote. But he omits the root of the tree, which lies on the line that separates the bacterial line of descent from that which led to archaea and eucaryotes. The root of the tree fundamentally separates Bacteria from Archaea. There is no natural grouping that corresponds to the term procaryote.

Professor Whitman admits this: “The procaryotic classification could also be criticized because it is paraphyletic [sic], but this objection is not substantive if the identification of monophyletic groups is not a major goal of the classification.”

But the identification of monophyletic groups is a main goal of scientific classification and the results should capture the patterns of evolution. With his admission that his procaryote is a polyphyletic (not “paraphyletic”) group, Professor Whitman flies in the face of Darwin (“Our classifications will come to be, as far as they can be so made, genealogies.”[1]) and even Stanier who, with colleagues Douderoff and Adelberg, espoused “...grouping living organisms in the manner which expresses best the degree of their evolutionary relatedness.” (2)

The key point here, one often missed in debates about the procaryote concept, is that as scientists we do not have the luxury of making a classification based on arbitrary criteria. A conceptually sound classification scheme should smoothly converge as more data accumulate, because the data do not, and cannot, undermine the scientific principle that underlies a valid scheme. One hallmark of a capricious classification scheme is that it will be “high-maintenance”, sometimes requiring radical readjustment and uprooting as the underlying assumptions turn out to be contradicted by the data. Fortunately, in biology there is one, and only one, relationship that has been uniquely

defined over the last four billion years -- the evolutionary relationships between organisms. The procaryote concept is discredited by the evolutionary data.

Professor Whitman's proposal of a modern concept of procaryote has all the hallmarks of a "high maintenance" classification scheme, and his essay clearly indicates the way in which the procaryote concept needs to be continually extended to keep pace with scientific discovery. Yet at the same time the concept fails to make testable scientific predictions.

Professor Whitman does not explain what is the goal of his defense of procaryote. Why promote bad phylogeny and the concomitantly flawed grouping? Why try to resurrect a disproved hypothesis? How can such a muddled concept contribute to progress toward better understanding biology? As biology becomes a science in the true meaning of the word, it must become self-conscious of the structure of the theoretical foundation that can unify our understanding. Only in this way will biology ever become more than a disconnected collection of facts, such as the purported characteristics of procaryote that Professor Whitman has laid out for us. Our scientific understanding of the deepest genealogy of life has advanced greatly over the past three decades of molecular discovery. The concept of procaryote, traditional or "modern," denies that progress.

Professor Whitman's "modern procaryote" concept needs to be rejected because, rather than clarifying the issue, it confuses it further. The original procaryote at least was a testable scientific hypothesis, even though upon test it proved false. Professor Whitman's "modern procaryote" seems to me not only false because it is based upon the original false assertion, but also because it is mushy to the point of being untestable. Procaryote is a "high-maintenance" concept with no useful predictive value.

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References

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