

Paper 2 Review

A Kuhnian Analysis of Paradigm Shift in Recent Biological Taxonomy

In his 1962 book¹ *The Structure of Scientific Revolutions*, Thomas Kuhn challenged the previously held notion that scientific progress is a gradual continuum. Kuhn instead suggested that scientific progress is based on a structure of a shared set of beliefs assumed to be true in specific scientific field², known as a paradigm, and the manner in which these paradigms are formed, built upon, or overturned for the creation of new paradigms. Sherrie Lyon's article "Thomas Kuhn Is Alive and Well: the evolutionary relationships of simple life forms—a paradigm under siege?" explores how Kuhn's ideas of paradigms can be applied to the recent dilemma in biology about whether there are two or three primary types of life forms (prokaryotes, eukaryotes, and possibly archaeobacteria). Kuhn's structure of scientific process can be used to examine this controversy by looking at how the formerly held paradigm that there are two fundamental life forms is being overturned and replaced by the new paradigm that archaeobacteria is also a fundamental life form, and the implications this may have for the scientific community.

Lyon describes Kuhn's idea of a paradigm as a "set of shared beliefs and achievements by a specific group of scientific practitioners." In *The Structure of Scientific Revolutions*³, Thomas Kuhn argues that before scientific discoveries become significant, they have to be related and in agreement with a preconceived notion. Scientists want to solve an old paradigm, not start a new one. There is first

¹ This sounds oddly worded.

² "...in a specific scientific field," or "in specific scientific fields,"

³ Italicize "The Structure of Scientific Revolutions"

a “pre-paradigmatic” stage, which is basically random fact gathering, in which scientists are unsure of what information and discoveries are significant and which should be disregarded. Then, once enough information is assembled and accepted as true by the scientific community, the paradigm is established. Fundamental principles of a field becomes⁴ fixed, and scientists focus on problems in⁵ which they know have a definite solution. If enough anomalies are found, the current paradigm is challenged, what Kuhn calls revolutionary science⁶, and it is either flexible enough to survive or a new paradigm is established in its place.

Sherrie Lyons applies Kuhn’s idea of paradigms to the modern debate over whether there are two or three fundamental groups of living organisms. She describes a scientific paradigm that originated by the beginning of the twentieth century: that the every⁷ living organism could be divided into two fundamentally different groups, eukaryotes and prokaryotes. Eukaryotes were defined as such by the fact⁸ that they possessed a distinct membrane bound⁹ nucleus. Rather than being defined by shared qualities, prokaryotes were defined by their lack of certain characteristics. The relationship between different prokaryotes and their shared qualities were not yet known, and until the late 1950s and 1960s, when the field of molecular evolution was born¹⁰, the classification of prokaryotes was still in a “preparadigmatic stage.”

⁴ Remove the “s” in becomes

⁵ Remove “in”

⁶ Add quotation marks around “revolutionary science”

⁷ What do you mean by “that the every?”

⁸ “...as such by the fact that they” is extremely wordy; try removing all the conjunctures and get to your point faster

⁹ Add a hyphen between “membrane” and “bound”

¹⁰ Using “born” here is not the best word choice

By the 1980s, Carl Woese and his coworkers suggested another fundamental division of organisms: archaeobacteria. They discovered that this group of “archaeobacteria” were no more closely related to prokaryotes than eukaryotes, and they established several fundamental differences between archaeobacteria and prokaryotes, such as the environments they are found in, their evolution rates, and metabolisms. Woese argued that since archaeobacteria are a distinct group with a separate, individual line of descent from their ancestors, they should be classified as a distinct fundamental group. This became the prevailing paradigm, overturning the past paradigm that there were only two fundamental groups.

In the 1990s, however, Radney S. Gupta, a biochemist, came up with significant evidence to challenge Woese’s paradigm, and suggest¹¹ a reversion to the previously held notion of two basic divisions among organisms. Gupta discovered a deletion in a sequence of gram-positive bacteria that did not hold with Woese’s findings. Gupta upheld Woese’s finding that archaeobacteria and eubacteria are different, but found a close evolutionary relationship between archaeobacteria and gram-positive bacteria. This led Gupta to suggest a new classification: there is a great distinction between prokaryotes and eukaryotes so they are still the basic building blocks of taxonomy. Within the prokaryotes there are two subdivisions based on the relationships between the prokaryotes and their environment: “monoderms”(archaeobacteria and gram-positive bacteria, which only have one membrane), and “diderms” (gram-negative bacteria, which has two different membranes). Gupta’s findings suggest that the old paradigm might not necessarily

¹¹ suggested

be overturned but that it may be flexible enough to survive to fit new found data.

Sherrie Lyons asserts that “if one accepts Gupta’s interpretation, then the three-domain hypothesis cannot be correct.” She says that the findings of Gupta and Woese cannot coexist and that one paradigm or another must be overturned. But has any paradigm necessarily been overturned? The original paradigm established at the advent of microscopy simply defined eukaryotes, and left the group of prokaryotes still in the “pre-paradigmatic” stage. If this group was still in the preparadigmatic stage, can a paradigm truly be overturned? Much of Gupta’s research drew upon or elaborated on Woese’s work, and confirmed that archaebacteria was fundamentally different from other types of prokaryotes. Lyons says that “to return to a classification that only recognizes two domains would be a major setback in the understanding of both the prokaryotic world and the role that microorganisms play in the history of life,” but at the moment it is inconclusive how many fundamentally different types of prokaryotes there are, but they still can be grouped together by the fact that they are not eukaryotes. Modern scientists are still in the process of classifying and defining them, but putting them under an umbrella term does not dampen our understanding of them or their fundamental differences and roles in evolution and the environment.

Review Summary

The entire paper seems to build up for a very in-depth analysis, however, proved to be highly anticlimactic. Most of the paper is dealing with everyone else's theory but lacks the reasoning a title such as *A Kuhnian Analysis of Paradigm Shift in Recent Biological Taxonomy* might warrant. The thesis was to show how Lyons analyzes whether or not Kuhn's idea identifies a paradigmatic shift in this debate about archaeobacteria. Your second paragraph deals mostly with explaining Kuhn's idea of how paradigms develop. The fourth and fifth paragraphs of the paper, which combined take up one of the three and a half pages of your paper, deals with explaining the Woese and Gupta. In total, more than half of your paper does into deal with Lyons in the slightest. There is only one paragraph at the end which lightly brushes on this idea of Lyons's which loosely combines the research of Gupta and Woese.

I think spending more time with actually explaining Lyons's analysis of the dispute about fundamental life forms would help your paper stay focused to the thesis. It seems to be tying in a lot of conclusions into a few sentences. These ideas could be developed into a nicely-concluded paper. Try narrowing down the parts about Gupta and Woese and expand on the ideas of Lyons.

I also noticed that there seems to be something wrong with the paper's structure. Either the margins are more than one inch from the right or the file distorted itself once it was saved as a PDF.