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# Defining a Discipline: George Gaylord Simpson and the Invention of Modern Paleontology

William S. Kearney  
[wkearn@sas.upenn.edu](mailto:wkearn@sas.upenn.edu)

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# Defining a Discipline: George Gaylord Simpson and the Invention of Modern Paleontology

## **Abstract**

Kearney studies how the paleontologist George Gaylord Simpson worked to define his own field of evolutionary paleontology.

## Defining a Discipline

### George Gaylord Simpson and the Invention of Modern Paleontology

William S. Kearney

The synthesis of Darwinian evolution by natural selection and Mendelian genetics was the crowning achievement of early 20<sup>th</sup> century biology. It gave an underlying theoretical basis for every major field of biology from molecular biology to zoology to community ecology. And by no means was the synthesis the work of one man. American, British, German and Russian geneticists, naturalists, and mathematicians all provided major theoretical contributions to the synthesis. But in paleontology it was a different story. One man, George Gaylord Simpson, in one book, *Tempo and Mode in Evolution*, effectively synthesized evolutionary biology and paleontology. While Simpson's theories have been criticized and in some cases rejected since the publication of *Tempo and Mode* in 1944, he was, in evolutionary terms, a bottleneck in the study of evolutionary paleontology. Nearly all evolutionary paleontologists after Simpson, including Stephen Jay Gould, Niles Eldredge and Philip Gingerich, owed the theoretical underpinnings of their discipline to Simpson. Gould and Eldredge took their indebtedness further by proposing their theory of punctuated equilibria, a related version of which, quantum evolution, had been proposed by Simpson in *Tempo and Mode*. In the process of making paleontology a force to be reckoned with in the study of evolution, Simpson carved out a disciplinary identity firmly based in the history of paleontology.

The incorporation of paleontology into the modern synthesis before Simpson was hampered by two major problems, both a result of the historical circumstances of the development of the science. Biostratigraphy dominated the science of paleontology for the one-and-a-half centuries since William

Smith first used fossils to correlate strata in his geological map of Britain.<sup>1</sup> Biostratigraphy emphasizes the horizontal divisions between layers of fossils in order to determine the relative positions – and thus the ages – of those divisions.<sup>2</sup> The study and identification of strata through fossils is economically important for coal and other mineral extraction and for the petroleum industry, which Simpson noted had seen the creation of “a subsience of micropaleontology, rather oddly distinguished by the fact that the fossils it studies are smaller and can more often be recovered from oil wells.”<sup>3</sup> The problem with biostratigraphy is that it requires no recourse to an evolutionary explanation of its findings. Adam Sedgwick and Roderick Murchison were essentially doing biostratigraphy during the early 19<sup>th</sup> century, and Sedgwick was a strident opponent of Darwin's theory of natural selection.<sup>4</sup> It was, and still is, possible to study biostratigraphy without accepting evolution because the correlation of various strata bases its interpretations of the presence of different “morphospecies,” “defined as any group of fossils which differ morphologically from other fossils in the same genus” rather than other definitions of species, such as two populations that do not interbreed, that neontologists, biologists who are not paleontologists, use.<sup>5</sup> Since paleontology had relied so heavily on this purely descriptive, non-evolutionary subfield for so much of its existence, paleontology lagged behind the rest of the biological sciences in both the modern evolutionary synthesis and the acceptance of the synthesis among practitioners: Keith Young, writing in 1960, said that “Only recently have Darwinian concepts been completely accepted by most paleontologists.”<sup>6</sup>

The other impediment to a paleontological synthesis was that paleontology did not fit into standard divisions of scientific disciplines into biological and physical sciences. Alfred Romer wrote an

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1 Keith Young, “Biostratigraphy and the New Paleontology,” *Journal of Paleontology* 34, no. 2 (March 1, 1960): 347.

2 *Ibid.*, 350.

3 George Gaylord Simpson, *Life of the Past; an Introduction to Paleontology* (New Haven: Yale University Press, 1953), 33.

4 James Secord, *Controversy in Victorian Geology: The Cambrian-Silurian Dispute* (Princeton, New Jersey: Princeton University Press, 1986), 228-229.

5 Young, “Biostratigraphy and the New Paleontology,” 351.

6 *Ibid.*, 347.

extended letter to Simpson early in both men's careers detailing the complications that paleontology's precarious position would entail for the applicant to Romer's former position in the University of Chicago's Department of Geology. The department head, Edson Sunderland Bastin was a traditional geologist who objected to Romer's attempts to carve out an independent identity for paleontology centered on the Walker Museum and linked to both the Divisions of Biological Sciences and Physical Sciences. This tense atmosphere had already driven Georg Baur and S.W. Williston away before eventually causing Romer to leave for greener pastures at Harvard.<sup>7</sup> The position of paleontology within geology departments is undoubtedly related to its origins in biostratigraphy and economic biostratigraphy in particular. Geology departments were responsible, in Romer's words, to train students to become professional geologists, and the paleontologist's job was "the teaching of the vertebrates to graduate students who are going into geology from the point of view of historical geology."<sup>8</sup> In such a situation, collaboration between paleontologists within geology departments and the wider community of geneticists and other evolutionists stalled. Simpson's synthesis recognized that "Paleontologists operate between two other sciences...they are more than a bit of each plus something distinct from the other."<sup>9</sup> That paleontologists, with their unique disciplinary history and training in multiple scientific traditions, had something important to contribute to the theory of evolutionary biology was, more so than any of Simpson's actual theories, the key scientific achievement of the Simpsonian synthesis.

Yet Simpson's science cannot be downplayed. While the majority of paleontologists were of the biostratigraphical persuasion and "either professed no interest in evolution at all or else worked with outdated biological concepts," Simpson was not working within a field entirely cut off from

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7 Alfred Sherwood Romer, letter to George Gaylord Simpson, 16 July 1934, George Gaylord Simpson Papers, American Philosophical Society (Philadelphia, Pennsylvania).

8 Ibid.

9 Simpson, *Life of the Past; an Introduction to Paleontology*, 20.

evolutionary theory. There were two major pre-Simpsonian evolutionary paleontologists.<sup>10</sup> The German Schindewolf had used the mutation theory of Hugo de Vries to explain the ever-present gaps in the fossil record. More importantly for Simpson's work, the American Henry Fairfield Osborn had created his own theory called orthogenesis, which posited that there was an intrinsic force driving evolution forward to more advanced forms. The oft-cited example, specifically relevant to Simpson, who spent a good portion of his professional career studying Mesozoic and early Cenozoic mammals, is the evolution of the horse foot from three toes to one.<sup>11</sup> The internally directed macroevolution of orthogenesis is, however, not consistent with the microevolutionary population genetics of Fisher, Wright, and Haldane who believed in external selective pressures slowly driving evolution along.

Simpson realized this problem, and so in *Tempo and Mode* he framed what Gould called “a consistency argument” maintaining that evidence of macroevolution in the fossil record is consistent with genetic principles.<sup>12</sup> First, Simpson proposed the existence of three different tempos of evolution, bradytelic, horotelic, and tachytelic which correspond, respectively, to extremely slow rates of change (as in the tuatara, a New Zealand lizard that has essentially not evolved since the Triassic<sup>13</sup>), rates of change previously associated with orthogenetic evolution, and extremely fast rates of evolution. Then Simpson developed three modes of evolution related to but not defined by the tempos previously identified. “Speciation” is basically identical to Ernst Mayr's speciation that occurs when two populations become reproductively isolated. “Phyletic” evolution is caused by the “sustained, directional (but not necessarily rectilinear) shift of the average characters of population.”<sup>14</sup> Since the majority of paleontological evidence shows signs of phyletic evolution, Simpson states that certain

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10 Stephen Jay Gould, “G.G. Simpson, Paleontology, and the Modern Synthesis,” in *The Evolutionary Synthesis: Perspectives on the Unification of Biology*, eds. Ernst Mayr and Will Provine (Cambridge, Mass: Harvard University Press, 1980), 155-156.

11 George Gaylord Simpson, *Tempo and Mode in Evolution*, Columbia biological series no. 15 (New York: Columbia University Press, 1944), 161.

12 Gould, “G.G Simpson,” 161.

13 Simpson, *Tempo and Mode in Evolution*, 125.

14 *Ibid.*, 202.

paleontologists such as Osborn were led to believe that all evolution is phyletic.<sup>15</sup> Simpson's own pet theory, which he acknowledged as the most controversial of the three, was quantum evolution.<sup>16</sup> In quantum evolution, genetic drift randomly pulls a population out of equilibrium. When the population falls back into equilibrium, it can either fall back towards its ancestral adaptive zone or to a new one. When it falls to the new one, an extremely quick jump between species occurs in the fossil record.<sup>17</sup> The presence of gaps in the fossil record, which Schindewolf had explained by saltation, Simpson solved with his theory of quantum evolution. The theory fit so well with Sewall Wright's theory of genetic drift that Wright was inclined to dismiss it as simply a "natural deduction from genetic principles."<sup>18</sup> But as it was a theory consistent with genetic evidence but based on paleontological evidence, it served to ally the field of paleontology to existing fields of evolutionary theory.

Joining two fields in such a way could lead to the absorption of the newer and smaller one by its larger and better established companion, especially if, as Sewall Wright believed, paleontological evidence merely confirmed what geneticists already knew. Gould eventually concluded that "Simpson bought unity at the price of independence."<sup>19</sup> But Simpson invented a clever explanation of paleontology that, when read against what we might call the non-scientific aspects of his work, plays an instrumental role in defining the discipline. He invents a distinction between historical and nonhistorical events. In the field of chemistry, a historical event would be one specific reaction performed at one time by Lavoisier. It has a meaning within a specific time and location. A nonhistorical event would be the abstract concept of the reaction itself. It has always been and will always be the same reaction. In geology, nonhistorical events are like the process of weathering while the actual existence of the Grand Canyon is historical.<sup>20</sup> Geology and paleontology primarily use these

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15 Ibid., 203.

16 Sewall Wright, "Review: Tempo and Mode in Evolution: A Critical Review," *Ecology* 26, no. 4 (October 1, 1945): 419.

17 Simpson, *Tempo and Mode in Evolution*, 206.

18 Wright, "Review," 415.

19 Gould, "G.G Simpson," 170.

20 George Gaylord Simpson, "Historical Science," in Geological Society of America, *The Fabric of Geology* ed. Claude C.

historical events as their evidence for any kind of theorizing. They both attempt to explain the history of the Earth and of life on Earth. Paleontology and other natural sciences that rely heavily on description are historical in more than this sense, though, as the process of discovery becomes paramount. The location of fossils are found and their situations within sequences of rocks are extremely important if anything more valuable than their identity is to be determined. So the history of the discipline – of fossil finding expeditions and of theoretical contributions – is a prominent side interest of Simpson as well as other paleontologists including Gould. Some paleontologists like Martin Rudwick even turn entirely to history.

The sense of historical contingency pervades Simpson's works. In his treatise on penguins (yet another side interest he avidly pursued) Simpson begins with two chapters outlining the history of the discovery of penguins and the development of his own interest in them.<sup>21</sup> The amount of etymological and archival research that Simpson discusses in those chapters throws into doubt his deference in a letter to Rudwick in “a field where you [Rudwick] are a professional and, as historian, I am an amateur.”<sup>22</sup> More discussions with Gould involve criticism, particularly of Leonard G. Wilson's edition of *Lyell's Scientific Journals on the Species Question*, that is explicitly historical or historiographical. Simpson even goes so far to say that Wilson made “quite a few slips that I think a professional historian should have avoided.”<sup>23</sup> Two articles published by Simpson deal with the earliest paleontological discoveries in America: those of the mammoths.<sup>24</sup> All of this historical work, by demonstrating the unique development of his field as a bit of biology and geology “plus something distinct from either,” delineates Simpson's evolutionary paleontology.

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Albritton Jr. (Reading, Mass: Addison-Wesley Pub. Co, 1963).

21 George Gaylord Simpson, *Penguins: Past and Present, Here and There* (New Haven: Yale University Press, 1976), 1-40.

22 George Gaylord Simpson, letter to Martin J. S. Rudwick, 25 August 1969, George Gaylord Simpson Papers, American Philosophical Society (Philadelphia, Pennsylvania).

23 George Gaylord Simpson, letter to Stephen Jay Gould, 21 July 1971, George Gaylord Simpson Papers, American Philosophical Society (Philadelphia, Pennsylvania).

24 George Gaylord Simpson, “The Beginnings of Vertebrate Paleontology in North America,” *Proceedings of the American Philosophical Society* 86, no. 1 (1942): 130-188; George Gaylord Simpson, “The Discovery of Fossil Vertebrates in North America,” *Journal of Paleontology* 17, no. 1 (January 1, 1943): 26-38.



Simpson once claimed, again to Gould, that “I am not greatly concerned with the judgment of posterity on my reputation.”<sup>25</sup> It is fortunate that he was not, because Gould was also a master of deploying history for his own ends. Gould's revolutionary contribution to paleontology was the theory of punctuated equilibria, developed in 1972 with Niles Eldredge.<sup>26</sup> Punctuated equilibria explained the presence of long periods of stasis where fossils did not change perceptibly over time punctuated by relatively short, geologically speaking, periods of speciation. Essentially, they emphasized the speciation component of Simpson's three modes rather than quantum evolution. Whether punctuated equilibrium actually happens, whether it actually constitutes a revolutionary theoretical change in evolution and whether it provides a concrete basis for future experimental programs is debatable<sup>27</sup> and not particularly important, for Gould would have answered all of these questions in the affirmative. So Gould sets about delineating paleontology with punctuated equilibria from genetics along the micro-/macro- split. Simpson had unified paleontology with evolution “at the price of admitting that no fundamental theory can arise from the study of major events and patterns in the history of life.”<sup>28</sup> For Gould, paleontology works on a different hierarchy of life than microevolution, and microevolutionary processes cannot be extrapolated, like Simpson had done with genetic drift, to explain the diversity of life. Gould claims that Simpson's work was necessary “at its moment in history” but that it ultimately may lead paleontology into stasis.<sup>29</sup> Needless to say, as Simpson was still alive in declining health at this point in his life, he did not react well to Gould's claims. The two eventually fell out in their correspondence, largely because Simpson believed that Gould was forgetting the actual history of his discipline in claiming that punctuated equilibrium is a revolutionary new theory separated from its

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25 George Gaylord Simpson, letter to Stephen Jay Gould, 27 September 1974, George Gaylord Simpson Papers, American Philosophical Society (Philadelphia, Pennsylvania).

26 Niles Eldredge and Stephen Jay Gould, “Punctuated Equilibria: An Alternative to Phyletic Gradualism,” in *Models in Paleobiology*, ed. T.J.M Schopf (San Francisco: Freeman Cooper, 1972), 88-115.

27 Francisco J. Ayala, “The Structure of Evolutionary Theory: on Stephen Jay Gould’s Monumental Masterpiece,” *Theology and Science* 3, no. 1 (2005): 97.

28 Gould, “G.G Simpson,” 170.

29 *Ibid.*, 169.

forefathers, Simpson and Osborn.<sup>30</sup> While Simpson is wrong – Gould readily acknowledges the influence of Simpson on the discipline<sup>31</sup> – Gould substantially revises the history and philosophy that he writes in order to validate the theory of punctuated equilibria. As some of the best revisionist histories are, Gould's is tinged with Marxism. He argues that the conflict between Osborn's orthogenesis and Simpson's expanded microevolution represent a Hegelian dialectic leading to the synthesis:: punctuated equilibrium.<sup>32</sup> His Marxist history does get a bit Whiggish at times: he identifies paleontology has happening in three stages, that of Schindewolf and Osborn, that of Simpson, and finally that of Gould and Eldredge.<sup>33</sup> While Gould does acknowledge the possibility that, “if the profession is worth anything,” there will be a fourth and fifth stage, he does portray his theory, like Simpson's legitimately was, as a bottleneck in the history of paleontology. He neglects the work of other paleontologists like Philip Gingerich, with whom Simpson had an extended and consistently cordial correspondence, as well as other evolutionary biologists like Leigh Van Valen, Nils Stenseth, and John Maynard Smith, all of whom tackled the problem of stasis and who would need to be considered at such a stage because Simpson's work had synthesized evolutionary biology and paleontology. Simpson tried to maintain an identity for paleontology through the history of the science, readily acknowledging that there was no real scientific difference between paleontology and neontology outside of that history. Gould on the other hand tried to save his discipline from amalgamation through focus on the definition of the science and a nearly exclusive emphasis on the paleontological data.

The question of identity in a discipline situated so equally between two other, well-defined, sciences, is a major concern for all of its practitioners. Simpson's answer that “they are more than a bit

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30 George Gaylord Simpson, letters to Stephen Jay Gould, 1980-1981, George Gaylord Simpson Papers, American Philosophical Society (Philadelphia, Pennsylvania).

31 Gould, “G.G. Simpson,” 169.

32 Stephen Jay Gould, “The Promise of Paleobiology as a Nomothetic, Evolutionary Discipline,” *Paleobiology* 6, no. 1 (January 1, 1980): 106.

33 Gould, “G.G. Simpson,” 170.

of each plus something distinct from either” leaves unanswered the identity of that distinct something. Simpson believed that it was the discipline's history, and since paleontology's status as a “historical science” had already primed him for that kind of research, he avidly pursued it. Gould, on the other hand, said scale was the distinction; paleontology operates on a different hierarchy from the other segments of evolutionary practice. Both are legitimate ways of self-identifying, though one seems to have been more successful than the other at least to the nonscientific public. Because of Gould's work in popular science and his staunch anti-creationism activism – both things which Simpson also participated in several years or even decades before Gould – Gould is much more well known as a paleontologist outside of scientific communities, though there are other paleontologists who may be more culturally important (Jack Horner, technical advisor to Steven Spielberg's *Jurassic Park*, comes to mind). Perhaps Simpson's lack of concern for his own historical record prevented him from so vociferously defending his theories as Gould or from organizing conferences to solidify his role like he criticized Ernst Mayr for doing.<sup>34</sup> But Simpson's role in bringing paleontology out of the descriptive doldrums and away from its economic roots cannot be underestimated. As much as Gould would have liked to have completely superseded him, Simpson is by no means just a “kiwi wing bone,” i.e. a vestige, in the history of paleontology.<sup>35</sup>

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34 Simpson, letter to Stephen Jay Gould, 27 September 1974.

35 Simpson, letter to Stephen Jay Gould, 21 July 1971.

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