

George Gaylord Simpson: empirical theoretician

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ABSTRACT

George Gaylord Simpson published some 21 books and monographs, 79 notes, and 271 research articles from 1925 through 1971. This primary literature totals 371 titles and 12,656 pages; 4,451 pages (35%) are devoted to mammals, and 2,363 pages (19%) are devoted to evolution. Simpson published primarily on Mesozoic and Paleocene mammals, but he also contributed significantly to the study of Eocene and Pleistocene mammals as well. Early work was concentrated on North American faunas, but interest later shifted to South America. Simpson published some 224 titles and 5,785 pages of empirical work, much of it during the first 20 years of his career. He published 109 titles and 6,675 pages of theoretical work. Research collections and museum support were important throughout Simpson's working life. The concentration of empirical research early in Simpson's career, with later emphasis on theoretical questions, affirms that observation and experience are important in generating ideas of lasting value.

INTRODUCTION

Physics represents what most people think science should be. When I was an undergraduate in the late nineteen-sixties, many geology departments in universities across the country changed their names, adding geophysics to their titles to reflect expansion in this direction. My department went even farther, changing its name to "Department of Geological and Geophysical Sciences"—lest anyone think that geology, even geophysics, might not be science. The extended name was a nuisance from the beginning for anyone trying to fit it on an envelope, and I suspect that many still wonder at the department's vision of itself every time they address a letter.

A little more thought about old Alma Mater is appropriate here, because adding "geophysics" and "science" to the department's name proved not to be enough. The professor of paleobotany was allowed to retire without replacement. Then a half-endowed professorship in vertebrate paleontology was allowed to lapse. Finally, last year, the department decided to give away its paleontology research collections. The department was founded by a vertebrate paleontologist and maintained an outstanding national and international reputation, indeed distinguished tradition, in vertebrate paleontology for most of a century. In discussing "de-accession" of the vertebrate collections, I and other members of an assembled advisory committee protested that the department was now making a precipitous decision precluding later participation in an important scientific endeavor—it is impossible to rebuild, once lost, the libraries and research collections necessary for quality research in vertebrate paleontology. The department responded, "Oh, we may be giving away the research collections, but we're not necessarily giving up paleontology. If we were to hire a professor of vertebrate paleontology, we would undoubtedly hire an outstanding theoretician,

one who wouldn't require research collections—someone like George Gaylord Simpson."

Simpson, architect of the modern evolutionary synthesis (with Dobzhansky, Mayr, and others), is undoubtedly one of the leading paleontologists of the twentieth century in terms of his contribution to important issues in biogeography, evolution, systematics, and other fields. But it is, I think, a misrepresentation to promote George Gaylord Simpson as a theoretical paleontologist whose genius developed independently of collection-oriented empirical research. Simpson made many collecting expeditions to Argentina, Brazil, Florida, Montana, and New Mexico, doing original field work as long as his health permitted. He wrote more than two hundred papers describing new fossils collected on these and other expeditions. Analysis of Simpson's career is warranted to better understand the role empirical research plays in generating paleontological and evolutionary theory.

SIMPSON'S RESEARCH PUBLICATIONS

Publications provide one source of information about a person's professional career. Simpson was a proficient writer, publishing some 667 titles and 19,934 pages during the years 1925 through 1971 (Table 1). All were not written alone. Simpson's highly successful biology textbook *Life: An Introduction to Biology*, for example, involved collaboration with C. S. Pittendrigh and L. H. Tiffany on the first edition, and W. S. Beck on the second. Some titles and many pages included in Simpson's bibliography are reprints and translations of work published previously. However, Simpson was the sole author of the vast majority of titles, and the principal author on virtually all the rest. His publications undoubtedly reflect both his interests and his prodigious productivity.

Simpson's professional writing was accomplished first as a graduate student in the Peabody Museum at Yale

TABLE 1. PUBLICATIONS BY GEORGE GAYLORD SIMPSON FROM 1925 TO 1971.

Genre	Titles	Pages
Abstracts	14	28
Bibliography (G.G.S.)	1	6
Books and monographs	21	7,149
Books (edited)	1	557
Books (popular)	1	295
Book reviews	148	276
Comments	6	16
Forewords	4	24
Letters	15	27
Notes	79	218
Obituaries	14	113
Popular articles	38	207
Reprinted books and articles	39	5,562
Research articles	271	5,289
Secretarial contributions	14	164
Sound recording	1	3
Totals:	667	19,934

University, then as a professional paleontologist at the American Museum of Natural History, the Museum of Comparative Zoology at Harvard, and finally at the University of Arizona. Simpson continued to write long beyond 1971, of course, but I have limited analysis of his publications to the years 1925-1971—the span of his regular working career. Simpson's bibliography through 1971, the source of information for this analysis, was published by Hecht and others (1972).

Published titles and pages do not measure the importance of a writer's work. Some subjects are more easily serialized. Some journal pages are shorter than others. Some authors have access to the large blocks of time necessary to write books and monographs, while others suffer constant interruption. It would be difficult to compare the volume of Simpson's writing to that of other paleontologists without making corrections for subject, style, and the demands of other responsibilities. The value of this exercise lies not in comparing Simpson's productivity with that of other authors, nor even in comparing early Simpson with later Simpson. My goal is rather to characterize Simpson's changing interests, and to examine the relationship of his empirical and theoretical work.

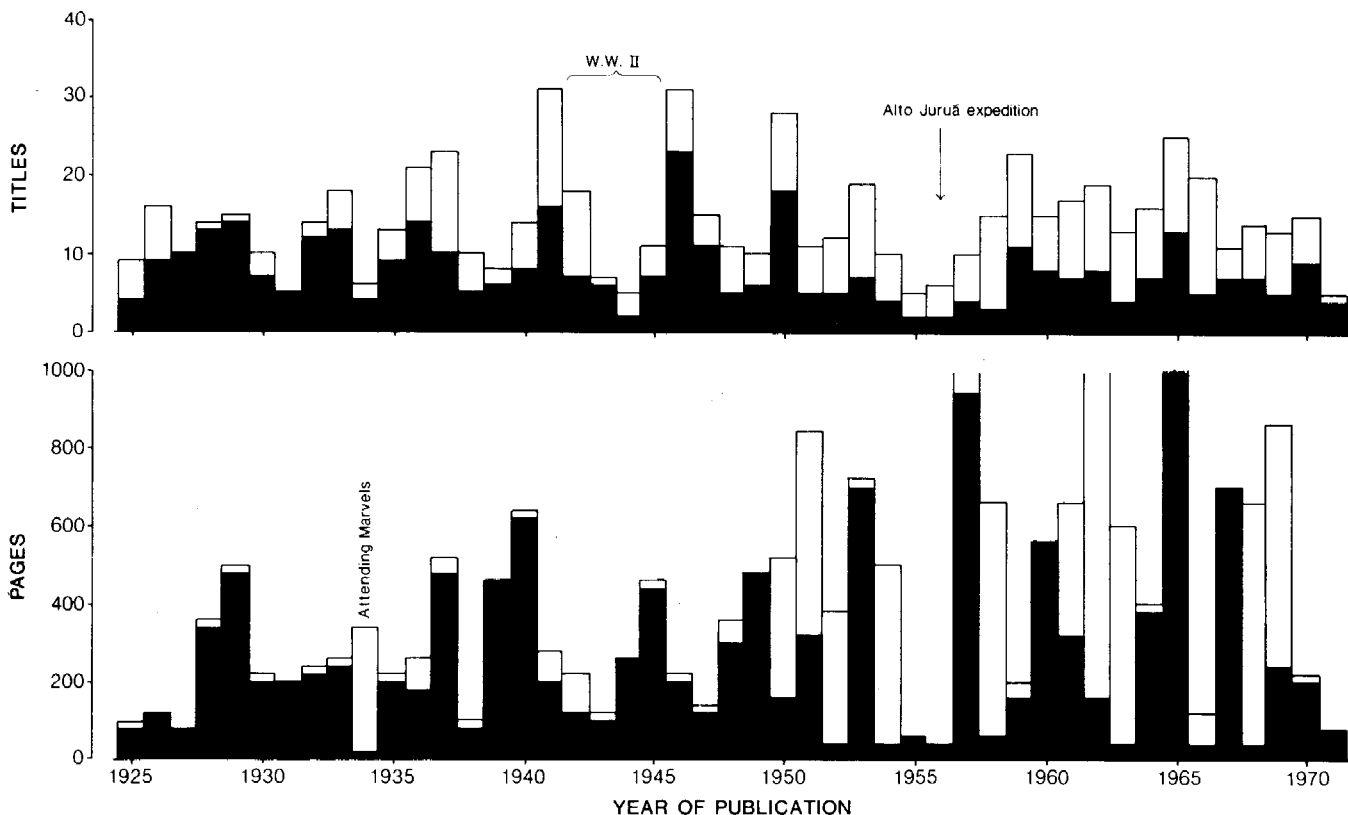


Figure 1. Titles and pages published by George Gaylord Simpson from 1925 through 1971. Open histograms represent all 667 titles and 19,934 pages, including reprints and translations, listed in Hecht and others (1972). Solid histograms are 371 titles and 12,656 pages considered here to represent primary scientific literature. Simpson served in U.S. Army during World War II, from December 3, 1942 until October 7, 1944. He was seriously injured by a falling tree, and had to be evacuated from a remote part of the Amazon Basin of Brazil during 1956 Alto Juruá expedition. *Attending Marvels* is a popular book based on Simpson's 1930-1931 expedition to Patagonia in Argentina. Karen Klitz drew this and following figures.

PRIMARY AND SECONDARY LITERATURE

The pattern of Simpson's productivity over time is shown graphically in Figure 1. The two highest peaks in published titles lie on either side of his two-year term of military service (1942-1944) during World War II. Military service itself is reflected by a low valley in published titles for these years. A second low valley occurs in 1955-1956, presumably reflecting much of a sabbatical year (1954-1955) spent in Brazil and Argentina, work on the textbook *Life*, several months of field work in Brazil in 1956, and, only incidentally, Simpson's accident on the Alto Juruá at the end of the 1956 expedition.

The most important publications listed in Table 1 are the 21 original scientific books and monographs (including substantially revised second editions), 79 notes, and 271 research articles. Also original but of lesser importance are the abstracts, a personal bibliography, an edited book, a popular book (*Attending Marvels*), numerous book reviews, several comments, four forewords in books by others, letters to editors, obituaries, popular articles (principally in *Natural History*), secretarial contributions (for the Explorer's Club and Society of Vertebrate Paleontology), and a sound recording. Reprinted books and articles include those originally published in English and translated with little modification into other languages. It is sometimes difficult to draw a line between comments, letters, and notes—shorter contributions of substantial original or summary value are here identified as notes and regarded as primary literature. Notes also include a number of brief reviews contributed to encyclopedias; these did not, in the end, fit comfortably into established analytical categories, and they might better have been listed separately from the start.

Eliminating abstracts and other secondary publications, the remaining data base includes 371 scientific books and monographs, research articles, and notes, totaling 12,656 printed pages (Table 2 and solid histograms in Fig. 1). These can be divided by subject, by geological age, by geographic location, and by theoretical content, yielding patterns offering insight into the course of Simpson's research career.

MAMMALS AND EVOLUTION

Simpson is most widely known for his work on evolution. As shown in Table 2, 47 of his 371 primary publications (13%), and 2,363 of 12,656 printed pages (19%) were devoted to evolution. For comparison, 198 primary publications (53%) and 4,451 printed pages (35%) were devoted to the morphology and systematics of living and fossil mammals, roughly twice the number of titles and pages devoted to evolution. The large number of pages published on general biology reflects two editions of the textbook *Life*. In terms of published pages, biogeography, quantitative methods, and systematics appear to have been next most important to Simpson.

Figure 2 illustrates the temporal pattern of Simpson's work on mammals (solid histograms) and evolution (shaded areas). Work on the morphology and systematics

TABLE 2. PRIMARY PUBLICATIONS BY GEORGE GAYLORD SIMPSON, 1925-1971, ORGANIZED BY SUBJECT.

Subject	Titles	Pages
Amphibians	1	2
Biogeography	17	621
Biology (general)	8	1,812
Biostratigraphy	13	137
Birds (penguins)	8	201
Ethnography	2	477
Evolution	47	2,363
Exploration	1	2
Faunas	1	11
Fishes	1	6
General (misc.)	9	80
Geology	3	82
History of paleontology	7	122
Mammals	198	4,451
Paleontology (general)	4	219
Philosophy	11	104
Quantitative methods	7	900
Reptiles	14	181
Systematics (general)	15	823
Techniques	1	6
Variation	3	56
Totals:	371	12,656

of living and fossil mammals dominated the first fifteen years of his professional career. Simpson's book *Quantitative Zoology*, with Anne Roe, was published in 1939, and his book-length ethnographic monograph, *Los Indios Kamarakotos*, was published in 1940. Publication on evolution began with a 1941 article on the role of the individual, followed by Simpson's classic *Tempo and Mode in Evolution*, completed in 1942 and published in 1944. *Principles of Classification and a Classification of Mammals* was also completed in 1942, but publication was delayed until 1945. This work is certainly evolutionary in perspective, but more strictly systematic than evolutionary in subject; hence it is not shaded in Figure 2. Other publications on evolution include *The Meaning of Evolution* (1949), *The Major Features of Evolution* (1953), *This View of Life* (1964), a revised edition of *The Meaning of Evolution* (1967), and *Biology and Man* (1969). *This View of Life* and *Biology and Man* are (largely) collections of previously published essays on evolution, and arguably they could have been classified as secondary reprints.

MESOZOIC AND CENOZOIC MAMMALS

Simpson is best known for his work on Mesozoic and early Cenozoic mammals. He published 37 titles and 902 pages on Mesozoic mammals, 38 titles and 1,384 pages on Paleocene mammals, and 32 titles and 561 pages on Eocene mammals (Table 3). Simpson published extensive-

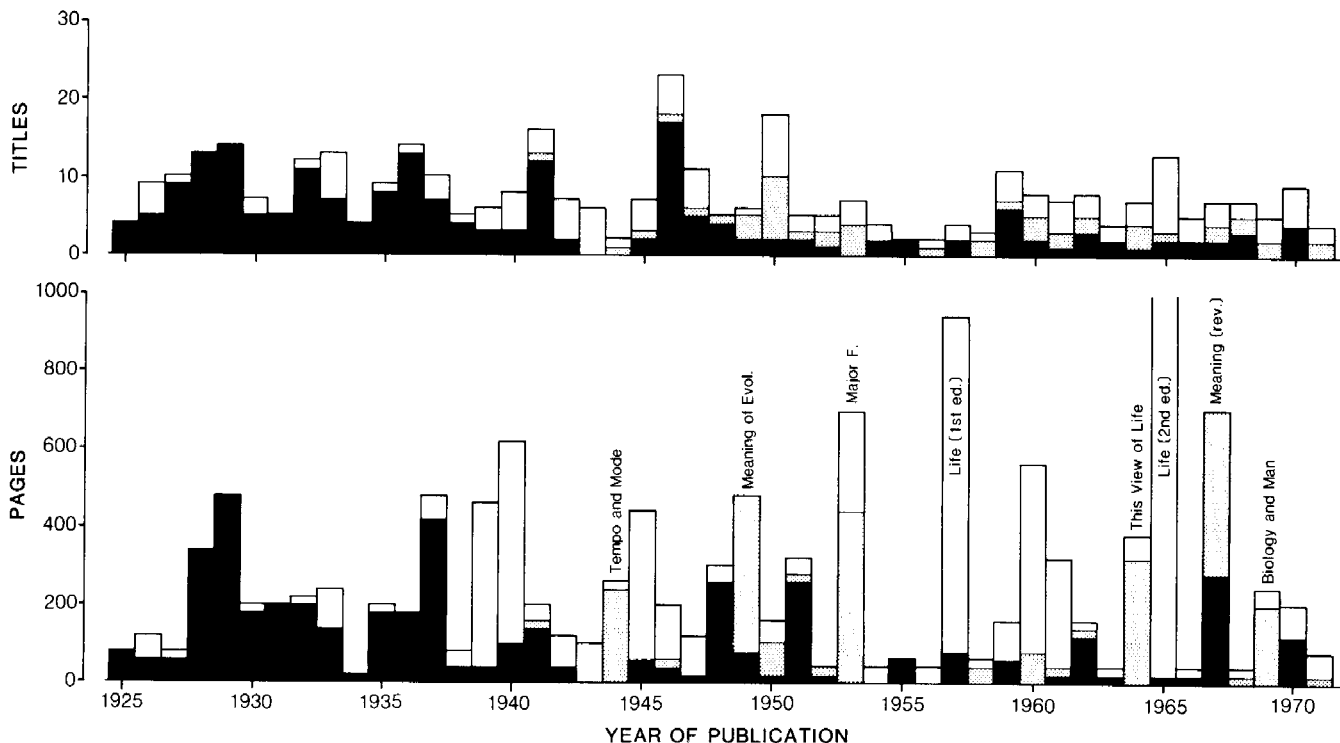


Figure 2. Titles and pages on mammals (solid histograms) and evolution (shaded areas) published by George Gaylord Simpson from 1925 through 1971, outlined against a silhouette of all primary literature published during this interval. Titles of books on evolution and two editions of textbook *Life: An Introduction to Biology* also are shown.

TABLE 3. PRIMARY PUBLICATIONS ON MAMMALS BY GEORGE GAYLORD SIMPSON, 1925-1971, ORGANIZED BY AGE .

Age	Titles	Pages
Recent	3	32
Pleistocene	19	583
Pliocene	1	4
Miocene	5	137
Oligocene	14	200
Eocene	32	561
Paleocene	38	1,384
Mesozoic	37	902
Totals:	149	3,803

in 1928. By the end of 1928 Simpson could claim to have studied all of the Mesozoic mammals known at the time. This early emphasis shows up clearly in Figure 3, where Mesozoic mammals dominate Simpson's first five years of publication.

Simpson began work at the American Museum in 1927 and initiated work on Paleocene mammals immediately, describing Barnum Brown's small Paskapoo fauna in 1927, and the Bear Creek fauna in 1928 and 1929. Simpson's major paper of 1929 was a revision of Paleocene multituberculates published with Walter Granger. He initiated field work in the early Paleocene of New Mexico in 1929. Simultaneously, Simpson worked on late Tertiary and Pleistocene mammals of Florida. Field work in Patagonia (Argentina) began in 1930 to clarify the beginning of the age of mammals in South America. Two monographs on South American Paleocene (and Eocene) faunas were eventually published in 1948 and 1967.

In 1932 Simpson was asked to write a monograph on the U.S. National Museum collection of Paleocene mammals from the Crazy Mountain Field in Montana, and the summers of 1932 and 1935 were spent in the field in Montana. In connection with this work, Simpson published a three-part revision of the type Tiffanian land-mammal age (late Paleocene) fauna based on American Museum collections from Colorado.

Simpson's Eocene research was never so clearly focused. He published an 87-page study on the Eocene

ly on Pleistocene mammals, but relatively little on those of the Oligocene, Miocene, and Pliocene.

Simpson's doctoral dissertation on American Mesozoic mammals was completed in 1926, and a revised version was published in 1929. Simpson was given access to Mesozoic mammals collected by the American Museum's Central Asiatic Expeditions (published in part with W. K. Gregory in 1926), and he spent the academic year 1926-1927 in London studying European and African specimens in the British Museum of Natural History, publishing a monograph on British Museum specimens

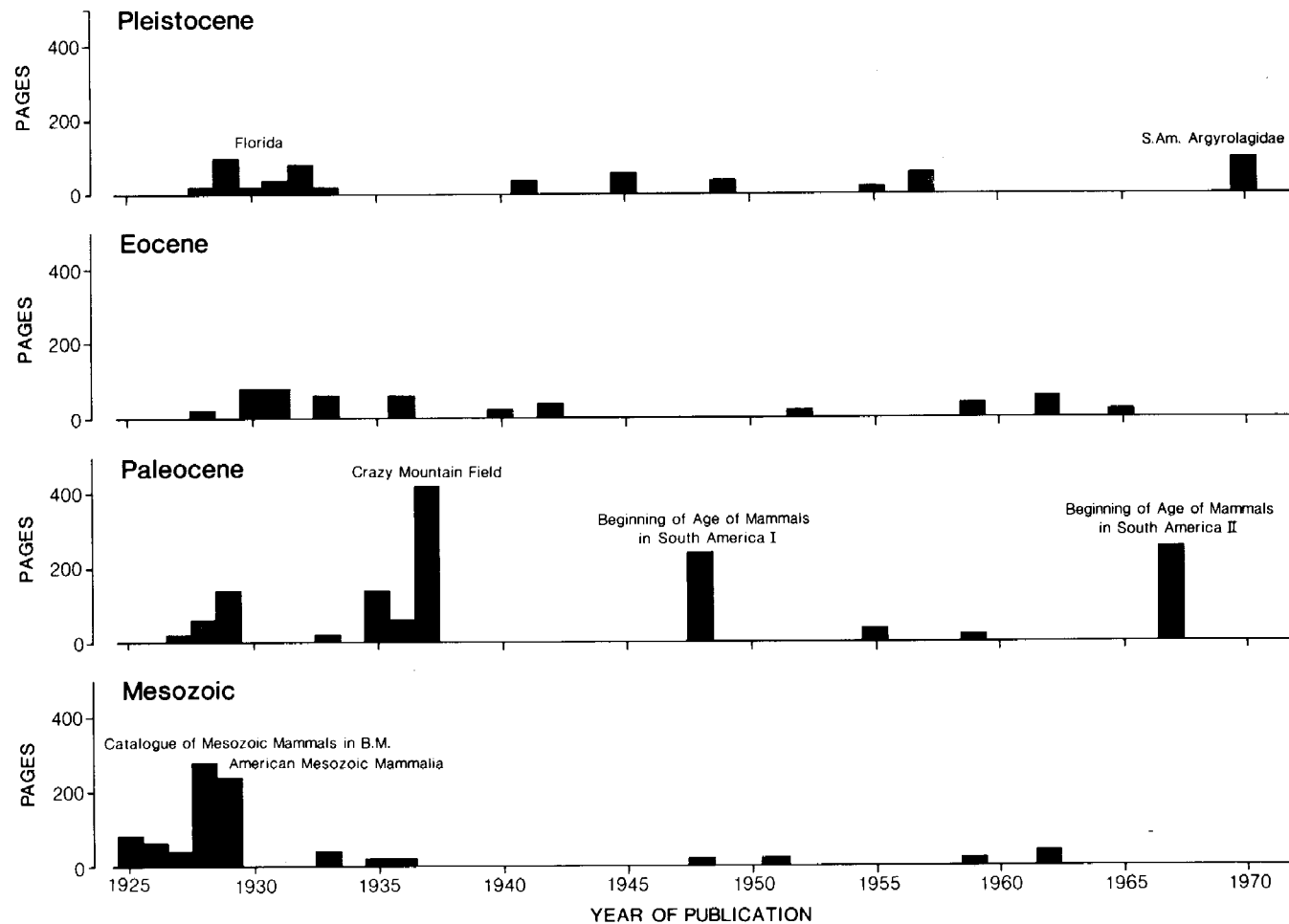


Figure 3. Titles and pages on Pleistocene, Eocene, Paleocene, and Mesozoic mammals (solid histograms) published by George Gaylord Simpson from 1925 through 1971. Note progression from early work on Mesozoic mammals, including two important monographs, to work on Paleocene mammals (three important monographs), and Eocene mammals (monographs on *Beginning of Age of Mammals in South America* also include Eocene faunas). Simpson's early research on Pleistocene mammals was concentrated in Florida. Later work on Pleistocene mammals included South American Argyrolagidae.

edentate *Metacheiromys* in 1931, and the monographs on the beginning of the age of mammals in South America include Eocene faunas, but the rest of Simpson's Eocene work, like that on the Oligocene, Miocene, and Pliocene, consists of short articles and notes.

Pleistocene research began, as noted above, in Florida, and virtually all of Simpson's Pleistocene work from 1928 through 1933 was concentrated in Florida. Jaguar bones and footprints took him to Tennessee in 1941, and peccaries to Missouri in 1946. Other major studies, on tapirs, mastodons, and argyrolagids were all based on South American fossils.

NORTH AMERICAN AND SOUTH AMERICAN MAMMALS

Most of Simpson's research on fossil mammals concerned those of the Western Hemisphere. He published some 87 titles and 2,014 pages on the mammals of North America, and 56 titles and 1,521 pages on the mammals

of South America (Table 4). As outlined above, and illustrated in Figure 4, intensive study of North American faunas preceded a similar effort in South America. Simpson's first paper on South American mammals, published in 1928, concerned the affinities of Polydolopidae—marsupials with a convergently multituberculate-like dentition. This study and an early review of post-Mesozoic marsupials undoubtedly motivated further interest in Paleocene and Eocene mammals of South America; field work began in 1930, yielding a steady stream of research articles and the 1948 and 1967 monographs on the beginning of the age of mammals in South America.

Simpson's principal study of African mammals was a review of Tertiary loriform primates published in 1967. He published one article in 1940 on Antarctica as a faunal migration route (Antarctic mammals were, of course, unknown at the time—when found, interestingly, the first were polydolopids like those that drew Simpson to South America). Most of Simpson's papers on

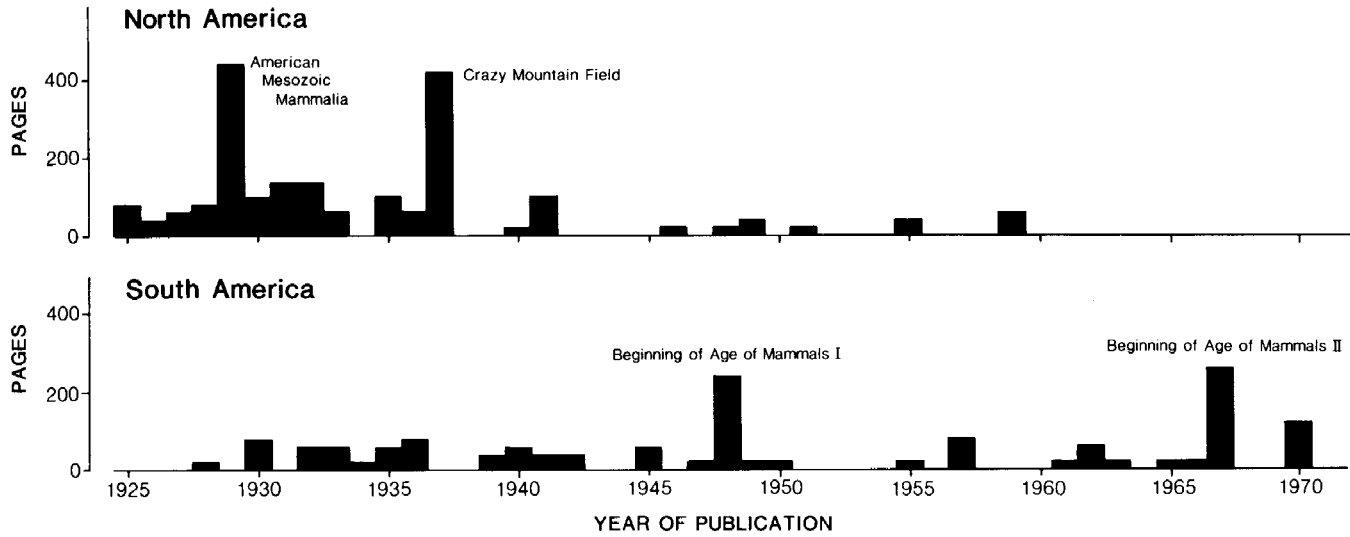


Figure 4. Titles and pages on North American and South American mammals (solid histograms) published by George Gaylord Simpson from 1925 through 1971. Note shift in emphasis from North American to South American faunas.

TABLE 4. PRIMARY PUBLICATIONS ON MAMMALS BY GEORGE GAYLORD SIMPSON, 1925-1971, ORGANIZED GEOGRAPHICALLY.

Continent	Titles	Pages
Africa	4	33
Asia	9	122
Australia	2	30
Europe	8	283
North America	87	2,014
South America	56	1,521
Totals:	166	4,003

Asian mammals concerned Cretaceous remains from Mongolia.

Two papers on extant monotremes (one on the dentition of the platypus, and one on the ear region of the platypus and echidna), and one on historical zoogeography constitute Simpson's entire publication record on Australian mammals (the latter included here under biogeography; several other papers dealt with penguins). Most of Simpson's papers on European fossils concerned Mesozoic mammals, but he reviewed Paleocene and early Eocene mammals in 1929 and 1936, and added short articles on French "*Menatherium*" (*Plesiadapis*) and British *Hyracotherium* in 1948 and 1952.

SIMPSON AND THEORY IN PALEONTOLOGY

Simpson published some 224 titles and 5,785 pages of empirical work, most descriptive and systematic, although a few papers were functional and more interpretive. He published 109 titles and 6,675 pages of

theoretical and synthetic work, beginning with his first classification of mammals in 1931 and including two editions of *Quantitative Zoology* in 1939 and 1960, *Tempo and Mode in Evolution* in 1944, *The Principles of Classification and a Classification of Mammals* in 1945, two editions of *The Meaning of Evolution* in 1949 and 1967, *The Major Features of Evolution* in 1953, two editions of *Life: An Introduction to Biology* in 1957 and 1965, *Principles of Animal Taxonomy* in 1961, *This View of Life* in 1964, *The Geography of Evolution* in 1965, and *Biology and Man* in 1969.

The pattern and proportion of empirical and theoretical work in Simpson's career is shown in Figure 5. Fifty-three titles and 1,295 pages of primary empirical work were published before his first theoretical contribution. One hundred twenty-one titles and 2,806 pages of primary empirical work were published before *Quantitative Zoology* in 1939, and 142 titles and 3,560 pages were published before *Tempo and Mode in Evolution* in 1944.

Two stages are evident in Simpson's professional career. During the first empirical stage, lasting some twenty years from 1925 through about 1944, Simpson averaged seven titles and 178 pages of primary empirical work per year. During the second and largely theoretical stage, from 1945 through 1971, Simpson still averaged three titles and 82 pages of empirical work per year. The choice of 1944 as a division between the two stages is, of course, arbitrary, reflecting both the end of Simpson's active military service and publication of *Tempo and Mode*. It is noteworthy that for 47 years, from 1925 through 1971, Simpson published at least one primary empirical study every year except 1958 (many book reviews were published in 1957 and 1958, following the Alto Juruá accident).

It is fair to say that the comparative work required during the first, predominantly empirical, stage of Simp-

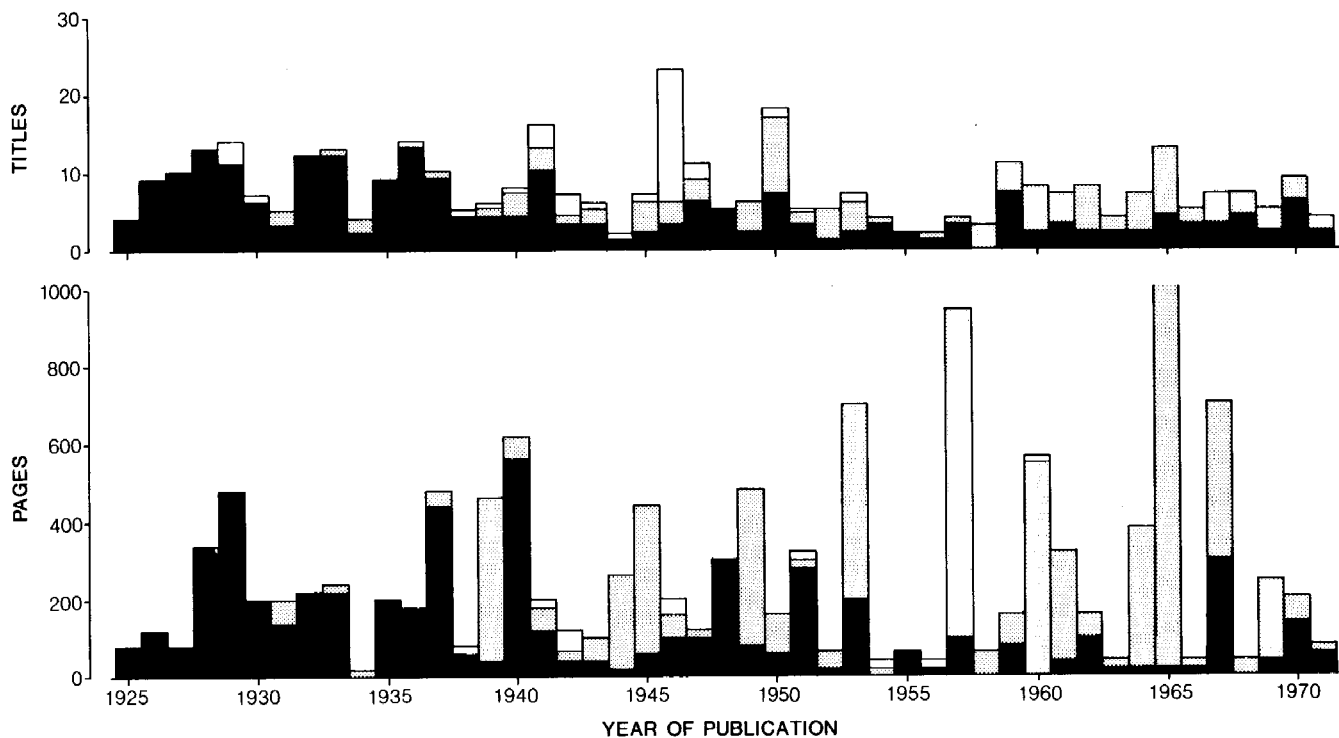


Figure 5. Titles and pages of empirical (solid histograms) and theoretical work (shaded areas) published by George Gaylord Simpson from 1925 through 1971, outlined against a silhouette of all primary literature published during this interval. Note initiation of theoretical work in 1931, and shift in emphasis from predominantly empirical to predominantly theoretical work in early 1940s.

son's career could not have been carried out without access to museum collections for comparative purposes, and conservation of reference material would not have been possible without museum support. The second, predominantly theoretical, stage of Simpson's career also made use of collections and libraries in research museums (first at the American Museum, and later the Museum of Comparative Zoology). Museums are a resource essential for research in natural science, and research is their most important function.

It is popular in some paleontological circles to argue that theory develops independently of observation, that science is deductive rather than inductive, and that compilation of empirical catalogues in hopes of generalization is effort both misdirected and nonscientific. Simpson's research career stands as evidence to the contrary. His career began with many years of empirical collecting and cataloging. From this grew integration, synthesis, and theory. Simpson's citation on presentation of the Geological Society's Penrose Medal credits "a foundation of hard work and a dedication to the principle that big thoughts grow from many little facts" (Jepsen, 1953).

No one would accuse Simpson of counting pebbles and describing colors in a gravel pit, and yet much of his work involved both counting and describing in vacuo so large (Mesozoic and early Cenozoic mammals in gen-

eral, and those of South America in particular) that the task cannot have been approached with particular views or preconceived theories in mind. The work was undertaken to provide basic information necessary for integration and synthesis, making theory possible. If South American mammals are interesting to paleontologists outside South America, it is largely because Darwin, Ameghino, Simpson, and others, have made them so.

Returning to Alma Mater, wouldn't it be nice to hire a theoretician like Simpson, . . . someone who wouldn't require museum resources or research collections.

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