



After two long sea voyages and some adventures, tribulations, and efforts ashore, I first set foot on Patagonian soil on Sunday, 28 September 1930. I had been fascinated by South America and its animals since childhood. While training for and entering the profession of paleontology, I had become aware that fossil mammals in Patagonia had been found by Charles Darwin nearly a century earlier and that extensive collections of them had been made since then. Yet much still remained to be done, and I became convinced that an earnest young paleomammalogist could find few, if any, more interesting things to do than to study the early mammals preserved as fossils in South America. The best way to start, after learning what had already been published about them, was to go to Patagonia, to study at first hand the successive strata in which early mammals were preserved, to collect as many as I could, to restudy the great collections already in Argentinian and some other museums, and to go on from there with my own researches and with following the continuing work of others.

Thus started a commitment to a lifetime of work and study, especially on the early mammals of South America but also on the whole history of mammals on that continent. During the fifty years that have elapsed since I definitely started such studies I have had to do many other things as well, but this subject was never far from my mind. Now I am summing up what is known about the history of South American land mammals, what I think about various, sometimes disputed points in that history, and what I find of special importance and interest in it.

This is not a book written particularly for my colleagues, although they will find some interest in it. I have not assumed any previous technical or detailed knowledge of the subject by any reader. At times close attention may be required, but I believe that any literate adult with a real interest in South America, in animals, or in evolution can read this account with pleasure and profit.

References given at the end of each chapter are extremely far

from being exhaustive. In general they should be helpful to anyone who wants to read further, and incidentally they may help a student to get started toward more detailed publications. A few references are to technical papers to substantiate some particular point beyond more general or background works. In quoting from foreign language sources I have used my own translations.

All the text figures have been drawn anew for this work by Judy Spencer, most of them in a technique that I find interesting, attractive, and apt and that is quite unusual in this field. In the illustration of fossil and some recent mammals, we have used all the available information from many sources (see the appendix for a note on the restoration of extinct animals). Restorations made under the direction of W. B. Scott, mostly by Bruce Horsfall, have been especially helpful but in no case have they simply been copied.

So many people in South America, North America, and Europe have contributed to my knowledge of this subject and aided me in concrete and direct ways that to name them all is impossible and to select a few may seem invidious. None of them is forgotten and I hope that none will feel so if I just salute the memory of such past friends as Carlos Ameghino and Lucas Kraglievich, both of whom facilitated and enriched my study of the great Ameghino collection in Buenos Aires, and Angel Cabrera, who did the same for study in La Plata. I hesitate to proceed to salute even the oldest and best of friends happily still living, but I am sure that I will not offend others, mostly younger, if I name only Justino Hernández, my indefatigable field assistant in Patagonia, Rosendo Pascual, the leading present Argentinian paleomammalogist, Carlos de Paula Couto, the leading Brazilian paleomammalogist, Bryan Patterson, an outstanding North American authority on this subject, and Robert Hoffstetter, an outstanding French authority on it. So many mammalogists, both paleo- and neo-, are now working in this field that, although I believe this book is well up to date as of February 1979, it will be out of date as to some details and new finds by the time it has been edited, indexed, manufactured, and issued.

The difficult task of transcribing the manuscript from my rough,

extensively interlined and revised manuscript to legible typescript was performed mainly by Renée Johnson, in lesser part also by my wife Anne Roe and by Carol Nowotny-Young. My wife has also read and usefully criticized the whole work and aided and abetted me in more ways than I can say.

Yale University Press has again been cordial and efficient, and Ellen Graham has again been an excellent editor. Barbara Palmer helped ably with the copy editing and the book has been designed for the Press by Sally Harris. Cynthia J. Plastino ably assisted in preparation of the index.

G. G. S.

*Tucson, Arizona*  
*8 February 1979*

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## Why, What, and How

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Why should someone write a book about the history of mammals in South America, and why should you and others read it? There are several good answers.

For a start, there are many strange mammals now in South America, fascinating to almost everyone: opossums, armadillos, tree sloths, anteaters, monkeys in great varieties, capybaras (the largest rodents now on earth), wild guinea pigs, tucu-tucus, and many other native rodents strange to us, jaguars and rather weird maned wolves, tapirs, peccaries, llamas and other humpless camels, such peculiar deer as the pudu and the huemul—to name just a few. Here is indeed an interesting mixture of creatures, and it takes only a modicum of human curiosity to want to know their history and to learn, as far as possible, how that mixture arose.

It is a mixture, and that is an essential part of the history. Some of those animals have had ancestors and relatives confined to South America at the beginning of the Age of Mammals and long thereafter, although some (sloths and anteaters, for example) have more recently spread into tropical Central America and a few even into the United States (an opossum and an armadillo). Some, ancestral rodents and monkeys, turned up quite suddenly around the middle of the history; where they came from and how will be discussed in due course. Still others appear rather late in the history as migrants from North America. Some of those, such as the camels, no longer live in North America. Others, such as jaguars and peccaries, are marginal here, and still others, like some rabbits and foxes, are now common on both continents. The tangle is rather complex, and that is part of the interest of the history.

The history becomes even more complex and more fascinating for another reason. As we look back into it, we find more and more mammals of groups entirely extinct such as lived nowhere else on earth. As men never saw them, they were not named until scientists who make that their business invented names for them, names strangely assorted as to origin but often coined from Greek: astrapotheres, "lightning mammals" (they were big and probably noisy, so they reminded Hermann Burmeister of thunder and lightning); pyrotheres, "fire mammals" (Florentino Ameghino called them that probably because their remains have been found in volcanic ashes); toxodonts, "bow teeth" (among Darwin's discoveries, so called by Richard Owen because their upper molar teeth are arched like bows); *Thylacosmilus*, "pouch-saber" (an odd combination coined by Elmer Riggs because they were marsupials, hence presumably had pouches like kangaroos, and had saberlike upper canine teeth)—and literally hundreds more. Just here the point is that the wholly extinct native mammals of South America were even more weird, wonderful, and numerous than those still living there.

Important beyond its sheer wonder is the fact that this history, to which Charles Darwin contributed a bit, provided some of the clues that led him to his understanding of the origin of species. Here it continues to play an incomparable role not just in demonstrating that evolution really did occur but in the more arduous, longer, still incomplete task of learning how and, in a causal sense, why it occurred. Some of the principles and causes of evolution can be observed in nature and studied experimentally in laboratories, but evolution involves time in the tens, hundreds, and thousands of millions of years. We cannot observe that directly in our lifetime or prolong our experiments to such lengths. But we can follow evolution at work for tens of millions of years in the history of South American mammals, and here it turns out that we have been provided with an almost ideal natural experiment.

It has been learned, as will be discussed in later chapters, that during most of the Age of Mammals, the Cenozoic in geological terms, South America was an island continent. Its land mammals then evolved in almost complete isolation, as in an experiment

with a closed population. To make the experiment even more instructive, the isolation was not quite complete, and while it continued two alien groups of mammals were nevertheless introduced, as might be done to study perturbation in a laboratory experiment. Finally, to top the experiment off the isolation ended, and there was extensive mixture and interaction between what had previously been two quite different populations, each with its own ecological variety and balance. Thus, we can also hope to follow the evolutionary factors in such an event under almost ideal conditions. The ecological mix in South America had changed, evolved, throughout the long history. Here toward the end it was most radically modified or remodeled.

Enough is known about this history to follow its broad sweep in many respects and to see considerable detail. Yet it is part of the fascination of the subject that many things about it are still uncertain and others still quite unknown. Within the scope of the grand history there are mystery stories the ends of which have not yet been read, although we can expect to find that those ends in many if not all cases have been written in the record of the rocks and their contained fossils. It is one of the exciting elements in this history, as it is in any pursuit of human knowledge, that not all is yet known.

So much at present for the why and some of the what of this book. Now must be considered how the subject, details of which could and do fill whole libraries, is to be presented in a single book. There have been several useful summaries of the history of South American mammals at shorter than book length and now inevitably more or less out of date. One of the best and most recent, published in 1972, carries on a long tradition of cooperation between Argentinian and North American paleontologists, here respectively Rosendo Pascual and Bryan Patterson. The present author has published several periodically, most recently in 1969. The great Argentinian paleontologist Florentino Ameghino in 1906 published in French a book-length discussion of the whole history of South American mammals as then known and interpreted by him. That could not serve as a model for later histories because it was at least as argumentative as expository and because

much of its theoretical basis soon had to be discarded, for reasons that will be given in the next chapter.

Now a valued classic is *A History of Land Mammals in the Western Hemisphere* by Princeton professor W. B. Scott, published in 1913 and then in a completely rewritten and updated version in 1937. That book gave top billing to North American fossil mammals, which then were and now to less extent still are better known than those of South America, but it did summarize the South American history as well as possible in the early 1910s and in the late 1930s. After several introductory chapters, Scott's plan was first to discuss the succession of faunas briefly, then to consider in some detail each of the major groups of mammals, and finally to devote a chapter to the then somewhat chaotic subject of modes and causes in evolution. The updated version followed almost the same plan but placed more emphasis on the geology of the rocks in which the fossil mammals were found. A peculiarity of Scott's approach was that throughout and in both versions he followed time sequences in reverse order, from the present into the increasingly remote past.

The present book must include the same main topics as Scott's and, more briefly, some others. Specifically, it must include consideration both of successive faunas as whole animal communities and of the roles, characteristics, and individual histories of each of the main groups of mammals involved. The organization, approach, and style, however, are here quite unlike Scott's. For one thing, what most people think of as the normal time sequence will be followed: from early to late, or from the oldest known South American fossil mammals to the mammals now living on that continent. The histories of particular groups of mammals and of whole faunas will be interwoven to some extent, with the two more interrelated and balanced than in Scott or most other previous studies.

An additional "why" for this book is that knowledge of the history of mammals in South America has itself an interesting history. To discuss all of the human history of the discovery and interpretation of the records of the natural history, the fossils of mammals involved in the latter history, would require more than



one book as long as this one. Here just the next chapter will be devoted to some of the comparatively early steps in the human history of the subject, those steps that seem to me to have been of special interest in laying the broad foundation on which later scholarship was based. The results of labors by the later scholars, roughly from the 1920s into the late 1970s, form the main subject matter of all chapters after the second.

For the benefit of students and other readers who want to go more deeply into some aspects of this history, and sometimes to document sources for this text, references to a few previous publications will be given as appropriate at the ends of chapters.

### References

The chapter references in this book are not meant to be research bibliographies. References to the major bibliographies useful for detailed research are added to this list.

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