

Pedro Da-Gloria · Walter A. Neves
Mark Hubbe *Editors*

Archaeological and Paleontological Research in Lagoa Santa

The Quest for the First Americans



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 Springer

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Foreword

Is Lagoa Santa a Tropical “Classic”?

What are the characteristics of a scientific contribution that make it become a “classic” in a given field of knowledge? How and why does an intellectual production (article, chapter, book) become elevated to a central position, acquire fundamental importance for a given field of knowledge, and become a “classic”? Is every work considered to be a “classic” necessarily old, dating back decades or even centuries, or can it be something more recent, almost as recent as yesterday?

A few years ago, I had some long and pleasant discussions with my friend Susan Lindee, a science historian at the University of Pennsylvania in the USA, regarding what it is that makes a work become a “classic.” Memories of those conversations came to my mind on several occasions during my reading of this important and stimulating book, organized by Pedro Da-Gloria, Walter A. Neves, and Mark Hubbe, on the past and present of the archaeological and paleontological research in Lagoa Santa.

On that occasion, Susan and I were writing the introductory text to a thematic issue for the journal *Current Anthropology* with articles originally presented at a Wenner Gren Foundation seminar on the history of physical/biological anthropology on the global scale (Lindee and Santos 2012). The question arose because, when thinking about the trajectory of a given intellectual field, immediately questions come to mind associated to certain authors and works that have been singled out in the course of time. The departure point for my comment was that anthropology, understood in its broadest sense as being composed of the subareas of social anthropology, archaeology, linguistics, and biological anthropology, does not currently possess a specific set of “classics” that are obligatory reading for students of its various specialties. Furthermore, there are important differences of temporalities to consider. For example, unlike social anthropology, in which the training process generally involves contact with authors from earlier centuries, especially the nineteenth and beginning of the twentieth century, like Emile Durkheim, Bronislaw Malinowski, or

Margaret Mead, the training of researchers in the area of biological anthropology rarely emphasizes the reading of works with a more distant temporality.

So why was that debate important for our argument? The question revolved around the fact that, quite often, researchers who work with human diversity, whether in the case of genetic studies or studies on plasticity (e.g., physical growth), do not read authors from the nineteenth or the early twentieth century who have written on the subject.

Susan asked me what I thought would be a “classic” for biological anthropology. Without hesitation, but not before having sipped a little of my wine (the conversations went on into the evening), I mentioned Franz Boas’s studies of the physical characteristics of the children of immigrants to the USA in the 1910s, as well as the influential work of population geneticist Richard Lewontin entitled “The apportionment of human diversity,” published in 1972. Those two texts, separated by half a century and based on very different theoretical and methodological perspectives, broadly redefined our views of the factors involved in the expression of human biological diversity. We spent hours reflecting on how important it could be for the training of future generations of biological anthropologists not only to include contact with more recent scholarship but also to become familiar with authors who, in their respective social, cultural, and historical contexts, had reflected on issues of human biological differences in the past.

From those exchanges, I came to the conclusion that whereas all works considered to be “classics” have also been historically significant for a certain field, the reverse is not always applicable. A given book may be of fundamental importance in the history of the constitution of a given study discipline, but those regarded as “classics,” for the most varied theoretical and/or methodological reasons, tend to constantly reappear in the rounds of discussions or even be reborn from the ashes. They may be less remembered at one time or another, depending on the intellectual fashion of the day, but they insist on reappearing, re-nurturing, and re-signifying the debates. Another point that was reasonably apparent to me was the wide variability of the temporality of the “classics” in science as a whole. For example, if philosophy has many of its seminal works way back in the times of the Greeks, thousands of years ago, areas such as robotics or molecular biology may have their “classics” emerging the mere blink of an eye ago. In the case of anthropology, the temporality patterns of the “classics” are extremely varied. I would not go so far as to talk about archaeology and linguistics, areas in which I have great friendships with colleagues but at the same time only shallow theoretical/methodological knowledge, but in a similar way to social anthropology and biological anthropology, as mentioned above, they show marked differences in the temporality of their “classics.”

Well, here I am in the seventh paragraph of this foreword and readers (at least those that have read this far) must be wondering whether the editor has not made a mistake and printed that of another book altogether. No, please do not give up (as yet). Everything that I have said above has been to emphasize that this volume, which involves almost two dozen Brazilian and foreign authors and addresses a vast set of

themes, exemplifies exactly how “classic” (and contemporary) the discussions around the Lagoa Santa question are.

Allow me to introduce another concept (I promise to be brief) that I came across some time ago and which I think may be useful for a reflection on anthropology and the history of bioanthropological research in Brazil (and beyond, obviously). It is the concept of “significant sites of cognition and critical reflection” proposed by Australian science historian Warwick Anderson (2012). One of Anderson’s main interests is the history of twentieth-century research in human biological diversity in a postcolonial perspective. He argues that there are certain places in the world which, in a singular and intense way, have been (and continue to be) differentiated focuses of research activities, many of which have been conducted for years or even decades. From such contexts, he argues, interpretations (and continual reinterpretations) have been generated that have strongly influenced the direction of scientific knowledge on a scale that goes well beyond the local or regional sphere.

There may be a few others, but in what situations in the Brazil of today, other than Lagoa Santa, is scientific knowledge in archaeology and bioarchaeology being produced which has such a vast spectrum of implications (time of occupation of the Americas by human populations, relations of that presence with environmental transformations, etc.) in a dialogue with ideas and perspectives emanating from investigations conducted more than 150 years ago? As can be concluded from this collection of chapters, many examples could be cited, but we can rate just one of them as being the most “classic” among them (also in the sense of perhaps being the most well-known): the so-called hypothesis of the contemporaneity of humans and the megafauna in Lagoa Santa. That theme, originally proposed by Lund in the first half of the nineteenth century, persists as a central one in the archaeological and paleontological debates around Lagoa Santa.

To make use of a more modern metaphor, perhaps we could say that, just like stem cells, Lagoa Santa has certain aspects of “totipotency,” an incredible capacity for differentiation into many other types of contents. As the authors of the chapters that follow show us, ever since the time of Lund’s pioneering studies, Lagoa Santa has been visited and revisited innumerable times over the years by scientific researchers and missions of the most varied countries of origin such as Denmark, France, the USA, and Germany, as well as by Brazilians, obviously.

While each new cycle of research has introduced new questions of interest and new investigatory techniques (including, e.g., new interpretations based on use of isotope dating procedures, beginning in the 1950s), themes and materials collected by Lund have commonly been reworked and debated in successive waves of investigation. On many occasions, going beyond the scientific interpretations, questions surrounding Lagoa Santa have influenced the relations among researchers and among institutions. An example is the interesting debates of amateur naturalists versus professional scientists about the region’s multiple archaeological and paleontological aspects like those involving the Minas Gerais Academy of Sciences and the National Museum in the 1930s and 1940s.

Lagoa Santa’s almost magical powers of generation and multiplication are present in the very constitution of the scientific collections of many of the more important

institutions involved in research in that region in the course of the last century and a half. That is exemplified by the group led by Walter A. Neves at the University of Sao Paulo and the recent “Origins” project which has been in course since the year 2000 and is closely related to the propositions that Lund launched. The project has been discussing new hypotheses for the human occupation of the Americas and at the same time has been training a whole generation of researchers by involving them in the studies of the Lagoa Santa caves.

Like me, I hope that those who delve into the following pages will similarly be captivated by the complex mix of past and present that is so evident in the scholarship on Lagoa Santa, which this volume convincingly portrays as a remarkable example of a “significant site of cognition and critical reflection.”

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Chapter 1

Introduction

Pedro Da-Gloria, Walter A. Neves, and Mark Hubbe

Abstract In the past two centuries, the Lagoa Santa Karst has been intensely explored by paleontologists and archaeologists, given the richness of the fossiliferous and archaeological record on the local caves and rockshelters. This chapter introduces and briefly describes the chapters that compose the volume and highlights how the multidisciplinary nature of the research in the region contributed to make Lagoa Santa one of the most important archaeological regions in Brazil and South America in general. The book is divided into two parts. The first consists of chapters referring to each one of the great research interventions that took place in the region, beginning with the work of Peter Lund and culminating with the most recent intervention in the region. The second part of the book consists of synthetic reviews of important topics for research in the region such as migration, health, mortuary rituals, paleontology, rock paintings, lithic technology, and geoarchaeology. Together, the 17 chapters of this volume bring for the first time a comprehensive review of the archaeological work in Lagoa Santa to the international public.

In the course of more than 180 years of research undertaken in the region, the Lagoa Santa Karst in Minas Gerais has received, and continues to receive, special attention in the Brazilian scientific scenario for having been one of the first places in our Brazilian territory to be the object of systematic archaeological and paleontological investigation. The findings in that region have constantly gone beyond national borders and have had direct impacts on the discussions and concepts surrounding the question of the antiquity and the mode of human occupation of the Americas. Nevertheless, gaining an understanding of the long history of the research

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conducted in Lagoa Santa has always required a huge effort on the part of researchers interested in local prehistory. The primary sources regarding the excavations are scattered in various archives in Belo Horizonte, Rio de Janeiro, São Paulo, and Copenhagen, and many of them are little more than handwritten manuscripts or internal reports. In that light, the idea emerged of bringing together, in a single work, researchers involved in the excavations, curatorship, and research in Lagoa Santa that would be capable of synthesizing all that dispersed information. Many of such authors have participated directly in the research trajectory described in this volume, and their reports and accounts are rich in details of how knowledge of the region was constructed. This book offers a space to representatives of multiple institutions that have contributed to research in Lagoa Santa, among which the National Museum of Rio de Janeiro, the Federal University of Minas Gerais, and the University of São Paulo are outstanding examples.

The concept of this book aims to reach out to a public of Brazilian and international researchers in the fields of archaeology, paleontology, cultural anthropology, and human sciences in general, and we have made every effort to adopt a precise scientific language well referenced in the specialized literature. On the other hand, the multidisciplinary nature of the research undertaken in Lagoa Santa requires a clear language that allows for efficient discussion among all those readers interested in details of the region's past. In that regard, we have orientated the authors of each chapter to avoid using excessively technical jargon. As the chapters of this volume clearly reveal, the studies in Lagoa Santa go beyond the boundaries of individual study disciplines and embrace dialogues among biology, archaeology, and anthropology, and we are very pleased to have been able to show that aspect here. Actually, the research efforts in Lagoa Santa have been and continue to be driven by very broad long-term scientific questions rather than being circumscribed by any single traditional knowledge field. As an example, many of the questions that have motivated research in Lagoa Santa, such as the man's antiquity in the Americas and his contemporary existence with the extinct mega-mammals, are the legacy of Peter Lund, a Danish naturalist who worked in the region in the 1830s and 1840s at a time when researchers could still transit freely among very different scientific fields.

The historical depth of the research in Lagoa Santa has made the region an area of great historical, cultural, and scientific value for Brazil. Indeed, the studies in Lagoa Santa are especially relevant and important for Brazil's historical and archaeological heritage. For decades, the region has been the target of mining activities exploiting the limestone rock and, therefore, threatening the preservation of the caves and archaeological sites. Besides the damage caused by mining, the destruction of archaeological sites by depredation and uncontrolled excavations still threaten the regional heritage. The preservation of the area has been the object of public-private initiatives such as the *Rota das Grutas Peter Lund* (Peter Lund Caves Circuit) endeavoring to harmonize preservation and the economic return generated by tourism. Within that context of preserving the Brazilian heritage, nothing could be more valuable than to publish a work that describes in detail all the rich array of knowledge produced in Lagoa Santa, with collections deposited in national and international public museums and universities. Indeed, it is our hope that the book

will attract attention to Lagoa Santa's scientific importance not only of academics of the respective fields but also of the relevant authorities in the national and international spheres.

The book has been organized in two parts. The first consists of chapters referring to each one of the great research interventions that took place in the region, beginning with the work of Peter Lund and culminating with the most recent intervention led by one of us (WAN). Those chapters provide the reader with the institutional context of the period, the identities of the main researchers involved, and the debates and scientific production generated by each of those individual researchers or research groups. The second part of the book consists of synthetic reviews of important topics for research in the region such as migration, health, mortuary rituals, paleontology, rock paintings, lithic technology, and geoarchaeology. The chapters describe the construction of a body of knowledge on each topic, including recent contributions and changes in concepts over the course of history. In addition, these chapters delineate prospects for future research, identifying possible gaps in knowledge of the region and the pathways that could be traced to fill them.

The first part begins with Chap. 2 "Peter Wilhelm Lund – life and work," which tells the history of Lund's life. The chapter describes in detail moments of transition in the naturalist's life, such as when he decided to come to Brazil for the first time in 1826 and again when he met Peter Claussen on his second trip to Brazil. At the same time, as the authors describe those events, they also report on the discoveries Lund made in the caves of the Lagoa Santa region. The number of excavations carried out is extraordinary and so is the diversity of topics he addressed, such as the formation of the caves and an accurate description of the region's extinct and living animal species.

Chapter 3, "Peter Wilhelm Lund's Scientific Contributions," summarizes the scientific discoveries that were made in the period from 1835 to 1844, when Lund was carrying out excavations in the Lagoa Santa region. Written by researchers trained in the geomorphology of caves, the chapter describes Lund's solid contribution to paleontology, geology, Karst geomorphology, stratigraphy of sediments, and cave taphonomy. The chapter shows, once more, the importance of Lund's work as the initial starting point for scientific investigation in Lagoa Santa.

Chapter 4 describes "the anthropological studies of Lagoa Santa in the National Museum of Rio de Janeiro: insertion, debates, and scientific controversies at the turn of the 19th to the 20th century." Written by a historian, the chapter brings a detailed account of the insertion of the Lagoa Santa studies in the institutional context of the National Museum of Rio de Janeiro. At that time, the Museum played an outstanding role in Brazilian science, not only in the natural sciences but also in anthropology. It is possible to identify the organization of important museological exhibitions such as the Brazilian Anthropological Exhibition of 1882 and field expeditions undertaken to collect material to enable an understanding of the origin of American man. In this chapter, the author delineates a panorama of the scientific dialogues that took place between the national museum and other national and international institutions.

Chapter 5, “The Physical Anthropology Archives of the National Museum of Rio de Janeiro: Lagoa Santa in the First Half of the 20th Century,” explores the documents in the national museum’s physical anthropology archives, mostly from the work of Jorge Augusto Padberg-Drenkpohl and José Bastos de Ávila about the Lagoa Santa region. The former researcher found human bones in five sites and incorporated a large number of human skeletons to the national museum’s collection, while the second worked in the Carrancas caves, where he also came across very ancient human skeletons. It is worth noting in this chapter how the question formulated by Peter Lund served as the driving force for much of the subsequent research in Lagoa Santa. The debate between the national museum and the Minas Gerais Academy of Sciences on the contemporaneity of humans and the extinct megafauna in the Lagoa Santa region is a typical example of the kind of debate that was occurring at that time.

Chapter 6 is entitled “The Minas Gerais Academy of Sciences – Lund’s inheritors.” It is written by an archaeologist, who seeks to redeem an important contribution the Academy made to the studies in the Lagoa Santa region. Even though they enjoyed no kind of public financing, the group undertook various archaeological and paleontological interventions in the region, publishing books and articles in Portuguese and English and organizing museological exhibitions. The author underscores how prolific were the academy publication record and its important role played in keeping alive the scientific questions formulated by Lund.

Chapter 7, “Archaeological Missions to the Lagoa Santa Region in the Second Half of the 20th Century,” is a protagonist report on the American-Brazilian missions, led by Wesley Hurt in 1955 and 1956, and the Franco-Brazilian mission, led by Anette Laming-Empeaire in the 1970s. That period marked the beginning of expeditions of professional archaeologists in the Lagoa Santa region, involving international partnerships and large research teams. In addition to the archaeological data generated, the author of the chapter shows the long-term legacy that stemmed from those exchanges. In the case of the Franco-Brazilian mission, the author provides details of the excavations that only someone who participated in them directly could be in a position to share.

Chapter 8 is entitled “The National Museum’s Contributions to Lagoa Santa Research in the Second Half of the 20th Century.” It has been written by two professionals attached to the National Museum of Rio de Janeiro, representing an institution that played an outstanding role in the academic discussion of Lagoa Santa, as well as being the repository of a significant part of the collection generated by those research activities. The authors make a review of the collections in the museum’s custody, totaling 1,500 archaeological and 41 paleontological items, in addition to 2,300 entries of human bones from Lagoa Santa. Furthermore, the chapter describes the museum’s scientific missions and projects in the second half of the twentieth century, undertaken by researchers like Marília de Mello e Alvim, Maria Beltrão, Luiz de Castro Faria, Carlos de Paula Couto, Fausto de Souza Cunha, and Martha Locks Guimarães.

Chapter 9 is called “The Origins Project and the First Americans’ Controversy.” It has been written by members of a team of the large-scale project that unfolded in

the Lagoa Santa region between 2000 and 2009. Led by one of us (WAC), the project “Origins and Microevolution of Man in America: A Paleoanthropological Approach” was structured around four research objectives referring to the fields of archaeology, biological anthropology, paleontology, and paleobotany. It is worth noting the large volume of academic products the project generated, with more than 200 written contributions to the four areas of research. The project involved fieldwork and curatorship of the archaeological and paleontological material, attempting to respond to important scientific questions outstanding since Lund’s day.

Chapter 10, “The Repercussions of the Human Skeletons from Lagoa Santa in the International Scenario,” inaugurates the second part of the book dedicated to thematic reviews of the research history in Lagoa Santa. In this chapter, the authors review the impact on the international scenario of the studies of human crania found in Lagoa Santa, from the time of Lund’s publications up until the most recent articles discussing the first occupations of the Americas. The chapter demonstrates how important the Lagoa Santa material is for understanding the first human settlement in the Americas, for the morphological and chronological contextualization of the first wave of migration, and for the question of New World morphological diversity.

Chapter 11, “The Lagoa Santa Skeletons and the Cranial Morphology of the First Americans,” explores the implications for Brazilian and international physical anthropology of the craniometrics studies conducted in Lagoa Santa. In it, we find a description of the changes in scientific approaches along the twentieth century, such as the introduction of multivariate statistical analysis and the use of big databases to gain an understanding of current and past morphological variability. Finally, the chapter addresses the recent discussions on the *Two Main Biological Components Model*, which is a genuinely Brazilian contribution toward understanding the arrival of humans in the Americas.

Chapter 12 is entitled “History of the Research into Health and Lifestyle in Lagoa Santa.” In this chapter, the authors make a review of texts published on the health of the prehistoric population in Lagoa Santa, observing that it is a line of research that has been marginalized compared with studies on migration and craniometrics. In the second part of the text, the authors propose new ways of investigating health and lifestyle in the region, including studies focusing on human skeletons and others on living populations. Those new approaches need the support of a solid archaeological context, which has only recently been incorporated to the studies in Lagoa Santa.

Chapter 13, “Burial Practices in the Lagoa Santa Region,” offers a review of another topic that has received little attention in the history of Lagoa Santa research. Up until recently, the descriptions of mortuary patterns in the region suggested a scenario that was at once simple and homogenous. However, recent excavations at the sites of Lapa das Boieiras and Lapa do Santo have made it clear that burial patterns are much more varied and elaborated than was formerly thought. The author describes three funeral patterns observed at the Lapa do Santo site, including dismembering, cremation, decapitation, multiple burials, and removal of flesh. The author interprets such manipulation of the body after death as a local, symbolic manifestation, possibly reifying cosmological principles.

Chapter 14, “Constructing the Past. A look at Lagoa Santa Paleontology,” presents a review of the paleontology studies of Lagoa Santa. This chapter describes the importance of the legacy bequeathed by Peter Lund for posterior work in the region. Among such work is that of Herluf Winge and his monumental treatise *E Museo Lundii* and of Carlos de Paulo Couto, whose writings extended over a period of 30 years. At the end of the chapter, the author delineates two projects that have yet to be undertaken with the paleontological material: an investigation of a list of recent mammals that Lund made and the examination of the collection of micro-mammals deposited in the Museum of Natural History in Copenhagen.

Chapter 15 is entitled “The History of the Studies of Prehistoric Rock Paintings in the Lagoa Santa Karst.” The authors describe the history of the study of the graphisms in the region, ranging from the illustrations of Peter Brandt in the nineteenth century to the chrono-stylistic review conducted by Alenice Baeta in the twenty-first century. In the second part of the chapter, the authors present some of the fundamental elements of the work with rock painting material, that is, the chronology, the characterization of the supports, the placement and relations among the figures, and their insertion in the landscape. Subsequently, the chapter includes the large stylistic traditions found in the region, such as the Planalto tradition and the Ballet figures. Finally, the authors describe the occurrence of overlapping, additions, and retouching of older paintings, showing how dynamic such registrations were.

Chapter 16 “Lithic Technology in Lagoa Santa in the Early Holocene” presents a complete discussion of the lithic material excavated in Lagoa Santa. The main lithic collections analyzed are those to be found in the National Museum of Rio de Janeiro and in the Institute of Biosciences at the University of São Paulo. The description of the lithic material comes with graphs showing the distribution of the pieces by raw material, by archaeological level, and by category of remains. That descriptive part is then used to underscore the challenging of the concept of homogeneous and simple industry in the region, insofar as Lagoa Santa shows a quite unique industry, made up of small artifacts with the occurrence of polished material and composite instruments. Another aspect underscored in the text is the exogenous nature of the raw materials, which may lead to an understanding of mobility and the complex interregional interactions. Once more, it becomes apparent that the archaeological scenario at Lagoa Santa has proved to be far more complex than its early descriptions would suggest.

Chapter 17 is called “Towards the Development of a Tropical Geoarchaeology: Lagoa Santa as an Emblematic Case Study.” This chapter approaches the developments of a tropical geoarchaeology in the Lagoa Santa region. Although previous researchers approached the archaeological matrix of the sites, only recently, in the Origins Project, a robust effort was made to understand the tropical soils of the region. The authors show the importance of the anthropic component to explain the deep archaeological packets in the rock-shelters of the region. In addition, geoarchaeology studies has shown its relevance for understanding paleoclimate, contributing to the discussion of the middle Holocene “Archaic Gap” and to the understanding of the sediment deposition in open-air sites. Finally, the authors high-

light the key role of cave geology and dating techniques to solve the long-held problem of the coexistence between man and extinct megafauna.

In short, we have brought together in this volume a great diversity of topics and theoretical approaches to the material in Lagoa Santa, emphasizing the temporal profundity of studies in the region. We hope the reader will enjoy the products of this richness of information and come to value and recognize the importance of the scientific heritage that the Lagoa Santa region represents. Good reading!

Part I
History of Research in Lagoa Santa

Chapter 2

Peter Wilhelm Lund: Life and Work

Birgitte Holten and Michael Sterll

Abstract Peter Wilhelm Lund (1801–1880) was a most remarkable nineteenth century Danish naturalist. During 10 years of intense work in the Brazilian limestone caves in the 1830s and 1840s, he generated new explanations for the evolution of the Earth, its fauna and flora, and human beings. His scientific methods were characterized by his unprecedented focus on complete systematic registration. Lund discovered and described an enormous range of extinct animals. He demonstrated that the extinction of prehistoric animals had by no means been complete, that actual animals in fact had lived side by side with animals that are now extinct and even that human beings had been contemporaneous with the extinct megafauna. Lund’s discoveries and analyses contributed toward the lasting and persistent reformulation of the history of the Earth and of humanity that eventually paved the way for a more general acceptance of Darwin’s revolutionary ideas. In fact, he offered to Darwin a long-term view of animal evolution. In addition, Lund performed a pioneering attempt of determining an absolute dating of the contents of a cave. This chapter gives an introductory survey of Lund’s work in the caves of the Lagoa Santa region, as well as a summary of his most important studies on cave fauna.

Peter Wilhelm Lund (1801–1880) was among the most remarkable Danish naturalists of the nineteenth century (Fig. 2.1). During 10 years of intense work in Brazilian limestone caves, he generated new explanations for the origin and evolution of the Earth, its fauna and flora, and human beings. His scientific methods were characterized by his unprecedented focus on complete systematic registration – whether it involved the contents of an individual cave, the taxonomy of the fauna of the Brazilian central plateau, or the vegetation around Lagoa Santa.

Lund’s discoveries and analyses contributed toward the lasting and persistent reformulation of the history of the Earth and of humanity that eventually paved the way for a more general acceptance of Darwin’s revolutionary ideas. The overriding aim of P.W. Lund’s excavation work was not merely to collect as many bones as possible but, above all, to create a comprehensive view of the “Brazilian animal

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Fig. 2.1 Photographic portrait of Lund aged 64 taken by Eugen Warming (Natural History Museum, University of Copenhagen)



world.” He did that by making detailed descriptions of the species, whether extinct or not, and their kinship relations.

Peter Wilhelm Lund was born into a wealthy family of cloth merchants in the Danish capital, Copenhagen. His father had left him and his two brothers a considerable fortune at his death in 1820. That inheritance, competently administered by his brothers, made Lund economically independent for the rest of his days.

In 1818, Lund entered the University of Copenhagen as a medical student, as the natural sciences were not yet included in the curriculum. Even so, Lund spent most of his time at the Museum of Natural History, presided over by Professor J.C. Reinhardt,¹ and at the botanical gardens with Professor J.F. Schouw.² At the age of 23, Lund graduated with the presentation of two dissertations, both of which were awarded the university gold medal. One of them, a treatise on vivisection (Lund 1825) became widely disseminated as a textbook at the universities of Europe. The subject of the other treatise was crustaceans, one of Lund’s principal interests under his first stay in Rio (Lund 1826).

Lund set off for Brazil shortly after his graduation. Unlike most of his colleagues, he did not need a travel allowance from the state; he was instead endowed with a monetary grant for the express purpose of making a collection of zoological material for the Museum of Natural History.

We have no explicit indications of why Lund chose to go to Brazil. We know, however, that the country’s recent independence had opened a new and unexplored field for naturalists. The resulting ample possibilities for making important discoveries and the warm climate is a valid explanation for the choice made by an ambitious and independent – as well as adventurous – young man.

¹Johannes Christopher Hagemann Reinhardt (1776–1845), zoologist and Lund’s professor at the University of Copenhagen. Father of Johan Theodor Reinhardt (1816–1882), zoologist and curator of the Lund collection at the Museum of Natural History in Copenhagen.

²Joakim Frederik Schouw (1789–1852), professor of Botany and an important political figure in Denmark.

Lund spent most of his first journey in Rio de Janeiro, with some incursions in Niteroi and a more prolonged stay near Nova Friburgo. Apart from the material he collected for the museum, the journey rendered good results for Lund's scientific endeavor and yielded important studies on tanagers (which became the object of Lund's doctoral thesis; Lund 1829),³ mollusks (Lund 1834), vultures (Lund 1832), and ants. Lund returned to Europe in 1828 full of new experiences and with a profound and long-lasting love for the Brazilian Nature. This first trip was decisive for the course of his life.

Back in Denmark in 1829, Lund soon set off on his grand tour across Europe, visiting museums and making contacts with colleagues in the big cities. He passed through Berlin and Vienna, and on arrival in Italy, he took off to Sicily to study botany and marine zoology. While there, he received the news that his mother had passed away. Even devastated by the loss, he welcomed his freedom to travel and stay abroad. First, he decided to spend the winter of 1830–1831 in Paris where he attended George Cuvier's lectures on comparative anatomy and made acquaintance with leading figures in the field of natural history like Alexander von Humboldt, Henri Milne-Edwards, and Jean Victoire Audouin.⁴ In the spring of 1831, he informed his family of his wish to make another trip to Brazil to complete the material already collected (Holten and Sterll 2010:69–85).

At the end of 1832, Lund set off once more for Brazil, arriving in Rio de Janeiro in January 1833. After a stay in Rio, he arranged to make an expedition to the interior with the botanist Luiz Riedel, a veteran of the ill-fated Langsdorff expedition.⁵ They set off for São Paulo in 1833, spent the rainy season in Campinas, and then headed north, intending to pass through the province of Goiás. However, repeated bouts of fever delayed them so much that they opted for a shorter route across the northern part of Minas Gerais province (Holten and Sterll 2010:106–28). The immediate result of this expedition was an important botanical paper, which like Lund's other work was published in Copenhagen (Lund 1837a). Herein, Lund discusses the effects of fires on the *cerrado* (Brazilian savannah vegetation), stating his conviction that they occurred before the arrival of the Europeans in Brazil. This understanding would later serve his interpretation about the extinct megafauna way of life (Lund 1841b, 1846).

In the village of Curvelo, in the north of Minas Gerais province, Lund had an accidental and decisive encounter with his compatriot Peter Claussen.⁶ A common industry of this region was the extraction of saltpeter from caves for the manufacture

³Small passerine bird inhabiting forests in Brazil, Argentina, and Paraguay (Family: Thraupidae). Lund studied the *Euphonia* genus which today is attributed to the Fringillidae family, subfamily Euphoniinae.

⁴Georges Cuvier (1769–1832), French zoologist, instrumental in establishing the fields of comparative anatomy and paleontology. Alexander von Humboldt (1769–1859), German geographer, explorer and diplomat, known for his expeditions in Latin America. Henri Milne-Edwards (1800–1885), French zoologist, publisher of *Annales des sciences naturelles*. Jean Victoire Audouin (1797–1841) French entomologist and ornithologist.

⁵Luiz (Ludwig) Riedel (1790–1861), German botanist, became director for the department of botany and the botanical garden of the Natural History Museum of Rio de Janeiro.

⁶Peter Claussen (1804–1855), also known as Pedro Claudio Dinamarquez and Chevalier Claussen. Danish natural history collector, business man, and adventurer.

of gunpowder. Claussen was heavily involved in this industry, as he possessed several caves at his nearby farm. At the end of the extraction process, huge bones were frequently found, which the local people believed were the remains of “giants.” Claussen, however, was better informed. He had participated in the expeditions of Friedrich Sellow in the 1820s and had at that time established a lucrative trade, selling fossilized bones to European museums.⁷

Lund immediately realized the significance of Claussen’s findings and changed his travel plans. After accompanying Riedel to Ouro Preto, Lund returned to Curvelo to explore the caves with Claussen. Two important incidents marked Lund’s return to Curvelo. First, at Claussen’s home, he met the Norwegian Peter Andreas Brandt, who for almost 30 years went to work with him as his illustrator and assistant.⁸ Second, Lund realized that he could not stand Claussen’s company. Indeed, they crossed paths many times in the years that followed (for further details, see Holten and Sterll 2010:131–34, 164–172).

In October 1835, Lund and Brandt traveled from Curvelo to Lagoa Santa where they intended to spend the rainy season. Lund, however, was captivated by the little town by the lake, and after 2 year of residence, he purchased a house on a large plot of land that went right down to the lake’s edge. This house became his home for the next 43 years and the center of his scientific activity. The grounds were large enough for an ever-increasing number of sheds to store and study the findings from the caves. The garden was planted with specimens of the regional vegetation, including orchids, and gardening became Lund’s main leisure activity. It also housed several animals – armadillos (Fig. 2.2), bush dogs, sloths, monkeys – that the boys from the town used to bring to him. In addition to company, these animals were utilized as study objects and references for the past megafauna behavior.



Fig. 2.2 Armadillo. Drawing by Lund (Museum of Natural History, University of Copenhagen)

⁷Friedrich Sellow (1789–1831), German botanist and naturalist. One of the earliest scientific explorers of Brazil.

⁸Peter Andreas Brandt (1792–1862), Norwegian artist and publisher; Lund’s illustrator and assistant.

Excavations

During 10 years of work in the Lagoa Santo region, Lund excavated and researched innumerable caves. What follows is a summary of his enterprise.

In 1836, Lund undertook three journeys. Two of them were to the Fazenda do Mocambo and the Cerca Grande cave complex (Lund 1837c), and one was to the more distant Sete Lagoas region.

In 1837, Lund made two trips, the first returning to the Fazenda do Mocambo where Lund visited the Cerca Grande cave and the Lapa do Baú. On his second trip, Lund made a brief and unfruitful visit to the Sumidouro cave before returning to Cerca Grande and Baú.

In the years that followed, Lund cut down his trips to one every year, as he had already collected an enormous quantity of bones. In 1838, he visited the Lapa do Baú cave and made another try in the region of Sumidouro. In 1839, he began explorations at Sumidouro and visited the Escrivânia cave complex for the first time, before completing the excavations at Cerca Grande.

The decisive year of 1840 was marked by the first discovery of fossilized human remains. It was made at Lapa de Sumidouro, which is usually flooded. Lund wrote:

Sunday, (July) 26. Visit to two caves in the rock at the eastern extremity of the Sumidouro Lake one of which I had been inside the year before but I had not got very far because it had been full of water. In a corridor of that cave, which had been under water the year before and probably becomes submerged periodically during the rainy season, two extraordinarily old, completely petrified human skeletons were found, in addition to some animal remains.⁹

In 1841, Lund concentrated his efforts on the Baú and the Sumidouro caves, as both continued to yield good results. The following year, he visited Baú and Escrivânia until the work was interrupted by a local insurrection, which stopped any further travel.

The year of 1843 became Lund's most productive one – he undertook no fewer than six expeditions, simultaneously excavating various caves and continuing work until the height of the rainy season. The largest project was the emptying of the Sumidouro cave to such an extent that it became possible to obtain a complete view of its geology and evaluate the deposits of human bones found together with those of extinct animals. The project was destined to yield one of his most important papers (Holten and Sterll 1998; Lund 1845a, b).

The last year of excavations, 1844, was dedicated to the complete removal and registration of all the material from the Lapa da Escrivânia V (Lund 1846). This was a daring experiment attempting to obtain an absolute dating of the contents of the cave. The cave's entrance was a vertical shaft stretching downward from the rock surface. A scaffold was mounted over the entrance, and during three and a half months, a dozen men extracted 6552 barrels of earth from within. The mandibles of small mammals contained in one barrel - chosen at random - were counted. Then followed a series of complicated calculations that considered the reduced numbers

⁹Lund: Travel Diaries (manuscript); Royal Library, Copenhagen, Add. 1128 4°.

of animals in the deeper layers of sediment. From that inventory, Lund estimated that the cave had contained 7,590,650 animals, most of them mammals and representing a total of 56 species.

The next step was the result of many years of ornithological observations. Lund was quite familiar with the white owls (*Glaucidium perlatum*) living in the caves, one couple to each cave, and he knew that each couple captures and devours about four mice a day, afterward regurgitating their bones. If the cave had been occupied without interruptions, the owl's devouring of 7.5 million mice would have required no less than 5137 years.

This estimate was in concordance with the high age of the Brazilian central plateau that Lund had emphasized in his scientific memoir on the excavations at Sumidouro (Lund 1845c). Lund's investigation of the owl pellets is remarkable as one of the first qualified attempts ever made to obtain an age estimate of paleontological material based on empirical observations.

Working Methods

Work in the caves was often carried out in complete dark, only sparsely illuminated by torches or candles. To reach the bone breccia, the layers of stalagmite covering most of the sedimentary deposits had to be removed using hammer and chisel. When the breccias were brought to the surface, the next step in the process was to evaluate their contents, cutting free the more interesting parts for supplementary investigation. In addition to thousands of isolated bones, Lund's collection included a great number of bone breccia to help the interpretation of how the bones were deposited. Lund himself described the organization of this work in these words:

First the breccias are separated and divided into two classes: those that should be preserved just as they are, and those that should be sacrificed to extract the bones. The former, according to the circumstances, may undergo a finishing process, partly to eliminate any useless parts, and partly to obtain characteristic surfaces showing not only the bones but also the material surrounding them. The second class calls for more work and the use of different instruments, according to the hardness of the mass and the condition of the bones. For three months, two people have been busy at this work under my constant supervision. Similarly, the bones are separated into two groups: one comprising the complete bones and those with ancient fractures; the other comprising those with recent fractures and all the broken parts with the same characteristics. In spite of all the care taken, many bones are broken during the excavation or in the separation process and it is not always possible to localize and adjust the parts that should fit together. Piles of broken bones and bone fragments are always accumulating, and the cleaning up this veritable Augean stable calls for great patience and implies a great loss of time. It is like a puzzle, putting each of those pieces in its proper place and afterwards gluing and reconstructing the complete bones. Naturally, only I can carry out that work and it has taken me several months. Afterwards, each bone has to be examined, determined, numbered and introduced in the catalogue and, as you, Sir, are well aware, my own house does not have space enough for all those things, so I have packed up a large part of them and sent them to Rio. Only after all those preparations have