


História, Ciências, Saúde-Manguinhos



This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited. Fonte; http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0104-59702014000300809&lng=pt&tlng=pt. Acesso em: 17 dez. 2019.

REFERÊNCIA

LOPES, Maria Margaret; PODGORNÝ, Irina. Between seas and continents: aspects of the scientific career of Hermann von Ihering, 1850-1930. **História, Ciências, Saúde-Manguinhos**, Rio de Janeiro, v. 21, n. 3, p. 809-826, jul./set. 2014. DOI: <http://dx.doi.org/10.1590/S0104-59702014000300002>. Disponível em: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0104-59702014000300809&lng=pt&nrm=iso. Acesso em: 17 dez. 2019.



Between seas and continents: aspects of the scientific career of Hermann von Ihering, 1850-1930

Maria Margaret Lopes

Guest professor, Programa de Pós-graduação em Ciência da Informação/
Universidade de Brasília; researcher, Núcleo de Estudos de Gênero, Pagu/
Universidade Estadual de Campinas.
Cidade Universitária Zeferino Vaz
13083-870 – Campinas – SP – Brazil
mariamargaretlopes@gmail.com

Irina Podgorny

Researcher, Facultad de Ciencias Naturales y Museo/
Universidad Nacional de La Plata; senior grant holder,
IKKM Institut Bauhaus-Universität Weimar.
Paseo del Bosque s/n
1900 – La Plata – Argentina
podgorny@retina.ar

Received for publication in November 2013.

Approved for publication in March 2014.

Translated by Rebecca Atkinson.

<http://dx.doi.org/10.1590/S0104-59702014000300002>

LOPES, Maria Margaret; PODGORNÝ, Irina. Between seas and continents: aspects of the scientific career of Hermann von Ihering, 1850-1930. *História, Ciências, Saúde – Manguinhos*, Rio de Janeiro, v.21, n.3, jul.-set. 2014. Available at: <http://www.scielo.br/hcsm>.

Abstract

This paper covers some periods in Hermann von Ihering's scientific trajectory: his training in zoology in Germany and Naples, his international activities based in Brazil, and his return to Germany. It deals with aspects of the formulation of his theories on land bridges. It focuses on the network of contacts he maintained with German émigrés like himself, and primarily with Florentino Ameghino, which allowed him to interact in international scientific circles. It mentions excerpts of his letters and his publications in the periods when he began corresponding with Ameghino (1890), when he travelled to Europe in search of support for his theories (1907), and when he published his book on the history of the Atlantic Ocean (1927).

Keywords: history of science; Hermann von Ihering (1850-1930); land bridges; Atlantic Ocean.

During the Secondary and also at the beginning of the Tertiary, the organic life of Ethiopia possessed a great kinship with that of Brazil. From this emerged the theory that I have defended since 1893, the theory of *Archhelenis*, a land bridge that then linked both regions. If this theory is correct, no Atlantic Ocean existed during the Cretaceous and Tertiary ... More recent researches have supplemented the data published in 1907 and encouraged me to write this work, which seeks to resolve the problem of the history of the Atlantic Ocean through a comparative study of the coastlines of today and yesteryear ...

(Ihering, 1927a, p.III).

The Atlantic Ocean did not yet exist in the Cretaceous and Eocene periods, and there were land bridges connecting parts of Africa and South America, according to the theories of Hermann von Ihering expounded in the early twentieth century. Unlike today's accepted theory based on Plate Tectonics (Wilson, 1976), Hermann von Ihering (1850-1930) – director of Paulista Museum (Museu Paulista) in São Paulo from 1894 to 1916 and therefore a legitimate member of the scientific community studying the sciences of biogeography, zoology and paleontology – defended the existence of such land bridges in many of his articles from the 1890s to the late 1920s. He based his beliefs on his studies of fossilized and living mollusks and on the work of Florentino Ameghino (1854?-1911),¹ a renowned specialist on South American mammal paleontology and director of the Buenos Aires Museum (Museo de Buenos Aires) from 1902 to 1911.²

In his works from the 1890s, Ihering strongly refuted the conceptions put forward by Wallace (1823-1913) about the permanence of the great oceanic basins. Later in his career, in the first decades of the twentieth century, like many others who subscribed to land bridge theory (Greene, 1985), he also expressed criticism of the continental drift theories proposed by Frank Taylor (1860-1938) and Alfred Wegener (1880-1930) (Oreskes, 1999, 2002; Frankel, 2012).

This article investigates certain periods in the scientific career of Hermann von Ihering: his education in zoology in Germany and Naples, his international career while based in Brazil and on his return to Germany. We cover certain aspects of the development of his land bridge theories, especially the network he maintained with German émigrés like himself and primarily with Florentino Ameghino, which allowed him to interact in international scientific circles. We also mention fragments of his letters and publications at the time he was beginning his correspondence with Ameghino in 1890, on his trip to Europe to drum up support for this theories in 1907, and on the publication of his book about the history of the Atlantic Ocean (Ihering, 1927a).

“Infected by the Jena epidemic”

Hermann Friedrich Albrecht von Ihering was born on October 9, 1850 in Kiel, and died on February 24, 1930 in Büdingen, Germany. He moved to Brazil in 1880, aged 30, after his marriage on April 26, 1880, to Anna Maria Clarz Belzer Wolf (1846-1906), a widow with a

10-year-old son, against the wishes of his father, a well-known German jurist and Göttingen professor, Rudolf von Ihering (1818-1892). He expected his son to go on the planned trip to South America then return to Europe to take up an offer to lecture at the University of Warsaw (Losano, 1992; Azevedo, 2000).³ In Germany he had studied at Giessen. Under the influence of Rudolph Leuckart (1822-1898), he studied medicine from 1868 to 1873 in Berlin and Göttingen, where he was Carl Claus's (1835-1899) zoology assistant in 1873 until Claus moved to Vienna University. Claus had studied under Leuckart in Giessen and specialized in crustaceans, coming to oppose the theories proposed by Haeckel (1834-1919). In a work published in *Zeitschrift für Ethnologie* in 1873 on anthropology, another topic that interested him his whole life, Ihering presented himself as a doctor and assistant at the Zoological Institute of Göttingen. His articles give no clues as to his institutional ties or in which periodicals he published his academic output.⁴ In 1874, it appears that Hermann von Ihering accepted – since there is a decree to this effect – a position as professor of zoology at the National Academy of Exact Sciences at the University of Córdoba, which Hermann Burmeister (1807-1892), a German who ran the Public Museum of Buenos Aires (Museo Público



Figure 1: A young Hermann von Ihering (Available at <http://www.kb.dk/images/billed/2010/okt/billeder/object145452/en/>)



Figure 2: Hermann von Ihering with his first wife, Anna Maria Clarz Belzer Wolf (Available at <http://www.kb.dk/images/billed/2010/okt/billeder/object145453/en/>)

de Buenos Aires) (Podgorny, Lopes, 2008), was forming in Argentina, but gave up the idea after receiving a better offer in his country (Burmeister, 1874, p.506-507). From Göttingen, Ihering returned to Leipzig, where he studied under Leuckart as his assistant.

In 1875, Ihering spent some time as a trainee at the well-known *Stazione Zoologica* of Naples, where he had spent his winter vacations with his father. Founded in 1872 by zoologist Anton Dohrn (1840-1909), *Stazione* was a model institution for the “re-naturalization” of laboratories. Marine laboratories, which were being created throughout Europe and the USA based on this model, took shape as diversified spaces that combined natural and built areas. As part of a program that was reacting against the excesses of laboratory-based morphology, these “infrastructure experiments” called for the scope of the discipline to be expanded. They were about reconnecting the world of the laboratory with the world of nature through boundary zones, in which field and lab work coexisted, opening up new potential for research (Kohler, 2002). Despite the influence of Haeckel’s evolutionary morphology program at Jena, researchers like Dohrn proposed that modern evolutionary biology should not be limited to morphology alone. These new spaces were constituted to harbor broad-based biological studies, including physiology, and incorporating, as Dohrn said, the study of *Lebensweise der Tiere* – the habits and living conditions of animals –, repeatedly stressing that general biology could not be confined to laboratories or museums (De Bont, 2009, p.201).

Dated Naples, February 7, 1879, one of Ihering’s many articles on the comparative morphology of mollusks⁵ was published in the well-known *Zoologischer Anzeiger*, edited in Leipzig by Julius Victor Carus (1823-1903), who translated Darwin into German and was one of the leading lights in this golden era of German zoology. The periodical, founded the year before, came out every other week, and served as a much-needed communication channel for the research findings of the new generation of German zoologists under constant pressure to publish their work (Nyhart, 1995).

Ihering’s doctorate in zoology about the ontogeny of *Cyclas* (fresh water mollusks), which he defended at the University of Göttingen, was published in Leipzig in 1876. In the same year, Ihering also published his *Habilitationsschrift* (equivalent of a doctoral thesis), obtained in Erlangen, and in 1878 he was referred to in the *Zoologischer Anzeiger* as a *Privatdocent für Zoologie* (freelance lecturer in zoology) at the Zoology Institute of the University of Erlangen, run by Emil Selenka (1842-1902). Selenka, another member of the select group of German zoology professors,⁶ was simultaneously trying to attract students to his small university in Bavaria and, like his colleagues, concerned about the future of these young researchers attracted by the potential ramifications of Haeckel’s theories. In 1879, the personal section of *Zoologischer Anzeiger* announced that Ihering had left Erlangen and gone to work as a lecturer in Leipzig.⁷

Ernest Haeckel’s formulations in the 1870s, which combined evolutionary morphology with empirical research (studies of limestone sponge embryos) based on his fundamental law of biogeny (that ontogeny recapitulates phylogeny) and his *gastrea* theory⁸ – the cornerstone of his evolutionary formulations –, started to take studies of germ layers as their basis for investigation. These and more crucially his opponents’ criticisms attracted a growing number of people keen to take part in the competitive environment that had taken shape in Germany’s universities (Nyhart, 1995). One of the areas of empirical research

that was on the rapid increase was precisely about establishing whether germ layers also developed in the countless organisms Haeckel had not studied.

These theories opened up a rich field of research for the young scientists, who could already count on new microscopy techniques for observing, dying, fixing and dissecting embryological material to establish systematic relationships between living organisms and their predecessors, drawing on comparative anatomy, embryology, morphology and paleontology (Nyhart, 1997). A number of theses, dissertations and articles were spawned in the period containing specific, detailed studies of different organs of different species. Ihering, for instance, published an article on the morphology of the kidneys of mollusks, in which he confirmed the existence of two renal organs in the genus *Patella*, which was already known, but stressing that both renal sacs represented two organs, as in lamellibranchia. In 1876, he had already identified affinities between *Aplacophora* and *Chiton*, creating a new class, *Amphineura* (Parodiz, 1996).

Ihering frequented the institutions responsible for the most important zoology research of the day. It is worth mentioning these institutions for the reasons proposed by different authors interested in the geography of scientific activities: namely, that at each seat of knowledge, nature has been experienced differently, objects have been analyzed from different theoretical perspectives, and different disciplinary traditions have been constructed (Livingstone, 2003). Ihering had contact with the scientific circles and institutional spaces in which the new generation of German zoologists were demonstrating the most vigorous efforts to interpret and criticize Haeckel's germ layers, including Leuckart's institute in Leipzig and Claus's in Vienna. Leuckart wrote to Claus in some "consternation" on November 26, 1876, about "Herr Dr. v. Ihering" and another collaborator, saying that he had also been "infected by the Jena epidemic" (Nyhart, 1995, p.196-197).

Ihering's doctoral thesis about the genus *Cyclas* was clearly part of this critical context: "how could the development of organs be understood when their adult state seemed homologous, but they took different lines of development?" Refuting Haeckel's theories, Ihering argued that the ontogenic development of the germ layers in the *Cyclas* did not constitute a reliable source of information about their origins. In his 1877 monograph about the comparative anatomy of the nervous systems and phylogeny of mollusks, Ihering was more emphatic on the topic, stressing the greater reliability of conducting comparative anatomy studies of adult forms. When Leuckart commented that Ihering had succumbed to the "Jena epidemic," he was not saying that his former student had become a firm follower of Haeckel's conceptions, but rather that he had been attracted to "the domain of the phylogeneticists and perhaps their use of a controversial, speculative tone" (Nyhart, 1995, p.196-197).

Ihering himself commented that these formative years and the influence of Virchow (1821-1902), Ernest Haeckel and especially Rudolf Leuckart, his professor at Giessen and Leipzig, were decisive for his career. Under pressure to divulge his research and gain an academic position, Ihering published at least thirty articles in the leading zoology and anthropology journals published in German – *Zoologischer Anzeiger*; *Archiv für Naturgeschichte* and *Zeitschrift für wissenschaftliche Zoologie* –, between 1872 and 1880, when he moved to Brazil, and it was to these journals that he submitted most of his work throughout the rest of his career. Even though his research focused on mollusks, it seemed to follow the orientation of his professors, who preferred, in the few competitions for posts that opened up, for candidates to

have a broader background, encompassing studies of different organs and classes of animals. If factors of a personal and professional nature conspired to attract Ihering to Brazil, there can be no doubt that the competitiveness of German zoology⁹ and the shortage of jobs were among them.

Looking back on his half century of scientific work, Ihering himself considered his first ten years of academic life as having been dedicated primarily to the morphology and phylogeny of mollusks. These studies were followed by forty years devoted to the development of science in Brazil. His studies of marine mollusks, zoogeography and conchology of the Tertiary formations of Patagonia unveiled to him the history of the Atlantic Ocean and its former landmasses (Ihering, 1922).

Networks, shells, letters, continents and oceans

From his arrival in Rio Grande do Sul in 1880 to his appointment as director of Paulista Museum, Ihering mostly published in German as a *Naturalista des brasilianischen Reichsmuseums* (naturalist of the Brazilian Imperial Museum). He lived in Taquara until 1883, and every year spent time in Pedras Brancas (now Guaíba), Rio Grande and São Lourenço do Sul. As of 1885, the year in which he gained Brazilian citizenship, he spent seven years on an island in the mouth of the Camaquã river, which came to be known as “Doctor’s Island”. In several of his articles, Ihering stressed that his medical training had been very helpful for his and his family’s survival in their first years in Brazil. Faced with the impossibility of continuing to work as a travelling naturalist for the National Museum of Rio de Janeiro (Museu Nacional do Rio de Janeiro) at a distance because of a change in the republican legislation concerning the civil service (Lopes, 2009), he looked for work at the Montevideo Museum (Museo de Montevideo) and in São Paulo, where Orville Derby, head of the São Paulo Geography and Geology Commission (Comissão Geográfica e Geológica de São Paulo), arranged for his appointment as director of Paulista Museum (Lopes, Figueirôa, 2002-2003).

When Ihering was still working for the National Museum and living in Rio Grande do Sul, occupying himself with his study of the region’s mammals and mollusks, he began corresponding with Florentino Ameghino. It was January 1890, and Ameghino had just published a broad-ranging monograph with a 1,028 page atlas, called *Contribución al conocimiento de los mamíferos fósiles de la República Argentina*, which was of the greatest interest to Ihering. They commenced an enduring, intense exchange of letters, shells, publications and information; indeed, Ihering’s partnership with Ameghino and his theories about the geographical distribution of mollusks and land bridges is already explicit in his first articles from the period.

In 1891, an article of his entitled “On the ancient relations between New Zealand and South America” was introduced as the subject of discussion at a meeting of the Philosophical Institute of Canterbury, New Zealand, by Frederick Wollaston Hutton (1836-1905). Hutton had written *Manual of the New Zealand Mollusca* in 1880, and was curator of the Canterbury Museum, president of the New Zealand Institute, and profoundly interested in the history of the Pacific Ocean.¹⁰ Ihering’s article already discussed the former connections between continents, and already demonstrated how wide a network of correspondents he had, as well

as his criticisms of Wallace, as we have commented on in more detail in other publications specifically on the topic.¹¹

In the first lines of the article in which Ameghino is mentioned, Ihering thanks Hutton for having sent him a copy of his *On the origin of the fauna and flora of New Zealand: presidential address to the Philosophical Institute of Canterbury*, of 1884, mentioning that the work had inspired him to write “Über die alten Beziehungen zwischen. Neuseeland und Südamerika” for volume 18 of *Das Ausland* (1891), a periodical which, modeled on the *Foreign Quarterly Review*, provided a communication channel for the German community the world over, and one in which Ihering published several articles. Ihering’s article was translated into English by Swiss Henri Hans Heinrich Suter (1841-1918),¹² an émigré naturalist, like Ihering, who had moved to New Zealand in 1887 and studied snails. In 1900 he published an article in *Revista do Museu Paulista* about the classification of land snails Ihering had sent him. Hutton, Suter and Ihering shared the same interests about the possible ancient connections between the continents of the southern hemisphere and their respective fauna.

What was at stake was the existence in the past of two of the now submerged continents: Atlantis, in the Atlantic, and Lemuria, in the Indian and Pacific oceans. Atlantis already had a long tradition in western records. The name Lemuria had been coined in the 1860s by British zoologist Philip Sclater to refer to a hypothetical land bridge between Africa, Madagascar and southern Asia to explain the observed similarities between the animal fossils in these now distant continents. The possibility of such connections was also popularized in the form of maps by Haeckel, to explain the absence of the “lost link” in fossil records (Bowler, 1996; Ramaswamy, 2004; Richards, 2008). In an 1891 article Ihering commented that Haeckel considered the existence of Lemuria in his works on the geographical distribution of animals, but not Atlantis.

Stressing the apparent randomness of Wallace’s arguments, Ihering summarized his criticism in the following points, already detailed in Lopes and Podgorny (2007, 2009). First, he argued that Wallace made little distinction between the different groups in the animal kingdom, especially their existence over geological time. Ihering had far greater faith in his own studies, especially into Naiadae and fresh water fauna in general, than in the birds and mammals that Wallace supposed to be more reliable for reconstructing the geological history of Polynesia. To make matters worse,

Mr. Wallace’s explanation of the distribution of the Lacertidæ through Polynesia as far as the Sandwich Islands by means of a migration across the ocean is just as bold a hypothesis as his attempt to explain the occurrence of identical fresh-water fishes in New Zealand and Patagonia by the transport of their fry on icebergs. To such theories may those adhere who wish to save Wallace’s hypothesis of the stability of the continents and depths of the seas; but one cannot ask unprejudiced scientists to accept such incredible explanations. (Ihering, 1891, p.443).

What interests us specifically for the purposes of this article is that Ihering challenged the ideas Wallace set forth in the second edition of his book on Darwinism, published in 1889, about the permanence of continental and oceanic areas based on arbitrary depths to establish the boundaries of ancient continents. Ihering was not Wallace’s only critic. Several authors, including the president of the Royal Geological Society, William Thomas Blanford

(1832-1905), and stratigrapher Alfred John Jukes-Browne (1851-1914), also contested this fixed depth limit (1,000 fathoms) proposed to define the lands, islands and waters to be studied as “continental” or “oceanic”.

At the time of the publication of the article commented on by Hutton, Ihering already had 15 years of anatomical observations of the smallest details of several classes of animals under his belt. He was already practiced in arguing against the leading authorities of the time, and had acquired ten years’ field work in Rio Grande do Sul. He therefore began his correspondence with Ameghino proposing that their work on mollusks would be useful to complement the recent contributions of paleontology in Argentina about the phylogeny and geographical distribution of the *Plagiaulacidae* family of fossil mammals. Ihering offered to date the geological formations in La Plata and Patagonia, where Ameghino had obtained his mammal fossils, in exchange for the receipt of mollusk fossils from those regions to complete his collections and build up a continental overview of the geology of the south coast of the Atlantic. Ameghino asked Ihering for some mammal skulls, because with his wide network of fossil finders and his brother Carlos’s (1865-1936) fieldwork, he was sure to be able to offer Ihering mollusk fossils and living mollusks from Argentina’s different regions and geological formations (in Ameghino, 1935, p.119-121, letter dated Jan. 12, 1890; and p.121-123, letter dated Oct. 4., 1890). It was this cooperation with Florentino Ameghino that enabled Ihering to trace the history of the Atlantic Ocean and demarcate his former Brazilian-African land connection of Archhelenis (Ihering, 1907a).

It was in the first decades of the century that Ihering and Ameghino were involved in what Otto Wilckens (1876-1943), a paleontologist from Freiburg, called the Patagonia controversy. As their ideas became known, their stratigraphic sequencing of Patagonia – which changed many times in their letters and publications as new classifications were made – started to be questioned by Argentinean, European and especially US specialists (this latter group from the Princeton Expeditions), as discussed elsewhere.¹³ In these controversies with the Americans, while Ihering’s theory about the former continent of Archhelenis was more widely accepted, Florentino Ameghino’s interpretations of the geological age of the landmasses, the evolution of the mammals, and their dispersion from South America were more severely criticized. In the midst of these disputes, Ihering travelled to Europe and Argentina to visit his European colleagues involved in the debate, as suggested by Irina Podgorny (2005a), while also recovering his health, taking part in conferences, publicizing his most recent publications, visiting museums, marrying again, and meeting Ameghino, who, despite their intense correspondence, he did not meet until 1907.

Ihering started to plan his trip shortly after the death of his first wife in August 1906. He was finishing his book, *Archhelenis und Archinotis* (Ihering, 1907a), and a piece on “Les mollusques fossiles du tertiaire et du crétacé supérieur de l’Argentine” (Ihering, 1907b) to occupy six hundred pages of *Anales del Museo Nacional de Buenos Aires* made available by Ameghino. Unable to travel before finishing the final chapter of this text, he started to express in his letters to Ameghino his interest in visiting Argentina on his return from Europe. He was keen to conduct a grand tour in Ameghino’s company, considering that if they went together, they would be “assured a scientific outcome of importance.” He listed a number of places where he hoped to complete his collections of the Tertiary deposits in the

Superpatagonian of Santa Cruz, Yegua Quemada, La Cueva, the Magellan Formation, Carmen Silva, Punta Arenas and, if possible, some deposits from the Chilean coast (letter dated Aug. 28, 1906, in Ameghino, 1936, p.231-232). Ameghino expressed his desire to take part in such an expedition, but thought it unfeasible to take on quite the proportions Ihering intended (letter dated Sep. 15, 1906, in Ameghino, 1936, p.233-234).

“The assurance of a scientific outcome of importance” and Ihering’s desire to set foot on Argentinean soil to personally see the outcrops where his shells came from meant clearing up some of his own doubts about the geological ages of the strata in the geological formations. Ameghino had entrusted this work to the experienced eyes of his brother, Carlos, who was in charge of doing the field work. For Ihering, the trip would definitively consolidate his position towards the Americans’ questionings.

With the date of the trip delayed and its size diminished, the friends continued to work on the details of their respective tasks. Ameghino’s new publications had almost “the nature of a Geological Manual of Patagonia.” Ihering was increasingly inclined to agree “on almost every point” with his friend (letter dated Sep. 21, 1906, in Ameghino, 1936, p.234-235). His primary doubt had to do with the delimitation of the Upper Cretaceous, and studying just mollusks, he explained, he had to proceed with caution (letter dated Jul. 20, 1906, in Ameghino, 1936, p.229-230). In the letters in which he commented on his perusals of the international publications, Ihering asked, as always, for more shells and specimens to refine his analyses (letter dated Nov. 14, 1906, in Ameghino, 1936, p.238-239). “Remember the ‘selachii’ teeth from Patagonia you promised me. Are there no Teleost otoliths? I am again interested in them in these studies of mine of fish and I cannot understand their absence from the Patagonian Tertiary” (letter dated Dec. 27, 1906, in Ameghino, 1936, p.244-245). Ameghino’s reply: “I know of no otoliths of the Patagonian Tertiary” (letter dated Jan. 15, 1907, in Ameghino, 1936, p.245). The letters are full of this kind of detail and much else, demonstrating stage-by-stage how they put together their publications, changed their opinions with each new classification, criticized their opponents, and maintained such close cooperation.

Ihering explained to Ameghino that he was visiting Europe on his doctor’s orders in the second half of April in the company of his daughter, and that he would return via Buenos Aires to meet his friend personally (letter dated Jan. 22 1907, in Ameghino, 1936, p.247). He confided to Ameghino that he hoped to gather detailed information from the specialists he met on his trip. Hopeful, Ihering did not doubt that Ameghino’s book on mammal fossils and his on mollusks would finally change the minds of the foreign scholars. He added that “the main thing is that in possession of so many and such important data, our conviction is founded on safe ground” (letter dated Apr. 6, 1907, in Ameghino, 1936, p.250-251).

In Europe, Ihering visited museums, colleges and institutions and divulged his own work. At Kaiserlich-Königliche Zoologisch-Botanische Gesellschaft in Vienna, he gave a conference on the origins of Neotropical fauna, which was attended by almost all Vienna’s zoologists and botanists (letter dated Jun. 14, 1907, in Ameghino, 1936, p.254-256). In it, he divulged his compilation works, *Archhelenis und Archinotis* (Ihering, 1907a), published in Leipzig, and “Les mollusques fossiles”, published in Buenos Aires (Ihering, 1907b).¹⁴

The translation of his talk at the Royal Imperial Society of Vienna published in *Revista do Museu Paulista* begins with his previously formulated criticisms of Wallace, for whom

“America never suffered a continuity solution” (Ihering, 1911, p.435). Ihering’s output since 1891 had clearly established that South America had not always been a zoogeographical unit, and that only as of the Pliocene had it been a continent. Prior to this, America had been a single continent, Archamazonia, encompassing central and northern Brazil, while Archiplata comprised southern Brazil, Uruguay, Argentina and Chile, connected to the south by an Antarctic continent that Ihering called Archinotis. The continent that linked Brazil to West Africa was given the name of Archhelenis (Ihering, 1907a). To Ihering’s mind, existing geological knowledge did not sustain Wallace’s theories, all the data he supplied to differentiate continental lands from islands were completely arbitrary, and the best region for disproving Wallace was America, particularly South America. Considering existing paleogeographical reconstructions and leaving open the questions about the extent of the Atlantic Ocean and possibility of the Tertiary uplift of the Brazilian coastal mountain ranges, Ihering continued to claim that Wallace’s theories, especially about the depth of oceans, should not only be rejected for South America, but were also untenable for Australia and Polynesia. Basing himself on studies of mammals and mollusks, Ihering made oblique reference to the discussions against his and Amaghino’s work. The mammals of South America, especially Patagonia, based on data produced by Ameghino, deserved greater attention: “the state of Patagonian geology has been relegated to obscurity, which is why so many different opinions have been put forward so strongly” (Ihering, 1911, p.435).

Aligning himself with the main authors who defended the then prevailing land bridge theory, he invoked the almost unanimously accepted ideas of Eduard Suess (1831-1914), author of the classic *Das Antlitz der Erde*. He also quoted Arnold Edward Ortmann (1863-1927), who had classified the mollusks from the Princeton Expeditions and supported his theory, and aligned himself with the researches of Melchior Neumayr¹⁵ to demonstrate that the theories were nothing new. His new data, obtained by him and his friend, specialists in South America, merely confirmed them and filled out some detail.

He continued to justify himself in his speech: “The strata of sediments on the Patagonian coast have proven admirably complicated, regularly alternating marine and terrestrial layers, which are sometimes almost schematically discriminated” (Ihering, 1911, p.436). All of which constituted a fine example for the purposes of comparing different marine, fluvial and land sediments, to determine the relative age of the stratigraphic sequence. In other words, Ihering’s mollusk shells confirmed the existence of terrains harboring shallow seas and rivers in former geological periods. Together with Ameghino’s studies of mammals, his investigations of land snails confirmed the existence of landmasses, since these creatures could not cross deep seas. Without committing explicitly to one of Ameghino’s central theses, that Patagonia had been the center of the global dispersion of mammals, Ihering stated that no other region offered such important information concerning “the first evolutionary development of mammals as Patagonia” (Ihering, 1911, p.436). Marsupials, apes, rodents and certain groups, such as subungulates and edentates, alongside extinct groups of this fauna, were represented in Argentina (according to Ameghino) in the oldest strata, which were taken to be from the Cretaceous (Ihering, 1911, p.436). In the year before, Ihering had written to Ameghino congratulating him on his “important discoveries

about the history of edentates. These discoveries seem to me increasingly to confirm the reliability of our hypothesis of an African-South American link” (letter dated Jan. 26, 1906, in Ameghino, 1936, p.220).

In Ameghino’s defense, Ihering ended his speech stressing that “the central point for the final sentences on the history of the fauna and flora of South America is today Patagonia, and no name has ever been so intimately connected with this province of science than that of Florentino Ameghino” (Ihering, 1911, p.453). Just as Ameghino’s studies “set the true foundations for the history of mammals in the southern hemisphere,” his mollusks had allowed him to reconstruct ancient continents and trace the history of the Atlantic Ocean (Ihering, 1911, p.453) For Ihering, the destruction of his ancient continent had started in the north during the Cretaceous, and run its course in the Oligocene. “The immense tropical sea, *Thetis* – as we call it with the great Viennese geologist Suess – came into contact with the southern sea, *Nereis*. Thus was the Atlantic Ocean formed” (p.447).

In his letters to Ameghino, Ihering wrote about the success and acceptance of his land bridge theories. Everyone he spoke to agreed with his theory about the ancient connection between Brazil and Africa. He added, however, that his friend’s work had been less well received, but said that they had both been given support at the Museum of

Natural History (Muséum d’Histoire Naturelle) in Paris (letter dated Jun. 21, 1907, in Ameghino, 1936, p.257-258), and reported in dialogue form everything he could recall of a rather disagreeable conversation in Munich with Max Schlosser (1854-1932), a zoologist and paleontologist specialized in mammals, who, though he did not refute the Archhelenis theory straight out, considered Ameghino’s ideas extremely misled and his collections poorly formed. Bearing witness to the breadth of his network of correspondents, he referred to recent communications by other peers, who made fun of Ameghino’s ideas about Tertiary man and how it would be “easy to crush him” (letter dated Jun. 14, 1907, in Ameghino, 1936, p.254-256). At the Pre-History Congress in Cologne, Germany (letter dated Aug. 15, 1907, in Ameghino, 1936, p.259-261), held by the Anthropology Society for the inauguration of the city’s Anthropology Museum, Ihering had commented on South American man, but had not received Ameghino’s letter in which he informed him of a primate, “man’s true precursor” at Monte Hermoso (letter dated Jul. 10, 1907, in Ameghino, 1936, p.256-257). This



Figure 3: Hermann von Ihering with his second wife, Meta Buff von Ihering, possibly in Alto da Serra Forest Reserve, São Paulo state, Brazil (Available at <http://www.kb.dk/images/billed/2010/okt/billeder/object147776/en/>)

finding and others that followed it fed another controversy of international dimensions involving Ameghino (Podgorny, 2009).

Come late October and early November 1907, Ihering and Ameghino had the chance to finally get to know one another personally. We do not have their letters or other documents to build up a picture of their personal impressions and what they discussed about mammals and mollusks and what seas they had crossed or not. The discussions of their theories did, however, go on, as did their correspondence about new studies, Ihering's land bridges, which extended from Central America to East Asia (letter dated Nov. 3, 1909, in Ameghino, 1936, p.315-316), the Buenos Aires Congress in 1910, Ihering's interesting voyage to La Plata River, how much he had enjoyed spending time again with Ameghino, information about international articles, constant requests for ever more shells (letter dated Aug. 6, 1910, in Ameghino, 1936, p.322-323), and the desire, in the last letter, that Ameghino quickly regain his health (letter dated Jun. 2, 1911, in Ameghino, 1936, p.337-338). Ameghino died on August 6, 1911, and Ihering continued to investigate different groups of animals and the distribution of mollusks. During his time as director of the Paulista Museum, from 1894 to 1916,¹⁶ Ihering published, alongside his journalistic texts and papers in periodicals like *Revista do Museu Paulista* and the Historical Institute of São Paulo (Instituto Histórico de São Paulo) periodical, around 25 articles about different groups of *Mollusca*, both fossilized and living, mostly in German journals. The over three hundred articles he published in German, English, French and Spanish from 1872 to 1931 were read and discussed the world over.

Final considerations

Ihering was removed from his position at the Paulista Museum in a convoluted process in which he was accused of taking away collections that he regarded as his own (Ribeiro, 1916). He spent some years in Santa Catarina with the idea, unrealized as it turned out, of building a museum of natural history there. In 1919 he visited Uruguay and Argentina, where he did some field work with Carlos Ameghino and other researchers to the north-west of Miramar to examine possible human fossil remains. He was subsequently elected a corresponding member of the National Academy of Exact, Physical and Natural Sciences (Academia Nacional de Ciencias Exactas, Físicas y Naturales) in Buenos Aires, in 1927.

When he left Brazil, before settling as an honorary professor of paleontology at the University of Gissen, Ihering returned to Stazione Zoologica in Naples in 1921 to review "all the literature I was unfamiliar with about mollusk anatomy" (Ihering, 1927a, p.IV), thanks to the support of Francesco Monticelli (1863-1927), who ran the institution from 1915 to 1924. In his last book on the history of the Atlantic, he summed up his version of what historiography had considered to be the period of crisis and even disintegration of German morphology and embryology, which had failed to deliver the hoped-for contributions to the modern interpretations of evolutionary biology (Hossfeld, Olsson, 2003). He was disappointed by the course taken by German zoology. "Unfortunately", hardly any work was now done in zoogeography, with works in "biology and ecology" being attributed to the area (Ihering, 1927a, p.IV).

In four decades, German zoology had developed in one direction, turning zoologists into histologists and embryologists, researching Mendelism, and neglecting the "good old

collections of zoology and comparative anatomy,” abandoning completely phylogeny, studies of fauna, and zoogeography (Ihering, 1927a, p.IV). Confirming the impression of his former teachers, he said that his work in zoogeography and genetic research, founded in phylogeny and paleontology, and in malacology had been undermined by the direction taken by the discipline.

Zoology could not remain as it was in Germany. Museums could not perform well without adequate physical and human resources; “the universities were no longer at their height,” and Ihering, now working as a professor of paleontology, drew comparisons. He said that South America’s geological surveys only had geologists and petrographers working for them, but that the situation in Germany was not much better. Everything was about geology, the only science that could offer some prospect of progress, although paleontology was essential for the study of sedimentary deposits. And he gave a warning: there would soon be consequences, when the pillars would buckle. Who knew how to classify “Tertiary and recent *Cochylis*”? And he went on: he had identified “selachii of Patagonia and Africa, but we do not yet know those of Germany” (Ihering, 1927a, p.V).

Possibly one of the last presentations of Ihering’s work to select audiences, as had been the case in Canterbury and Vienna, was given by British geologist John Walter Gregory (1864-1932)¹⁷ of his “Land-Bridges across the Atlantic and Pacific Oceans during the Kainozoic Era” (Ihering, 1931) at the Geological Society on June 1930, a few months after Ihering’s death in Büdingen, Germany, on February 24, 1930. In this article, which coincided completely with Gregory’s studies (Lopes, 2011), Ihering compiled the results of his book into the history of the Atlantic Ocean: “In short, it was in Miocene times that, on the African side as on the American, an open passage in the Atlantic Ocean first came into existence, by which marine animals could pass over the equator and spread far to the south” (Ihering, 1931, p.377).

Ihering referred not only to all his revised studies on mollusks, Ameghino’s contributions, and the latest literature that supported his arguments, but he also mentioned those first studies from 1891 in which, studying crustacean ectoparasites, he postulated that Argentina and New Zealand had shared shallow-water seas. These studies, which continued to be acknowledged for their pioneering investigations of the co-evolution of hosts and parasites (Brooks, 1992; Klassen, 1992), were of great value to analytical studies in the spheres of zoogeography and paleogeography, as Ihering advocated.

In the article published by the Geological Society, Ihering held back in his criticisms of the continental drift theories put forward by Wegener, Taylor and South African geologist Alexander du Toit (1878-1948). He merely mentioned that “all German geologists with whom I have been in contact” had rejected it (Ihering, 1931, p.376). The speculative, controversial tone – an inheritance from Jena – that marked many of his works was also present in his final one. In his research into the history of the Atlantic, Ihering claimed he had always given scant attention to continental drift theory, much as Wegener had paid no heed to his theory of Archhelenis.¹⁸ For Ihering, Wegener’s theories were no more than “speculation to satisfy geophysicists and would soon be relegated to history” (Ihering, 1928, p.59). They were fantasies that would vanish into thin air like soap bubbles (Ihering, 1927a).

The last chapter of his book on the Atlantic Ocean was however dedicated to tackling Taylor and Wegener’s theories. He insisted that the paleontological evidence and the detailed

phylogenetic analysis of plants and animals was perfectly sufficient to delimit the ancient migratory routes, coastlines, seas and lands. He remained staunchly against any preconceived ideas, such as the permanence of continental and oceanic areas, and also stood against the proponents of polar shift theory, which in his view did not exist and did not influence paleoclimatic change. His data clearly refuted Wegener, who supposed that Patagonia had had a glacial climate during the Upper Cretaceous, but higher temperatures in the early Quaternary (Podgorny, 2005b), which was not a new criticism. Alongside other articles on the subject (Lopes, 2011), he had written to Ameghino in 1908, commenting on his readings: “Worse still, and without scientific foundation in my view, is the book I have just received from my friend Simroth *Pendulationstheorie (Die Pendulationstheorie, de 1907)*¹⁹, according to which the position of the pole is always changing, causing temperature changes.” And he quoted a phrase attributed to Latin poet Juvenal: “It is hard not to write satire” (letter dated Feb. 13, 1908, in Ameghino, 1936, p.268-269).

The commentaries on these works that marked some moments in Hermann von Ihering’s scientific career were included in this article to highlight some aspects of his eminently international career, supported by a vast network of interlocutors. His output circulated widely as part of the dominant paradigms of his day. They illustrate perfectly the local and necessarily global dimensions of geological and paleontological studies. Unique local findings, taken from their formative environments, transported alone or as part of schema, frameworks, drawings or photos, must abide by the prevailing classification systems, altering them or not, and be given meaning in conceptual frameworks, permitting in this case that maps be drawn of times past, showing outlines of imagined continents and oceans. His networks of data providers, especially in Argentina, coupled with his position as a local observer, enabled Ihering to administrate and represent data from different sources to create new scientific theories and objects (Schäffner, 2008). He can therefore be seen as having occupied a “privileged” position for theorizing about the zoogeography of the past, especially that revealed in South America, in the present.

ACKNOWLEDGEMENTS

To Talita Gross for the translation into Portuguese of texts by Hermann von Ihering from *Die Geschichte des Atlantischen Ozeans*. Maria Margaret Lopes wishes to thank CNPq for the funding given for her research, and Irina Podgorny would like to thank IKKM/Bauhaus-Universität Weimar.

NOTES

¹ See Ambrosetti (1912) and Podgorny (1997, 2002, 2005a), works of reference on Florentino Ameghino.

² The over three hundred letters Ihering and Ameghino exchanged (Ameghino, 1935, 1936) constitute a boundless set of documents with information on the paleontology, geology, anthropology and zoogeography of South America, which we have used in several articles and continue to source as part of CNPq Project 477134/2011-4, “The global nature of scientific cultures in the early twentieth century: a study of land bridges by Hermann von Ihering (1850-1930),” of which this article is part.

³ A more complete biography of Hermann von Ihering has yet to be reconstructed. The interest in this topic was to characterize briefly the scientific and institutional environment of Ihering’s formative years. The data were gathered from articles he wrote and other sources, which contain some flaws and contradictions. Mentioning his father’s correspondence, Losano (1992) supplies data on his career in Germany and considers his marriage, which was a veritable family calamity, the reason for his moving to Brazil. Other sources consulted will be mentioned throughout the text.

⁴ The references to Ihering's articles come from the 321 works from 1872 to 1928 collated by Ihering himself (1929), the 310 works listed in a commemorative text upon the 50th anniversary of his doctorate (Ihering, 1927b), and reviews of databases such as JSTOR, Europeana and at the libraries of Paulista Museum, the Zoology Museum and Geoscience Institute at the University of São Paulo, Campinas State University, La Plata Museum, the Argentinean Scientific Society (Sociedad Científica Argentina), and especially the Bernardino Rivadavia Natural Science Museum of Argentina (Museo Argentino de Ciencias Naturales Bernardino Rivadavia) in Buenos Aires, where most of his articles and correspondence are kept. In Ihering (1927b), the author's 310 works (1872-1924), actually stretching until 1926, are classified by him into different areas of knowledge: (1) Germany, biology; (2) anthropology; (3) geography and colonization; (4) paleontology and geology; (5) botany; (6) zoology; (7) zoogeography and paleontology. The scope of this article does not permit the analysis of the works of a strictly zoological nature or their links with evolutionary studies, which would certainly require other research, or indeed the whole body of his work, which still deserves to be undertaken.

⁵ The zoological, paleontological and geological terms are reproduced here as they were used by Ihering in his articles.

⁶ Between 1865 and 1870, nine zoologists had become tenured professors (due to retain their posts for many years) at German universities, representing progress in the research of the morphology school, which, as of the late 1880s, would start to lose its edge: Haeckel in Jena, Claus in Vienna, Weismann (1834-1914) in Freiburg, Semper (1832-1893) in Würzburg, Ehlers (1835-1925) in Göttingen, Karl Möbius (1825-1908) in Kiel, and Leuckart in Leipzig (Nyhart, 1995).

⁷ *Zoologischer Anzeiger* can be accessed at <http://www.biodiversitylibrary.org/bibliography/8942#/summary>

⁸ For analyses of Haeckel's theories and his research at Jena, see, for instance, Mayr (1998) and Hossfeld, Olsson (2003). For an overview of gastrea theory, see Santos (2011, p.9), who presents it as "a set of formulations which aim to establish a definition of metazoa based on the notion of the gastrula form. The central argument of gastrea theory combines these two notions to organize an overview of the evolutionary history of the animal kingdom, based on studies of comparative embryology."

⁹ Several authors apart from those already cited specifically analyze the academic circumstances and context in Germany; see, for instance, Olesko (1989), as well as Nyhart's extensive output (1995).

¹⁰ For further information on Hutton, see <http://www.teara.govt.nz/en/biographies/2h59/hutton-frederick-wollaston>.

¹¹ Lopes and Podgorny (2007, 2009), referring to several paragraphs from Ihering's 1891 text, discuss in some detail his criticisms of Wallace, which he maintained throughout his career. Unlike these two texts from 2007 and 2009, which address Ihering's 1891 article, this one includes new literature and translations of works and syntheses of Ihering to investigate certain aspects of his career and the development of his land bridge theories and the origins of the Atlantic Ocean.

¹² For further information on Suter, see <http://www.teara.govt.nz/en/biographies/3s40/suter-henry>.

¹³ In Lopes (2001) and particularly Podgorny (2005a), in which the controversy is analyzed in detail, other letters than those mentioned in this article between Ihering and Ameghino in this period are also discussed in detail.

¹⁴ According to Ihering, the article published in *Anales del Museo Nacional de Buenos Aires* – chapter 12 of which was translated for *Revista do Museu Paulista* (Ihering, 1907c) – presents his central ideas about the formation of Archhelenis and Archinotis, published in the book which, in 16 chapters, brings together all Ihering's articles about the history of the development of the South American continent (Ihering, 1907a).

¹⁵ In his studies into the distribution of ammonite fossils, German paleontologist Melchior Neumayr (1845-1890) had insisted since 1887 on the existence of a former "Brazilian-Ethiopian continent".

¹⁶ On Ihering's activities at Paulista Museum see Lopes (2009, 2010), Alves (2001), Brefe (2005), and especially Gualtieri (2008), who analyzes Ihering's publications there.

¹⁷ John Walter Gregory (1864-1932) was a geology professor in Melbourne, director of the Geological Survey of Victoria, and a member of the British National Antarctic Expedition. He was later appointed a professor in Glasgow, and became one of the central figures in studies of mountains, especially the African rifts. For further information, see <http://adb.anu.edu.au/biography/gregory-john-walter-6479>, accessed June 26, 2014.

¹⁸ In the fifth chapter of this text, counterpointing the paleontological and biological arguments of those who defended land bridge theory, Wegener cites Ihering as one of the voices in this debate (Wegener, 1924, p.67-79).

¹⁹ Heinrich R. Simroth (1851-1917) was a professor at Leipzig, a malacologist, and a slug specialist. His theories about polar oscillations, which were nothing new, followed, amongst others, the theories of engineer Paul Reibisch. Simroth (1908) believed they helped explain different zoogeographical situations.

REFERENCES

- ALVES, Ana Maria de A.
O Ipiranga apropriado: ciência, política e poder, o Museu Paulista, 1893-1922. São Paulo: Humanitas; FFLCH-USP. 2001.
- AMBROSETTI, Juan Bautista.
Doctor Florentino Ameghino, 1854-1911. *Anales del Museo Nacional de Buenos Aires*, t.22 (s.3, t.15), p.XI-XLVIII. 1912.
- AMEGHINO, Florentino.
Obras completas e correspondência científica de Florentino Ameghino. v.22. La Plata: Taller de Impresiones Oficiales. 1936.
- AMEGHINO, Florentino.
Obras completas e correspondência científica de Florentino Ameghino. v.21. La Plata: Taller de Impresiones Oficiales. 1935.
- AZEVEDO, Maria von Ihering.
Hermann von Ihering. Painel. *Boletim CEO*, n.14, p.53-61. 2000.
- BOWLER, Peter J.
Life's splendid drama: evolutionary biology and the reconstruction of life's ancestry, 1860-1940. Chicago: University of Chicago Press. 1996.
- BREFFÉ, Ana Cristina F.
O Museu Paulista: Affonso de Taunay e a memória nacional, 1917-1945. São Paulo: Editora Unesp; Museu Paulista. 2005.
- BROOKS, Daniel R.
Introduction to the von Ihering Centenary Symposium. *Journal of Parasitology*, v.78, n.4, p.571-572. 1992.
- BURMEISTER, Hermann.
Cronica de la Academia de Ciencias Exactas durante el año 1874, por el Director de la misma. *Boletín de la Academia Nacional de Ciencias Exactas existente en la Universidad de Cordova*, t.1, p.503-508. 1874.
- DE BONT, Raf.
Between the laboratory and the deep blue sea: space issues in the marine stations of Naples and Wimereux. *Social Studies of Science*, v.39, p.199-227. 2009.
- FRANKEL, Henry R.
The continental drift controversy: Wegener and the early debate. Cambridge: Cambridge University Press. 2012.
- GREENE, Mott.
Plate tectonics and biogeography in historical perspective. *Earth Sciences History*, v.4, n.2, p.93-97. 1985.
- GUALTIERI, Regina C. Ellero.
Evolucionismo no Brasil: ciências e educação nos museus, 1870-1915. São Paulo: Editora Livraria da Física. 2008.
- HOSSFELD, Uwe; OLSSON, Lennart.
The road from Haeckel: the Jena tradition in evolutionary morphology and the origins of "Evo-Devo". *Biology and Philosophy*, v.18, n.2, p.285-307. 2003.
- IHERING, Hermann von.
Land-bridges across the Atlantic and Pacific oceans during the Kainozoic Era. *Quarterly Journal of the Geological Society*, v.87, n.1-4, p.376-391. 1931.
- IHERING, Hermann von.
Bibliographie der vom Verfasser in den Jahren 1872-1929 herausgegebenen Schriften. In: Ihering, Hermann von. Die Nephropneusten in systematischer und phylogenetischer Hinsicht. *Abhandlungen des Archiv für Molluskenkunde*, v.2, n.2, p.203-226. 1929.
- IHERING, Hermann von.
La teoría de la deriva de los continentes, de A. Wegener, y su admisión por los geólogos. *Investigación y Progreso*, v.2, n.6, p.58-59. 1928.
- IHERING, Hermann von.
Die Geschichte des Atlantischen Ozeans. Jena: Gustav Fischer. 1927a.
- IHERING, Hermann von.
Bibliographische Uebersicht der wissenschaftlichen Arbeiten (1872-1924). *Phoenix*. (Festschrift für Prof. Dr. Hermann von Ihering). n.1-2, p.18-60. 1927b.
- IHERING, Hermann von.
Phylogenie und System der Mollusken. Frankfurt a. M.: Moritz Diesterweg. 1922.
- IHERING, Hermann von.
Origem da fauna neotrópica. *Revista do Museu Paulista*, v.8, p.434-453. 1911.
- IHERING, Hermann von.
Archhelenis und Archinotis: Gesammelte Beiträge zur Geschichte der Neotropischen Region. Leipzig: Wilhelm Engelmann. 1907a.
- IHERING, Hermann von.
Les mollusques fossiles du tertiaire et du crétacé supérieur de l'Argentine. *Anales del Museo Nacional Buenos Aires*, s.3, t.7, p.1-611. 1907b.
- IHERING, Hermann von.
História da fauna marinha do Brasil e das regiões vizinhas da América Meridional. *Revista do Museu Paulista*, v.8, p.337-430. 1907c.
- IHERING, Hermann von.
On the ancient relations between New Zealand and South America. *Transactions and Proceedings*

of the New Zealand Institute, v.24, p.431-445. 1891.

KLASSEN, Greg J.
Coevolution: a history of the macroevolutionary approach to studying host-parasite associations. *Journal of Parasitology*, v.78, n.4, p.573-587. 1992.

KOHLER, Robert E.
Landscapes and labsapes: exploring the lab-field border in biology. Chicago: The University of Chicago Press. 2002.

LIVINGSTONE, David N.
Putting science in its place: geographies of scientific knowledge. Chicago: University of Chicago Press. 2003.

LOPES, Maria Margaret.
Culturas científicas no início do século XX: um estudo sobre as pontes continentais de Hermann von Ihering (1850-1930). *Livro de Anais Scientiarum Historia IV*. Rio de Janeiro: Universidade Federal do Rio de Janeiro. p.54-70. 2011.

LOPES, Maria Margaret.
Os catálogos de Hermann von Ihering: o arquivo dos resultados obtidos na exploração científica do Brasil. In: Heizer, Alda; Videira, Antonio A. Passos (Org.). *Ciência, civilização e república nos trópicos*. Rio de Janeiro: Mauad, Faperj. p.291-304. 2010.

LOPES, Maria Margaret.
O Brasil descobre a pesquisa científica: os museus e as ciências naturais no século XIX. São Paulo, Brasília: Hucitec, UnB, 2009.

LOPES, Maria Margaret.
Viajando pelo campo e pelas coleções: aspectos de uma controvérsia paleontológica. *História, Ciência Saúde – Manguinhos*, v.8, supl., p.881-897. 2001.

LOPES, Maria Margaret; FIGUEIRÔA, Sílvia Fernanda de Mendonça.
A criação do Museu Paulista na correspondência de Hermann von Ihering (1850-1930). *Anais do Museu Paulista*, v.10-11, p.23-35. 2002-2003.

LOPES, Maria Margaret; PODGORNÝ, Irina.
Paleontologia e evolucionismos no sul da América: a biogeografia de Wallace como um dos obstáculos centrais para interpretar a história geológica do hemisfério sul. In: Domingues, Heloisa M. Bertol et al. (Org.). *Darwinismo, meio ambiente, sociedade*. São Paulo: Via Lettera; Rio de Janeiro: Mast. p.143-160. 2009.

LOPES, Maria Margaret; PODGORNÝ, Irina.
Oceanos e continentes em debate. *Fênix*, v.4, n.3. Disponível em: <http://www.revistafenix.pro.br/PDF12/dossie.artigo.6-Maria.Margaret.Lopes.pdf>. Acesso em: 5 jun. 2014. 2007.

LOSANO, Mario G.
Um precursor da ecologia no Brasil: Hermann von Ihering. *Revista USP*, n.13, p.88-99. 1992.

MAYR, Ernest.
O desenvolvimento do pensamento biológico: diversidade, evolução e herança. Brasília: Editora da Universidade de Brasília. 1998.

NYHART, Lynn K.
Natural history and “new” biology. In: Jardine, Nicholas et al. (Ed.). *Cultures of natural history*. Cambridge: Cambridge University Press. p.426-443. 1997.

NYHART, Lynn K.
Biology takes form: animal morphology and the German Universities, 1800-1900: science and its conceptual foundations. Chicago: The University of Chicago Press. 1995.

OLESKO, Kathryn (Coord.).
Science in Germany: the intersection of institutional and intellectual issues. Chicago: University of Chicago Press. 1989.

ORESQUES, Naomi.
Plate tectonics: an insider’s history of the modern theory of the Earth. Boulder: Westview Press. 2002.

ORESQUES, Naomi.
The rejection of continental drift: theory and method in American Earth science. Oxford: Oxford University Press. 1999.

PARODIZ, José J.
The taxa of fossil Mollusca introduced by Hermann von Ihering. *Annals of Carnegie Museum*, v.65, n.3, p.183-296. 1996.

PODGORNÝ, Irina.
El sendero del tiempo y de las causas accidentales: los espacios de la prehistoria en la Argentina, 1850-1910. Rosario: Prohistoria. 2009.

PODGORNÝ, Irina.
Bones and devices in the constitution of paleontology in Argentina at the end of the nineteenth century. *Science in Context*, v.18, n.2, p.249-283. 2005a.

PODGORNÝ, Irina.
La Tierra en el laboratorio: las ciencias de la Tierra en el siglo XX. In: Estany, Anna (Ed.). *Filosofía de las ciencias naturales, sociales y matemáticas*. Madrid: Trotta. p.129-161. 2005b.

PODGORNÝ, Irina.
“Ser todo y no ser nada”: paleontología y trabajo de campo en la Patagonia argentina a fines del siglo XIX. In: Visacovsky, Sergio; Guber, Rosana (Org.). *Historia y estilos de trabajo de campo en Argentina*. Buenos Aires: Antropofagia. p.31-77. 2002.

PODGORNY, Irina.

De la santidad laica del científico: Florentino Ameghino y el espectáculo de la ciencia en la Argentina moderna. *Entrepasados*, v.13, p.37-61. 1997.

PODGORNY, Irina; LOPES, Maria Margaret.

El desierto en una vitrina: museos e historia natural en la Argentina, 1810-1890. Ciudad de México: Limusa. 2008.

RAMASWAMY, Sumathi.

The lost land of Lemuria: fabulous geographies, catastrophic histories. Berkeley: University of California Press. 2004.

RIBEIRO, Abrahão.

Em defesa do dr. Hermann von Ihering: diretor do Museu Paulista. São Paulo: Secção de Obras do Estado de São Paulo. 1916.

RICHARDS, Robert J.

The tragic sense of life: Ernst Haeckel and the

struggle over evolutionary thought. Chicago: The University of Chicago Press. 2008.

SANTOS, Guilherme Francisco.

A teoria da gástrica de Ernst Haeckel. Dissertação (Mestrado em filosofia) – Universidade de São Paulo, São Paulo. 2011.

SCHÄFFNER, Wolfgang.

El procesamiento de datos de Alexander von Humboldt. *Redes*, v.14, n.28, p.127-145. 2008.

SIMROTH, Heinrich.

Die Pendulationstheorie. Review by Robert E. Richardson. *Science*, v.28 n.716, p.375-379. 1908.

WEGENER, Alfred.

La génesis de los continentes y océanos. Madrid: Revista de Occidente. 1924.

WILSON, J. Tuzzo.

Continents adrift and continents aground. San Francisco: Freeman. 1976.

