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How to build a palaeontological collection: expeditions, excavations, exchanges.

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Paleontological collections in the making – an introduction to the special issue

Collections paléontologiques en développement – introduction au numéro spécial

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This special issue of *Colligo* grew out of a conference session entitled "*How to build a paleontological collection: expeditions, excavations, exchanges*", held at the 5th International Paleontological Congress in Paris, France, in July 2018. In conceptualizing this issue, which includes two additional papers specially written for it, we benefited from the comments of fellow participants and audience members as well as of the advice of several colleagues.

The aim of this session was to explore how fossil collections have been built, from the early days of palaeontology to the present. Exchanges and sales of casts and duplicates, confiscations, especially in wartime, transportation of fossils from the field to the museum / laboratory, networks of fossil exchange as well as organization of fieldwork, "bone wars", marketing strategies connecting the collection and exhibition of dinosaurs with the request of more money for the development of palaeontology were some of the topics discussed in Paris (Tamborini, 2016; also Brinkman, 2010; Roberts, 2009). Our symposium was global in geographical scope, with special emphasis on international expeditions and exchanges. It covered all types of fossil collections and collectors, from plants to mega-mammals and dinosaurs, from provincial tax collectors and bakers to very well established professors in Paris and Buenos Aires.

When it comes to exploring the making of the nineteenth-century global world, museum collections have been studied as being crucial parts of Western centers of calculation in the sense of Bruno Latour. However, the landscape of nineteenth-century collections is certainly much wider, more nuanced and complex than the current historiography, centered on the metropolitan collections assembled by northern Europe's colonial powers, has suggested. As Pietro Corsi (2020: 1) recently wrote, "*Almost inevitably, successive generations of historians, together with national and international professional associations and journals, have established a variety of (often contradictory) criteria of relevance, lists of issues and actors worth spending time on. With notable exceptions, the study of actual practices of knowledge of the past has rarely attracted sustained attention*." This issue addresses some of those neglected actors, events, contingencies, and spaces that shaped the practices of fossil collecting.

Museums and collections generated and channeled a flow of data, natural specimens and artifacts that through their relationship with people, travelled to diverse places, and in a variety of directions. This has often been overlooked, so that many important movements remain almost invisible. Against this background, the workshop suggested a change of perspective. Thus, for example, Podgorny's paper –centered on the brief existence of the Geological Society of Auvergne and the fossils from the Perrier Mountain in central France- suggests a change of perspective, proposing to explore those many collections that came to less central cities and institutions, which up to

now have largely remained out of historians' purview.

We wanted to explore the flow of data, namely bones, casts, fossil prints, etc., as well as the movements of humans and things, in order to problematize the traditional center/periphery bias of museum and collection studies. By juxtaposing alternative approaches we introduce previously understudied global narratives to shape future research agendas. Moreover, as some of the papers in this issue suggest, some museums actually acted as centers of fragmentation, confusion, and dispersion (Podgorny; Vanni *et al.*). In that sense, the papers here collected are a plea to listen to the testimonials of the historical actors that alerted of the dangers that the disorder created by the museums (which was the rule more than the exception) represented for the actual practice of many disciplines, including the practice of palaeontology, geology, and comparative anatomy (see for instance British egyptologist W. Flinders-Petrie's diagnosis of the museums in the 1900s as "*a cemetery of murdered evidence*", in Podgorny (2008), or Cuvier's complaints about the state of the Parisian collections around 1800 in Corsi 2020).

With this special issue, we aim at furthering our understanding of the diverse ways in which these collections connected places and people in most unexpected ways, generating new sociabilities. This issue thus focuses on collections in the so-called peripheries: the colonial and post-colonial territories of South America, Indochina, and the Indian Ocean, (Angst & Buffetaut; Buffetaut; Lopes; Hansen; Vanni *et al.*, Waligora; Forel) and the European provinces (Podgorny; Vanni *et al.*). It highlights how these collections, through their relationship with people, travelled and connected the world from the nineteenth up to the twentieth century, creating networks that were not necessarily centralized around either the European metropolises or the respective national museums. (Angst & Buffetaut; Waligora; see also Caciagli, and Ferrari, 2009). We deemed it worthwhile, to study these collections and the sociabilities that go with them beyond the metropolis.

Ways to build a paleontological collection include fossil collecting, sometimes in the course of expeditions to remote parts of the world (Forel), which may involve individual field work as well as large-scale excavations, the funding of which (by institutions, patrons, private means etc.) needs further consideration. The papers by Margaret Lopes, Irina Podgorny, and Mariana Waligora included in the issue, show how fossil collecting was also a collateral result of mining and/or surveying for oil and coal.

A point worth investigating was how some well-known nineteenth-century palaeontologists used the sale of fossil specimens to fund their fieldwork, careers or even their every-day life and survival: that was the case of the Ameghino brothers (mentioned by Virginia Vanni *et al.*), Auguste Bravard (Podgorny) and Santiago Roth (Hansen). Another significant way of building and increasing fossil collections, especially in the nineteenth and early twentieth centuries, was through exchange and/or purchase of fossils, either between institutions or between individual palaeontologists or fossil dealers, the topic of Hansen's paper, which shows the different actors and mechanisms that are behind the Danish South American fossil mammal collections.

We propose exploring the many factors behind the making of nineteenth-century paleontological collections in non-metropolitan settings. By highlighting the varied trajectories of people and objects travelling between the Americas, Africa, Asia, and Europe, the papers look closely at the sundry traditions and routes, which contributed to the shaping of collections (Waligora; Angst & Buffetaut; Hansen; Buffetaut; Forel). This includes investigating provincial and university museums, from monumental to one-room displays, from commercial or private endeavours to state-run sites (Hansen; Vanni *et al.*). By discussing this diversity, the papers united in this issue revise the idea of the collections as a mere by-product of colonialism and imperialism. Thus, focusing on how collections were constructed "on the move", Hansen, Vianni and Buffetaut discuss how, for instance, South American fossil mammal collections in European museums, were closely connected to the biographies of specific individuals who acted independently from the centralized and colonial logic of states.

The papers discuss how practices of fossil collecting reflected political agendas closely linked to various colonial endeavors as well as other political projects (Lopes; Forel). However, they also problematize the agency of those individuals who appealed to those agendas, combining the promise of new knowledge with the opportunity for self-promotion (Buffetaut;

Podgorny). Why should a tax collector in the middle of Auvergne or the French and Danish residents in Argentina and Brazil, collect fossil bones? Why should they invest in books, mules, and time to classify and ship these collections? Studies on specific items, such as *Glossopteris* collections, Brazilian fossil plants and mammals, and Dodo bones will further these questions, in particular adding to the workshop's main objective to also shed light on collector's stakes in acquiring and displaying these objects.

People collect things but collections bring people together (Rudwick 1997). Finally, we want to illuminate how collecting connected people around objects, crossing borders of all kinds: national, local, disciplinary, theoretical. In this vein, the papers published here (Angst & Buffetaut; Buffetaut; Vanni *et al.*; Hansen; Forel; Podgorny) discuss those hubs where such encounters happened and how knowledge production was linked with sociabilities of different kinds (Richard, 2016). Hence, they pay attention to the events that define sociability, such as gifts, theft, donations, and exchange, as well as to the institutions, activities and professions that they generated, such as scientific societies, excursions, and exchange markets (Lopes & Matos, 2015).

By researching different provincial settings as well as their intertwining, we suggest to enlarge the attention of global historians towards specific localities which – looked at more closely – might turn out to be rather translocal as they had been shaped by multiple global entanglements, too (Waligora; Forel). In this sense, we also intend to use microhistorical approaches that might help us conceptualize new ways of writing global history beyond the metropolis (Podgorny) but also to shed light on the collections our museums exhibit and keep. All in all, we underscore the necessity of a more nuanced apprehension of what the global world of the nineteenth and early tewentieth centuries was all about especially when it comes to the history of palaeontology. Focusing on palaeontological collections and sociabilities and connecting bones with archival documentation we intend to further our understanding of the reflexive potential that this history involves.

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PALÉONTOLOGIE

La guerre, la paix et la querelle. Les sociétés paléontologiques d'Auvergne sous la Seconde Restauration

War, Peace, and Quarrels: The paleontological Societies in Auvergne during the Second Bourbon Restoration

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Résumé : Cet article présente une des plusieurs « querelles au sujet des fossiles » si habituelles dans la paléontologie du XIX^e^ siècle : notre cas en particulier se réfère à la propriété des collections d'ossements de vertébrés fossiles faites dans les années 1820 en Auvergne, France. En prenant pour exemple les sociétés établies pour l'exploitation des terrains et gisements tertiaires auvergnats, on montre et discute les enjeux commerciaux, légaux, politiques et scientifiques dans le contexte si conflictuel de la Seconde Restauration des années 1820, caractérisé aussi par l'intervention de l'Église catholique dans la société française parisienne et provinciale. En réalité, la possibilité d'une géologie catholique était à la base de plusieurs initiatives. Ensuite, les dispositifs promus par la police politique (la délation, la dénonciation, la calomnie des rapports secrets) pendant le gouvernement de Joseph de Villèle influencent les pratiques scientifiques et sociales et vont modeler la communication et les transactions des sociétés paléontologiques, organisées pour l'extraction, l'exhibition, la description, la publication et la vente potentielle des ossements. Finalement, l'article pose la question de la nature procédurière qui a caractérisé l'émergence de la paléontologie dans les contextes les plus divers.

MOTS-CLÉS

Auguste Bravard
Maurice de Laizer
ossements fossiles
géologie catholique
baron de Férussac
collections provinciales
Clermont-Ferrand
France

Summary: This article presents one of several "fossil quarrels" so common in nineteenth-century paleontology: our case in particular refers to the ownership of collections of fossil vertebrate bones made in the 1820s in Auvergne, France. Taking the societies established for the exploitation of Auvergne's tertiary deposits, it discusses the commercial, legal, political and scientific issues at stake in the context of the Second Restoration of the 1820s, characterized by the intervention of the Catholic Church in French metropolitan and provincial sociability. Indeed, the possibility of a Catholic geology was at the root of several initiatives. Then, the mechanisms promoted by the political police (such as denunciation and secret reports) shaped scientific and social practices and the transactions of the « fossil associations », organized for the extraction, exhibition, description, publication and potential sale of bones.

KEY-WORDS

Auguste Bravard
Maurice de Laizer
fossil bones
religion and geology
baron de Férussac
provincial collections
Clermont-Ferrand
France

Introduction

En 1999, grâce à un projet ECOS-SUD et à des recherches aux Archives du Muséum National d'Histoire Naturelle, aux Archives nationales à Paris et aux archives du Natural History Museum à Londres, j'ai pu suivre l'activité de l'architecte issoirien Auguste Bravard et de son compatriote François Séguin (Podgorny, 2001 ; 2006 ; 2009 ; 2021). Tous deux avaient vécu en Argentine, s'occupant de la vente de fossiles aux musées des deux côtés de l'Atlantique. En 2003, grâce à la Fondation Humboldt, les recherches se sont poursuivies aux Archives et au Musée Lecoq de Clermont-Ferrand et à Issoire, dans la maison de M^me^ Jean Monghal, descendante d'Auguste et d'Emma Bravard. À l'époque, la numérisation des journaux et des bibliothèques n'était qu'un projet : aujourd'hui, les progrès réalisés dans ce sens permettent de

retrouver les livres les plus insaisissables et de lire la presse auvergnate des années 1820 partout dans le monde. Grâce à cela, les documents révélés il y a 20 ans dévoilent une histoire encore plus compliquée, « la fourmilière de la vie » – comme dirait Tolstoï – pleine de personnages les plus divers qui, du fait des destins les plus contingents, s'impliquent dans l'assemblage des collections paléontologiques et dans la contestation de leur propriété. Ces histoires, qui, sauf pour les détails, se sont répétées en Argentine, en France et dans de nombreux autres contextes, montrent que le commerce des fossiles et les pratiques connexes sont transocéaniques. Je suis reconnaissante envers les bibliothécaires et les archivistes qui ont mis à disposition tous ces documents : l'accès à ces sources, complété par les matériaux de Maurice de Laizer, réunis par le Général Hugues de Fontaines (2009) dans le livre qu'il avait rédigé sur son aïeul, est essentiel pour clarifier les nombreux ponts entre le hasard, la personnalité, l'économie et la nationalité qui, en fin de compte, montrent les passions qui animent l'histoire de la paléontologie et de ses collections.

L'article est structuré en cinq sections : la première présente l'itinéraire d'Auguste Bravard, fournisseur de fossiles et géomètre d'Issoire pour rejoindre ses partenaires dans les années 1820. La deuxième partie est consacrée à la famille noble des de Laizer et à la fondation en 1823 de la Société de géologie de Clermont-Ferrand, une initiative du comte Maurice de Laizer, un émigré qui revint sur ses domaines après avoir grandi en Russie et servi le Tsar. Dans la troisième partie, suite à la dissolution de la Société, les propositions pour une géologie catholique sont discutées dans le cadre de l'administration du ministère Villèle. Pour finir, les deux dernières sections montrent la série de trahisons croisées suite à la découverte des couches fossiles de la montagne de Perrier. L'ordre n'est pas nécessairement chronologique : au contraire, nous avons préféré montrer d'abord le débat rendu public dans les journaux de 1825 et ensuite, dans la dernière section, revenir sur le conflit qui – par contrat entre les parties – reste caché et ne peut être rendu visible que grâce aux documents privés du comte de Laizer.

Une lettre d'Issoire

Les archives du Muséum National d'Histoire Naturelle de Paris conservent une lettre non datée de l'auvergnat Auguste Bravard (1803-1861), géomètre et architecte de l'arrondissement d'Issoire (**Annexe 1**). Écrite autour de 1845, Bravard y demande à Charles Léopold Laurillard (1773-1853), ancien dessinateur, préparateur et secrétaire particulier de Georges Cuvier (1769-1832), s'il pouvait intervenir pour l'aider dans ses affaires avec l'administration du Muséum. Comme le souligne Claude Cardot (2012), « *grâce à Cuvier, le Muséum était devenu dans le monde le lieu où étaient rassemblées les plus importantes collections d'histoire naturelle. Après sa mort, les savants et les administrateurs avaient gardé comme objectif de conserver son rang et son prestige à cet établissement, notamment en y recueillant des collections privées. Et* (...) *c'est Laurillard qui était chargé de leur évaluation et de leur réception.* »

Bravard avait été l'un des nombreux correspondants de province du réseau structuré autour des recherches sur les ossements fossiles de Cuvier (Rudwick, 1997a et b). Henri-Marie Ducrotay de Blainville (1777-1850), qui à la mort de Cuvier le remplaça à la chaire d'Anatomie comparée, vers 1845, jouait un rôle décisif dans les achats des collections pour le Muséum (Appel, 1980). La dernière lettre avec les prétentions de Bravard lui avait été remise déjà quarante jours auparavant mais la réponse n'arrivait pas. Bravard, pour l'obtenir, recontacte Laurillard en faisant recours au patriotisme et à la concurrence entre les musées européens. Bravard souligne qu'un musée étranger s'intéresse à son cabinet et sa collection – « *aujourd'hui la plus précieuse du monde* » –, comprenant le produit de ses investigations paléontologiques des dix dernières années : un total de 194 espèces trouvées dans les alluvions volcaniques, les cavernes, les fentes et les terrains d'eau douce d'Auvergne. Il a fait cette collection après son mariage avec la fille du greffier d'Issoire, dont la position sociale et économique lui avait permis de reprendre les études de sa jeunesse.

La lettre fait en effet référence à ce moment passé de sa vie : Bravard revient vers Laurillard après une quinzaine d'années d'absence de la scène paléontologique française. Cuvier est mort, le mot « paléontologie » (introduit par de Blanville en 1822) est adopté en France et outre-Manche, mais les fournisseurs de fossiles – en nombre croissant – continuent à concourir pour l'attention des savants et les achats des grands et petits musées. Bravard, dans une

sorte de récit autobiographique, fait appel à de vieilles connaissances et essaie de comprendre, à travers ses anciennes alliances, l'époque et les acteurs clés de l'administration actuelle. Ce faisant, Bravard donne quelques indications sur la sociabilité scientifique en Auvergne et à Paris dans les années 1820.

Bravard occupe un lieu central dans l'histoire des sciences en Argentine, où il est arrivé vers 1850 pour mourir en 1861 dans le tremblement de terre de Mendoza. Bien intégré dans les milieux scientifiques et littéraires argentins, Bravard y continue son métier de collectionneur pour les musées de Londres, de Buenos Aires, de Paraná et de Paris. Comme le souligna Hermann Burmeister (1864 : 3 et 7), le directeur prussien du Musée Public de Buenos Aires, Bravard fait passer le nombre d'espèces connues de mammifères antédiluviens extraits du sol de Buenos Aires de huit à cinquante. Bravard reste cependant à la marge de l'historiographie sur la paléontologie en France (Buffetaut, 2015) ; d'ailleurs il est aussi oblitéré d'un épisode clé du débat géologique international : la faune disparue de l'Auvergne, un chapitre de la Restauration que Rudwick décrit en soulignant « *the centrality of central France* » (Rudwick, 2008 : 216-224). Cet essai, loin de vouloir placer Bravard au centre de l'histoire, vise à montrer le côté contingent de ces associations qui conditionnent la pratique de la paléontologie et la collecte des fossiles dans les années de la Restauration.

Bravard, né à Issoire le 29 prairial an XI (18 juin 1803) avait acquis des connaissances géognostiques à l'Ecole des mineurs de Saint-Etienne, ville alors en plein essor grâce à ses mines de charbon, où il fut admis comme boursier en 1818, en sortant en 1819 avec le diplôme de maître-mineur. Cette école fut établie en 1816 par Louis XVIII suite à la séparation de la Sarre et la Savoie de la France, qui la privait des écoles pratiques des mines de Geislautern et Peisey-Nancroix. À l'aube de la révolution industrielle, le pays a besoin de cadres pour l'extraction de la houille. Donc Bravard, attaché successivement aux mines d'antimoine d'Anzat-le-Luguet (Puy-de-Dôme), puis aux riches houillères de Brassac, parcourt le Puy-de-Dôme et la Haute Loire (Mège, 1884).

Bravard acquit une expertise en tant qu'anatomiste, en travaillant pour le comte Maurice de Laizer (1781-1855) à Clermont-Ferrand, chez Laurillard au Muséum de Paris et chez Richard Owen (1804-1892) au British Museum. Son expertise par rapport au monde des vertébrés fossiles était bien reconnue par les paléontologistes et zoologistes de Paris et Londres (Podgorny, 2017). Dans ce sens, la lettre de 1845, nous donne la clé pour entrer dans le monde de la paléontologie en province en suivant les personnages impliqués dans l'exploitation des gisements fossiles d'Auvergne découverts au début des années 1820 grâce à la popularité des travaux de Cuvier et William Buckland et à la prospection minière de la région (Podgorny, 2001, 2017). Elle montre aussi la dimension de la pratique de la paléontologie pour ces personnages que le modèle de Cuvier encourage à suivre son chemin, une promesse de réussite économique, scientifique et sociale. Ainsi, sans grande fortune, Bravard et d'autres décident d'investir du temps et de l'argent dans leur formation et dans la collecte, la publication, la description et la vente d'ossements aux musées et collectionneurs européens.

Bravard fit la connaissance de Laurillard vers la fin des années 1820, quand il se présenta devant Cuvier à Paris pour lui montrer les ossements fossiles découverts dans plusieurs gîtes en Auvergne. C'est vers 1828, probablement, que Bravard se décida à aller habiter Paris. Selon Mège (1884 ; voir aussi Pénicaud, 2002 : 51), André Étienne Just Pascal Joseph François d'Audebard, baron de Férussac (1786-1836) avec lequel il a parcouru l'Auvergne en 1822 et qui l'avait en grande estime, venait de l'attacher à titre de rédacteur spécial à la partie géologique du *Bulletin général et universel des annonces et des nouvelles scientifiques* (1823-1831), qui comprend les mathématiques, l'histoire naturelle, la médecine, l'agronomie, la technologie, la géographie, l'histoire et la science militaire, et dont les bureaux, ainsi qu'une bibliothèque importante sont installés dans la demeure de Férussac qui devint un lieu d'échanges savants de la capitale. [1]

Avec ce projet Férussac suggère un système pour la diffusion des connaissances, afin « *d'établir, après le long isolement où la guerre avait retenu les savants des divers pays, des rapports habituels et un lien commun qui pût les réunir* ». Au début du XIX^{e} siècle, l'ancien problème de la compilation des informations sur le monde naturel du monde entier s'est révélé encore plus compliqué qu'auparavant. La multiplication de sociétés savantes dans différents pays, la prolifération des revues, des faits et des artefacts, la spécialisation des disciplines et les nombreuses langues utilisées dans la propaga-

1. Bravard ne figure pas sur la liste des contributeurs du *Bulletin* de Férussac pour ces années-là. Les notes sur la géologie sont signées "A.B.", les initiales d'Ami Boué (1794-1881), géologue d'origine française qui vécut essentiellement en Allemagne, en France et en Autriche, à l'époque installé à Paris. (Sur Boué, voir Rudwick, 2010 ; Corsi, 1988).

tion de la science sont vécues comme une menace à la simple possibilité d'acquérir de nouvelles connaissances (Podgorny, 2016). Loin du réseau récepteur structuré sur l'allure du grand-homme à la façon de Cuvier et Lamarck (Rudwick, 1997b ; Corsi, 1983), le *Bulletin* travaille comme un radar et réémetteur permanent et collectif des nouvelles : il reçoit, traite et répand en temps quasi réel la production scientifique métropolitaine et en province – qu'elle soit française, allemande ou anglaise – et, pendant son existence, joue un rôle crucial en articulant les journaux de plusieurs points de la planète. Comme l'évoque Charles Laurillard en 1836 – le *Bulletin* déjà disparu – il entraîne un investissement énorme de ressources difficile à soutenir et à répliquer :

> « *Nous avons décidé dans notre première réunion administrative qu'on mettrait à la fin de chaque feuille du bulletin une liste aussi complète que possible, vu nos petits moyens, des livres qui auront paru sur les sciences naturelles. Ce serait pour remplir une partie du vide que laisse dans la science la fin du Bulletin de Férussac. Je dis une partie car comme nous n'avons pas tous les journaux comme les avait M. Férussac, notre liste ne sera pas aussi complète. Nous ne ferons point d'analyse ; cela nous entraînerait trop loin. Il nous faudrait alors des rédacteurs et nous n'avons pas les moyens d'en payer. Chaque membre du bureau se chargera seulement de la traduction des titres des ouvrages relatifs à sa partie.* » (Lettre de Laurillard à Louis George Duvernoy – cousin lointain de G. Cuvier –, à l'époque doyen de la faculté des sciences à Strasbourg, Paris, le 22 février 1836, *in* Cardot, 2012 : 130).

Selon Férussac (1825 : 440), Bravard avait porté à Paris tous les ossements à Cuvier, lequel – avec Laurillard – les a déterminés. Ils y ont reconnu, dans les seuls quadrupèdes, près de 20 espèces dont plusieurs nouvelles :

> « *à savoir, dans les Pachydermes, un mastodonte beaucoup plus petit que le* Mastodon *tapiroïde ; un Éléphant ; un Rhinocéros ; un Hippopotame ; un Tapir plus petit que les autres espèces décrites. Dans les Ruminants, deux espèces de B ufs dont une se rapproche de l'Auroch ; au moins deux espèces de Cerfs ; un Daim ; un Chevreuil, tous quatre nouveaux. Dans les Rongeurs, un Castor qui paraît être l'espèce ordinaire d'Europe. Dans les Carnassiers, au moins 2 Ours nouveaux ; trois espèces du genre Chat analogues aux Panthères; une Hyène; un Renard; une Loutre, tous trois nouvelles espèces. En 1829, à Paris Bravard publiait la « Monographie de la Montagne de Perrier* », avec deux espèces fossiles du genre *Felis* (*Megantereon* et *Cultridens*) et, en 1830, une « *Monographie du* Cainotherium *genre nouveau de la famille des pachydermes* ».

Mais à cette époque, avant partir pour Paris, Bravard cédait à l'abbé Croizet et à M. de Laizer ses collections paléontologiques, et ils décrivirent les fossiles avec des noms et une classification concurrents. En octobre 1835, Bravard, de retour à Issoire depuis 1830, épouse Jeanne Henriette Aimable Fayolle, dont il a deux filles et un fils. Dix ans plus tard, en juin 1845, Bravard a fait une nouvelle collection. A cause de « *la médiocrité de ma fortune et l'avenir de mes enfants* » et pour « *me couvrir au moins des dépenser que j'ai faites* », il l'offre au Muséum et au British Museum pour 30.000 francs. En août, le British Museum refuse l'achat (voir **Annexe 1, b**). Peut-être pour cette raison, Bravard insiste alors sur le fait qu'il est « *bien disposé à faire en faveur de mon pays d'importants sacrifices* », en lui vendant sa formidable collection réunie avec celle de l'abbé Croizet (voir **Annexe 1, a**).

Ainsi, Bravard s'intègre à plusieurs réseaux et espaces d'articulation des connaissances tant à Paris que dans son Issoire natale : d'abord, celui des fournisseurs de fossiles avec son centre au laboratoire de Cuvier, où il apprend à travailler et à observer des objets sous la tutelle de Laurillard. Ensuite, au bureau du *Bulletin*, où, en plus de rencontrer les collaborateurs et les relations de Férussac, il a accès à l'une des bibliothèques les plus complètes de Paris et acquiert un rythme de lecture de la production contemporaine en géologie et en paléontologie que peu de spécialistes peuvent égaler. Enfin, à Issoire/Clermont-Ferrand, il a non seulement accès aux chasseurs, agriculteurs et ouvriers locaux, mais grâce à ses travaux comme maître mineur et géomètre, il connaît le territoire comme peu d'autres, avec un œil éduqué à l'école de Saint-Etienne et dans les laboratoires/bibliothèques de Paris. Géomètre de la ville d'Issoire, excellent dessinateur, il avait inventé sa propre méthode, appelée « *Tachygraphie* » pour la reproduction des objets (Podgorny, 2009 ; 2005).

Par ailleurs, il ne faut pas oublier que l'origine des volcans d'Auvergne – à la fin du XVIII[e] siècle et dans les premières décennies du XIX[e] siècle – est l'une des questions les plus brûlantes de la science de l'époque, ce qui fait de cette région l'une des plus fréquentées par les chercheurs européens en quête d'une réponse sur le terrain. A Clermont-Ferrand, en revanche, l'étude des sciences naturelles est liée à l'activité minière potentielle. Dans les années 1820, les cabinets du XVIII[e] siècle sont reconstitués en fonction des nouveaux intérêts et de la création d'un public pour la science, avec le concours des journaux et des imprimeurs locaux. Une sociabilité qui intègre, pas toujours de façon amicale, les émigrés et la nouvelle bourgeoisie auvergnate, parmi lesquels on compte le comte de Laizer, l'abbé Croizet, les libraires et tous ceux qui veulent se faire un nom lié aux nouvelles sciences du XIX[e] siècle.

Les Laizer, les mines et la Société de Géologie, Minéralogie et Botanique d'Auvergne (1823-1824)

Dans sa lettre, Bravard mentionne qu'à la fin des années 1820, il a vendu ses collections à M. Laizer et à l'abbé Croizet, avec qui, en 1845, il s'est de nouveau associé pour vendre sa nouvelle collection au Muséum de Paris. Cette lettre, qui présente un déroulement tout à fait harmonieux, cache une histoire commerciale plus complexe de contrats rompus et de trahisons croisées entre les acteurs qui, vers 1825, veulent s'attribuer la découverte des gites à vertébrés fossiles de la montagne de Perrier près de la ville d'Issoire.

Maurice de Laizer (1781-1855) – qui, selon plusieurs documents, était l'employeur de Bravard – était le fils de Louis Gilbert, marquis de Laizer (1760-1808), à qui l'on attribue la découverte des vertus de l'eau d'Evian et avait eu une activité scientifique importante avant et après la Révolution. Membre de l'administration provinciale, le marquis en fut nommé président en 1788, fixant l'attention sur les travaux publics et les routes. De 1784 à 1790, il avait réuni des collections de minéraux dans son château de Montaigut-le-Blanc, un lieu de rassemblement de tous les savants qui visitaient l'Auvergne pour étudier ses volcans et ses basaltes. Sa collection, proposée à la vente comme bien national, fut finalement retirée par la direction départementale. L'inventaire mentionne que son cabinet n'avait que des roches et des substances de la pharmacopée ou de la toilette de la fin du XVIII[e] siècle :

> « *Dans la chambre de sieur de Laizer nous avons trouvé, rempli de différentes pierres composant le cabinet d'histoire naturelle, une petite table, trois bouteilles de chopine dans lesquelles il y avait du brou de noix, dans une autre de l'essence de térébenthine.* » (Extrait de l'inventaire des biens nationaux de Montaigut fait le 24 avril 1792, cité par de Fontaines, 2009 : 141, note 1 ; sur les cabinets privés existant en France vers la fin du XVIII[e] siècle voir Lacour, 2012 ; 2014).

Emigré en 1790, de Laizer fut, en 1791, l'un des chefs de la coalition d'Auvergne, placée par le roi Louis XVI sous les ordres du comte d'Artois, devenu plus tard Charles X, et servit ensuite à l'armée du prince de Condé, jusqu'à son licenciement, en 1801. De retour en France, en 1802, n'ayant rien retrouvé de sa fortune, il donna des cours de sciences naturelles et se livra de nouveau à ses études, publiant dans les *Annales des mines* de nombreux mémoires sur les puys et la constitution du sol de l'Auvergne ; les minéraux corindon et haüyne (décrite pour la première fois en 1807) ; et la géognosie de la Limagne d'Auvergne, avec une carte des environs de Clermont (Aigueperse, 1836, 2 : 6-7). C'est le marquis de Laizer qui donne la première indication de l'existence d'ossements fossiles de quadrupèdes en Auvergne dans une lettre écrite à l'Institut en 1805 : un fémur et un astragale de Rhinocéros, qu'il avait trouvés auprès de Montaigut-le-Blanc, sous une énorme couche de produits volcaniques. Cette découverte établissait selon lui l'antériorité de l'espèce animale sur la déflagration des volcans (Devèze et Bouillet, 1827 : 4).

Maurice, son fils, par contre, resta en Russie où il servit le tsar Alexandre I[er] pour ne revenir en France que sous la Restauration. Lui comme sa sœur sont élevés à l'étranger dans une société familiale de réfugiés politiques, d'émigrés aux ressources affaiblies, déracinés. Contrairement à la génération des parents, une foi vivace se développe chez les Laizer sous la tutelle de l'abbé Delzongle, vicaire à Issoire, qui les avait rejoints en émigration. Royaliste et catholique n'ayant pour passé politique que les combats et complots contre la République et Napoléon, les Laizer s'associent aux ultras qui appartiennent pour la plupart à la petite et moyenne noblesse de province. Depuis 1822, Maurice de Laizer

collectionne des antiquités d'Auvergne en complément de ses recherches minéralogiques car il voulait former trois cabinets : une collection géognostique d'Auvergne la plus complète possible ; une collection oryctognostique générale d'échantillons entre 1 et 3 pouces « *mais d'un joli choix* » ; et un cabinet d'antiquités, surtout ce qui a rapport au pays et aux Celtes (« *Lettre à M. Peschier de Genève* », dans Fontaines, 2009 : 151, note 17).

Dans ce contexte, le 24 novembre 1823 on créa à Clermont-Ferrand une Société de Géologie et Minéralogie, la première en France dédiée spécifiquement à ces disciplines. Cette création est célébrée à Paris dans le *Bulletin* de Férussac mais aussi à Nuremberg, dans *Archiv für die gesammte Naturlehre* (Férussac, 1824 ; Kastner, 1824), un fait qui montre que la communication n'est pas seulement entre la province et la métropole mais aussi entre les différents centres provinciaux qui, comme les allemands, sont très actifs dans la propagation des nouvelles (voir Corsi, 2020 : 9 et 13 pour le jugement de Cuvier sur la sociabilité universitaire allemande en province par rapport à la parisienne autour de 1800).

L'initiative associe, entre autres, Maurice de Laizer (président), François Dominique de Reynaud, comte de Montlosier, et les abbés Paul-François Lacoste – qui avait adressé à Cuvier un os de Rhinocéros et quelques ornitholites (Devèze et Bouillet, 1827 : 4), Antoine Dubois, curé de Saint-Nectaire, et Jean-Baptiste Croizet (secrétaire). Son but : étudier la province, former une collection détaillée de sa géognosie et un musée général de sciences naturelles, accompagné d'une bibliothèque spéciale. L'abbé Lacoste en est nommé Conservateur du musée, étant aussi en charge des collections d'histoire naturelle (un cabinet de minéralogie) que l'abbé avait donné à la ville [2]. Avec la création de la Société, on voulait « *utiliser la position toute géologique du sol d'Auvergne pour obtenir quelque influence dans cette science et en faire servir l'étude vraie à renverser les systèmes absurdes que les philosophes fondent encore sur des faits très faussement ou insidieusement exposés*. » (Fontaines, 2009). L'Auvergne, en effet, était depuis le XVIII[e] siècle un des endroits que les géognostes ont visités pour observer les volcans par rapport aux études sur l'origine des roches.

La Société se compose de vingt membres résidents, de dix membres honoraires, d'associés libres et de correspondants. Si l'on compare la liste des membres résidents (**Table 1**) avec l'information publiée par l'*Annuaire du département du Puy-de-Dôme* pour l'année 1827 (**Table 2**), on voit que plusieurs d'entre eux possédaient des collections minéralogiques classées suivant différents (et souvent opposés) systèmes (Balan, 1979 ; Guntau, 1996 ; 2009 ; Corsi, 1988) : le système de l'abbé René J. Haüy (sur la forme des cristaux/cristallographie et la composition chimique), l'ordre des terrains (méthode géognostique de Werner) et l'ordre de montagnes. La collection d'ossements fossiles n'y est mentionnée qu'en 1827.

2. En 1822, le Conseil de la commune de Clermont votait une pension de 800 f en faveur de l'abbé Lacoste en raison de sa collection et une somme de 1,800 f (budget 1823) pour les armoires et précieux décors de la salle destinée aux collections de la Société (*Bulletin de la Société Académique d'Auvergne*, 1822 ; Archives départementales du Puy-de-Dôme).

Le seigneur Bellaigue de Rabanesse, propriétaire
Bertrand, membre de la Légion d'Honneur, docteur en médecine
Blatin, docteur en médecine, professeur de l'école secondaire
L'abbé Croizet, curé à Neschers
Duvernin-Montcervier, propriétaire à Vic-le-Comte
L'abbé Dubois, curé à Saint-Nectaire
Le chevalier Grasset, chevalier de l'ordre de S. Wladimir, maire de la ville de Mauriac
L'abbé Lacoste, professeur d'histoire naturelle au Collège royal de Clermont
Le comte Laizer, colonel, chevalier de St. Louis
Mercier, docteur en médecine
Le comte Montlosier, chevalier de St. Louis, propriétaire à Randanne
Monestier, officier supérieur, maire de la Sauvetat
Monestier-Savignat, avocat à Issoire
Le marquis Montaignac, propriétaire à Saint-Sandoux
Mossier, docteur en médecine à Clermont
Mossier, pharmacien à Clermont
Peghoux, docteur en médecine à Clermont
Le baron de Tournemine, membre de la Légion d'Honneur, président du Tribunal civil de Mauriac

Table 1. Liste des membres résidant en Auvergne (Archives départementales du Puy-de-Dôme ; voir aussi *in* Kastner, 1824 : 482, sans les titres nobiliaires ni la profession).

Très-beau cabinet confié aux soins de Lecoq, professeur de Minéralogie.
MM. **le comte de Laizer** à Clermont.
Peghoux, D.-M idem : sa collection est classée par ordre de terrain.
Jobert aîné, receveur des contributions directes, id. : sa collection est classée d'après le système d'Haüy.
Bouillet, id. : sa collection est classée par ordre de montagnes, et composée uniquement des produits du département.
Fouilhoux, id.
L'abbé Chassaing, directeur du petit séminaire, id.
Tailhand père, avocat à Riom.
Monestier, maire de la Sauvetat : il possède une très-belle collection des produits d'Auvergne.
Monestier fils, avocat à Issoire.
Duvernin-Montcervier, à Vic-le-Comte, il possède une des plus belles collections du département.
Cuel fils, à Vic-le-Comte : il a une autre collection à Champeix.
Dediane fils, à Orcet.
MM. **Bravard**, **l'abbé Croizet** et Jobert possèdent une très belle collection d'ossemens fossiles du département, sur lesquels ils publient en commun un ouvrage important. Il en est de même de MM. **Devèze de Chabriol** et Bouillet.
MM. de **Laizer** et **Peghoux** possèdent aussi des collections d'ossemens fossiles.

Table 2. Collections de minéralogie et d'ossements fossiles appartenant à la ville et à des particuliers à Clermont-Ferrand vers 1827 (Bottin, 1827 : 52, en caractères gras les membres de la Société de Géologie en 1824)

Le baron de Férussac (1824 : 177) rapporte dans son *Bulletin* l'influence de cette Société et les efforts du colonel de Laizer sur le développement de l'histoire naturelle et sur le progrès économique du pays. Un premier résultat : le vote de 1500 francs alloués par le conseil général pour la recherche des mines, confiée au polytechnicien Claude Burdin (1788-1873), ingénieur du département, professeur à Saint-Étienne, futur créateur de la première turbine (1825). Le 7 janvier 1823 (?), le comte d'Allonville, préfet du Puy-de-Dôme, prépare ensuite une circulaire adressée aux maires – une des premières en France – sur les recherches minéralogiques à faire dans le département. De Laizer, le 7 mars, lui envoie un rapport sur ses activités privées depuis 1822 : il avait découvert des bancs de pierres lithographiques, des gisements de talc et pierre ollaire, de la plombagine, des filons d'oxyde de manganèse gris, de l'albâtre, des roches talqueuses, des filons de plomb sulfuré et 7 mines de fer différentes. On envisage l'exploitation de plomb et surtout de fer, dans la proximité de la formation houillère et Laizer promet de proposer ses vues sur la manière de mettre en valeur les gisements.

Quelques mois plus tard, Maurice de Laizer rend compte au préfet de la découverte d'une ancienne mine retrouvée sur le bord de la Couze d'Issoire, avec des échantillons de cuivre gris et de galène très-argentifère, exploitée à une époque inconnue. De Laizer y descend le 20 mars 1824 accompagné de Bravard, « *élève de l'école des mines, jeune et zélé minéralogiste* » (Anonyme, 1824 : 326, *Journal du Puy de Dôme*, 15 avril 1824). Au delà de l'intérêt économique, Buckland avait déjà publié ses explorations dans les cavernes de Kirkdale et, comme Rudwick l'a souligné, la visite des mines et fissures se popularise rapidement tant en Europe qu'en Amérique du Sud (Lopes, 2008 ; voir aussi le travail de Kasper Lykke Hansen publié dans ce volume).

La première séance générale annuelle de la Société de Géologie et Minéralogie est tenue le 1er septembre 1824, en présence des autorités et d'un cercle choisi. Les détails sont publiés par le *Journal du Puy de Dôme* et repris par le *Bulletin* de Férussac. Croizet, secrétaire de la Société, curé du canton de Champeix, ouvre la séance par un discours de trois quarts d'heure où il indique la direction qu'il faut imprimer aux travaux sur la géologie. Il expose une théorie nouvelle pour expliquer « *d'une manière simple et naturelle des phénomènes volcaniques.* » S'inspirant du discours de Cuvier sur les Révolutions du Globe, il expose les différentes hypothèses présentées par les anciens et les modernes pour expliquer la formation de la planète. Il cite Saint-Augustin, Deluc et Cuvier, pour établir l'accord de la géologie et de la Genèse ; et il en conclut que, non seulement la géologie n'est pas contraire à la Révélation, mais qu'elle lui fournit des réponses solides à des difficultés sérieuses, et qu'elle dissipe les préventions de personnes respectables : « *Il est avantageux, ajoute-t-il, de suivre le mouvement du siècle, de profiter de ses vraies lumières, et de lais-*

ser en arrière ceux qui jadis étaient si bien disposés à nous prodiguer la décoration de l'ordre de l'éteignoir. » (Dans Grellet, 1863). Sous la Restauration – il faut le souligner – l'éteignoir, l'instrument en forme de cône creux, destiné à éteindre la flamme de la chandelle, autrement dit, à éteindre la lumière/les lumières, fut un motif caricatural fort prisé dans les milieux libéraux. Les rédacteurs du journal le *Nain Jaune* (1814-1815) imaginèrent de ridiculiser les hommes au pouvoir et les partisans du clergé en leur décernant l'Ordre des Chevaliers de l'Eteignoir, dénonçant l'obscurantisme et l'aveuglement des milieux royalistes. Le *Nain Jaune* décore aussi de « l'Ordre des girouettes » leurs revirements politiques incessants, G. Cuvier étant un des épinglés (Ferrière, 2009). La référence de Croizet à l'Ordre montre que le journal était connu aussi par les élites provinciales et que ses blagues lui ont survécu plusieurs années [3].

De sa part, Maurice de Laizer rend compte des travaux de la société : un commencement d'herbier, une petite bibliothèque, des minéraux du pays et cinq à six cents échantillons de minéraux étrangers rangés dans des armoires et soigneusement étiquetés. Il présenta aussi ses recherches entreprises dans la région, « *s'occupant de la partie utile et industrielle, il a décrit nombre de filons et de gisements métalliques.* » De Laizer expose des faits ou des circonstances géognostiques observés tant par lui que par Auguste Bravard et quelques autres personnes. Son opinion « *que jamais la mer n'a séjourné sur le sol actuel de l'Auvergne* » trouve une forte opposition de la part des abbés Lacoste et Croizet, « *sans que cependant ces messieurs aient cité dans la vallée de l'Allier aucune formation sous-marine* ». Mais – selon le correspondant du *Journal du Puy-de-Dôme* – la partie la plus importante de son rapport était le plan et trois coupes en profil du grand plateau, accompagnés de nombreux échantillons extraits du tuf :

> « *Des os de très-gros animaux, complétement pétrifiés et transformés en chaux carbonatée, sans avoir perdu ni leur forme ni leurs contexture ; un morceau de corne ou d'ardillon d'une corne de cerf, transformé en agathe* ; (…) *sous le tuf, des dents, une mâchoire, et deux cornes appartenant à deux espèces de cerfs, actuellement perdues, et de plus, un crâne avec ses deux cornes, appartenant à une grande espèce de cerf ou d'élan… Avec ces objets* (…) *M de Laizer a aussi produit une dent molaire de mastodonte ou mammout* (…) *Nous croyons que c'est la première fois* – signalait le *Journal* – *qu'il a été rencontré des corps organiques terrestres sous les tufs et les basaltes anciens. Cette importante découverte, due au zèle actif et éclairé de M. le comte de Laizer, portera une grande lumière sur l'âge relatif de nos volcans anciens Ils sont donc postérieurs aux dernières formation, puisqu'ils les recouvrent ; et cependant ils sont contemporains des animaux qu'ils ont entrainés ou ensevelis ?… –Sujet de méditation pour MM. les géologues* » (*Journal du Puy-de-Dôme*, 19e année, N° 108, Mardi 7 septembre 1824 : 2)

Ni le *Journal du Puy-de-Dôme* ni le *Bulletin* de Férussac ne spécifient l'endroit d'une telle découverte mais selon Devèze de Chabriol (1827), les produits fossiles avaient été recueillis à la montagne de Boulade, près d'Issoire, dans une couche faisant partie du même système que celles de Montaigut-le-Blanc, explorées par le marquis de Laizer en 1805.

La séance ayant duré près de trois heures, Bravard – qui attendait son tour de parole – ne peut pas lire son mémoire sur les terrains primordiaux d'Auvergne et on continue par la nomination de nouveaux membres : le recteur de l'Académie universitaire, Jean Sébastien Devèze de Chabriol (1790-1842), ancien ingénieur-géomètre de l'administration des Forêts, membre correspondant du Conseil d'Agriculture et de la Société royale et centrale d'Agriculture à l'époque de Napoléon, résidant à Clermont, et Auguste Bravard, correspondant d'Issoire : on les retrouve un an plus tard se disputant la découverte qui venait de s'annoncer. Mais en 1824, Bravard travaille comme minéralogiste et, comme on le voit, sur les terrains dont le caractère distinctif est de ne contenir aucun fragment de terrains antérieurs et aucun vestige de corps organisés. Devèze, de sa part, avait produit un grand nombre de brochures sur les bêtes à cornes et sur les bêtes à laines du Cantal (Déribier-du-Châtelet, 1853 : 266). Les espèces perdues donc leur étaient, jusqu'à ce moment, à tous les deux presque étrangères.

Espionnage et géologie catholique

De Laizer obtint l'autorisation pour établir la Société de Géologie par ordonnance royale

3. Voir aussi http://parismuseescollections.paris.fr/fr/musee-carnavalet/oeuvres/l-eteignoiriff-4#infos-principales (consulté le 14 avril 2019).

mais la nouvelle société fut rapidement contestée [4] : les livres pour la bibliothèque et les échantillons des minéraux reçus du muséum d'histoire naturelle ont créé des « difficultés » entre Maurice de Laizer, le maire et le conseil municipal de la Ville [5]. En septembre, un arrêté d'Alexandre Louis, comte d'Allonville (1774-1852), préfet du Puy-de-Dôme, approuvé plus tard par le ministre de l'intérieur, dissout la société géologique pour l'incorporer à la Société des Sciences, Arts et Agriculture (établie en 1818) qui reprenait le nom de l'institution établie en 1747 mais supprimée par la Révolution par le décret du 8 août 1793. Fusionnées, elles deviennent l'Académie des Sciences, Belles-Lettres et Arts de Clermont, présidée par le comte de Montlosier, fonction qu'il conservera jusqu'à sa mort en 1838. L'abbé Lacoste continua comme conservateur du muséum d'histoire naturelle et, à sa mort en 1826, est remplacé par le pharmacien botaniste de Paris Henri Lecoq (De Fontaines, 2009 : 144-145 ; Pénicaud, 2002 : 34).

Le comte d'Allonville, préfet du Puy-de-Dôme entre 1823 et 1828, était aussi un royaliste, antiquaire, administrateur efficace qui – en qualité d'officier dans le régiment Loyal-Émigrant – avait servi les Bourbons jusqu'en 1797 et, plus tard, Napoléon comme directeur des finances de la campagne d'Egypte. Le comte de Laizer fait appel de sa décision : le dossier qui se trouve aux archives départementales du Puy-de-Dôme contient les copies de lettres autographes des personnages tournant leur adhésion à la Société géologique et à de Laizer, dont l'ingénieur Charles Coquebert de Montbret, conseiller d'État honoraire et membre de l'Institut, le comte Christophe de Chabrol de Crouzol, conseiller d'État et ministre de la Marine, et Jacques-Joseph Guillaume François Pierre, comte de Corbière, ministre, secrétaire d'État de l'intérieur.

Maurice de Laizer et ses descendants ont vu dans la dissolution de la Société « *une conspiration des voltairiens et les libéraux, hostiles à l'influence grandissante de l'Église catholique, partisans de sa séparation de l'Etat* ». De Laizer « *un vrai serviteur de la royauté, inscrit dans la pensée officielle de l'Église* », élevé en exil par un jésuite émigré, aurait été considéré trop religieux dans un contexte local où la droite la plus ultra perd de son influence. Dans cette logique, Maurice de Laizer expose la situation à Paris en termes politiques et stratégiques dans une lettre datée de septembre 1824 et envoyée à son ami François Franchet d'Esperey, le directeur général de la police au Ministère de l'Intérieur de Jacques-Joseph, comte de Corbière, sous le Conseil présidé par Villèle, dont Corbière était proche :

> « *De notre première séance, nous avons émis des principes tout bibliques. Dans la 2e, j'ai prouvé que l'on peut suivre cette marche et travailler très utilement en géologie. Ne pouvant nous réfuter, on nous a attaqués administrativement* (…) *Dans cet état de choses, je crois de mon devoir de vous prévenir, monsieur, que la nouvelle société sera loin de marcher sur la route que vous m'aviez surtout recommandée. Elle sera composée à peu prés ainsi :*
>
> *-Un tiers, royalistes religieux*
> *-Un tiers, royalistes antireligieux à la Montlosier*
> *-Un tiers, libéraux antireligieux*
>
> *La géologie y sera hautement antireligieuse et si vous nous détruisez, vous n'aurez pas même le contrepoids que nous eussions si utilement mis dans la balance car incorporés, amalgamés, nous serons en grande minorité.* » (De Fontaines, 2009 : 147-148)

Compte tenu de l'expérience de Laizer comme espion en Russie (Fontaines, 2009) et que sous l'impulsion de Villèle, après les nominations de Franchet d'Esperey à la direction générale et de Guy Delavau à la préfecture de Police de Paris, on organise les pratiques d'espionnage et de délation, on peut se demander si sa lettre à Franchet n'était qu'un rapport secret, une réponse aux instructions et conseils reçus de Paris pour observer la sociabilité clermontoise organisée autour de la science et des collections [6]. Ce système d'espionnage, délations, dénonciations, accusations et rapports secrets, instauré par la police politique des ultraroyalistes à partir de 1824, caractérise aussi les transactions des sociétés paléontologiques qui vont s'établir en Auvergne pendant et après le Restauration. De cette manière, après la révolution de 1848, l'abbé Croizet va dénoncer Bravard aux administrateurs du Muséum pour sa sympathie pour « *la politique rouge* » et le confiseur François Séguin, à Buenos Aires, insistera plus tard sur sa loyauté à la France et à l'Empire en contraste avec le républicanisme de Bravard (Podgorny, 2001 ; 2009).

La dénonciation de l'ennemi politique promue par le cabinet Villèle (mais pas inventée par lui) est utilisée comme un mécanisme pour

4. Ordonnance du Roi, Charles, pour la grâce de Dieu, Roi de France et de Navarre, Archives départementales du Puy-de-Dôme.

5. Lettre de la préfecture du Puy-de-Dôme à M. le comte Maurice de Laizer, à Clermont, 30 juin 1824 (Objet : Bibliothèque de la Ville de Clermont, Société de Géologie et Minéralogie, Livres et Minéraux), Réponse à une lettre du 30 juin 1824, Archives départementales du Puy-de-Dôme).

6. Sur le livre et le cabinet noirs de Franchet, voir Année, 1829 ; Froment, 1829. Voir aussi Spitzer, 1971 : 14.

soutenir une position ou un intérêt personnel en relation avec les institutions ou les collections scientifiques. Ou, comme le montre le cas de Croizet et Séguin, pour discréditer le concurrent et s'assurer que les professeurs du Muséum achètent leurs collections et non celles de "l'ennemi" dans une dynamique où le perdant est toujours Bravard, de loin le plus pauvre mais aussi le plus colérique, comme en témoignent plusieurs contemporains [7]. C'est un argument banal qui non seulement déclenche des rivalités mais détermine aussi les itinéraires de vie des uns et des autres, ainsi que l'achat de collections basé sur la loyauté courtoise, une logique de confrontation sans fin et une morale opportuniste – « girouette », aurait dit *le Nain Jaune*. Loin des transactions basées sur l'offre, la demande et l'intérêt scientifique, ces ventes exposent la vie morale et politique des opposants, la biographie du vendeur étant plus importante que le produit offert (Podgorny, 2001 ; 2009 ; 2021).

Le cas de la société géologique de Maurice de Laizer montre également les articulations locales de la politique de la Restauration, où les alliances ne répondent pas toujours au pouvoir central parisien. Le comte de Montlosier, qui avant la Révolution avait publié une *Étude sur les volcans d'Auvergne* (1789), était hostile aux jésuites et l'ultramontanisme, défendant le gallicanisme, la doctrine religieuse et politique qui cherchait à organiser l'Église catholique de façon autonome par rapport au pape. Montlosier publie de nombreux écrits contre les jésuites où il y dénonce une force occulte politico-religieuse : le parti ultramontain français et la congrégation, composée par le parti jésuitique dont le centre est à Rome (Larouzière, 2003 ; sur les ultras et le mythe de la congrégation jésuite, voir Lauvergnée, 2009). Croizet, de sa part, devait compter sur le tiers loyal à Dieu, la géologie et le Roi, ce qui ne veut pas dire que Croizet et de Laizer partagent ses vues géologiques sur l'Auvergne. On peut se poser la question plus générale du changement possible que le nouveau règne de Charles X amène dans la province, car les actions contre la Société, fondée avant 1825, et sa suppression *de facto* pourraient rentrer dans les mesures de virage à l'extrême droite.

Si les efforts utiles de Maurice de Laizer sont clairs par rapport aux mines et la minéralogie, sa géologie religieuse des années 1820 a laissé peu de traces. Le rapporteur du *Journal du Puy-de-Dôme* donne des indices, en rappelant son opinion « *que jamais la mer n'a séjourné sur le sol actuel de l'Auvergne* », à laquelle s'opposent les abbés Lacoste et Croizet. Et, en effet, la question de la présence de la mer en Auvergne était liée aux débats sur l'extension et l'historicité du déluge et sur l'extension des catastrophes et des révolutions du globe et d'une manière plus ample, la conciliation entre le récit mosaïque et « *l'observation des faits* » pour expliquer l'évidence du phénomène incontestable : le déplacement du lit des mers. Si comme Pietro Corsi (1988 : 51) l'a dit, « *geology was rapidly increasing in popularity among the (Anglican) clergy, probably helped by the fact that in Anglican circles it was generally regarded as a safe science* », pour les catholiques et les ultras français ce n'était pas si différent.

Dans la conclusion de son célèbre *Discours sur les révolutions de la surface du globe et sur les changemens qu'elles ont produit dans le règne animal (Recherches sur les ossements fossiles des quadrupèdes, 1812)*, Cuvier, qui à l'époque n'avait décrit que 90 espèces de mammifères disparus, donne son accord à Deluc et Dolomieu par rapport au fait que « *la surface de notre globe a été victime d'une grande et subite révolution dont la date ne peut remonter beaucoup au-delà de cinq ou six mille ans.* » Selon Laplanche (2014), c'était surtout cette conclusion, « *confirmant le récit biblique* » (c'est-à-dire, la réalité historique du déluge), que retinrent les apologistes, en particulier en Angleterre mais aussi en France : « *notre globe offre partout des traces si évidentes, qu'aucune vérité physique n'est aujourd'hui regardée comme plus certaine par les géologues* » – disait Félicité Lamennais dans son « *Essai sur l'indifférence en matière de religion* » (1817-1823). Donc, on essaie de prouver la vérité incontestable des écrits sacrés, relativement aux évènements qui se sont passés dans le monde et sa corroboration par des faits physiques de toutes les parties du globe.

Si les Anglais ont eu une tendance particulière pour ces sortes de recherches – disait Ami Boué en 1833 – « *il paraît aussi quelquefois en Allemagne et même en France, des ouvrages semblables*. » Louis Athanase Chaubard publie ses *Elémens de géologie* (Paris, 1833) qui offrent, suivant lui, la concordance des faits géologiques avec les faits historiques tels qu'ils se trouvent dans la Bible, les traditions égyptiennes et les fables de la Grèce. Dans une *Lettre sur le Déluge, dans laquelle on a examiné la possibilité d'accorder le récit de Moïse*

7. Le procès contre Bravard en 1832 rapporte : « Bravard, enchérissant sur les autres, se permit contre lui (l'adjoint) les propos les plus véhémens, le traitant de transfuge, de gredin, etc.; et lorsque M. l'adjoint lui répondit qu'il n'avait jamais marché sous de bannières que sa présence aurait souillées, et lui tournait le dos, il s'est caché entre deux individus, et a tenté de lui lancer un coup de pied qui l'a effleuré à la hanche gauche. » (Anonyme, 1832 : 4).

avec les faits constatés par l'observation et les principes de la physique (Paris, 1833), Félix Passot a prétendu prouver la formation aqueuse simultanée de toutes les couches à restes organiques. De sa part, Nérée Boubée promit le développement du tableau 4e, l'état du globe à ses différents âges, où il démontrait la *concordance des faits géologiques avec la Genèse* ; et il imprimait aussi une *Géologie élémentaire à la portée de tout le monde*, où il décrit sa théorie des déluges d'origine cométaire (Boué, 1833 : LXXIV-LXXV ; voir aussi Laplanche, 2014).

Le premier article du *Bulletin* de Férussac, par exemple, est une dissertation sur le déluge universel, un sujet que le Bulletin va reprendre souvent pendant les neufs ans de son existence. Ainsi, le baron de Férussac en 1827 publia un « *Examen analytique de la conférence de Mgr l'évêque d'Hermopolis, dans laquelle Moïse est considéré comme historien des temps primitifs* », où il félicita Monseigneur Denis-Antoine-Luc, comte de Frayssinous (1765-1841), ministre des Affaires ecclésiastiques et de l'Instruction publique (1824-1827) dans le gouvernement de Villèle, et ministre des Cultes dans le gouvernement de de Martignac, pour avoir fait concorder la parole de l'Ecriture Sainte et les écrits scientifiques. Férussac, comme de Laizer et plusieurs autres, pense que la géologie pourrait maintenant « *servir à appuyer la cosmogonie de Moïse* ». Dans ses travaux sur les mollusques, Férussac rejette le créationnisme envisagé de manière globale et propose donc une hypothèse de créationnisme anti-catastrophiste. Comme souligne Blanloeil (1988), « *l'explication qu'il avance est celle de nids de création se répétant à des distances plus ou moins variables, hypothèse qu'il préfère à celle des migrations. Différents bassins peuvent donc coexister en divers points du globe suivant que les circonstances climatiques le permettent*. » Férussac détermine la loi de la répartition des espèces sur la surface de la terre, il y montre que les changements que la vie a éprouvés sur le globe ont été gradués, qu'elle n'a point été renouvelée, que les races n'ont point été modifiées, mais qu'à mesure que les conditions d'existence changeaient, ou qu'il s'en développait de nouvelles, de nouvelles espèces ont remplacé celles qui ne pouvaient plus exister, et qui n'avaient plus de rôle à remplir, et cela jusqu'à l'époque où, pour chaque partie de la surface terrestre successivement, l'équilibre entre les causes influentes a été établi (Rabbe, 1836 : 1681). Cette idée de révolutions et déluges locaux et de la variabilité des espèces en fonction de l'influence des localités va être reprise par Auguste Bravard (1828 : 15-16) mais aussi, comme métaphore, sert pour comprendre la pertinence des enjeux scientifiques locaux et l'impossibilité de contrôler totalement la démarche d'une société de géologie en province (la Société géologique de France date de 1830).

Dans cette région où les volcans et les minéraux ont attiré l'attention du monde savant depuis l'Ancien Régime, comme celle de Louis-Girard, le père de Maurice de Laizer, dans les années de la Restauration, les naturalistes auvergnats se passionnent pour les espèces perdues. (Rudwick, 2010, Pénicaud 2002). En partie à la suite de la popularisation de la géologie à l'anglaise (Rudwick, 2010), de l'appel de Cuvier et son collecte d'alliés internationaux et nationaux (Rudwick, 1997b), de la publication de ses Recherches sur les ossemens fossiles (première édition en 1812, deuxième édition, enrichie de faits nouveaux, fournis par ses correspondants publiée de 1821 à 1824) mais aussi de *Reliquiæ Diluvianæ or, Observations on the Organic Remains Contained in Caves, Fissures, and Diluvial Gravels and on other Geological Phenomena attesting the Action of an Universal Deluge* en 1823 par William Buckland, qui visita l'Auvergne en 1820 et 1826 (Rudwick, 2007 ; 2010). Mais surtout par la confluence contingente de plusieurs acteurs avec des intérêts et formations différents autour de la Société géologique de Clermont-Ferrand et de la découverte de gites fossilifères d'une richesse encore inconnue grâce à la promotion de l'activité minière sous la Seconde Restauration.

Les mammifères perdus d'Auvergne, 1825

Dans la séance constitutive de la Société de Géologie et Minéralogie, on parle de zèles et désirs partagés, du progrès des sciences et de l'extension des connaissances personnelles sur la nature de la province. Le Règlement institue la veille de la Saint Louis, le 25 août, jour de fête en France au XVIIIe siècle, la fête des arts et aussi quand les Académies ouvraient leurs salles pour attribuer les prix et admettre de nouveaux membres. Les deux premiers buts de la société étaient, en effet, liés à la coopération : « *De nous faire mutuellement part du résultat de nos recherches, sur tout ce qui a rapport à l'histoire naturelle du pays* » ; « *de contribuer, en*

tout ce qui dépend de nous, à former, et successivement à augmenter un musée, où les étrangers puissent trouver des collections aussi complètes que possible des produits minéralogiques et géognostiques », et « *de déposer et conserver en un seul et même lieu des notes exactes sur les localités les plus intéressantes, comme sur les divers gisements remarquables qui ont été ou seront observés* ». On cherchait surtout à réunir les travaux sous le rapport des volcans anciens et modernes. (Règlement 1824, 3-4).

Une fois la société liquidée et la position de Maurice de Laizer affaiblie, le fait qu'ils se sont partagé et montré mutuellement les résultats de leurs recherches va éveiller, chez chacun des participants à la réunion de septembre 1824, l'avidité de s'approprier la paternité de la découverte des fossiles. Bravard, Dèveze de Chabriol et Croizet sont rejoints par trois acteurs : le banquier, antiquaire et minéralogiste Jean Baptiste Bouillet (1799-1878), le publiciste Antoine Claude Jobert, receveur des contributions directes (1797-ca. 1855) et le *Journal du Puy-de-Dôme*, un journal politique et littéraire consacré aux événements du département et à l'analyse des journaux de France, publié depuis 1805. Devenu royaliste après les Cent-Jours, le *Journal du Puy-de-Dôme* affiche son soutien aux ultras et au parti clérical. En 1824, il est publié les mardi, jeudi et samedi sous les mots « *Vive le Roi long-temps et les Bourbons toujours* ! », on s'abonnait à Clermont chez Thibaut -Landriot, administré par François Thibaut, libraire et imprimeur du roi, et à Riom, chez Laurent Thibaud, imprimeur-libraire.

Le mardi 7 juin 1825, le *Journal du Puy-de-Dôme* (année 20, N°68) publie l'annonce suivante avec des résonances pré-cuvieriennes :

> « *L'importance des presses lithographiques établies à Clermont et l'utilité dont elles peuvent être pour ce pays, seront grandement prouvées par le beau travail dont elles vont faciliter la publication. Ce travail est un essai géologique sur la montagne de Boulade, près d'Issoire, avec la description et la figure des ossemens fossiles qui y ont été recueillis. Ces ossemens qui proviennent de grandes espèces perdues, ou d'espèces qui vivent encore, mais dans des contrées lointaines et des climats différens, présentent, dans leur étonnante réunion, un problème dont la solution jettera une nouvelle lumière sur les révolutions physiques du globe. Toutes les idées nouvelles que cette localité fait naître, seront exposées dans le texte, dont la rédaction sera due à un savant recommandable, estimé et connu des membres de l'Institut, qui souvent, ont eu l'occasion d'apprécier ses utiles recherches. C'est la même personne, aussi modeste qu'elle est instruite, qui a réuni avec une longue persévérance un grand nombre de fossiles curieux, que la lithographie retracera avec exactitude et talent, par les soins d'un jeune naturaliste de cette ville, plein de zèle pour la science, M. Bouillet ; nous en jugeons par la première livraison de ces planches, déjà lithographiées, qui suivent de près le prospectus, actuellement sous presse, et qui sera joint au numéro prochain de ce journal.* »

Si les lecteurs du *Journal* sous l'euphémisme « *savant recommandable* » pensaient pouvoir entrevoir le nom "Maurice de Laizer", ils se trompaient : le samedi suivant (11 juin 1825), on annonce la mise en vente de la première livraison de l'*Essai géologique*, avec la description et les figures lithographiées, un ouvrage « *composé de 27 planches in-folio, et divisé en cinq livraisons qui paraîtront de mois en mois. La dernière, accompagnée d'un volume de texte, in 8°. Le prix de chacune est de 3 fr. pour les souscripteurs, et de 15 fr. pour l'ouvrage entier, 18 fr. pour les personnes qui n'auront pas souscrit au Bureau du* Journal. » Les noms des auteurs sont dévoilés : M. Devèze de Chabriol et M. J.-B. Bouillet. La réponse ne se fait pas attendre : le samedi 18 juin, le *Journal* publie trois lettres adressées au rédacteur signées Jobert, Bravard et Croizet (**Annexe 2, a**) qui sont adressées à Thibaut pour le charger également de l'impression des planches et du texte de leurs recherches sur les fossiles découvertes dans la montagne de Perrier. Les parties se sont accusées mutuellement de contrefaçon.

Comme la monographie sur la Boulade est publiée par livraisons et que la première manque de texte, Devèze et Bouillet le rédigeront en guise de défense et de preuve de leur paternité et propriété intellectuelle de la description et de la collection, ou du moins d'une partie de celle-ci. Ainsi, dans l'introduction, ils mentionnent non seulement le marquis de Laizer, le père de Maurice, mais aussi donnent les noms des chasseurs, les premiers à avoir trouvé une corne de cerf fossilisée et un fragment de mâchoire : MM. Devergèse et Gauthier-Person (Devèze et Bouillet, 1827 : 4-5). Devèze montre que la découverte était due – comme presque toujours – au hasard et à l'observation de « *deux jeunes chasseurs d'Issoire, qui ont montré des fossiles de ce gisement long-temps*

avant que, ni moi ni M. Bravard, ne le connoissions » (Annexe 2, b). Devèze, dans sa lettre au *Journal*, insiste : la découverte des chasseurs a suscité l'intérêt de plusieurs collectionneurs du département qui commencent à accumuler des ossements ou d'autres pièces, comme la belle dent de mastodonte conservée dans le cabinet d'un chirurgien-dentiste de la ville. Face à cette nouvelle passion locale (et internationale) et en vue de la publication de Devèze et Bouillet, Bravard aurait été prompt à rechercher des partenaires pour rivaliser dans le même domaine : « *aujourd'hui Bravard a formé une société qui voudroit faire ce que nous faisons*. » (voir **Annexe 2, b**).

L'éditeur et libraire se trouvait entre deux feux. Le 30 juin, suivant la lettre de Devèze (voir **Annexe 2, b**) et commentant qu'il croyait que cette question intéressera « *bien foiblement* » le public, il publia la lettre qu'il avait adressée à l'un des membres d'une autorité compétente en matière de droits de publication. Le traité avec Devèze et Bouillet avait inclus deux articles sur lesquels on doutait :

> « *Je m'engage, 1°. à 8°. A donner tous mes soins pour contribuer au débit et au succès de l'ouvrage, tant par les annonces dans mon journal, que par mes relations en librairie ; 9°. A n'imprimer aucune contrefaçon de l'ouvrage de MM. Devèze et Bouillet, comme aussi de n'en pas tirer un plus grand nombre que celui convenu.* » Thibaut, « *ne voulant point agir contre les devoirs de ma profession, qui sont indépendans de la clause que l'on a très-inutilement exprimée en l'art. 9 de mon traité ; mais ne voulant non plus, ni ne pouvant refuser, sans cause légitime, le service de mes presses à ceux que y ont recours, j'attends votre solution pour me décider à commencer le second ouvrage ou à en refuser l'impression* ».

Devèze dénonce que M. Bravard n'avait, non plus qu'aucun d'autre, songé à entreprendre un pareil travail, une idée qui apparaît après la première livraison de l'ouvrage sur la Boulade ; Bravard cherche des associés, des dessinateurs et des lithographes, pour publier un ouvrage sur la montagne de Perrier et dénonce que les fossiles sont à lui. Si Thibaut voulait de la publicité, cette querelle dans son *Journal* attire l'attention du monde savant et du public auvergnat pendant tout le mois de juin. Le 6 juillet, Bouillet envoie une lettre au *Journal* pour mettre fin à la question face au public : la découverte géologique avait paru exciter l'attention des personnes éclairées « *mais, je ne pense pas que ces mêmes personnes prennent un vif intérêt à la discussion élevée à ce sujet par M. Bravard. C'est pour cela que je me dispenserais de répondre à sa dernière lettre insérée dans votre Journal du 5 de ce mois ; je lui dirai seulement qu'au lieu de s'occuper du soin de relever minutieusement les erreurs qui, suivant lui, se sont glissées dans note prospectus, il convient qu'il s'occupe, préalablement à toute publication, du soin, plus important, d'examiner la question de propriété qui s'élève relativement aux os fossiles qu'il possède* » (voir **Annexe 2**).

Férussac – suivant le *Journal du Puy-de-Dôme* – rapporte toute l'affaire et rappelle que cette découverte était tout à fait annoncée par le président de la Société académique de Clermont en l'accompagnant d'un plan des localités et de trois coupes ou profils du plateau, ainsi que de nombreux échantillons de ces ossements. Ensuite, on est surpris par l'irruption des nouveaux acteurs dans un sujet qui deux ans avant, n'existait pas dans l'horizon scientifique ni biographique des impliqués :

> « *La reconnaissance de ce gisement est due à un jeune élève de l'école des mineurs de Saint-Étienne, M. Bravard, dont nous avions pu apprécier peu de temps auparavant l'intelligence et les connaissances diverses. L'on assure, à la vérité, que l'on en doit la première découverte à deux chasseurs ; mais il n'en est pas moins incontestable que c'est au mouvement imprimé par M. de Laizer en Auvergne, pour les observations de ce genre, que l'on doit les résultats de cette découverte que M.de Laizer fit valoir et dont il étendit par là l'importance, ainsi qu'aux travaux et aux recherches de M. Bravard. Le projet de M. de Laizer, ainsi qu'il l'annonça dès le début à M. Cuvier et à nous, était, après avoir soumis ces ossemens au jugement de ce restaurateur de l'antique animalité du globe, d'en publier la description et les figures. Dans le nombre des amateurs qui s'empressèrent à fouiller le gisement de Perrier, devenu célèbre dans le pays, M. Devèze fut un des plus heureux ; il recueillit aussi des échantillons précieux, et il paraît qu'ayant également l'ambition de les publier, il se hâta de prévenir, en société avec M. Bouillet, l'ouvrage que préparait avec moins de précipitation soit M. de Laizer, soit M. Bravard.* » (Férussac, 1825 : 437)

Bravard et Devèze s'étaient mutuellement communiqué les ossements qu'ils trouvaient, et en

prenaient respectivement des dessins. Pas seulement à la Société de Géologie de Clermont : comme on va voir plus tard, Bravard travaillait pour le comte de Laizer et, en demeurant chez lui, y reçoit ses futurs concurrents. Férussac continua en soulignant la naïveté de Bravard dans un contexte que Férussac connaît bien, se caractérisant par la délation et la trahison :

> « *Sans entrer dans les motifs que nous ignorons et qui ont pu déterminer cette confiance de la part du premier vis à vis du second ; sans savoir comment, sans un consentement positif de M. Bravard, M. Devèze peut publier des communications nées d'une confiance mutuelle, mais qui n'eussent certainement pas eu lieu si des entreprises rivales devaient en être le résultat, nous dirons que les personnes qui s'occupent de la science furent surprises de l'annonce de M. Devèze et de la précipitation qu'il semblait mettre dans sa publication, comme ainsi de ne point trouver le nom de M. de Laizer à la tête de l'une ou de l'autre de ces entreprises. Chacun, à la vérité, est libre de publier le résultat de ses recherches ; mais le tribunal de l'opinion est là pour juger les faits, et la science ne saurait gagner à ce que les moyens de lui être utile soient dispersés, et qu'au lieu de réunir en commun des efforts partiels pour produire un travail plus complet et plus parfait, les savans soient obligés d'acheter deux ouvrages au lieu d'un sur le même sujet. D'ailleurs il est des matières que tout le monde ne peut traiter avec un égal avantage pour la science. On attendait la publication annoncée par M. de Laizer, qui devait soumettre les matériaux de son ouvrage à M. Cuvier, ce qu'était une garantie importante et une sécurité nécessaire. Le nom de MM. Devèze et Bouillet était inconnu jusqu'à présent des géologues et des naturalistes, et leur première livraison prouvait déjà que la détermination de leurs échantillons n'était pas toujours juste, et les faits importans annoncés dans leur prospectus complètement exacts. Tout montre donc qu'il eût été plus convenable de se moins presser et de se réunir, plutôt que de chercher à se devancer. Le prospectus de MM. Bravard, Croizet et Jobert, que nous annonçons, nous apprend du reste que M. de Laizer a remis à ces messieurs le soin de publier les matériaux qui lui appartiennent ; on doit lui savoir gré de cette généreuse communication : c'est ainsi que les véritables amis des sciences doivent agir, en sachant sacrifier à leur intérêt toute gloire personnelle. Ce long préambule, avant d'arriver à faire connaître les deux entreprises que nous annonçons, ne saurait être inutile aux sciences et aux savans ; ils le sentiront aisément ; il était d'ailleurs nécessaire pour qu'on sache comment les mêmes objets vont être reproduits dans deux écrits différens. Et d'abord nous préviendrons, quant aux titres distincts des deux ouvrages, qu'il s'agit absolument de la même localité, et beaucoup plus d'ostéologie que de géologie ; il paraît que M. Devèze donne le nom de Boulade à une partie du plateau de Perrier. D'ailleurs l'ouvrage de M. Bravard contiendra des ossemens d'autres gisemens, et spécialement des ornitholithes et des empreintes de poissons que M. Devèze ne se propose point de publier dans l'ouvrage qu'il fait paraître aujourd'hui.* » (Férussac, 1825 : 438-9).

Trahisons croisées

La générosité de Maurice de Laizer, loin de l'être, était plutôt un résultat de la querelle pour la propriété des ossements. En 1827, il adressa un texte pour résumer l'épisode de 1825 à l'académie de Lyon :

> « *Messieurs, lors de mon dernier voyage à Lyon, il y a trois ans, vous eûtes la bonté d'accueillir avec bienveillance quelques observations générales sur la géologie d'Auvergne et spécialement sur les gisements fossiles que j'avais signalés, l'année précédente comme existant dans nos roches et dans les sédiments et qui jusque là n'y eussent pas encore été remarqués. Je comptais alors publier moi-même les découvertes et pour donner à cet effet à mes fouilles tout le développement dont elles étaient susceptibles, j'avais appelé auprès de moi un jeune élève de l'école des mineurs de Saint Etienne (M. Bravard). Déjà une année entière avait été consacrée à ce travail, ou aux dessins, plans, coupes géologiques qui en étaient la conséquence. Forcé de faire une absence de quelques mois, j'avais laissé mon jeune collaborateur dans ma maison de campagne et je l'y croyais occupé à surveiller et à promouvoir mes travaux de recherches lorsqu'à mon arrivée de Lyon, j'appris par un prospectus qu'il m'avait subitement quitté emportant mes matériaux et qu'associé à deux individus du voisinage (l'abbé Croizet, secrétaire de l'académie, et M. Jobert), il publia l'ouvrage que j'avais annoncé. Déjà tous les gisements fossiles, par moi*

> *réunis, se trouvaient chez M. Cuvier pour en obtenir la détermination et passaient pour la propriété de mes adversaires. En même temps, M. Devèze et Bouillet fouillant le même terrain et creusant les mêmes excavations par moi commencées, promettaient aussi au public un essai géologique sur la montagne de Boulade* » (dans Fontaines, 2009 : 149).

Bravard, en fait, avait été employé de Maurice de Laizer et avait travaillé aussi sur sa demande de concession minière de Brassac, un sujet aussi contesté et qui attirait des investissements de plusieurs acteurs, comme le montrent les dossiers sur la concession existant dans les archives départementales du Puy-de-Dôme. En 1825, le comte ne voulant pas un scandale public, préfère transiger avec ses rivaux. Ensuite, sa sœur, la comtesse Marie-Alexandrine, ancienne chanoinesse de Neuville, décédait en février 1825. Tous les deux travaillaient sur une histoire de la Celtique depuis les temps les plus reculés jusqu'à l'incorporation de l'Aquitaine à la France au X^{e} siècle. Dévasté et affaibli par la mort de sa sœur, en juillet 1825 – les derniers jours du débat public dans le *Journal du Puy-de-Dôme*, auquel il ne participe pas – Laizer écrit dans son journal :

> « *Le 5, traité entre moi et Mr. Croizet où je cède beaucoup pour avoir la paix. Il y a manque à l'instant même.*
> *Le 6, je me plains à monsieur l'Evêque de Mr. Croizet et demande restitution de mes pièces.*
> *Le 14, arrivée de Mr. L'abbé Croizet, violente querelle, puis nouveau traité de part et d'autre pour gagner du temps et éviter rupture trop hostile.*
> *Le 18, Mr. Croizet et Bravard viennent me voir. Bravard me demande de signer une rétractation de ce que j'avais dit sur lui. Je repousse sans lire, avec hauteur ; l'abbé m'invite à lire, assure que il n'y a rien que de convenable. Je réponds que le titre seul est trop inconvenant pour que je le regarde. Bravard menace violemment, il va imprimer des copies de papiers qu'il a pris ou conservés à mon insu notamment mon compte avec la préfecture pour les antiquités. Je le fais sortir de chez moi. L'abbé consent à me rendre de suite les ossements En fin, me croyant réellement devancé dans la description des espèces, je renonçais à ce travail dont je m'occupais depuis plus de 18 mois* » (dans Fontaines, 2009 : 150, note 15).

Dans l'intervalle, Bravard, élève de l'école des mineurs. Croizet, membre de la Société académique de Clermont-Ferrand et Jobert trésorier de la même société, publient un prospectus de leur ouvrage présenté à la Société : les *Recherches sur les corps organisés fossiles de la montagne de Perrier, près d'Issoire, et dans plusieurs autres gisemens du département du Puy-de-Dôme*, un volume in-4^{o}, d'environ 120 à 150 p, de texte, papier grand raisin, et de 25 pl. lithographiées. Parmi celles-ci sont comprises des coupes pour les principaux gisements, une carte géologique extraite d'un travail plus considérable qui comprend tout le Puy-de-Dôme, et une vue de la montagne de Perrier. Le prix de l'ouvrage est fixé à 15 francs pour les souscripteurs avant le 1er octobre prochain, et à 18 fr. pour les non-souscripteurs. Ils promettent la description d'un nombre remarquable de grandes espèces de quadrupèdes, les ossements d'oiseaux et les empreintes de poissons et aussi la description des végétaux fossiles qu'ils ont trouvés en Auvergne, mais, finalement, ils se sont décidés à laisser à Adolphe Brongniart le soin de les décrire dans l'ouvrage complet qu'il prépare sur les débris de l'antique végétation du globe. Enfin les coquillages des dépôts formés sous l'eau douce, devant paraître dans l'*Histoire naturelle des mollusques terrestres et fluviatiles* de Férussac, les auteurs ont renoncé à publier ceux qu'ils avaient recueillis, pour borner leur entreprise aux seuls animaux vertébrés, leur ouvrage étant alors plus en harmonie avec celui de Cuvier dont ils vont adopter le format et la justification. Cette promesse, comme nous le verrons, ne sera jamais tenue, du moins au nom de la société qui l'annonce.

Les livraisons de l'ouvrage de Devèze et Bouillet, par contre, continuent leur marche. Peut-être à cause du travail de Devèze sur les animaux à cornes, les premières planches sont dédiées aux parties de la tête et des bois de cerf ou d'élan mais sans reconnaître si ces espèces étaient les mêmes que celles qu'a décrites Cuvier, sans explication, sans synonymie, ni noms nouveaux. On ne dit pas à quel genre et à quelle espèce elles appartiennent. D'ailleurs la fig. 3 de la pl. VI n'appartient pas à un ruminant, mais à un Tapir. Comme Bravard le rapporte dans le *Journal du Puy-de-Dôme*, Devèze se serait trompé en annonçant dans son prospectus des ossements de Cétacés qui n'existent pas en Auvergne (**Fig. 1 et 2**).

Dans son compte-rendu, Férussac (1825) signale que l'exécution, sous le rapport de la

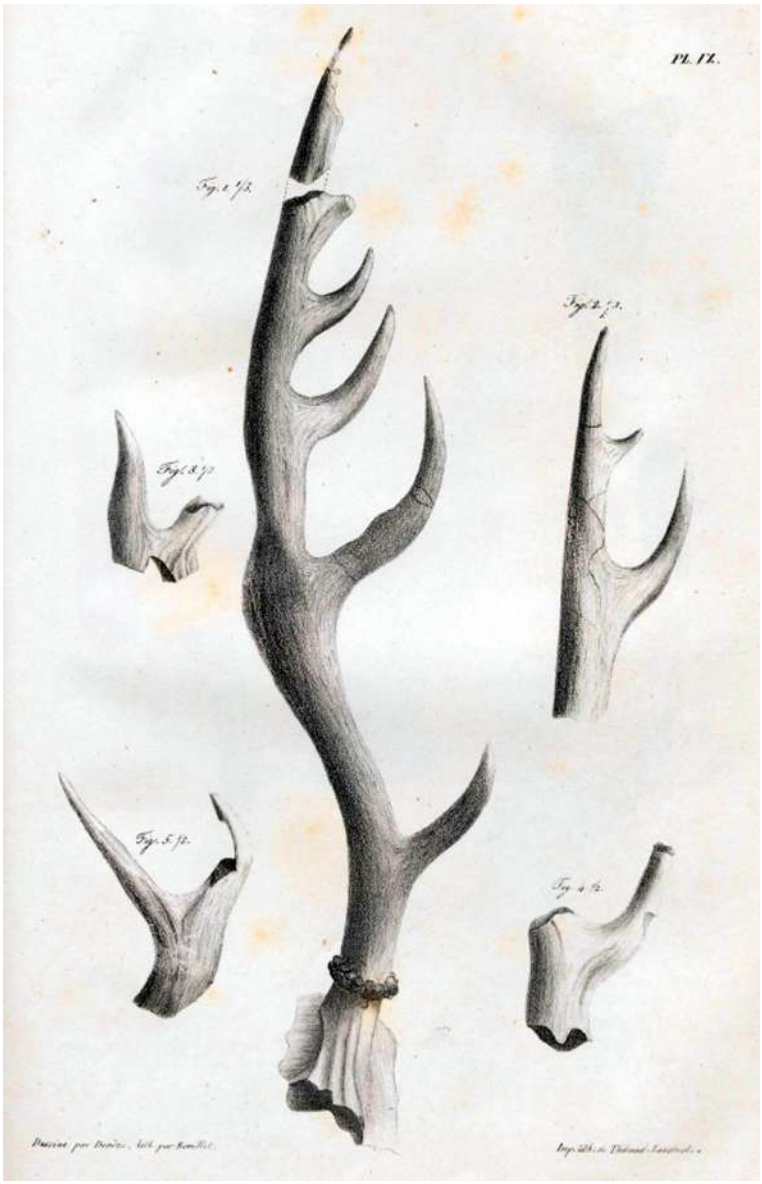


Fig. 1. Planche dédiée aux bois de cerf ou d'élan, extraite de l'ouvrage de Devèze et Bouillet.

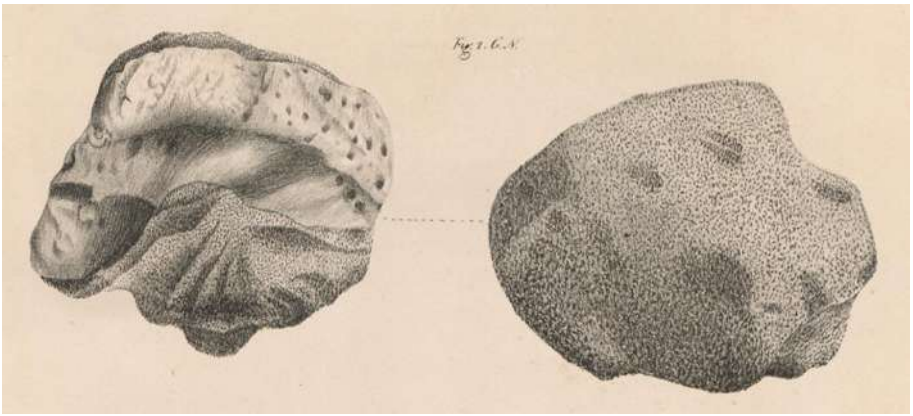


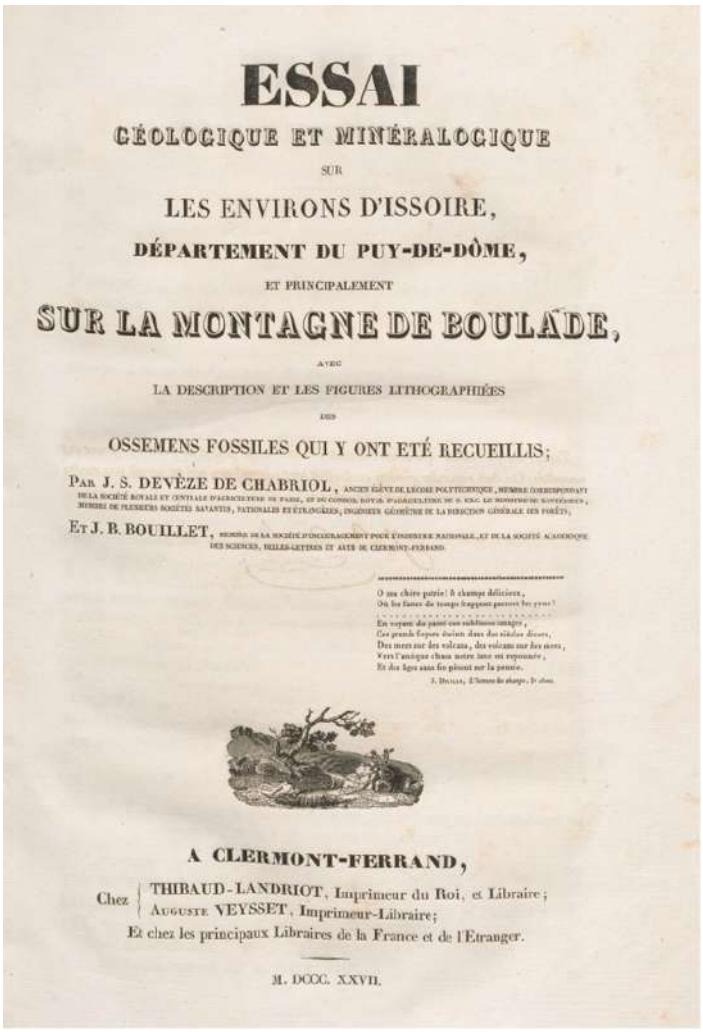
Fig. 2. Planche VI avec la figure 3 illustrant un prétendu ruminant (en réalité un Tapir), extraite de l'ouvrage de Devèze et Bouillet.

lithographie, est très-satisfaisante mais, sous le rapport du dessin

> « *on ne saurait en dire autant ; plusieurs figures paraissent évidemment pécher par les proportions respectives de leurs parties, et c'est un défaut capital pour des objets dont la différence repose souvent sur ces mêmes proportions. Les auteurs, quelque capables qu'on les suppose, ne peuvent d'ailleurs avoir les connaissances d'anatomie comparée et l'habitude de l'examen des ossemens fossiles nécessaires pour parfaitement déterminer les espèces d'animaux, et même les genres auxquels ces ossemens ont appartenu.* » (Férussac, 1825 : 439).

Férussac est par contre favorable à de Laizer et Bravard (que Férussac considérait toujours comme loyal au comte) et espère dans l'ouvrage promis par Bravard, Croizet et Jobert, « *un indispensable supplément au grand ouvrage de M. le baron Cuvier* ». En plus, toutes les espèces décrites et figurées par Devèze se trouveront dans l'ouvrage de Bravard, qui possède des ossements nombreux de toutes ces espèces, ainsi que de plusieurs autres qui ne seront pas dans celui de M. Devèze. Selon Férussac : « *Nous avons vu plusieurs des dessins et des lithographies de cet ouvrage, et nous pensons qu'ils ne laisseront rien à désirer tant pour l'exactitude que pour l'exécution.* » (Férussac, 1825 : 440).

Les espoirs de Férussac n'ont pas pu être réalisés : en novembre 1827, l'année du rapport de Maurice de Laizer à Lyon, Bravard signe avec Jobert un acte par lequel il rompt la « société fossile » établi en 1825. Jobert conserve seul la propriété de l'ouvrage (pertes et gains). Il paye 200 f. de dettes de Bravard, lui fait remise de tout ce qu'il lui doit pour nourriture. De plus, Jobert et l'abbé Croizet payent chacun à Bravard 100 f. comptant et le laissent libre de publier de son côté tout ce qu'il voudra sur le même sujet. Jobert, trésorier de la nouvelle Académie, receveur des contributions directes, c'est-à-dire celles assises directement sur les fonds de terres ou sur les personnes, qui se lèvent par des rôles où les contribuables sont nominativement indiqués, connaissait bien les dettes de Bravard et en sa qualité receveur, contrôle son futur. Croizet et Jobert (1828) publient leurs travaux à Clermont chez Thibaut en utilisant le même motif dans la couverture que celui utilisé par Devèze et Bouillet (**Fig. 3a et b**). Pour l'instant, ils vont dédier l'ouvrage à Cuvier et changer le titre : au lieu de « *Recherches sur les corps organisés* », ils adopteront le nom de l'ouvrage du baron : « *Recherches sur les ossemens fossiles* », un titre bien à la mode et qui laisse de côté les végétaux fossiles, déjà chez Adolphe Brongniart.


ESSAI
GÉOLOGIQUE ET MINÉRALOGIQUE
SUR
LES ENVIRONS D'ISSOIRE,
DÉPARTEMENT DU PUY-DE-DÔME,
ET PRINCIPALEMENT
SUR LA MONTAGNE DE BOULADE,
AVEC
LA DESCRIPTION ET LES FIGURES LITHOGRAPHIÉES
DES
OSSEMENS FOSSILES QUI Y ONT ETÉ RECUEILLIS;
PAR J. S. DEVÈZE DE CHABRIOL,
ET J. B. BOUILLET,
A CLERMONT-FERRAND,
Chez THIBAUD-LANDRIOT, Imprimeur du Roi, et Libraire;
AUGUSTE VEYSSET, Imprimeur-Libraire;
Et chez les principaux Libraires de la France et de l'Etranger.
M. DCCC. XXVII.

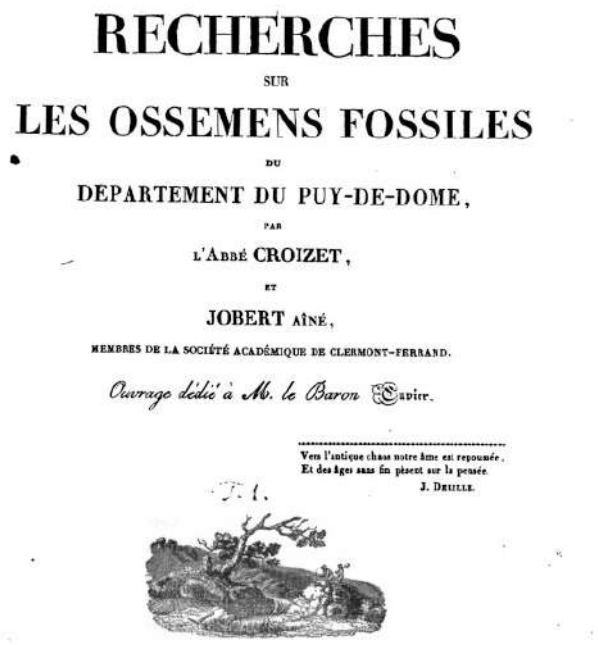

RECHERCHES
SUR
LES OSSEMENS FOSSILES
DU
DÉPARTEMENT DU PUY-DE-DOME,
PAR
L'ABBÉ CROIZET,
ET
JOBERT AÎNÉ,
MEMBRES DE LA SOCIÉTÉ ACADÉMIQUE DE CLERMONT-FERRAND.
Ouvrage dédié à M. le Baron Cuvier.
Vers l'antique chaos notre âme est repoussée,
Et des âges sans fin pèsent sur la pensée.
J. DELILLE.

Fig. 3 a. Couverture de l'ouvrage de Devèze et Bouillet, intitulé "Essai géologique et minéralogique sur les environs d'Issoire, département du Puy-de-Dôme".
b. Couverture de l'ouvrage de l'abbé Croizet, intitulé "Recherches sur les ossemens fossiles du département du Puy-de-Dôme".
Noter l'épigraphe de Delille sur chacun des ouvrages

Bravard, séparé de Croizet, de Jobert, en litige avec Maurice de Laizer, Devèze de Chabriol et Bouillet, part pour Paris où il retrouve Laurillard. Sa *Monographie de la Montagne de Perrier, près d'Issoire (Puy-de-Dôme) et de deux espèces fossiles du genre Felis découvertes dans l'une de ses couches d'alluvion* (Paris, 1828) va être imprimée chez Levrault à Strasbourg, c'est-à-dire chez l'imprimeur d'Alexander von Humboldt. Dans cet ouvrage, Bravard va reprendre des idées de la géologie de Férussac mais aussi la discussion sur la rareté des carnassiers fossiles dans les terrains de sédiment ou terrains meubles par rapport aux cavernes comme Kirkdale. Par contre, Bravard montre que les terrains meubles d'Auvergne sont pleins d'animaux toujours à l'affût de leurs victimes. Peut-être une autre métaphore de la paléontologie sous la Restauration. Et pour se défendre, Bravard, dans une note, va inclure une estocade contre Devèze et son prétendu cétacé indéterminable, un vestige probable du déluge et de la présence de la mer en Auvergne :

> « *Cette erreur qui est une des plus légères de l'échafaudage de sophismes qu'ils ont donné ( ), ne mériterait certainement pas d'être réfutée. Cependant, comme elle résulte d'une particularité assez plaisante dont je suis témoin, je vais raconter le fait. Au mois de décembre 1825, pendant que je comparais mes fossiles avec leurs analogues dans les espèces vivantes, dont on conserve les squelettes dans les galeries d'anatomie du jardin du Roi, M Laurillard était occupé à déterminer le petit nombre d'ossemens que possède M. Devèze. Sur chaque os, ce dernier avait placé une étiquette inexacte que M. Laurillard enlevait en écrivant sur l'os lui-même des détails spécifiques : mais un fragment de l'un d'eux se trouvant trop inégal pour y tracer des caractères, il y laissa la bande de papier qui portait pour étiquette, OSSEMENT DE CÉTACÉ, et sans avoir la précaution d'effacer cette sottise, écrivit au-dessous, indéterminable, d'où notre savant a fait son cétacé indéterminable* (Bravard, 1828 : 91).

Conclusion

Cette erreur montre aussi la série de contingences et de fragmentations qui modèlent la pratique de la paléontologie et de l'anatomie comparée, organisée avec le concours d'hommes et de femmes qui se détestent, s'associent, se font la guerre et se volent les uns les autres en invoquant la Genèse et la Patrie. L'itinéraire français de Bravard est aussi un exemple qui s'articule à des problématiques transnationales et locales comme la propriété des ossements, le droit d'auteur, l'économie des pratiques scientifiques, la diffusion et publicité du savoir ; bref, les enjeux commerciaux, légaux, politiques et scientifiques dans le contexte si conflictuel de la Seconde Restauration des années 1820. En ce sens, Bravard nous conduit dans l'univers social de la paix de la Restauration et de ses créations marquées pour le litige et la délation. Mais aussi vers la question de la nature procédurière et judiciaire qui a caractérisé l'émergence de la paléontologie dans les contextes les plus divers, que ce soit en Patagonie, dans le Massif central ou dans l'Ouest américain, on voit souvent ce type de conflit sur la propriété des ossements, un conflit moins visible dans les domaines de la zoologie et des autres disciplines qui se basent sur les collections. Une question qui reste ouverte, un prospectus pour un livre qui, comme cette histoire nous l'apprend, seul l'avenir peut dire si jamais quelqu'un la résout. D'autre part, le cas d'Auguste Bravard nous montre qu'entrer dans l'histoire des pratiques de la paléontologie française grâce aux clés fournies par cet illustre inconnu, peut contribuer à dévoiler ce que Pietro Corsi (2020 : 1) appelait « *the multiple layers – social, generational, political, and disciplinary – that at any given time characterize the actions of populations of individuals claiming to pursue and possess knowledge*. »

Remerciements

Je remercie très vivement les personnes et institution qui m'ont apporté leur soutien pendant ma recherche et l'écriture de cet article : en 2003, Pierre Pénicaud, la famille de Madame Monghal à Issoire. Dans ces dernières années, Nathalie Richard. Madame de Fontaines, Susana García, Miruna Achim, Karoline Noack, Eric Buffetaut et le soutien de l'action ECOS-SUD A15H02 Sciences citoyennes : les espaces de l'amateurisme scientifique (1850-1950) ; PICT 2015-3534 ; et du PIP 0153-CONICET. Il y a aussi quelques noms qui sont récurrents à l'époque et maintenant : Maribel Martínez Navarrete, Margaret Lopes et la Fondation Alexander von Humboldt (*Once a Humboldtian, always a Humboldtian – Humboldtien une fois, humboldtien toujours*). Mais je dois aussi reconnaître une autre continuité avec le passé : en 1999, lors-

que j'ai trouvé les dossiers Bravard/Séguin sur une mission de l'action ECOS dirigée par Yves Coppens et Jorge Rabassa, j'ai suivi le séminaire que Pietro Corsi donnait au Centre Koyré, encore dans le Jardin des Plantes. Impressionnée par la quantité de petites histoires autour de la classification des zoologues et minéralogistes de 1800, ce travail se veut une minuscule reconnaissance à cette histoire en filigrane qu'il a su transmettre dans ses travaux.

Annexe 1

a. Lettre de Bravard à Laurillard (Archives du Muséum National d'Histoire Naturelle, Paris)

Monsieur,

Il y a bien longtems, c'était en 1829, un tout jeune homme qui venait de découvrir en Auvergne plusieurs gîtes à ossemens fossiles, se présenta devant vous et votre illustre ami le Baron Cuvier sans autres lettres de recommandation que sa découverte. L'accueil bienveillant qu'il reçut de vous, les leçons et les conseils que vous lui avez prodigués avec une sollicitude toute paternelle (sont encore) sont encore pour lui de bien glorieux souvenirs, et il est heureux aujourd'hui de vous exprimer toute la reconnaissance qu'il vous doit pour les soins que vous avez donnés à son éducation scientifique. Le jeune homme de 1829 peut il espérer que vous ne l'avez pas complétement oublié ?

Je vous dois compte, en retour de tout ce que vous avez fait pour moi, en retour des nombreux témoignages d'amitié que vous m'avez donnés autrefois des quinze années qui se sont écoulées depuis que je ne vous ai vu, je vais le faire sommairement.

En 1828 je publiai ma monographie de la Montagne de Perrier et deux espèces fossiles du genre felis (Megantereon et Cultridens)

En 1830 je fis paraître un petit mémoire sous le titre de « Monographie du Cainotherium genre nouveau de la famille des pachydermes » que MM de Laizer et Parieu ont depuis décrit sous le nom de Oplotherium.

Á cette époque, privé de fortune je du songer à me faire une position dans le monde et ... lors je renonçai a l'étude des sciences naturelles pour me livrer à l'architecture que j'exerce depuis douze ans ; et pour en plus avoir d'occasion de me détourner de mon état je cédai a M. l'abbé Croizet et à M. de Laizer mes collections paléontologiques.

Mon travail et mon mariage avec la fille du greffier en chef du tribunal d'Issoire m'ayant procuré quelque aisance, j'ai pu consacrer depuis quelques années de l'argent et tous mes momens de loisir à la formation

Vous savez qu'en 1828 lorsque l'abbé Croizet et moi faisions paraitre, chacun de notre côté, le résultat de nos recherches, nous ne connaissions encore que 40 espèces des alluvions anciennes et une vingtaine des terrains tertiaires 60 en totalité, vous verrez par l'énumération suivante de combien s'est accrue la liste des anciens animaux de l'Auvergne :d'une nouvelle collection et je suis parvenu à des résultats que j'étais loin de prévoir car ma collection se compose en ossemens seulement de 4 à 9000 morceaux appartenant à plus de cent cinquante espèces perdues recueillies soit dans les terrains tertiaires d'eaux douces, soit dans les alluvions volcaniques anciennes soit enfin dans des cavernes ou fentes de roches.

Eléphant, Mastodontes, hippopotamus, Rhinocéros, Chevaux, Tapir, Cochon, Felis, Castor : 70 espèces provenant uniquement des alluvions volcaniques.

Dans les cavernes j'ai trouvé les espèces suivantes qui diffèrent toutes de celles qui précèdent (28 espèces bien déterminées et cinq qui ne le sont pas encore. En tout 33) Les terrains tertiaires d'eaux douces m'ont fourni des dépouilles des animaux qui figurent dans la liste d'autre part

3 Cainotherium	
2 Anthracothérium etc.	*total 91*
Récapitulation	
Alluvions volcanique	*70*
Cavernes et fentes	*33*
Terrains d'eaux douces	*91*
Total	*194*

Voilà Monsieur, le produit de mes investigations paléontologiques. C'est sans contredit un résultat immense que je n'aurai certainement pas obtenu si ma position d'architecte de l'arrondissement d'Issoire ne m'eut créé des rapports avec tous les carriers et fabricants de chaux de notre pays, rapports par suite des quels tout ce qui se découvre est immédiatement mis à ma disposition. Mais outre ce qui m'a été apporté de part et d'autre, il est bon de vous dire que j'ai fait pratiquer à très grand frais pendant l'espace de trois années, d'immense fouilles dans les alluvions de la montagne de Perrier et de divers autres gites que j'ai découverts depuis que vous avez visité nos contrées.

Vous concevez qu'une collection de cette importance ne peut et ne doit demeurer la propriété d'un simple individu qui d'ailleurs ne s'occupe plus de science si ce n'est en simple amateur ; l'impossibilité de disposer de salle assez vaste pour la recevoir et les frais dispendieux que nécessite son entretien me prescrivait également de m'en défaire, je songeai a la proposer à M. de Blainville pour l'administration du Jardin des plants. J'écrivais donc à ce sujet au savant directeur du muséum et je lui envoyai le catalogue de ma collection. Deux lettres que j'ai reçues m'indiquaient le désir de l'administration d'acquérir ma collection, et dans la dernière M. de Blainville m'engageait à formuler mes prétentions, ce que j'ai fait.

Voilà déjà quarante jours que ma dernière lettre a du être remise a M. de Blainville et je n'ai point de réponse ; cependant comme j'avais reçu des propositions d'un musée étranger pour l'aliénation de mon cabinet et que je suis pressé d'y répondre, je viens vous prier d'avoir l'extrême obligeance de vous occuper dans mon intérêt de la solution de cette affaire. Je tiendrai sans doute beaucoup à ce que la France conservait ma collection qui est sans contredit aujourd'hui la plus précieuse du monde ; mais bien que disposé à faire en faveur de mon pays d'importants sacrifices, la médiocrité de ma fortune et l'avenir de mes enfants me font un devoir de me couvrir au moins des dépenses que j'ai faites.

Mr., pour peu que l'administration mette encore du retard à répondre à mes propositions, je me verrais dans l'obligation d'accepter quoique à mon grand regret les offres qui me sont faites d'ailleurs. L'Abbé Croizet dans une lettre ci inclue vous parle d'un arrangement qui vient d'avoir lieu entre nous, de la réunion de nos deux collections ; cette circonstance ajoute un immense intérêt a ce que je possédai déjà, plus de 20 espèces viennent d'être ajoutées à la liste de celle que je vous ai signalée ; vous voyez donc que ces deux collections réunies font le plus beau monument.

b. Lettre de Forshall à Bravard (Archives du Natural History Museum, London)

British Museum, August 5 1845

Sir,

I am directed by the Trustees to acknowledge the receipt of your letter of the 26th June giving an account of the collection of fossils formed by yourself and M. the Abbé Croizet its present extended state, and offering it to the Museum at the price of thirty thousand francs, and I am, thanking you for the offer thus made, to acquaint you that the Trustees find themselves under the of declining the purchase.

I have the honour to be, with much consideration, Sir, your very obedient servant, J. Forshall, Sec.

Annexe 2

a. Lettre de Jobert, Bravard et Croizet à M. le rédacteur du *Journal du Puy-de-Dôme*, samedi 18 juin 1825 (*Journal du Puy-de-Dôme*, 20e année, N°73, samedi 18 juin 1825)

Clermont-Ferrand, 17 Juin 1825

J'ai l'honneur de vous envoyer, Monsieur, une lettre de M. Bravard, que je vous prie d'insérer dans le plus prochain numéro de votre journal, et une lettre de M. Croizet, qui vous autorise à insérer celle de M. Bravard.

Votre dévoué serviteur, A. JOBERT

Clermont-Ferrand, le 13 juin 1825

Monsieur, j'appris par le numéro de votre journal, du 7 de ce mois, que M. Devèze, de concert avec M. Bouillet, étoit sur le point de publier un ouvrage (...) J'ai sous les yeux le prospectus de cette publication et la première livraison des planches lithographiées. Ce n'est pas sans quelque surprise que j'ai reconnu, Monsieur, parmi les lithographies d'ossemens de la montagne de BOULADE une foule de fossiles dont je suis propriétaire, et que j'ai découverts dans la montagne de PERRIER : j'en ai, à la vérité, donné connaissance à M. Devèze il y a quelques mois ; mais je me propose de mettre, moi-même, le public à portée d'apprécier le degré d'importance que peut offrir ma découverte, et

le résultat des recherches que je fais depuis plus de deux ans. J'ai l'honneur de vous prier, en conséquence, de vouloir bien annoncer dans votre journal, que je viens de me réunir à M. l'abbé Croizet, qui a recueilli dans la même montagne de PERRIER beaucoup de fossiles, dont plusieurs figurent, comme les miens, dans la première livraison des lithographies de M. Devèze. M. Jobert qui, de son côté, a rassemblé un grand nombre d'ossemens trouvés sur d'autres points de ce département, vient aussi se joindre à nous ; et nous pourrons, par ce moyen comprendre dans notre travail la description de plusieurs autres gisements qui présentent un grand intérêt.

Nous nous occupons, au surplus, de la rédaction d'un prospectus qui fera connaître le plan de notre ouvrage. A. BRAVARD

Au même

Monsieur, M. Bravard, M. Jobert et moi, nous nous occupons d'un travail sur les ossemens fossiles que nous possédons, je consens, par conséquent, à ce que mon nom se trouve dans les articles, prospectus, etc., que nous jugerons convenables de faire paroître, Neschiers, le 15 juin 1825, CROIZET. »

b. Lettre de Devèze de Chavriol à M. le rédacteur du *Journal du Puy-de-Dôme*, Issoire, 2 juillet 1825 (*Journal du Puy-de-Dôme*, 20e année, N°78, jeudi 30 juin 1825)

Thiézac, par Saint-Fleur, le 26 juin 1825

Monsieur, vous avez inséré, dans le N° du 18 juin de votre journal, une lettre signé Bravard, qui exige de ma part une réponse. J'espère que vous voudrez bien lui donner place dans votre plus prochain numéro.

Ce n'est, sans doute, pas sérieusement que M. Bravard parle du gisement de *Boulade* comme d'une découverte qui seroit sa propriété : cette découverte, si c'en est une, appartient à deux jeunes chasseurs d'Issoire, qui ont montré des fossiles de ce gisement long-temps avant que, ni moi ni M. Bravard, ne le connoissions. Quoi qu'il en soit de ce fait peu important, il est vrai que M. Bravard et M. l'abbé Croizet, curé de Neschers, ont recueilli des ossemens fossiles à *Boulade* ; M. Jobert, receveur des contributions, a pu, de son côté, s'en procurer quelques-uns à Clermont. Permis à ces messieurs (comme il le seroit à M. César, chirurgien-dentiste, possesseur d'une très belle dent de Mastodonte) de publier à ce sujet tout ce qui leur conviendra, jusqu'à ce point, pourtant, que leur ouvrage ne puisse être considéré, en tout ou en partie, comme une contrefaçon de celui dont la propriété est assurée, tant à moi qu'à M. Bouillet. J'ai dessiné une partie des ossemens dont M. Bravard est possesseur, comme de son côté il a pris le calque de quelques-uns de mes dessins. Avant la publication de la première livraison (...), M. Bravard n'avoit, non plus qu'aucun d'autre, songé à entreprendre un pareil travail. Cette première livraison paroît, elle obtient l'approbation des personnes instruites ; sur le champ M. Bravard se met en émoi : il cherche des associés, des dessinateurs et des lithographes, pour publier un ouvrage sur la montagne de *Perrier*. Mais comme il lui est facile d'imaginer de quelle nature sont les clauses du traité que nous avons passé avec vous, il arrange les faits de manière à faire croire que sa publication, si elle avoit lieu, seroit étrangère à celle à laquelle vous donnez vos soins. Selon lui, le gisement de fossiles n'est plus à la montagne de *Boulade* ; il est à la montagne de *Perrier*, et voici pourquoi : c'est que M. Bravard suppose que vous pourriez prêter vos presses pour les fossiles de *Perrier*, et non pour ceux de *Boulade* ; amis c'est jouer sur les mots ; j'ai fait d'assez fréquentes courses pendant deux ans, soit seul, soit avec M. Bravard, soit, en dernier lieu, avec M. Bouillet, au gisement des ossemens fossiles, pour le parfaitement connoître ; M. Bravard le connoît tout aussi bien que moi : il sait que le lieu où il existe se nomme *Boulade*, comme la maison de campagne qui est au-dessous (Note : Il ne faut pas confondre ce lieu avec la tour de Boulade, qui se trouve sur la rive droite de l'Allier). Ainsi, que l'on adopte notre dénomination ou la sienne, toujours est-il qu'il ne s'agit que du même gisement. Il suit de ce fait évident, que l'on voudroit offrir au public, sous un titre différent et avec certaines modifications nécessaires au but qu'on se propose, le même ouvrage que celui dont la seconde livraison va paroître ; et que, sous un format réduit ou étendu, les figures de l'atlas projeté seroient, au moins en partie, les mêmes que celles que je publie avec M. Bouillet. Si M. Bravard nous avoît devancé, en applaudissant à son zèle, il ne nous seroit pas venu dans la pensée de *contrarier* ses efforts, et surtout nous n'aurions pas imaginé de proposer à son imprimeur de nous prêter ses presses pour un ouvrage qui nous eût paru une contrefaçon du sien. M. Bravard est à la place où nous nous serions trouvés. Son ouvrage, s'il est, en tout ou en partie, la contrefaçon ou une contre-épreuve du nôtre, peut-il s'imprimer dans les mêmes ateliers ? Nous avons trop de confiance, Monsieur, en votre loyauté, pour craindre un moment que les droits résultant pour nous du traité que nous avons conclu avec vous, puissent subir la moindre altération.

Je finirai par une dernière observation. Lorsque j'ai dessiné les ossemens dont M. Bravard étoit possesseur, c'étoit bien certainement de son consentement : mon intention de les joindre à la collection que je me

proposois de publier lui étoit parfaitement connue ; cependant ce n'est pas sans quelque surprise, dit-il dans sa lettre, qu'il a reconnu parmi les lithographies d'ossemens de la montagne de *Boulade*, UNE FOULE de fossiles dont il est propriétaire. La surprise de M. Bravard s'explique facilement : livré à lui même, il étoit satisfait de voir des dessins de ses ossemens entrer dans l'ouvrage que j'allois publier ; aujourd'hui il a formé une société qui voudroit faire ce que nous faisons ; il voit les choses sous un autre aspect. Voilà pourquoi il a reconnu dans notre première livraison, qui se compose de 43 figures, dont 27 sont tirées de notre collection, *une foule* de fossiles dont il est propriétaire. Au reste, la plus grande bonne foi a régné et régnera dans notre publication. Nous avons dit, dans notre prospectus, que nous indiquerions les fossiles que d'autres que nous avoient recueillis ; nous tiendrons religieusement notre promesse. DEVÈZE DE CHABRIOL

c. Lettre de Bravard à M. le rédacteur du *Journal du Puy-de-Dôme*, Issoire, 2 juillet 1825 (*Journal du Puy-de-Dôme*, 20e année, N°80, mardi 5 juillet 1825)

Monsieur, la lettre insérée dans le numéro de votre journal, du 30 juin dernier, me paroissant avoir pour but de jeter de la défaveur sur l'ouvrage que M. Devèze juge, par anticipation, devoir être une contrefaçon ou contre-épreuve de celui qu'il n'a pas encore publié, je me crois obligé de soumettre à vos lecteurs quelques réflexions sur le contenu de cette lettre, et je pense que vous ne refuserez pas d'insérer la mienne, puisque je ne fais qu'user du droit légitime de la défense.

C'est très-sérieusement, Monsieur, que j'ai déclaré avoir découvert dans la montagne de Perrier, une foule de fossiles dont je suis propriétaire, et que MM. Devèze et Bouillet publient sans m'en avoir même prévenu.

Il me seroit facile de prouver que depuis la fin de 1821, j'ai fait des fouilles dans la montagne de Perrier ; mais en admettant que les gisements nombreux, dont la plupart sont ignorés de M. Devèze, m'ont été indiqués, il n'en reste pas moins démontré que c'est moi qui ai appelé l'attention des naturalistes sur ces faits géologiques, dont j'ai le premier reconnu l'importance. Sans nous appesantir, au surplus, sur des détails qui ne présentent aucun intérêt pour la science, il suffit que nous ayons en notre possession des ossements fossiles, pour qu'on ne puisse nous contester le droit de les faire lithographier.

Notre ouvrage n'est pas, d'ailleurs, établi sur les mêmes bases que celui de MM. Devèze et Bouillet ; ce n'est pas la seule montagne de Perrier, ce n'est pas le seul ravin des Etouaires (que l'on continue à vouloir nommer Boulade) qui a fourni les objets de nos travaux ; notre plan est plus vaste ; il embrasse des terrains secondaires, tertiaires et d'alluvion, ainsi qu'on pourra en juger par notre prospectus qui étoit sous presse bien avant la lettre à laquelle nous répondons : que l'on ne dise donc plus que nous voulons offrir au public le même ouvrage que M. Devèze ; nous ne voulons pas calquer ses dessins ; les nôtres seront faits d'après nature ; il sait bien que M. Thibaud, son imprimeur, est le seul qui possède à Clermont des presses lithographiques, et que c'est précisément pour cela que nous avons imaginé de nous en servir. Sans m'arrêter plus long-temps à combattre des allégations dont je pourrais toujours démontrer le peu de fondement, et qui n'intéressent pas le public, je passe à la dernière phrase de la lettre de M. Devèze qui est ainsi conçue :

> Voilà pourquoi il (*M. Bravard*) a reconnu dans notre première livraison ; qui se compose de 43 figures, dont 27 tirées de notre collection, une foule de fossiles dont il est propriétaire. Au reste, la plus grande bonne foi a régné et régnera dans notre publication. Nous avons dit, dans notre prospectus, que nous indiquerons les fossiles que d'autres avoient recueillis ; nous tiendrons religieusement notre promesse.

La première livraison de MM. Devèze et Bouillet se compose en effet de 43 figures ; mais il est impossible que 27 soient tirées de leur collection. Nous nous engageons à représenter en nature cinq objets qu'ils n'ont pas désignés par une astérisque, et dont voici le détail : Planche V, figures 4 et 5 ; planche VI, figure 10, et planche X, figures 1 et 2 ; et qui, déjà, réduit à 22 le nombre des fossiles qui peuvent leur appartenir dans les lithographies qu'ils ont publiées. Nous n'attaquons pas la bonne foi des auteurs, mais leur exactitude : leur prospectus contient des erreurs importantes.

Il n'y a point de coulée basaltique sur la montagne de Perrier, mais bien à la cime de celle de Boulade, *qui se trouve en face du ravin des Etouaires, à une lieu de là, et sur l'autre-rive de l'Allier.*

Ils se trompent lorsqu'ils croient avoir trouvé des ossemens de cétacées dans le gisement isolé dont ils comptent publier la description.

Beaucoup d'autres point pourroient encore être critiqués avec raison : mais ils redresseront sans doute ces erreurs dans le texte qui accompagnera leur dernière livraison. Nous sommes. d'ailleurs bien décidés à laisser sans-réponse toutes les attaques que ces Messieurs voudraient diriger contre nous personnellement, persuadés que des discussions de cette nature fatiguent inutilement le public.

Les personnes éclairées jugerons notre ouvrage, et s'il obtient leur approbation, notre but sera rempli.

J'ai l'honneur, etc. BRAVARD.

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Two South American palaeontological collections in the Natural History Museum of Denmark

Deux collections paléontologiques d'Amérique du Sud au Musée d'histoire naturelle du Danemark

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KEY-WORDS

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Summary: Two large South American palaeontological vertebrate collections are housed in the Natural History Museum of Denmark, the V. Lausen Collection and the P.W. Lund Collection. Both were collected in the 19th century. During the last ten years these two collections have been reviewed, reassessed and digitalized. New information has been gathered from museum archives, letters, interviews and newspapers. Fossil material has been identified through morphological analysis. The research into the V. Lausen Collection in particular yielded much that was virtually unknown to the public before. Today the collections are kept in a storage facility and are very rarely accessed or studied.

MOTS-CLÉS

P.W. Lund
Dr. V. Lausen
Fossiles
Mammifères
Quaternaire
XIXe siècle
Musée d'histoire naturelle du Danemark

Résumé : Deux grandes collections de vertébrés fossiles sud-américains sont conservées au Musée d'histoire naturelle du Danemark, la Collection V. Lausen et la Collection P.W. Lund. Les deux ont été rassemblées au 19e siècle. Au cours des 10 dernières années, ces deux collections ont été revues, réévaluées et numérisées. De nouvelles informations ont été recueillies dans les archives du musée, des lettres, des interviews et des journaux. Le matériel fossile a été identifié par analyse morphologique. La recherche sur la collection V. Lausen en particulier a produit beaucoup d'informations qui étaient pratiquement inconnues du public auparavant. Aujourd'hui, les collections sont conservées dans une installation de stockage et sont très rarement consultées ou étudiées.

Introduction

The Natural History Museum of Denmark (NHMD) houses two relatively large fossil vertebrate collections from South America of historical and scientific importance. The less well-known of the two collections is Dr. Lausen's. Valdemar Lausen (1834-1889) was a Danish medical doctor who worked and lived for most of his adult life in Buenos Aires, Argentina. He had a general interest in palaeontology and fossils, and acquired a substantial number of specimens from various "fossil dealers" during his time in Argentina (on the concept of "fossil dealers" and the trade in fossil bones from the Pampas see Podgorny 2013). The combined value paid by Lausen is estimated at no less than 100,000 Francs, the equivalent of 1,600,000 – 1,700,000 Euros in today's money. Some very impressive almost complete skeletons of ground sloths and glyptodonts, skulls of sabre-toothed cats and remains of rare Miocene mammals are among the highlights of this collection. Dr. Lausen donated his entire collec-

tion to Copenhagen University. The more famous of the two is the P.W. Lund Collection from Lagoa Santa, Brazil. The natural historian Peter Wilhelm Lund (1801-1880) excavated limestone caves, and, over the course of a 10-year period, collected and studied vast quantities of Late Pleistocene vertebrates which he eventually donated to King Christian VIII of Denmark. Lund's personal history, as well as most of his scientific collection, has previously been studied in some detail (Reinhardt, 1880; Holten & Sterll, 2010). In the years following the collection's arrival in Denmark, zoologist Herluf Winge (1857-1923) described most of the mammal species in the five-volume monograph *E Museo Lundii* (1888-1915). Somewhat more recently, Carlos de Paula Couto, a very well-known Brazilian paleontologist, reviewed Winge's monograph and translated Lund's works. In 1950 he published a monumental book, *Memórias sobre a Paleontologia Brasileira*, that today is still regarded by many as the primary reference literature for studying Brazilian paleontology (Couto, 1950; Lopes, 2008). The collection itself includes almost 300 species of vertebrates and around 45 type specimens.

Both collections have been reviewed in their entirety. Previously unidentified fossil material was examined morphologically and classified to species level whenever possible. Previously identified materials were re-examined when their classification seemed doubtful or incomplete. The collections were re-packed and placed in new cardboard boxes and given new museum numbers. A digital file was created for each lot number for future reference.

Considerable effort went into tracing the origins of Dr. Lausen's purchases of fossils. Various sources were reviewed, including letters written by Dr. Lausen that are today kept at the Royal Library (Copenhagen), acquisition journals from the collections of the Natural History Museum of Denmark, personal correspondence with living relatives from the Lausen family and old newspaper articles.

Today, these two historical collections are kept in a storage facility at the Natural History Museum of Denmark, under Copenhagen University, in Denmark.

The V. Lausen Collection

This collection comprises more than 3,000 fossil skulls, teeth, bones and bone fragments divided into approximately 450 lot numbers. The fossil material was originally excavated in Argentina during the years 1875-1888, primarily and independently from each other by the two "fossil-dealers" Santiago Roth and José Larroque. The former was born in Switzerland in 1850. Soon after having immigrated to the Swiss colony in Baradero near Buenos Aires in 1866, Santiago began excavating and collecting fossils. As early as 1870 he started selling these fossils to various collectors and museums in Europe. In his later years Santiago Roth pursued an academic career and among other things functioned as Head of the Department of Palaeontology at the La Plata Museum in Buenos Aires (Saffer, 2009). José Larroque belonged to a French family of farmers settled in San Antonio de Areco and Mercedes, where they harvested fossils to sell in Buenos Aires and abroad (Podgorny, 2020). A few pieces were collected by other unnamed people. As far as is known, everything in the collection was bought by Dr. Valdemar Lausen (**Fig. 1**) and donated to Copenhagen University (NKS 3460, Royal Danish Library). As Lausen bought more and more fossils, he began dispatching them to Denmark. The larger fossil specimens were wrapped in newspaper and packed in wooden crates and transported by many different ships, beginning in 1877 and ending in 1889.

Fig. 1. Portrait of Valdemar Lausen, signed C. Rasmussen 1874 (Photo: Kasper Lykke Hansen).

Santiago Roth Pampas layer	Period	Epoch	Estimated age in millions of years BP
Superior	Quaternary	Pleistocene	0.085 – 0.12
Intermedium	Quaternary	Pleistocene	0.12 – 0.5
Inferior	Quaternary	Pleistocene	0.5 – 2.0

Table 1. Santiago Roth's system of Pampaen stratigraphic layers, here simplified from Damian Voglino (Voglino).

The provenance of the bones is generally not very well documented. Santiago Roth did not supply much information on his earliest pieces that were sold to Dr. Lausen. Most are labelled "Plata-landene" (in Danish), which roughly translates into something along the lines of: areas of land in the vicinity of the La Plata River. This should probably be interpreted in its widest form. Upon closer examination from the museum's historical registration journals (Z.M. acquisition journals) one can learn that Roth had excavated both within the city limits of Buenos Aires as well as hundreds of kilometres up the Parana River (which flows into the Rio de La Plata) all the way up to Santa Fe, 300 km to the northwest of Buenos Aires. This information pertains to Roth's later activities, but according to Roth's biography (Saffer, 2009) there is no reason to believe that his earlier finds came from outside of this general area. The fossils were mainly excavated from the banks of riverbeds and aside from supplying a vague geographical location for some of these finds, Roth sometimes placed a subtext of "Pampas Superior", Pampas Intermedia" or "Pampas Inferior" to the location (**Table 1**).

The material excavated by José Larroque also has almost no information, except that it is from the area of Mercedes, located around 50 km due west of Buenos Aires. The specific details of how and where the material was recovered by Larroque are unknown.

The age of the material in the Lausen Collection ranges from Late Miocene to Late Pleistocene age, with a few Holocene specimens as well. At least six species are from the Miocene. A few attempts at radiocarbon-dating pieces from the Lausen Collection have been made, but only a single one has been successful (T.W. Stafford, personal communication). This was a human phalanx dated to approximately 1950 years BP (14C Age: 1985 +/-15), corresponding to a pre-Columbian age, but not particularly interesting with regard to the colonisation of the New World by humans, as was originally hoped.

With regard to the present condition of the material in the V. Lausen Collection, the majority of the bones are intact or almost intact. Approximately 10-15% have fallen apart into smaller fragments or almost completely turned into a coarse-textured powder. Several individual skeletons are nearly complete and intact (**Fig. 2**).

Fig. 2. Edentates from the V. Lausen Collection on exhibit at the Natural History Museum of Denmark, The Evolution Exhibit 2018 (Photo: Kasper Lykke Hansen).

The V. Lausen Collection holds at least 55 mammalian species which are spread over 13 mammalian orders. The represented species are relatively diverse, ranging from aquatic dolphins and seals to sabre-toothed cats and enormous ground sloths. There are also a number of species that have not been adequately identified. This is due to either the bones being too fragmented to properly identify or in a few instances a lack of a higher level of expertise required for a final determination. A datasheet for each of app. 450 lot numbers containing about 3,000 fossil pieces in total has been produced for future incorporation into the Natural History Museum of Denmark's species database. There is also a single unidentified species of turtle (Testudines) and a number of unidentified fish and shark species in the collection.

The V. Lausen Collection includes three rediscovered type specimens: a piece of the right mandible of the rodent-like notoungulate *Protypotherium antiquum* Ameghino, 1882 (**Fig. 3**) and the left maxilla of the litoptern *Scalabrinitherium rothii* Ameghino, 1882 (**Fig. 4**), both of Miocene age (9.0 – 6.8 million years BP). *Neoprocavia mesopotamica* Ameghino, 1889 (**Fig. 5**), related to the capybara and of Miocene-Pliocene age, is under revision (Moreira *et al.*, 2012). This species is represented by a piece of the left mandible.

Fig. 3. *Protypotherium antiquum* Ameghino, 1882, Z.M.K. 21/1887, lingual view (Photo: Kasper Lykke Hansen)

Fig. 4. *Scalabrinitherium rothii* Ameghino, 1882, Z.M.K. 116/1887, buccal view (Photo: Kasper Lykke Hansen)

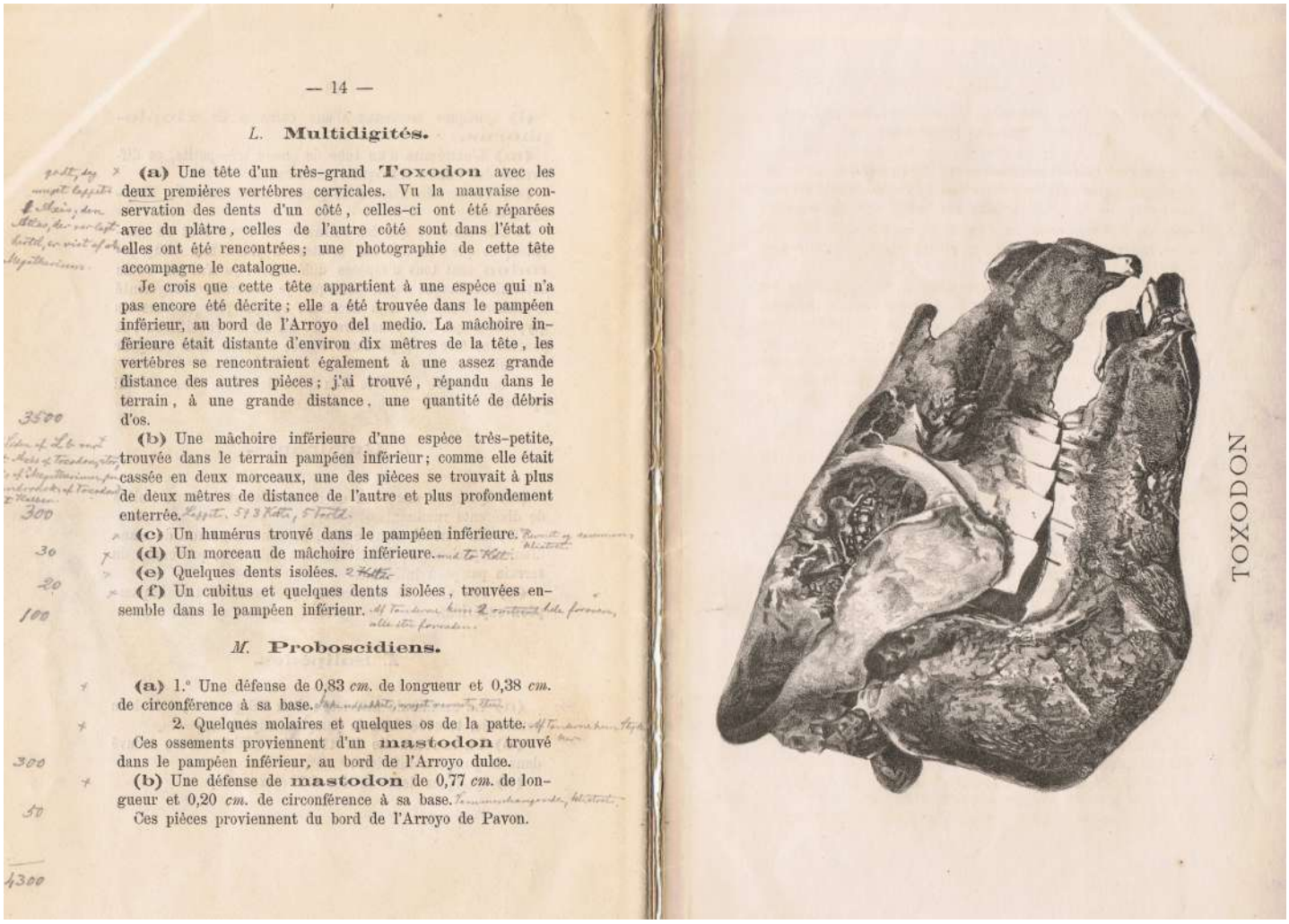
Fig. 5. *Neoprocavia mesopotamica* Ameghino, 1889, Z.M.K. 111/1887, buccal view (Photo: Kasper Lykke Hansen)

During his time in Argentina, Dr. Lausen also found time to send various other specimens of a more recent age back to Copenhagen. These reptiles and amphibians were probably caught by himself in and around the vicinity of Buenos Aires (**Fig. 6**). Around 10 species were received in alcohol through different couriers.

Fig. 6. *Liophis poecilogyrus* (*Erythrolamprus poecilogyrus* (Wied-Neuwied, 1825)) a small and common colubrid snake (Photo: Kasper Lykke Hansen).

As mentioned earlier both Roth and Larroque sold their fossils to museums around the world, but on occasion they sold to private investors as well. As a way of presenting their finds to potential buyers they produced catalogues. These ranged from hand-written lists of fossils to beautifully illustrated printed booklets in several different language versions (**Fig. 7**). Usually the fossils were individually priced, but on occasion one could buy the entire assemblage for a bundle price. Santiago Roth made the most elaborate catalogues and even numbered his later printed ones chronologically. Lausen bought everything in catalogues Nr. 2 and Nr. 3. Catalogue numbers 4-6 were sold to Swiss Museums, Nr. 5 for example is in Zürich. These catalogues not only display their role as scientific tools and knowledge bearers but also as crucial for the long-distance trade in fossil bones (Findlen, 1994; Alberti, 2005; Podgorny, 2013).

The total physical volume of the V. Lausen Collection is somewhat difficult to calculate, especially given the fact that four relatively large skeletons of ground sloths and glyptodonts are mounted. This increases their volume in sto-



— 14 —

L. **Multidigités.**

(a) Une tête d'un très-grand **Toxodon** avec les deux premières vertébres cervicales. Vu la mauvaise conservation des dents d'un côté, celles-ci ont été réparées avec du plâtre, celles de l'autre côté sont dans l'état où elles ont été rencontrées; une photographie de cette tête accompagne le catalogue.

Je crois que cette tête appartient à une espéce qui n'a pas encore été décrite; elle a été trouvée dans le pampéen inférieur, au bord de l'Arroyo del medio. La mâchoire inférieure était distante d'environ dix mêtres de la tête, les vertébres se rencontraient également à une assez grande distance des autres pièces; j'ai trouvé, répandu dans le terrain, à une grande distance, une quantité de débris d'os.

(b) Une mâchoire inférieure d'une espèce très-petite, trouvée dans le terrain pampéen inférieur; comme elle était cassée en deux morceaux, une des pièces se trouvait à plus de deux mêtres de distance de l'autre et plus profondement enterrée.

(c) Un humérus trouvé dans le pampéen inférieure.

(d) Un morceau de mâchoire inférieure.

(e) Quelques dents isolées.

(f) Un cubitus et quelques dents isolées, trouvées ensemble dans le pampéen inférieur.

M. **Proboscidiens.**

(a) 1.° Une défense de 0,83 *cm.* de longueur et 0,38 *cm.* de circonférence à sa base.

2. Quelques molaires et quelques os de la patte.

Ces ossements proviennent d'un **mastodon** trouvé dans le pampéen inférieur, au bord de l'Arroyo dulce.

(b) Une défense de **mastodon** de 0,77 *cm.* de longueur et 0,20 *cm.* de circonférence à sa base.

Ces pièces proviennent du bord de l'Arroyo de Pavon.

TOXODON

Fig. 7. Example from S. Roth's catalogue Nr. 2. (Natural History Museum of Denmark).

rage significantly as compared to if their individual bones were packed tightly together in appropriately sized boxes. The rest of the collection is generally stored into around 360 white cardboard boxes (14.5 cm x 32 cm x 49 cm) and a number of smaller white boxes of varying sizes (**Fig. 8**).

Today, the fossil V. Lausen Collection is kept in storage at the Natural History Museum of Denmark. The collection will probably not be kept as a single unit in the future and it will be integrated into the general collections of foreign origin. Depending on future storage dispositions, the collection will be physically accessible by guest scientists as well as digitally in the museum database.

The P.W. Lund Collection

The fossil collection consists of more than 100,000 fossil bones distributed in 14,000 lots, as well as more than 2,000,000 small bones from owl regurgitation pellets and around 1,300 breccia samples. Lund also sent many other samples to Denmark, including the skins of birds, various small animals in alcohol in

Fig. 8. Storage facility at the Natural History Museum of Denmark showing parts of the V. Lausen Collection (Photo: Kasper Lykke Hansen).

Fig. 9. P.W. Lund (Natural History Museum of Denmark).

glass containers, invertebrates, plants and even some ethnographical items. However, when the Lund Collection is referred to today, it is normal practice to only include the fossil material, which is kept together as one large unit in the storage facility. The subfossil specimens were collected by Lund himself (**Fig. 9**) in limestone caves near the town of Lagoa Santa in Minas Gerais, Brazil. The material was collected during the years 1834-1845. The material dates to the late Pleistocene and early Holocene age, and is similar to what has been found in large areas of Brazil (Eisenberg & Redford, 1999). C-14 dates taken from various mammal species yield dates of between 20,610 and 7580 YBP (calibrated age) (W. Neves, personal communication).

The limestone caves that Lund studied are integral parts of the karst terrain that covers large areas of Minas Gerais (**Fig. 10**). Most of this karst terrain has its origins in the Cambrian Period, around 500 million years ago (Auler & Farrant, 1996; Auler & Pessoa, 2020). Isolated linear limestone cliffs, often hundreds of meters long, spread across undulating dry grasslands with single standing trees and small lakes characterise the landscape. Rainfall is minimal and occurs in the late summer season. The caves have been established by the flow of slightly acidic water from nearby lakes and small rivers. Most of the caves that Lund explored were quite small compared to others in Brazil. Aside from the limestone itself, the karst terrain near Lagoa Santa consists of sandstone and a reddish-coloured clay/soil. The caves were rich in minerals, everything from diamonds to gold to nitre has been mined, and this field of work has been so intensive that it has given name to the region of Minas Gerais.

It was in these caves that Lund uncovered his many fossils, most of which were embedded into a matrix of sandstone and the reddish soil. Speaking from personal experience, the work of extracting the bones from the matrix must have been immensely difficult for Lund and his assistants, as this combination of the sandstone and reddish clay is rock hard.

What Lund discovered and later described, was a fossil fauna primarily consisting of vertebrates, but also including a few invertebrates. The vertebrates had ended up in the caves in different ways. Some had been dragged in by carnivores, some had fallen through a crack in the roof of the cave and others, probably the majority (Eisenberg & Redford, 1999), had drifted in with the current of a stream or the rise of local water level during the rainy season. There is also evidence of *Homo sapiens* being buried in the caves (Piló *et al.*, 2005). The invertebrates had probably entered the caves via waterways.

Fig. 10. The limestone cave Lapa da Cerca Grande, Brazil (Photo: Kasper Lykke Hansen).

Due to these special circumstances, the material in the Lund Collection is generally in a relatively poor condition. The majority of the bones are broken or fragmented and few, if any, skeletons are complete.

With a grand total of 293 vertebrate species in this fossil collection, one must consider it to be among the largest in the Natural History Museum of Denmark in this respect. Currently, the list (especially the rodents and marsupials) is in dire need of reclassification, as nearly all species are kept under Herluf and Oluf Winge's nomenclature from E Museo Lundii (1888-1915). One would assume that a reclassification would slightly alter the number of species in the collection. The list of vertebrates includes eight species of fish (Osteichtyes), one species of amphibian (Amphibia), 12 species of reptiles (Reptilia), 125 species of birds (Aves), and 147 species of mammals (Mammalia). Only a limited number of invertebrates (Invertebrata) are represented, probably less than 10 species (many have not yet been identified).

As mentioned above, reclassification may alter the number of species represented in the collection. However, there also exists a potential for discovering entirely new species in the collection from two different sources. To date, nobody has analysed the 28 boxes of owl-regurgitated small bones and fragments in detail (**Fig. 11**). Such an analysis would most likely expand the list of species within the rodent and marsupial groups, since these are by far the most commonly represented specimens based on a superficial examination of the boxes. The list can be further expected to grow as a more or less complete overview of small mammal fauna from Brazil is still a work in progress. New species are described regularly, both recent and extinct. A second source for discovering new species could be the more than 1,300 breccia samples Lund sent back to Denmark together with a small catalogue. In this catalogue, many of the major bones and bone fragments in the breccias are ascribed to various species by Lund. This catalogue, however, cannot be a completely satisfactory description, since many more bones are hidden inside the very hard clay and limestone matrix that holds the breccia together.

The P.W. Lund Collection currently holds 47 type species (**Fig. 12**) of which at least 25 have retained Lund's authorship. All of these are mammals except for one species of bird (*Chenalopex pugil* Winge, 1887). More than half

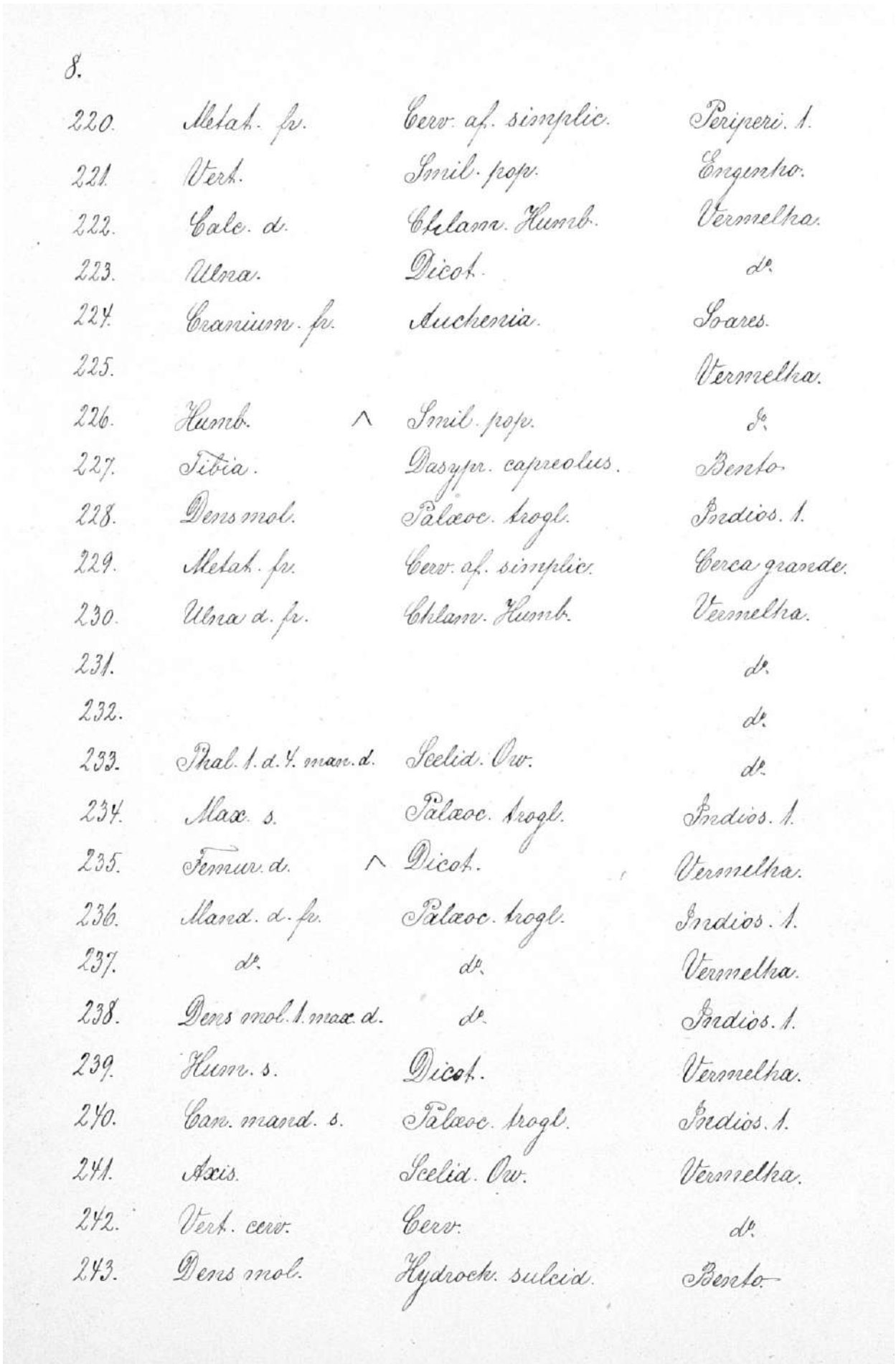
Fig. 11. Owl regurgitation sample (Photo: Kasper Lykke Hansen).

Fig. 12. *Smilodon populator* Lund, 1842, (Z.M.K. 1/1845:2554) canine tooth from upper jaw, one of several type specimens (Photo: Kasper Lykke Hansen)

of the type species are from Rodentia. The South American members of this order are currently under a massive process of revision, which has already impacted on the status and total number of Lund's type specimens and this trend is likely to continue in the years to come.

When Lund eventually decided to send his collection to Denmark it was accompanied by a number of catalogues handwritten by the artist Peter Brandt (**Fig. 13**). One of the catalogues (Katalog over Dr. P.W. Lund's palæontologiske Samling I) contained a list of 12,623 individual fossil bones, bone fragments, teeth and skulls, along with information on the cave from which they were excavated. An almost exact copy of this catalogue is also in existence, the only difference being a single less entry for a total of 12,622 items. This minor discrepancy remains a mystery. However, it is important to understand that none of these catalogues should be considered complete insofar as encompassing the entire fossil collection. They should rather be considered as the highlights. This is because many of the most impressive and unique specimens are included in the catalogues, whereas literally thousands of more mundane bones such as those from the deer (*Mazama*) have been omitted. As mentioned earlier, the fossil collection of P.W. Lund contains at least 100,000 individual fossil bones, bone fragments, teeth and skulls (personal information gathered during digitalisation). It is unfortunately a very common mistake made when describing Lund's works to only include the 12,623 items listed in the old catalogue. For the sake of completeness, it should be mentioned that a smaller catalogue including 1,337 breccia samples also exists (Katalog over Dr. P.W. Lunds palæontologiske Samling II Breccier.).

Another smaller curiosity observed from reviewing the Lund Collection is the fact that very few rib bones are present – it appears as if Lund purposely neglected to collect these. Out of the many figures depicted in Lund's work Blik på Brasiliens Dyreverden før sidste Jordomvæltning (1836-1847), only one rib is displayed. The lack of illustrations can, of course, be a coincidence, but the extremely low representation in the collection is so blatantly obvious, that this must be on purpose. In hind-



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220.	Metat. fr.	Cerv. af. simplic.	Periperi. 1.
221.	Vert.	Smil. propr.	Engenho.
222.	Calc. d.	Chlam. Humb.	Vermelha.
223.	Ulna.	Dicot.	d.
224.	Cranium. fr.	Auchenia.	Soares.
225.			Vermelha.
226.	Humb. ^	Smil. propr.	d.
227.	Tibia.	Dasypr. capreolus.	Bento.
228.	Dens mol.	Palæoc. trogl.	Indios. 1.
229.	Metat. fr.	Cerv. af. simplic.	Cerca grande.
230.	Ulna d. fr.	Chlam. Humb.	Vermelha.
231.			d.
232.			d.
233.	Phal. 1. d. 4. man. d.	Scelid. Ow.	d.
234.	Max. s.	Palæoc. trogl.	Indios. 1.
235.	Femur. d. ^	Dicot.	Vermelha.
236.	Mand. d. fr.	Palæoc. trogl.	Indios. 1.
237.	d.	d.	Vermelha.
238.	Dens mol. 1. max. d.	d.	Indios. 1.
239.	Hum. s.	Dicot.	Vermelha.
240.	Can. mand. s.	Palæoc. trogl.	Indios. 1.
241.	Axis.	Scelid. Ow.	Vermelha.
242.	Vert. cerv.	Cerv.	d.
243.	Dens mol.	Hydroch. sulcid.	Bento.

Fig 13. Example of a page from Lund's catalogue, specifying lot number, type of material, species and location. More than 12,000 lots were catalogued (Natural History Museum of Denmark).

sight it seems that the most likely reason for this anomaly is the tendency for mammal ribs to be relatively uninformative from a systematic point of view and therefore were disregarded by Lund.

The physical volume of this collection is quite extensive. The majority of the material is kept in approximately 300 brown cardboard boxes (16 cm x 37 cm x 60 cm) and 25 wooden boxes (20 cm x 38 cm x 38 cm). However, an additional special cupboard includes 30 cardboard boxes with skulls from *Homo sapiens*.

Today, the entire fossil P.W. Lund Collection is kept together as one unit in storage at the Natural History Museum of Denmark. Here it can be accessed physically by guest scientists as well as digitally in the museum database. It is planned that this database will be available via the Internet sometime in the near future.

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Conclusion

Many interesting scientific facts as well as fascinating personal stories can be discovered in the storage facilities and archives of old museums.

The importance of the Lund and Lausen fossil collections in the Natural History Museum of Denmark cannot be underestimated. Historically they have been a way for the two protagonists to display strange and wonderful treasures from distant lands, where they themselves decided to settle and live, to the population of Denmark. And more recently, the scientific value of these unique fossils has again become centre of attention, as new technological advances within the field of ancient DNA testing has emerged.

It is hoped that this review may be found useful to anyone wishing to delve further into the collections of P.W. Lund and V. Lausen.

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Cataloguing the Fauna of Deep Time: Paleontological Collections in Brazil in the Beginning of the 20th Century

Cataloguer la faune du temps profond : les collections paléontologiques au Brésil, au début du 20e siècle

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Summary: Since the beginning of the nineteenth century, the National Museum in Rio de Janeiro was the main institution that amassed paleontological collections, in Brazil. However, by the beginning of the twentieth century, two other strategic centers of research would also be significant places to consolidate paleontological sciences: the Paulista Museum, in the State of São Paulo, organized in 1894, and the Brazilian Geological and Mineralogical Survey in Rio de Janeiro, created in 1907. This paper argues that these paleontological collections and a vast network of interlocutors were fundamental, in the case of the Paulista Museum, to support the theories of director Hermann von Ihering (1850-1930) on land-bridges and on the History of the Atlantic Ocean. It would also consolidate Ihering's visionary proposal to transform the Paulista Museum into a South American Scientific Museum, which would challenge the supremacy of the Rio de Janeiro National Museum. At the Geological Survey, the geologists gathered paleontological collections and stratigraphic data to prove that it would be possible to find oil in the Brazilian territory, against general and international common beliefs. The goal of the Geological Survey was to centralize and coordinate paleontological scientific research in the institution, transforming a marginal research field in Geology into a consolidated research area. The publications of these institutions, as real modern catalogues, are fundamental to follow some aspects of their collections. The paper mentions just some examples of the work of cataloguing collections in these institutions to argue, in conclusion, that both examples shed some light into the importance and change of meanings attributed to paleontological sciences at the beginning of the twentieth century, also in Brazil. The collections supported the debates and economic activities – based on taxonomical studies in the Paulista Museum, and the absence of other resources in the Brazilian Geological and Mineralogical Survey – about the theories on the geological synthesis of the period.

KEY-WORDS

Paleontology
Oil
land-bridges theories
Paulista Museum
Brazilian Geological and Mineralogical Survey
XXth century

Résumé : Depuis le début du XIXe siècle, le Musée National de Rio de Janeiro était la principale institution qui rassemblait des collections paléontologiques au Brésil. Cependant, au début du XXe siècle, deux autres centres de recherche stratégiques devinrent également utiles pour consolider les sciences paléontologiques : le Musée Paulista, dans la ville de São Paulo, organisé en 1894 et le Bureau des Recherches Géologique et Minières à Rio de Janeiro, créé en 1907. Cet article soutient que ces collections paléontologiques et un vaste réseau d'interlocuteurs étaient fondamentaux, dans le cas du Musée Paulista, pour soutenir les théories de son directeur Hermann von Ihering (1850-1930) sur les ponts continentaux et sur l'histoire de l'océan Atlantique. La proposition visionnaire d'Ihering était de transformer le Musée Paulista

MOTS-CLÉS

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Musée Paulista
Bureau des Recherches Géologique et Minières
XXe siècle

en un musée scientifique sud-américain qui défierait la suprématie du Musée National de Rio de Janeiro. Au Bureau des Recherches Géologique et Minières, les géologues ont rassemblé des collections paléontologiques et des données stratigraphiques pour prouver qu'il serait possible de trouver du pétrole sur le territoire brésilien, à l'encontre de la croyance commune générale et internationale. L'objectif de Bureau des Recherches Géologique et Minières était de centraliser et de coordonner la recherche scientifique paléontologique dans l'institution, transformant ainsi un champ de recherche marginal en géologie en un domaine de recherche. Les publications de ces institutions, véritables catalogues modernes, sont fondamentales pour suivre certains aspects de leurs collections. Cet article cite seulement quelques exemples de travaux de catalogage de collections dans ces institutions pour affirmer, en conclusion, que les deux exemples mettent en lumière l'importance et le changement de signification attribués aux sciences paléontologiques au début du XX[e] siècle, également au Brésil. Les collections soutenaient les débats et les activités économiques - basés sur des études taxonomiques au Musée Paulista et l'absence d'autres ressources dans le Bureau de Recherches Géologiques et Minières -, sur des théories de la synthèse géologique de la période.

Introduction

The history of Paleontology in Brazil does not have an impressive founding episode [1]. Since colonial times, gigantic fossil bones have been found in gold mining in the Province of Minas Gerais, or by chance in well digging for water in the dry lands of the Northeast of the country. Among the first records about the discovery and transfer to Portugal of great animal bones from Minas Gerais, one must mention the historical information between 1770 and 1771 by the naturalist Alexandre Rodrigues Ferreira, the well-known explorer of the Portuguese Amazon at the end of the eighteenth century. Ferreira discussed the origin of such bones in accordance with the catastrophism world-view of the time and questioned Buffon about the inexistence of huge animals in America (Ferreira, [1790] 1972). In the same line of thought, in his Memoirs about the fossil bones and the fossiliferous terrains of the province of Ceará in the northeast of the country, the naturalist João da Silva Feijó would also challenge Buffon' view.

In addition to mentioning big bones, Feijó's registers are among the first observations about the outstanding paleontological characteristics of the region. Addressing the "Rare Petrifications", he mentions that in the Cariri Mountains, several hundred miles from the sea, one could find "the most rare and curious petrifications of fish and many genera of amphibians, some measuring up to four hands span" [circa 88 cm] [2] (Lopes *et al.*, 2005). The works of George Gardner (1841) and Louis Agassiz (1841) publicized these fossiliferous deposits of Ceará both in Europe and the United States. The results were published in the same volume of the *Edinburgh New Philosophical Journal*, which includes the discoveries of Peter Lund in the caves of Lagoa Santa.

The works of the Dane Peter Wilhelm Lund (1801-1880) in the caves of Lagoa Santa, state of Minas Gerais (Holten and Sterll, 2011), made the megafauna of Brazilian territory more internationally known in the middle of the nineteenth century. The paleontological researches that Lund undertook until his death in 1880 are well known and Lund was able to identify circa 150 species of fossil mammals in the material gathered from some sixty caves, in the region of Lagoa Santa, state of Minas Gerais (Couto, 1950; Lopes, 2008; 2010a). He identified as the "Lagoa Santa human race" 20 human skulls, which he considered to be contemporary with Pleistocenic fossil mammals.

Undertaking a systematic register of gigantic bones found in the country and beginning to classify the collections of the Rio de Janeiro National Museum, Frederico Leopoldo César Burlamaque (1803-1866) published, in 1855, a paper entitled "*Notícia acerca dos animais de raças extintas, descobertos em vários pontos do Brasil*" [News about animals of extinct races, found in various places in Brazil], considered

1. Referential and more general and descriptive historical approaches about the paleontological researches in Brazil were undertaken by well-known Brazilian paleontologists such as Josué Camargo Mendes (1945, 1981) and Setembrino Petri (2001).

2. These deposits of sedimentary rocks belonging to the Romualdo Member, a higher stratigraphic unit of the Santana Formation of the Araripe Basin, would originate from the Aptian-Albian (Lower Cretaceous). They are considered one of the most important paleontological deposits in Brazil (Kellner, 2002).

the first study of Pleistocene fossils in Brazil. Burlamaque was the director of Rio de Janeiro National Museum from 1847 to 1862 and one of the main responsibles for the consolidation of paleontological studies in the National Museum of Rio de Janeiro (Lopes, 2009; 2013).

The vast development of stratigraphic and paleontological research from 1830 onwards led to the establishment of basic units of stratigraphic successions in this period. These were based on the assumption of developing a comparable geological history of the earth around the globe and the setup of a logistics of cooperation networks (even if asymmetrical ones), of exchanges of objects and information that circulated data, beyond national borders, which would allow universal sequences to be determined. These sequences were based on studies of details of local specificities, which made it possible to negotiate the specifics of a region with a universal method of observation, communication and correlational registers. And the sequences would become even more controlled and standardized by the agreements established for the construction of geological maps, dictated by associations, geological surveys and international congresses that consolidated themselves throughout the nineteenth century (Rudwick, 1997; Podgorny *et al.*, 2008).

From the last decades of the nineteenth century onward, paleontological investigations were already a part of practices of scientific activities all over the world. With its consolidated practical significance for stratigraphy, its recognized importance for the exploration of mineral resources, paleontological research has ensured the increasing support of governments through geological surveys, as Martin Rudwick (1972) pointed out many years ago, and especially for coal and oil, including in Brazil.

By the beginning of the twentieth century, the National Museum in Rio de Janeiro continued its paleontological work, however two other strategic centers of research would also become significant places to consolidate paleontological sciences: the Paulista Museum, in the State of São Paulo and the Brazilian Geological and Mineralogical Survey in Rio de Janeiro. Orville Derby, who had already left the Rio de Janeiro National Museum to direct the Geographical and Geological Commission of São Paulo (1886-1907), would continue his paleontological activities as the first director of the Geological and Mineralogical Survey in Rio de Janeiro (1907-1915), where he would forge the tradition of paleontological works to search for coal and oil. And Hermann von Ihering, former National Museum's travelling naturalist for more than a decade, became the director of the Paulista Museum, in the city of São Paulo, in 1894, thanks to the support of Orville Derby, then at the Geographical and Geological Commission (Lopes and Figueirôa, 2003).

Cataloguing collections should be as or more important than public displays in the Paulista Museum

Hermann Friedrich Albrecht von Ihering was a renowned member of the international scienti c community, a specialist on biogeography, zoology, paleontology, anthropology. In Germany, he had studied at Giessen and received a degree in medicine in Berlin and Göttingen, under the influence of Rudolph Leuckart. Ihering's PhD in zoology about the ontogeny of *Cyclas* (freshwater mollusks), at the University of Göttingen, was published in Leipzig in 1876. He went to Brazil in 1880, where he developed his professional career (Lopes and Podgorny, 2014). For him, his museum would never be a local or provincial one. On the contrary, Ihering's work had acquired a continental dimension and thanks to his conception about specialization of science, his dream and his plan for the Paulista Museum was the construction of a Scientific Museum specialized in the Zoology and Paleozoology of South America, to challenge the supremacy of the generalist Rio de Janeiro National Museum.

Ihering published more than 300 papers in German, English, Portuguese, French and Spanish – mainly in German and Argentinean journals and in the Paulista Museum Journal, which he created. In many of these articles, Ihering described new species of marine and continental shells from South America, from the Brazilian Northeast to the sedimentary areas of Patagonia, Argentina (Lopes and Podgorny, 2014). Argentinean shells were systematically sent to him by his friend Florentino Ameghino, the specialist on South American fossil mammals (Podgorny, in press). Ihering and Ameghino exchanged more than 300 letters. Samples, mentions or requests of shells, were continual in all those letters. Throughout his scientific career, Ihering described and classified more than three hundred new fossil mollusks from

the Tertiary to the Pleistocene, including genera, subgenera, species and subspecies (Parodiz, 1996). He insisted that the Paulista Museum should be a scientific institution where research activities and cataloguing collections should be as or more important than public displays. Ihering gathered and catalogued some 17,000 fossil and modern mollusks, which were carefully stored in 480 drawers in the Museum. In these collections and several others that the Museum amassed, he based his contributions on the land-bridges theories. Ethnology was another of Ihering's main works at the Paulista Museum, and when he left the direction of the Museum in 1916, and went back to Germany – the institution held circa 80,000 Natural History and Ethnology specimens.

In order to receive publications needed for his work, Ihering exchanged the *Revista do Museu Paulista [*Paulista Museum Journal] with more than 400 scientific institutions from all over the world. He not only kept an extensive exchange network with European and North American researchers and institutions, but he also received collections from and built close ties with researchers from Uruguay, Chile, Argentina, South Africa, Australia, New Zealand. He also encouraged and supported a network of dealers and amateurs in Brazil to supply his Museum. The documents show that the Paulista Museum was among the Brazilian museums, the institution that acquired the most extensive collections from local and international commercial dealers (Grola and Barbuy, 2016). As Paula Findlen (1996) already pointed out some years ago, catalogues are among the most significant objects of a collection. The Paulista Museum Journal was truly a modern catalogue (Lopes, 2010). In order to exemplify Ihering's movement to catalogue collections in his networks, let's refer to some examples.

The Journal, according to Ihering '*was not a popular education journal but the archives of results of the Brazilian scientific explorations*' (Lopes, 2010). The annual reports detailed, over many pages, the objects received by the Museum, as well as the name of the specialists to whom the objects were sent to be classified and for publication in a future paper in the Museum Journal: for example, crustaceans were sent to Arnold E. Ortman (1863-1927), in Princeton, shells that Ihering received from Argentina also were sent to Gustav Steinmann (1856-1929) in Freiburg and to Alexandre Édouard M. Cossman (1850-1924) in Paris and land snails were dispatched to the Swiss Henri Hans Suter (1841-1918) in New Zealand. Bones were sent to Florentino Ameghino, and once a part of a jaw found in limestone caves of the South of the State of São Paulo (Iporanga, Monjolinho), that was sold to the Paulista Museum by the German born Ricardo Krone (1861-1917). Krone was an engineer and a dealer of natural history objects to several museums. (Grola, 2012). In his article about the detailed description of the caves of the region, Krone supposed that the bones belonged to some kind of *ground sloth* – *Nothrotherium*, typical of South America. The first remains of a young animal of this genus had been found by Peter Lund in the middle of the nineteenth century, in the caves of Lagoa Santa, Minas Gerais. In his letters to Ihering, Krone mentioned in his expectations that his works in the caves might compare with Lund' explorations (Krone, 1898; Grola, 2012), perhaps to increase the price of his specimens.

These few bones, broken to small pieces, remained stored for some ten years, at first at the private bookshop owned by Florentino Ameghino, and later at the Buenos Aires Museum. The bones would reappear in the pages of the Museum Paulista Journal, *Revista do Museu Paulista*, as the sole paper amongst Ameghino's huge production, published in that journal (Ameghino, 1907).

The most important object in that collection was an incomplete skull, with part of the jaw of an adult animal, which Ameghino identified as *Nothrotherium*, confirming Krone's identification. Ameghino then built, based on Lund's researches and on the main scientific authorities on the subject, Gervais, Reinhardt, Burmeister, Scott, and, of course, Ameghino himself, what was supposed to be the phylogenetic links that correlated the *Megalonyx* and *Nothrotherium* to the other Gravigrades (in Ameghino's acception), as evidence of the absence of intermediate forms, yet to be discovered.

But the importance of the jaw and some other bones was due not only to the corroboration by Ameghino about the relationships of the cave fauna of Brazil with that from the "Pampean Formation" in Argentina, but also because such collections provided "precise and decisive data" (Ameghino, 1907: 61). For Ameghino, since the *Nothrotherium* descended from a genus

characteristic of the higher Pampean formation in Argentina, this would prove that the fauna from Brazilian caves as well as those from Europe and North America were from the Quaternary, much more recent than the upper part of the Argentinean Pampean Formation. Such temporal sequences would undergo many changes in Ameghino's works, but they were fundamental data for his suppositions about the antiquity of the mammals in Argentine territories (Lopes, 2010).

To Arthur Smith Woodward (1864-1944), the well-known paleontologist at the British Museum, were sent only once photos of fossil fishes found in the course of exploration for oil and gas in bituminous shales in São Paulo, considered as a Gondwana area. Woodward compared the photos with other samples from the same region that Ihering had sent to the Senckenberg Museum, in Frankfurt. From Frankfurt, F. Kinkelin had sent some of these fossils to the British Museum for identification. The British Museum already possessed another important collection gathered by John Gordon in Rio de Janeiro. Such collections allowed Smith Woodward to identify the fossils in the photos as probably Tertiary fishes (Smith-Woodward, 1898).

Three almost complete vertebrae, a fragment of a vertebra, a four-phalanx finger and one isolated ungual phalanx became the most significant objects at the Paulista Museum. They were collected, in 1902 by Jango Fischer in a place known as *Sanga da Alemoa* in Santa Maria, Rio Grande do Sul state, in the South of Brazil, nowadays considered as one of the most important paleontological loci in the state of Rio Grande do Sul (*Paleorrota* Geopark). Jango was Dr. Fischer's nickname. Dr. João Guilherme Fischer (1876-1952) was an amateur naturalist and collector, with a degree in Agronomy and Pharmacy. He followed a long diplomatic career in Brazil, Chile and Paris, until 1944. Ihering quickly sent the bones to the British Museum. SmithWoodward published, at first, a note of just ten lines [3], most certainly to ensure his priority in mentioning the new fossil.

In 1907, the bone fragments returned in a more complete form, transformed into images and texts in the *Revista do Museu Paulista*, with a fac-simile translation to Portuguese. Smith Woodward identified the bones as those of a primitive short-necked dinosaur. The close similarity between the cervical vertebrae found in Brazil with those from the Karoo Formation of South Africa (Gondwanaland) increased their importance. The shape and characteristics of the cervical vertebrae found in Brazil, in comparison with those deposited in the British Museum, were considered as 'so closely similar to those of a corresponding vertebra from the Karoo Formation of South Africa ascribed to the Dinosaurian *Euskelosaurus*', by Harry G. Seeley (1839-1909) in 1894. The *Euskelesaurus* original vertebra belonged to the British Museum. Smith Woodward concluded that the new Brazilian fossils were allied to *Euskelosaurus* (Smith Woodward, 1907: 54). If the determination was correct, the rocks in which the bones were found would be Triassic and they would be the first land-reptile found in South America belonging to the Gondwana fauna. The bones became the *Scaphonix fischeri* in honor of Doctor Fischer (Smith Woodward, 1907: 54). Until today, it is one of the founding papers on the rhynchosaur group in South America.

Faunal connections that correlated the territories of America and other continents go beyond these examples. Precisely to enable such connections by means of land-bridges, the *Revista do Museu Paulista* systematically underlined the importance of the collection of fossil and modern mollusks. In his book *Archhelenis* and *Archinotis*, published in Leipzig in 1907 and many of his papers, Ihering supported the idea of land-bridges, considering that "*America exists as a single continent only since after the Pliocene, and South America, before that was in close connection to the West of Africa and to the South with an Antarctic continent*", (Ihering, 1907: 337). Ihering had proposed the name of *Archinotis* to identify the land mass linking South America and Antarctica and called *Archhelenis* the land mass uniting Brazil and Africa.

Ihering was dismissed from the Paulista Museum in the period of the First World War, precisely in 1916, in the middle of political and scientific controversies, including accusations about Ihering's misappropriation of the Museum collections. Prior to returning as an invited professor of Paleontology to the University of Giessen, in Germany, he stayed for a short-term visit (three months) in the well-known Naples Zoological Station, in 1921, to review the literature on the anatomy of mollusks, which he needed in order to finalize his last book on *Die Geschichte des Atlantischen Ozeans* [*The*

3. "On some Dinosaurian bones from South Brazil", by Smith Woodward, was presented at the Meeting of the British Association for the Advancement of Science, in Southport, in 1903 and published next year. An abstract notice of this paper was published in the *Report of British Association for the Advancement of Science*, 1904: 663.

history of the Atlantic Ocean], published in Jena in 1927 (Ihering, 1927). In this book, Ihering argued about the existence of land-bridges to establish the paleogeographical reconstruction of the relationships among South America, Africa and Australia. He upheld arguments to suppose that the Atlantic Ocean had not yet existed in the Cretaceous and Eocene periods.

It is important to remember that until the first decades of the twentieth century, the stability of the continental areas and the nature of the relations between these areas were among the fundamental questions to be solved in paleogeography and historical biogeography. Ihering strongly disagreed about the conceptions put forward by Wallace (1823-1913) regarding the permanence of the great oceanic basins (Lopes and Podgorny, 2009; 2014). Up to now, Ihering's studies are quoted also because he investigated the role of freshwater animals – while leaving aside the migrant fauna capable of crossing over major barriers – to address issues of historical biogeography (Choudhury and Pérez-Ponce de Léon, 2005).

Later in Ihering's career, like many other defenders of the land-bridge theories, he also disagreed with continental drift theories proposed by Frank Taylor (1860-1938) and Alfred Wegener (1880-1930) (Ihering, 1931). The fossil bones and shells that Ihering catalogued in the Paulista Museum enabled him to take an active part in those great geological debates that marked the beginning of the twentieth century. These debates remained at the basis of the research of those interested in more pragmatic results of the paleontological sciences, such as the search for oil in Brazil.

'In the end we have to find the terrestrial links of Africa and Brazil by land-bridges'
(Oliveira, 1940: 18)

By the first decade of the twentieth century, the interests in paleontology had changed significantly. In a recent work, Martin Rudwick discussed the context of paleontology in the 1920s in the United States and in Britain. He mentions that although '*paleontological research continued along traditionally stratigraphical and taxonomic lines, the foundation of the Journal of Paleontology*' was an indicator of the context of these changes that turned into oil prospection: "*The Journal of Paleontology was founded in 1927, not by Paleontological Society but by the Society of Economic Paleontologists and Mineralogists, and primarily for the publication of papers on fossils 'helping the understanding of American stratigraphy', particularly microfossils most useful to the oil industry*" (Rudwick, 2018:141).

The Brazilian Geological Survey's paleontological researches also highlight the same economic concern towards paleontological studies. In the absence of other resources, paleontology acquired an importance in the tasks of the Geological Survey in the search for oil in Brazil.

These paleontological researches also point out the persistence of the discussion about the land-bridges theories. The land-bridges theories supported especially by Hermann von Ihering in Brazil, were taken into consideration until the 1940s, in the works of technicians of the Brazilian Geological Survey as well as in other Brazilian institutions, such as the Rio de Janeiro National Museum.

In cultural practices that differ from those of Herman von Ihering, who did not have a work team at the Paulista Museum and had his personal network of collectors and dealers, in the Geological Survey, a team of technicians was organized and encouraged to publish. Collections continued to be shipped abroad to be classified by many foreign experts, now mainly North Americans. North American geologists were also hired at the Geological Survey by Orville Derby and his followers, such as Euzébio Paulo de Oliveira (1883-1939) who worked at the Geological Survey since its foundation in 1907 and occupied the post of interim and *de facto* director of that institution from 1922 until 1933.

The documents, the monographs and articles published by several co-workers allow us to identify that the first registers, the collections and the field notes were checked, made available to other technicians and taken into account in later researches and publications. As suggested by Marianne Klemun, *in the form of collective knowledge, they gained the status of being accepted* (Klemun, 2014: 282) and validated in the name of the institution.

At the beginning of the twentieth century, Brazil was considered a region without oil (Peyerl, 2017, Lopes 2019). The technicians of the Geological Survey discussed the status of knowledge on the previous geological studies,

based on their own experiences in the field, and followed the geological studies of Orville Derby.

The main problems of the Geological Survey, at that time, were the precariousness of the equipment, the lack of training of technicians to operate the machines and, of course, financial resources. However, the Geological Survey delimited the most promising sedimentary areas for the existence of oil in the country in three oil provinces: Amazon; Atlantic (coastal area from the northeast to the region of Campos, RJ) the main area, and the South of Brazil – especially São Paulo and Paraná states (Oliveira, 1920). Since the beginning of these more systematic activities (from 1919 until 1930), there were only 51 drillings in the country (Dias and Quaglino, 1993). Therefore, it is quite obvious that the geologists considered the paleontological samples collected in the course of field work and the geological structures identified as the main – or almost single – resources for the search for oil.

Drilling was the sole means available to obtain confirmation about the existence of oil on a commercial scale. On the other hand, detailed geological mapping of areas previously identified as a priority was the sole assurance to direct the precise coordination of the drillings. As Euzébio de Oliveira stated: "*only paleontological studies of a formation can then lead us to the knowledge of its nature, in order to conclude whether or not we are in the presence of oil-bearing rocks*" (Oliveira, 1937: 26).

To give some examples, the South of Brazil was one of the regions that received close attention in the search for oil. The south of the country was the region that was surveyed the most, from a geological point of view, since the nineteenth century, thanks to previous works of the provincial São Paulo Geological Commission (Oliveira and Figueirôa, 2019) and by the Coal Commission at the beginning of the twentieth century.

The Geological Survey's first Monograph published investigations carried out in the South of Brazil, especially on the state of Paraná Devonian fossils. The well-known North American paleontologist John Mason Clarke (1857-1925), catalogued the shells found in the course of field work by the technicians of the Geological Survey and also expressed his considerations on the existence of Gondwanaland at that time. He criticized Wegener's theory but with no conclusive opinion (Clarke, 1913). Euzébio de Oliveira would also criticize the concept of continental drift in his publications dealing with the geology of the State of Paraná.

The 1920s experienced quite an exceptional scientific and technical burst of activities in the states of São Paulo and Paraná. In Permian and Triassic areas, identified as Gondwanan lands, although the Geological Survey was unable to identify any oil field, it did prove the existence of natural gas, a major economic resource that until then had not been discovered in Brazil. As the years passed, and oil was not found in the South of Brazil, the Geological Survey would be harshly criticized for having concentrated its search on these regions of the country.

The Carboniferous fauna of the Amazon valley had been investigated by Derby since the nineteenth century (Derby, 1877; 1894). Mason Clarke had already classified what was named the "Amazonian fossil wealth" of the successive geological periods (Clarke, 1899). The geologists from the Geological Survey would renew such studies and undertake new field work as they believed in the possibility of finding oil in Amazonia. The geologists did not find oil in the Amazon region until the end of the 1930s, but were able to gather a significant collection of data about this vast region and their works constituted the most systematic investigation about the Tertiary sea that occupied the Amazon region at that time, which after the rise of the Andes had ceased to communicate with the Pacific and contributed to the complex geological history of the region (Roxo, 1924).

In one of his reports "What the Geological Service accomplished in the Amazon", ['*O que realizou o Serviço Geológico na Amazonia*'], Euzébio de Oliveira systematized, in 1929, the geological knowledge already produced about the region, since de nineteenth century. He underlined the then unpublished studies by Carlota Joaquina Maury on a rare variety of graptolites (from Silurian beds identified as Trombetas by Derby and José Correia de Freitas in 1876) – to reconstruct the geological evolution of the region and reaffirm his conviction about the need to carry out the search for oil in that huge area, given the scarcity of geological studies (Oliveira, 1929).

Glycon de Paiva, a well-known Brazilian geologist, considered the writings of Euzébio de

Oliveira about the regions identified as the Low Amazon (South of the Amazon and the state of Acre) '*as one of the best written pages of Brazilian geology*' (Paiva, 1940: XI).

In the search conducted in the Northeast, in the coastal areas of the state of Bahia, where commercial oil fields were discovered only in 1939, the pioneer investigations in the first decades of the twentieth century concentrated in areas of the Barreiras Formation. In these areas, deposits of bituminous rocks and monazite sands had been known since the nineteenth century and Paulino Franco de Carvalho, a technician of the Geological Survey, had collected fossil samples in these areas, which were known to be highly fossiliferous (Oliveira, 1924c).

Other studies conducted by the Geological Survey in the southeast of Brazil concentrated in areas of the municipality of Campos, in the state of Rio de Janeiro. This region is close to the off-shore areas which are nowadays held as the best bet for commercial oil exploration in Brazil. Promising fossiliferous areas in Campos consist of flat oceanic shores, with a very shallow ocean. The pilot drillings at the depth of 30 meters revealed Ostrea marine mollusks in sediments around the city of Campos, presenting evidence that in previous eras, in all probability, the region was a marine environment. The proposal for oil prospecting in the Campos area was thus based on the results of preliminary surveys, fossil evidence and data gathered by the Brazilian Navy about signs of coastal mountain ranges submerged in the sea. Such subaquatic areas, where vast amounts of organic matter from marine animals could accumulate, might represent areas favorable for oil formation, according to Roxo (1924a: 58) (Lopes, 2019).

It is interesting to note that the geology of Campos, in the northern coastal plains of the state of Rio de Janeiro, was associated to the geology of the Tampico area, a well-known important place for oil in Mexico, by Horace Williams, a north American geologist who worked under contract with the Brazilian Geological Survey. Williams supposed that the Cretaceous and Tertiary formations dived under the continental shelf along the coastline. His research was one of the first to undertake a general overview about the geology of the Brazilian eastern coastal plains in the segment from the state of Rio de Janeiro up to the state of Pernambuco, in the northeast, [circa 2,000 km], in which he correlated the sedimentary stratigraphy of Rio de Janeiro with the formations of Bahia (also classified as Tertiary and Cretaceous) (Lopes, 2019).

Carlota Joaquina de Paiva Pereira Maury (1874-1938) collaborated for twenty years – from 1918 to 1938 - with the Geological Survey, in field work and by cataloguing fossils mostly in the Atlantic region. In a letter to Luciano Jacques de Moraes, a geologist from the Geological Survey, dated 16 August, 1929, Carlota Maury presented herself as 'an old friend of the Geological Survey'. Carlota Maury was a North American paleontologist, one of the first women to work in research for oil companies (Arnold 2009; 2010). Making references to several articles by Hermann von Ihering and based on collections held at the Geological Survey, Carlota Maury considered that '*the true affinities of the South American and Antillean Tertiary faunas were with the North American Tertiary species and not with those of the Old World*'. And Carlota Maury dismissed the need of Ihering's *Archhelenis* continent to explain the difference between the molluscan faunas of northern and southern South America. Such differences could have been caused by oceanic currents, temperature or others factors. And this would be *'in accordance with the laws of growth of the continents and the relative stability of the great oceanic basins'*. For her, there was a consensus of opinions among American geologists against the existence of continental land-bridges, certainly in regard to Tertiary geological times (Maury, 1924: 15).

Until the end of the 1930s, in the works that grew over the years at the Geological Survey and other Brazilian institutions, arguments kept surfacing in favor or against the existence of land-bridges, or the Gondwana continent itself, and against the Wegener theory, about which there was a great diversity of arguments in paleontological publications. As an instance, Alberto Betim Paes Leme (1883-1938), former Geological Survey mining engineer and afterwards the director of Rio de Janeiro National Museum (1935-1938) was also one of the strongest Brazilian voices against continental drift theories (Figueirôa, 2012). Betim Paes Leme is considered as one of the persons responsible for the renewal of geological, paleontological and mineralogical studies at the Rio de Janeiro National Museum, after Derby left, since his hiring in 1911.

In his papers, widely anchored in the collections stored at the National Museum, Betim Paes Leme, criticized Wegner, but without being conclusive, arguing in favor of old continental bridges and isostatic movements that could be responsible for their sinking. The existence of continental rocks in Brazilian oceanic islands such as Trindade and Fernando Noronha was another argument in favor of land-bridge theories (Leme, 1930; 1943).

For Euzébio de Oliveira, the Geological Survey director, based on the technical studies that had already been undertaken in Brazil, from the relative age of fossiliferous areas in Sergipe, in the Northeast of the country, '*the basis for the existence of the Gondwana continent, of the links of vast portions of lands between Africa and Brazil did not stand. The collections of catalogued shells suggest the existence of a Triassic sea in this zone.*' The presence of terrestrial formations also in Abrolhos, a set of small islands with coral reefs on the coast of the State of Bahia, indicated a large extension of the coast line. It was another argument that suggested to Euzébio de Oliveira that "*it was possible that in the end we have to search for terrestrial links of Africa and Brazil by continental bridges*" (Oliveira, 1940: 18).

These short mentions were aimed at stressing, at first, the persistence of discussing the land-bridges theories in Brazil supported by evidence from the fossil collections and geological mapping that were carried out in our territory. And also, to underpin a different point of view from the traditional bibliography on oil in Brazil, that states that the strategic planning for oil in the country began only at the end of the 1930s, following the oil commercial production.

The paleontological and stratigraphic works of the Geological Survey in different regions of Brazil, since the beginning of the twentieth century, were fundamental to establish the long-term planning of the geological oil research in the Brazilian territory, even if the results would not appear in the short term (Lopes, 2019). They depended on the scientific, cultural and technical resources at hand in those given contexts.

Final Considerations

Both examples, Paulista Museum and Geological Survey, shed some light on the importance and change of meanings attributed to the works of amassing and cataloguing paleontological collections at the beginning of the twentieth century in Brazil, and on the persistence of the land-bridge theories, defended by Ihering and other followers in Brazil.

After Ihering was dismissed from the Paulista Museum in 1916, the Museum was transformed into the São Paulo Historical and Provincial Museum that no longer challenged the scientific supremacy of the Rio de Janeiro National Museum. Part of Ihering's malacological and paleontological collections is housed in the *Museo Argentino de Ciencias Naturales*, in Buenos Aires, Argentina. Ihering had applied for a job there and sold some collections, which he considered his personal property.

The majority of those collections catalogued by Ihering are today at the University of São Paulo Museum of Zoology – MZUSP – and Museum of Archaeology and Ethnology – MAE-USP.

With the fire at the Rio de Janeiro National Museum in 2018 and the loss of so many collections, thanks to initial efforts by Ihering and collaborators, the University of São Paulo Archaeology and Ethnology Museum – MAE-USP - keeps and preserves today probably one of the main indigenous heritage repositories in the country.

The collections of paleontological samples amassed by the Geological Survey technicians became the core of today's Earth Sciences Museum, in Rio de Janeiro (Pinto, 2009). With the loss of some of the National Museum's paleontological collections, the Geological Survey Museum thus holds one of the most significant paleontological collections in Brazil.

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The South American Mammal collection at the Museo Geologico Giovanni Capellini (Bologna, Italy)

La collection des mammifères d'Amérique du Sud au Museo Geologico Giovanni Capellini (Bologne, Italie)

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KEY-WORDS

Giovanni Capellini
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Hermann Burmeister
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MOTS-CLÉS

Giovanni Capellini
Florentino Ameghino
Hermann Burmeister
19e siècle
collections historiques
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correspondance

Summary: Near the end of the 19th century, Professor Giovanni Capellini acquired a rich collection of fossil mammal remains from South America, which became part of the permanent exhibit in the Museum that bears his name. We investigate the private correspondence of G. Capellini, in order to collect historical data on the collection. This correspondence includes a letter from Florentino Ameghino, which proves that he was born in Moneglia (Genova), Italy. Combining results from the letters found and the revision of the taxonomy of the specimens, we conclude that most of the collection was probably sent from Argentina by the German zoologist Carl Hermann Conrad Burmeister between 1863 and 1866.

Résumé : Vers la fin du XIXe siècle, le professeur Giovanni Capellini a acquis une riche collection de restes fossiles de mammifères de l'Amérique du Sud, qui sont devenus une partie de l'exposition permanente du Musée qui porte son nom. Nous enquêtons sur la correspondance privée de G. Capellini, afin de recueillir des données historiques sur la collection. Cette correspondance comprend une lettre de Florentino Ameghino qui prouve qu'il est né à Moneglia (Gênes), en Italie. En combinant les contenus des lettres trouvées et la révision de la taxinomie des spécimens, nous concluons que la plupart de la collection a probablement été envoyée d'Argentine par le zoologiste allemand Carl Hermann Conrad Burmeister entre 1863 et 1866.

Introduction

The Geological Museum Giovanni Capellini in Bologna hosts a rich variety of paleontological and geological collections that have been acquired primarily during the second half of the 19th century. Professor Giovanni Capellini (1833-1922, **Fig. 1**) himself devoted his life to these disciplines and to enrich the city of Bologna with specimens coming from all over the world. Thanks to his relationships with the most influent scientists of his time, Capellini was capable of travelling, collecting, and acquiring specimens that we can appreciate today in the museum that bears his name.

As single collections are represented by hundreds or even thousands of individual objects, several have never been fully catalogued or restored since their arrival in the Museum. Among neglected collections, the South American Mammal Collection is remarkable, including more than 500 fossil vertebrates repre-

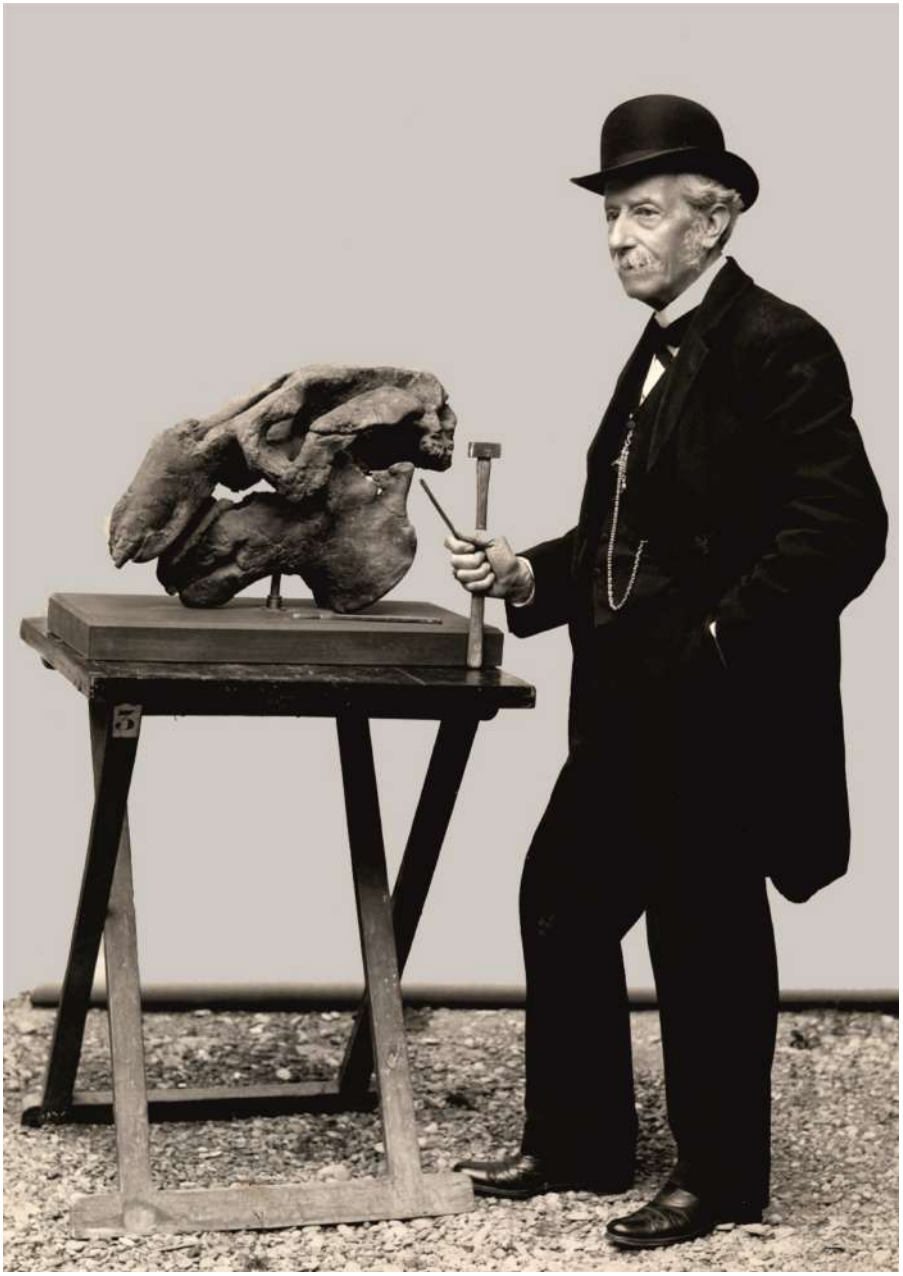


Fig. 1. Giovanni Capellini with a remarkably preserved skull of *Felsinotherium forestii* (today a synonym of *Metaxytherium subapenninum*). This Mediterranean sirenian species was described by Capellini in 1872. The specimen is currently on display at the Museo G. Capellini in Bologna. From the archive of the Museo Geologico G.Capellini, Bologna (Italy).

senting several xenarthran taxa from the Pampas, Argentina (**Figs 2-3**). A taxonomical revision that took place in 2016 allowed for a first comprehensive survey of the material. Glyptodonts (Glyptodontoidea Gray, 1869), and ground sloths (Megatheriidae Gray, 1821, and Mylodontidae, Gill, 1872) constitute the vast majority of the collection. A single tooth has been assigned to *Toxodon* sp., and several specimens to *Cuvieronius humboldtii* (Fischer, 1814). Surprisingly, very little data on when and how this material was acquired was available. Therefore, systematic revision of specimens was coupled with historical research in the Museum archive, and in the Biblioteca Comunale dell'Archiginnasio di Bologna (BCAB) in order to acquire detailed information on the year of acquisition, excavation locality, and inferred geological context of the specimens. Besides the fact that these researches revealed a few details on the provenance of this collection, we surprisingly found newsworthy information regarding the lives, connections and exchanges of paleontologists during the second half of the 19th century.

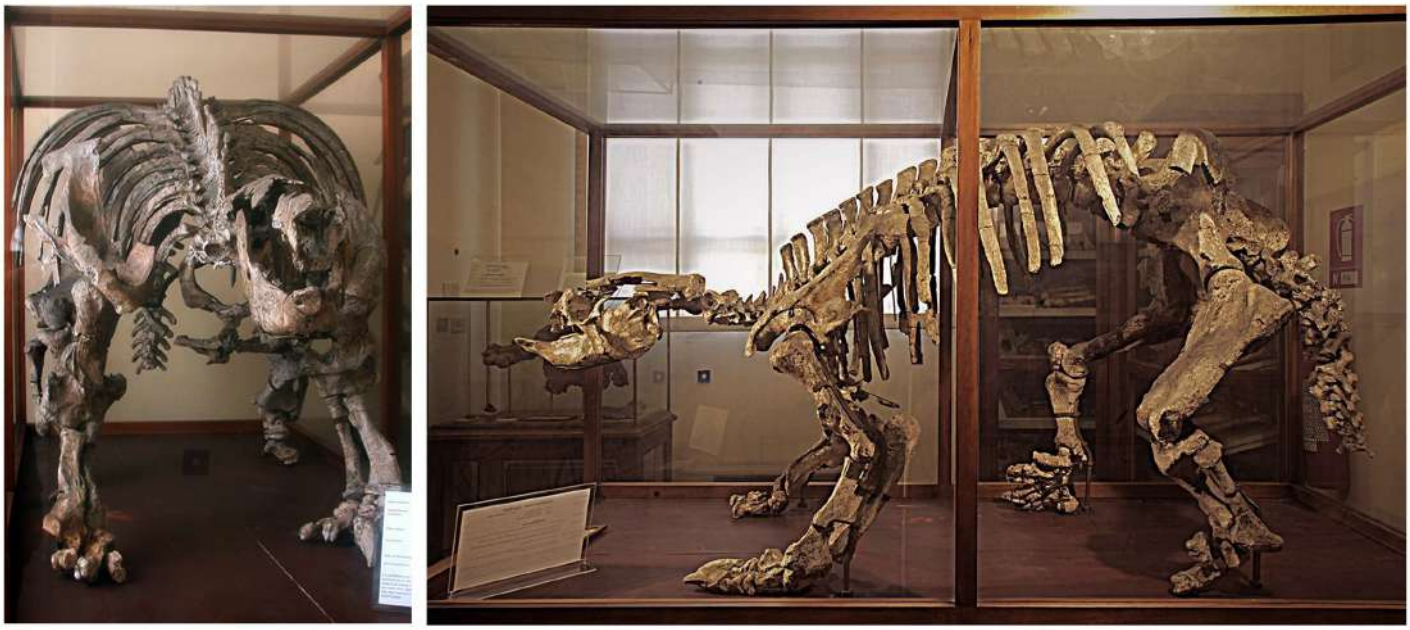


Fig. 2. The skeleton of a ground sloth labelled as *Scelidotherium capellinii* on display at the Museo G. Capellini in Bologna believed to be a gift from Florentino Ameghino. Photo of P. Ferrieri (MGGC).

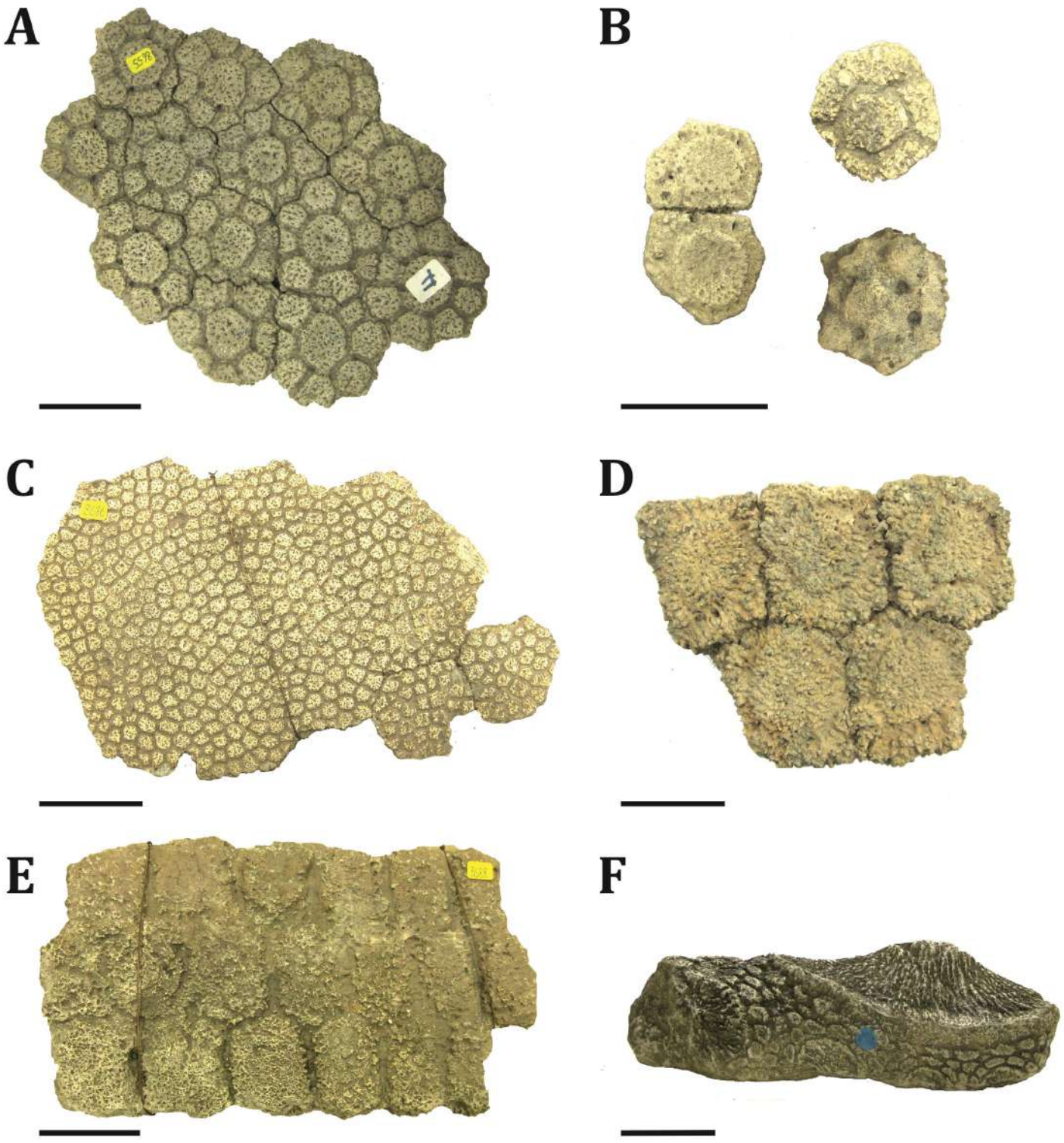


Fig. 3. Different osteoderm morphologies of glyptodont carapace documented in the 'South American Fossil Mammals collection' at the Museo G. Capellini. **A** - *Glyptodon clavipes*, dorsal portion of the carapace; **B** - Single osteoderms pertaining to: an unidentified species (left), the lateral carapace portion of *Glyptodon reticulatus* (upper right), *Doedicurus* sp. (upper left); **C** - *Panochtus tuberculatus*; **D** - *G. reticulatus*, juvenile; **E** - *Neuryurus* sp.; **F** - *Panochtus* sp., cast of a caudal tube's fragment. Scale bar: 50 mm (Identification follows Vanni, 2016)

Facts and beliefs on the history of South American Mammals Collection

From the 1984 Museum inventory, little information can be obtained. Indeed, the South American material is reported to be a gift, received in 1863. As collection locality, geological age, and deposit, is indicated: "*Pampas, Pampean, Pleistocene-Bonaerense-Lujanense*". Unluckily, the source of this information remains unknown, although it most likely resulted from a transcription of older catalogues. Moreover, the donor is not mentioned in the Museum inventory. For a few specimens, this information can be recovered by reading their descriptions.

1. MGGC 8673

2. MGGC 8664

An entire, partially restored carapace of a glyptodont is on permanent exhibition in the "*Tipi di Vertebrati*" room [1]. The description under the carapace mentions:

> "*Glyptodon typus, Nodot Buenos Aires province*
> *Restored by the technician Antonio Pozzi from Milan*"

It was donated by the King Umberto I in 1879 (Vai, 2009), probably to honor the second International Geological Congress held in Bologna in 1881, as he was the Protector of the Congress (Vai, 2004).

A remarkable specimen pertaining to the South American collection is represented by a complete skeleton that is on permanent display [2] (**Fig. 2**). The specimen is labeled as *Scelidotherium capellinii* Gervais and Ameghino (1880) and represents the sole, complete skeleton of a xenarthran in the Museum. In the description of this specimen we find written: "*Assembled by G. Capellini in 1887, who recognized it from material donated by the paleontologist Ameghino from Argentina*". Historically, and probably due to this latter description, it was believed that the collection represented a gift of the renowned Argentinian scientist Florentino Ameghino (1853-1911) to Giovanni Capellini. Nevertheless, in 1880 this skeleton had already been assembled in the Museum, as supported by the fact that Capellini published a volume regarding the Geological Congress of 1881, in which a drawing of this specimen can be found (Capellini, 1882; **Fig. 4**). Moreover, in their comprehensive description of South American fossil mammals published in 1880, Henri Gervais (1845-1915) and Ameghino erected the species *Scelidotherium capellinii* on the basis of a single mandibular fragment, while they mention a complete skeleton of *Scelidotherium leptocephalum* restored by Capellini that can be found at the Museum of Bologna (Gervais and Ameghino, 1880).

This suggests that some information is wrong in the museum description of the specimen, which for decades led to suppose that the collection was donated by Florentino Ameghino. Therefore, we decided to conduct additional researches in Professor Capellini's personal correspondence.

The correspondence of Professor Giovanni Capellini

One of the last requests of Giovanni Capellini was to leave to the academic community his personal correspondence with some of the most influent scientists of the 19th century (Sorbelli & Markbreiter, 1928; Caciagli & Ferrari, 2009). This rich archive is hosted in the "*Manoscritti e rari*" section of the Archiginnasio Library of Bologna. Relevant data on the South American collection came from the correspondence between Capellini and Florentino Ameghino, the Prussian entomologist Carl Hermann Conrad Burmeister (1807-1892), director of the Public/National Museum in Buenos Aires from 1862 to 1892, Emilio Cornalia (1824-1882), the director of the Natural History museum of Milano between 1866 and 1882), and Antonio Pozzi (1822-1898), a taxidermist from the same museum.

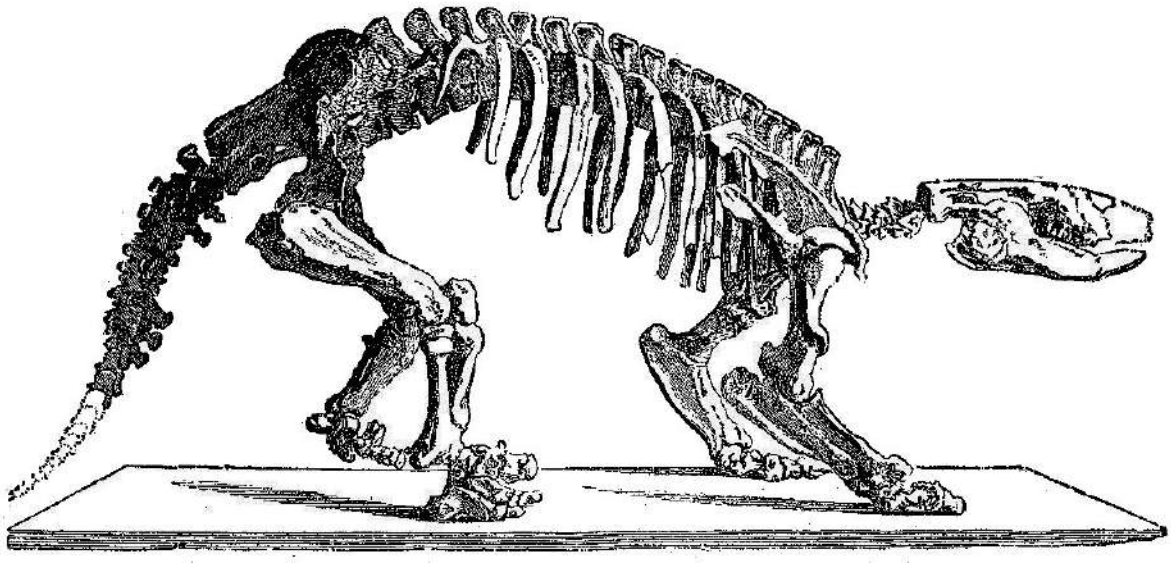


Fig 4. A reproduction of the *Scelidotherium* skeleton on display at the Museo G. Capellini, published in the volume of the Geological Congress (Capellini, 1882).

The correspondence with Hermann Burmeister starts in 1855, when Burmeister was ordinary professor in charge of the Zoological Museum at the University of Halle-Wittenberg. At that time, Capellini was still a student but he already had the opportunity to meet researchers from the international scientific community, as he was elected as corresponding member of the German Society of Naturalists of Halle (Fanti, 2010). The letters sent by Burmeister are rich in personal details. In a letter of 1856, the German entomologist asked Capellini, although he had just graduated (he was 23 years old), to translate in Italian his most recent zoology book [3], thus documenting his high opinion of Capellini already in that period, but also the necessity for Burmeister to publicize his work: since, according to a ministerial decree, medical students were free to attend science lectures, his lectures remained almost empty (Nyhart, 1995). The good and long relationship between these two scientists, which can be inferred from their letters and from the fact that they were on a first-name basis, could have influenced a recurring exchange of specimens, which is sometimes cited in their correspondence. In particular, in a letter dated March 1863, Burmeister wrote from Buenos Aires expressing his astonishment that he had been appointed director of the future (and non-existent) paleontological museum in Buenos Aires, a field which was not, in fact, his own (see Podgorny and Lopes, 2008 on Burmeister's career in Buenos Aires):

> "( ) *m'a fait professeur de zoologie et de !!!! paléontologie et directeur de l'institut et musée de Zoologie et de !! Paléontologie (qu'il faut encore créer)*"
> '(...) I've been nominated professor of zoology and !!!! Palaeontology and director of the museum and institute of Zoology and !! Palaeontology (which has to be created)'

> "*Je voudrais te demander, si tu me pourrais provenez des choses de votre pays, qui nous manquent presque tout à fait.*" [4]
> 'I want to ask you if you could send me some things from your country that we miss almost completely.'

At the end of this letter, Burmeister wrote that he was sending specimens for Capellini's collection, but unfortunately this part of the missive is ripped, and the objects that were sent remain unknown. However, since he was asking specimens from Capellini, and he was writing from Buenos Aires, it seems probable that he was sending South American specimens in exchange, but further evidences are needed to confirm this hypothesis.

From the correspondence between Capellini and Emilio Cornalia, we found another clue about the presence in the museum of the *Scelidotherium* skeleton, as early as 1872. The director of the Natural History Museum of Milano, writes:

> "*Il viaggio del Beagle- Fossili e Mammiferi* [5] *lo posseggo, ma troverai tu ben poco. Un cranio rotto di* Scelidotherium*, qualche ossa ( ) di arti, ma poco ti può servire per montare, però se lo vuoi te lo manderò* ( )." [6]
> 'I do own "viaggio del Beagle – Fossili e Mammiferi", but you will find there really few (things). A broken skull of *Scelidotherium*, some limb bones (...), but little can be useful to you to assemble, but if you want it I will send it to you (...).'

From these few lines, it seems clear that in 1872 Capellini was assembling a skeleton to place on display at the Museum in Bologna, probably of a *Scelidotherium*, and he was asking the director of the Museum of Milano for a copy of the book published by Richard Owen and Charles Darwin, apparently searching for some illustrations that could help him in the process of mounting the specimen. This supports again that the information written in the description of the *Scelidotherium skeleton* is wrong.

Antonio Pozzi is the same name that can be read under the *Glyptodon* typus carapace donated by King Umberto I. The Pozzis were a family of naturalist-preparators. Antonio Pozzi had worked for several European museums and in 1866 he was hired as a taxidermist at the Public Museum of Buenos Aires, where his son Santiago was incorporated as an assistant taxidermist and collector of Ornithology. Shortly afterwards, due to disagreements with Burmeister, they were exonerated from their positions and devoted themselves to the private sale of collections (García *et al.*, 2015). The letter kept in Capellini's archive gives an account of that activity and of Antonio's activity in Italy, where he took several Argentinean collections for sale (Podgorny, 2009).

As mentioned by García *et al.*, the Pozzis had connections with Florentino Ameghino, teaching him techniques for extracting fossils. At the 1882 South American Continental Exhibition, Santiago was awarded a prize for his pre-

3. Burmeister to Capellini, 1856. Biblioteca Comunale dell'Archiginnasio di Bologna (BCAB). Fondo Speciale "Giovanni Capellini" (FSGC), busta XXII, fascicolo 22.

4. Burmeister to Capellini, 1863. BCAB, FSGC, b. XXII, f. 22.

5. It refers to the book "Zoology of the Voyage of H.M.S. Beagle - Fossil Mammalia" by Richard Owen/ Charles Darwin (1840), where indeed images of *Scelidotherium* specimens can be found (see Lister, 2018).

6. Cornalia to Capellini, 1872. BCAB, FSCG, b. XXXVI, f. 10.

parations and two years later he was called to work at the museum in La Plata, the new capital of the Province of Buenos Aires. The Pozzi family settled there and opened a taxidermy and art dealer business. Santiago, as the first preparator of the La Plata Museum, was initially assigned to the arrangement of the paleontological collections and to participate in expeditions in the Province of Buenos Aires and Patagonia, being accompanied by his son Antonio. He -an accomplished taxidermist- also assembled animal skeletons for the Comparative Anatomy Hall and mounted birds. In 1902, he retired from the museum in La Plata and shortly afterwards he was called by Ameghino to work at the museum in Buenos Aires, where he would work for over two decades together with his sons Antonio and Aurelio. (García *et al.*, 2015) Antonio (father) died in La Plata in 1898 but in the 1870s, he was a technician in the Natural History Museum of Milano, and in his correspondence with Capellini it is clear that he travelled and excavated fossils in Argentina. In his letter of 1874 to Capellini, the former was leaving for Argentina with something for the director of the museum of Buenos Aires (who was Burmeister at that time) sent by Capellini:

> "( ) *le sia noto, che se lui o On.mo Sig.re Capellini desidera inviarmi ciò che crede (come me ne parlò verbalmente in Bologna) per il Sig. Direttore del Museo di Buenosayres, potrebbe fare la spedizione in Milano* ( )"
> "(...) If you Hon Sir Capellini want to send me what you deem (as you verbally told me in Bologna) for the Director of the Museum in Buenos Ayres, you could send to Milano (...)" [7]

Two other letters dated 1881 confirm that Antonio Pozzi, not only restored the carapace, but is actually the person who brought it to Italy and donated it to King Umberto I, who in turn donated it to the Geological Museum of Bologna. He also sent to Capellini a tibia and a fibula he found with it, four other carapace fragments and a single osteoderm. However, he writes:

> "*Sono alquanto spiaciuto a non poterle dare quelle strette ed elette relazioni riguardo alla località dove si è scoperta la corazza del* Gliptodon *Rubusto da me regalato a sua Maestà il Re Umberto. Da Buenos Aires, un giorno di cammino con le ferrovie del* ( ) *e poi un giorno di cavallo inclinando a sud*" [8]
> 'I'm sorry I can't give you the precise information about the locality where the *Glyptodon* carapace that I donated to King Umberto I came from. From Buenos Aires, one day by train (...) and a day by horse going south'

He was not able to provide additional information on the locality where the specimens had been collected but promised to elucidate this in future correspondence with Capellini. Unfortunately, no additional subsequent letters are preserved in the Bologna archive.

To summarize, in 1862 Hermann Burmeister was appointed as Professor and Director in the Museo Público of Buenos Aires; he asked specimens from Capellini, and he sent something to Capellini too (though the objects still remain unknown). In 1872 Capellini was already assembling a *Scelidotherium* skeleton, and two years later he sent something to Burmeister in Buenos Aires with the help of Antonio Pozzi, who was travelling in South America. Pozzi returned before 1881 to Italy, with an entire glyptodont carapace1 (which he gave to king Umberto I, whom in turn donated it to Capellini) and some other fossils that he sent to Capellini. Therefore, from the information acquired until now, we know that the collection of South American fossil mammals probably represents two or more acquisitions: one presumably from Burmeister, and one from Antonio Pozzi.

The correspondence between Florentino Ameghino and Giovanni Capellini

Florentino Ameghino was an Argentinean paleontologist, anthropologist, and zoologist whose date and place of birth have been debated for decades. He was the son of Italian immigrants, and a few years after his death in 1911, it was claimed that he had been born in 1854 in Luján, rather than in Moneglia in 1853 (Podgorny, 1997; 2020). The correspondence between Ameghino and Capellini consists of two letters. In the first one, Ameghino introduces himself to Capellini (therefore it represents the first in chronological order, although the date is missing), and he explains that he wants to obtain exemption from Italian military service in order to visit Italian museums (at that time he was residing in France) and asks for Capellini's intervention in return for gifts for his Museum. In this letter Ameghino also writes:

> "*Sono nato del 53 nella comuna di Moneglia,*

7. Pozzi to Capellini, 1874. BCAB, FSGC. b. CXIII, f. 32.

8. Pozzi to Capellini, 1881. BCAB, FSGC. b.CXIII, f. 32.

> *presso Chiavari. Il 55, a l'età di 18 mesi venivo trasportato a Buenos Aires dai miei genitori, dove mi sono educato, dedicandomi particolarmenti allo studio dell'antropologia, geologia e paleontologia."* [9]
> 'I was born in '53 in the district of Moneglia, Chiavari. In '55, at the age of 18 months, I was taken by my parents to Buenos Aires, where I have studied, particularly I dedicate myself to the study of anthropology, geology and palaeontology.'

This short message is of extreme historical relevance as it is the first direct evidence of Ameghino's place of birth, written by Ameghino himself. In addition, it suggests that as he was an Italian citizen and could not get an exemption from military service in Italy, he could not visit his home country but would have to acquire Agentinean citizenship once he was back in Buenos Aires if he wanted to travel to Italy, as he adds:

> "( ) *se non ce* ( ) *per ottenere la mia escepzione non andrei in Italia, e che di ritorno a Buenos Aires, sarei obligato a condiscendere ai desideri della popolazione di Mercedes che di fatto mi considera come uno dei suoi prediletti cittadini, prendendo carta di cittadinanza argentina*"
> '(...) and if there's no ( ) to obtain an exemption, I shall not go to Italy, and back in Buenos Aires, I shall have to follow the will of the inhabitants of Mercedes (...) and take the Argentinean citizenship'

The second missive dates from 1881; Ameghino sent to Capellini a copy of one of his new book: "*La antigüedad del hombre en el Plata*" [10]. However, in the correspondence between Capellini and Ameghino the dispatch of South American fossil specimens is never mentioned.

In a letter dated 1881, found in the *Obras Completas de Florentino Ameghino*, Capellini answers to both letters, specifying that there was no way to obtain exemption from military service, and at the end adding:

> "*Una casa di commercio di Genova (certi signori Hoefer) mi ha offerto di acquistare una ricca collezione di fossili dei Pampas, ma il Museo non ha mezzi e il Governo non è disposto a darne*." [11]
> "A commerce house of Genoa (a certain Mr Hoefer) offered me to buy a rich fossil collection from the Pampas, but the museum doesn't have the means and the government isn't willing to give any."

We still don't know if this collection was bought later on by Capellini, or donated to the museum, becoming part of the South American Mammals collection that we can appreciate today.

Further clues: the taxonomy of glyptodont specimens

Some evidence about the period of acquisition has been found during the revision of the taxonomy of glyptodont fossils. In fact, all glyptodont specimens in the Museo Capellini collection have been historically referred to the genus *Glyptodon*. Although incorrect, this taxonomic decision reflects the first description of glyptodonts (Owen, 1858), and, in particular, the classification proposed by Burmeister in 1863, as well as in the first volume of the "*Anales del Museo de Buenos Aires*" written by the latter author in 1864. With the discovery of additional fossil material, in 1870 Burmeister published another revision of the taxa, erecting the genus *Panochtus*.

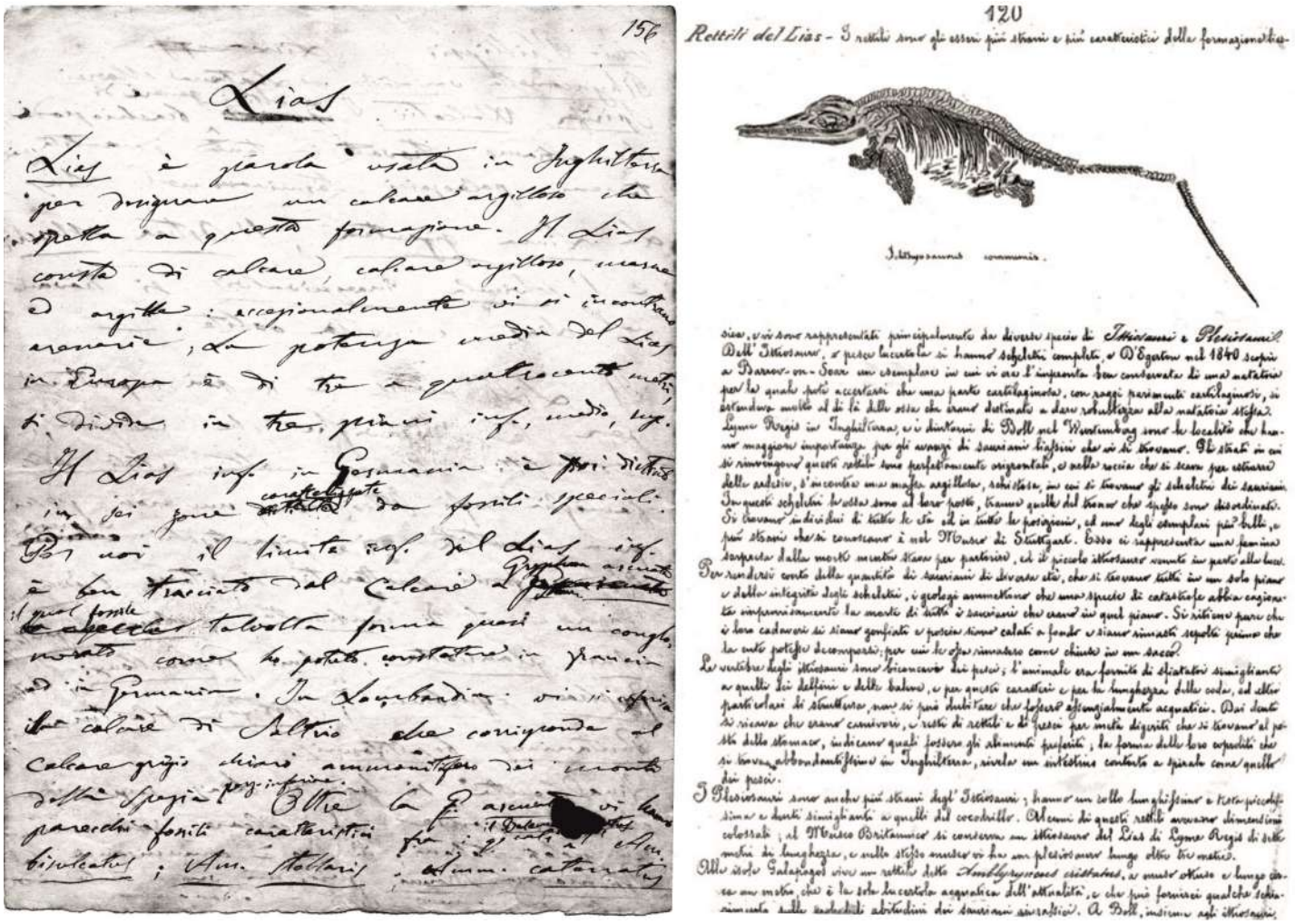
For example, some osteoderms on display in the Museum are labeled as "*Glyptodon asper* Burmeister", but the same osteoderms are assigned to *Glyptodon typus* Nodot in the official catalogue. The species *Glyptodon asper* was erected by Burmeister in 1863; in 1864 he recognized the synonymy with *Glyptodon typus* erected by Nodot but decided to maintain the name "*asper*" for this species (Burmeister, 1864); in 1866 he re-assigned the species to the genus *Hoplophorus*, and called the species *H. asper* (Burmeister, 1866). Finally, in 1880 Gervais and Ameghino referred all specimens to *Glyptodon* maintaining the name assigned by Nodot, *Glyptodon typus*, the same that is written in the catalogue (Gervais and Ameghino, 1880). Nowadays this species is no longer considered valid, as in 1889, Ameghino re-assigned this species to *Glyptodon reticulatus*, together with *Glyptodon/Hoplophorus pumilio* and *Glyptodon/Panochtus tuberculatus* (Ameghino, 1889), also found in G. Capellini's collection (**Fig. 3**).

Therefore, the nomenclature indicated in the labels is based upon the classification used by Burmeister in 1863; as in 1866 this classification was modified, it is possible that the majority of these fossils were acquired between 1863 and 1866.

9. Ameghino to Capellini, unknown year. BCAB, FSGC. b. II, f. 35.

10. Ameghino to Capellini, 1881. BCAB, FSGC. b. II, f. 35.

11. Capellini to Ameghino, 1881. In: Obras Completa de Florentino Ameghino, Florentino Ameghino 1853 -1911. Vol. 20: Correspondencia científica.



Two examples of Giovanni Capellini handwriting, taken from his notes (**left**) and from a lecture of 1863 (**right**).
From the archive of the Museo Geologico G. Capellini, Bologna (Italy).

Conclusion

The Museo Geologico Giovanni Capellini of Bologna hosts a remarkable number of fossils, coming from numerous different localities in the world. Recently, a restoration of the South American Mammals historical collection, together with a taxonomical revision of glyptodont specimens took place. We recognized that the history of acquisition of this rich collection was dubious, and details on the excavation localities and geological context were missing. Therefore, trying to understand the story of these specimens, we conducted research in Capellini's private correspondence. We found letters from the most important paleontologists of the last decades of the 19th century. These letters not only revealed the history (although still incomplete) of the South American Mammal Collection, but also gave us some unexpected information about the figures of that time. An original letter from the Argentinian scientist Florentino Ameghino turned out to be very significant for the biography of this famous scientist. In fact, his missive prove that he was born in Italy, precisely in Moneglia, Genova, in 1853, this being the first direct evidence about his place of birth, long debated among his biographers. Moreover, as Ameghino writes in his missive, probably he came back to Argentina in order to avoid the military service in Italy (See also Podgorny, 2020b). The Prussian scientist Carl Hermann Conrad Burmeister is most likely the person that sent the material to Capellini. Even if direct evidence in his letters is missing, the long scientific and personal relationship between these Professors could have encouraged the exchange of specimens for their museums. Burmeister was the Director of Buenos Aires Museum from 1862 and produced many publications regarding glyptodonts. Moreover, the classification followed in the Museum coincides with the first published by Burmeister, also suggesting that the major part of this material was acquired between 1863 and 1864, and classified following his publications.

A few specimens pertaining to the South Ame-

rican Fossil Mammals collection were sent in 1881 by Antonio Pozzi, a technician of the Museum in Milan. Pozzi apparently participated to excavations near Buenos Aires, he also restored and donated the entire Glyptodon carapace (MGGC 8673) to King Umberto I, who in turn donated it to G. Capellini. Unluckily, the collection localities of specimens of the entire collection still remain unknown.

The possibility remains open that part of this collection comes from the offer Capellini received in 1881 from a commerce house in Genoa, and which he mentions in his letter to Ameghino of 1881. We need to do more researches in Capellini's correspondence to exclude or confirm this possibility. However, in 1874 Capellini was already assembling a skeleton of *Scelidotherium*. As a result, the collection could be a set of gifts and purchases which, thanks to the work of Giovanni Capellini, have enriched the Geological Museum of Bologna.

In historical paleontological collections, it often happens that details regarding the acquisition of specimens are not clear or even wrong, and documents about their inferred age or excavation locality are missing. When the specimens pertaining to these collections are subjected to scientific analyses, the lack of such information prevents from giving important biological remarks about the specimens. Therefore, questioning the history of the collections is of fundamental importance in order to be able to further analyze them. In our case, this approach brought few results regarding the collection localities of specimens pertaining to the South American fossil mammals collection of Bologna Geological Museum G. Capellini. Nevertheless, thanks to our researches, we uncovered some unexpected information regarding the biography of scientists, their relationships, and exchanges for their museums, during the last part of the 19th century, which resulted in the great diversity of fossil collections that we can still appreciate nowadays.

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Archives

The letters of Florentino Ameghino are housed in the Biblioteca Comunale Archiginnasio of Bologna in the *Fondo Speciale"Giovanni Capellini"*, busta II, fascicolo 35.

The letters of Hermann Burmeister are housed in the Biblioteca Comunale Archiginnasio of Bologna in the *Fondo Speciale "Giovanni Capellini"*, busta XXII, fasc. 22.

The letters of Emilio Cornalia are housed in the Biblioteca Comunale Archiginnasio of Bologna in the *Fondo Speciale "Giovanni Capellini"*, busta XXXVI, fasc. 10.

The letters of Antonio Pozzi are housed in the Biblioteca Comunale Archiginnasio of Bologna in the *Fondo Speciale "Giovanni Capellini"*, busta CXIII, fasc. 32.

A Frenchman in Patagonia: the palaeontological expeditions of André Tournouër (1898-1903)

Un Français en Patagonie : les expéditions paléontologiques d'André Tournouër (1898-1903)

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KEY-WORDS

Tournouër
Patagonia
Palaeontology
Collections
Gaudry
Ameghino

Summary: In the course of three expeditions, from 1899 to 1903, the Frenchman André Tournouër (1871-1929), who had been raising cattle in northern Argentina, excavated various fossil localities in Argentinian Patagonia and brought together large palaeontological collections that he sent to the National Museum of Natural History in Paris. Hitherto unpublished or little known documents shed some light on Tournouër's collecting expeditions, about which relatively little was known. His relations with Albert Gaudry and Florentino and Carlos Ameghino are discussed, as well as the funding sources available for his field work, the shipping methods he used and his cryptozoological activities in search of the "mysterious animal of Patagonia". Tournouër's contributions to the geology and palaeontology of Patagonia were considerable and the collections he brought together are still being studied by palaeontologists today. However, he published relatively little about his discoveries and stopped his palaeontological activities soon after he returned from his last expedition in Patagonia. The possible reasons why this wealthy man turned to other pursuits are discussed.

MOTS-CLÉS

Tournouër
Patagonie
Paléontologie
Collections
Gaudry
Ameghino

Résumé : Au cours de trois expéditions, de 1899 à 1903, le Français André Tournouër (1871-1929), qui auparavant élevait du bétail dans le nord de l'Argentine, fouilla divers gisements fossilifères en Patagonie argentine et rassembla de vastes collections paléontologiques qu'il envoya au Muséum National d'Histoire Naturelle à Paris. Des documents jusqu'ici inédits ou peu connus fournissent des informations nouvelles sur les expéditions de Tournouër, sur lesquelles on savait relativement peu de choses. Ses relations avec Albert Gaudry et avec Florentino et Carlos Ameghino sont discutées, de même que ses sources de financement, les méthodes de transport des collections utilisées et ses activités cryptozoologiques à la recherche de « l'animal mystérieux de la Patagonie ». Les contributions de Tournouër à la géologie et la paléontologie de la Patagonie furent considérables et les collections qu'il amassa sont encore étudiées par les paléontologues d'aujourd'hui. Pourtant, il publia relativement peu de chose sur ses découvertes et cessa ses activités paléontologiques peu de temps après son dernier voyage en Patagonie. Les raisons possibles pour lesquelles cet homme fortuné se tourna vers d'autres activités sont discutées.

Introduction

During the last decade of the 19th century and the first years of the 20th, the fossil-bearing formations of Argentinian Patagonia attracted much attention among the international palaeontological community. In particular, the often unusual Cretaceous and Cenozoic vertebrates they yielded gave rise to controversies about their geological age and systematic affinities. While Argentinian palaeontologists, at the forefront of them Florentino Ameghino and

his brother Carlos (Podgorny, in press), were especially active in collecting and describing Patagonian fossils (in intense competition with the collectors from the La Plata Museum sent by Francisco Moreno), scientific institutions from other countries, notably the United States, also sent palaeontological expeditions to Patagonia (see Simpson, 1984, for a general account). As a result, large collections of fossils found their way to museums outside Argentina. The Muséum National d'Histoire Naturelle (MNHN) in Paris holds a large number of Patagonian fossils that were collected between 1898 and 1903 by André Tournouër (1871-1929). Although his name is not completely forgotten, and he is mentioned in various articles and books about the history of palaeontological research in Patagonia, what has been written about his life and work is scanty and often erroneous, partly because he published relatively little about his discoveries and left no detailed account of his expeditions. In the present paper, after providing a short biographical sketch (see also Buffetaut, 2016a), I try to reconstruct some aspects of Tournouër's collecting activities in Patagonia, on the basis of his published papers (some of them poorly known) and of hitherto unpublished documents in the palaeontology library of the MNHN. Quotations in French have been translated into English by myself.

Biographical sketch

As noted above, part of what has been written about André Tournouër is erroneous. Even his name has been misspelled: the American palaeontologist Loomis consistently called him "Tournier" (Loomis, 1914). Martinic (1996) misspelled it as "Tourneur". Mistakes were made about his given name, too. In 1903, Tournouër gave a talk at the Société des Américanistes de Paris about his travels in Patagonia, and for some reason the anonymous author of the report on this talk called him "Paul Tournouër" (Anonymous, 1904). Simpson (1984: 94), who corrected Loomis's mistake, made a possibly even worse one in claiming that "*In 1878 and 1879 André Tournouër himself had abstracts of two studies on fossil horses published in the bulletin of the Geological Society of France*". André Tournouër was 7 and 8 years old, respectively, in 1878 and 1879, and the papers were of course authored by his father Raoul (see below), who was mainly interested in fossil invertebrates but occasionally studied vertebrates, too (see Fischer, 1885 for Raoul Tournouër's list of publications, including the papers on fossil horses).

André Tournouër (**Fig. 1**) belonged to a wealthy upper-class family. His father, Jacques Raoul (usually called Raoul) Tournouër (1822-1882), a lawyer by training, had been an auditor at the Council of State. He gave up this position in 1851, when the Second French Republic was overthrown by Louis-Napoléon Bonaparte and replaced by the Second Empire. He then devoted himself to painting and science, becoming a well known stratigrapher and palaeontologist, specializing in fossil invertebrates (Fischer, 1885). In 1877 he was elected president of the French geological society. In the course of his palaeontological researches he befriended Albert Gaudry (1827-1908), then professor of palaeontology at the National Museum of Natural History in Paris. They collaborated on the study of the Miocene fauna from Mount Luberon in Provence. This friendship was to play an important part in the origination of André Tournouër's expeditions to Patagonia.

Fig. 1. André Tournouër (after Buffetaut, 2013).

Little is known about André Tournouër's early life, except that he was born in 1871. The work he did in Patagonia shows that he had a rather thorough knowledge of geology and palaeontology, but whether he studied geology at a university is not known. Training by his father must have been limited, since the latter died when André was only 11 years old. Sometime in the early 1890s (in 1902 he wrote that he had

resided in Argentina for 10 years), André Tournouër settled in Mendoza, Argentina, where he raised cattle. The reasons for this move are not known, but it proved determinant for his palaeontological activities. There is every indication that for most of his life he lived off his private income. His successive addresses, as given in the annual lists of members published by the French geological society (of which he became a member in 1900), are all in the posh districts of Paris and Le Havre, or at a castle in the vicinity of Paris, and the lists do not mention any professional occupation. André Tournouër returned to France sometime after his last expedition to Patagonia in 1903. In 1906 he married Isabelle Latham, heiress to a wealthy family of shipowners from Le Havre in Normandy, and around 1910 he settled in that city, where he became a founding member of the Société linnéenne de la Seine-Maritime (Buffetaut, 2013). According to the records of the French geological society, he returned to Paris in the 1920s and died there in 1929, aged 58.

André Tournouër's expeditions to Patagonia

How André Tournouër's expeditions to southern Patagonia began has been told by Gaudry in his both grandiloquent and sentimental style (my translation): "*One day, as he [André Tournouër] was back from Mendoza, I told him about the discoveries made by Messrs Ameghino and Mr Moreno in Patagonia; I asked him to undertake excavations, in order to do like his father and honour French science. When he heard his father's name, he gave me a deep and affectionate look: "I shall try to do like him", he told me; "I shall go to Patagonia, the Paris Museum will have fossils". He bravely kept his word*" (Gaudry, 1906). The timing and number of Tournouër's expeditions to Patagonia has long been somewhat obscure. Gaudry (1906) mentions six "excavations". Simpson (1984) is rather vague about this. However, Tournouër, both in a brief note about his palaeontological researches (Tournouër, 1902) and in his last paper about Patagonia (Tournouër, 1922), clearly stated that he first went to Patagonia from November 1898 to May 1899. He was there again from September 1899 to June 1900. He made a third trip from August 1901 to an unspecified date in 1903 (possibly February – he definitely was in Paris in May 1903: Anonymous, 1904). He temporarily left the expedition in 1902 to bring important *Pyrotherium* specimens to France himself. Uncertainties about the number of his trips to Patagonia probably stem from the fact that, for obvious reasons considering the Patagonian climate, he went there during the southern summer, so that his field campaigns were usually astride two successive years.

Before he launched his first expedition, Tournouër made preparations for it. An important point is that he visited Florentino Ameghino. The meeting had been prepared by Gaudry, who had met Ameghino during the latter's long stay in Paris (from 1878 to 1881). On 1st June 1898, Gaudry wrote a letter to Ameghino (Torcelli, 1935, letter 1309) in which he mentioned that the latter may have met Raoul Tournouër during his stay in Paris and went on to explain that his son André, who owned property in Mendoza, was planning to visit Patagonia and to collect fossils for the Paris Museum (which, contrary to the museums in London and Munich, had no such specimens – the London and Munich specimens had mainly been acquired from Ameghino). Gaudry therefore recommended André Tournouër to Florentino Ameghino and asked him to receive him. Ameghino complied and on 25 July 1898 (Torcelli, 1935, letter 1313) reported to Gaudry (whom he addressed as "*dear colleague and learned master*") that he had met André Tournouër and had provided him with all the necessary information for successful collecting in Patagonia, adding that he was likely to find abundant material in the Santa Cruz beds but that this was less likely in the *Pyrotherium* beds, in which mammal remains were not common. After this initial meeting, relations between Tournouër and Florentino Ameghino were cordial, as shown by the latter's published correspondence (Torcelli, 1935, 1936). However, Florentino Ameghino did not collect fossils himself in Patagonia, leaving that task to his brother Carlos, who spent many months there in the course of 14 expeditions, from 1887 to 1903 (Ameghino & Ameghino, 2006, Podgorny, in press). Tournouër regularly wrote to Ameghino, sometimes sending him photographs of his excavations (Torcelli, 1936, letter 1919), to keep him informed of his discoveries or to arrange meetings with him in La Plata when he stopped in Buenos Aires on his way to France. Ameghino's correspondence occasionally mentions such visits. For instance, in a letter sent to his brother Carlos on 30 June 1900 (Ameghino & Ameghino, 2006), he noted that Tournouër had visited him and had told him about his collecting trips to lake Colhue-

huapi and the Santa Cruz area, but could not show him the fossils, as they had already been sent to France. Tournouër had also mentioned that he intended to go back to Chubut and look for the mysterious "Jemmisch", which he had seen briefly and had unsuccessfully tried to shoot (see below). When in Patagonia, Tournouër also met Florentino Ameghino's brother Carlos and occasionally accompanied him in the field. Although relations were apparently very good between Florentino and Tournouër, they may have been a little more strained with Carlos. In a letter to his brother of 1899 quoted by Madden and Scarano (2010), Carlos explained that he had sent Tournouër off to Gran Barranca to get rid of him, as, having found very little so far, he was inquiring about where to go to find fossils. In a letter of 29 November 1902, Florentino asked his brother to try to be agreeable "*if possible*" with Tournouër, who was going back to his Deseado localities and was likely to meet him (Torcelli, 1936, letter 1491). His friendship was useful to them, he added, because the reports he sent to European palaeontologists, as well as his papers, were in their favour "*on all points*", and he asked his brother to provide Tournouër with information as accurate a possible. Ameghino was glad when Tournouër confirmed his views on some aspects of the stratigraphic succession in southern Patagonia, although they disagreed on the exact ages of the formations (see below).

Florentino Ameghino visited southern Patagonia only once, in 1903 (Podgorny, in press), to see by himself the places where his brother Carlos had been working for more than a decade, and on that occasion the brothers met Tournouër in the field, as mentioned in a letter from Florentino to the latter, dated 1 July 1903 (Torcelli, 1936, letter 1931), in which he mentioned the good memories he had of this trip in his "agreeable company" – a trip during which they checked some stratigraphic points.

Unlike other palaeontologists working there at the turn of century, including the Ameghino brothers and American researchers such as Hatcher, Brown and Loomis, who usually reached the fossiliferous areas from ports on the Atlantic coast, Tournouër initially did not go to Patagonia by sea. Instead, in 1898 he travelled all the way from Mendoza to southern Patagonia (some 1600 km) along the eastern slopes of the Andes with his workers, their equipment and a team of 40 mules (Tournouër, 1922).

Two relatively detailed accounts of all of Tournouër's expeditions are given in two of his papers (Tournouër, 1902; 1922). A map showing the main areas he visited in the course of his palaeontological explorations **(Fig. 2)** was first published in 1903 (Tournouër, 1903) and reproduced in his last paper (Tournouër, 1922). His accounts can be summarized as follows.

Fig. 2. Map showing the main fossiliferous areas in Patagonia visited by André Tournouër (from Tournouër, 1903b). The spellings used by Tournouër are not always those currently in use.

Tournouër's first expedition took place from November 1898 to May 1899. After travelling overland, along the Andes, from Mendoza to the Rio Senguer area of southern Patagonia with his men and mules, as noted above, he worked in the vicinity of lake Colhue-Huapi (which he spelled Coli-Huapi), or "Red Lake", in southern Chubut province, an arid and remote area a long distance (60 km) from the nearest settlement, where food and drinking water had to be brought from afar.

The specimens collected during this expedition were donated to the Paris Natural History Museum. The second expedition took place from September 1899 to June 1900. Via Punta Arenas in Chile, Tournouër met his men, who had overwintered near the coast, at the port of Comodoro Rivadavia. They mainly worked the continental deposits of the Santa Cruz Formation at "Monte Leone" (Monte León) near the town of Rio Gallegos, collecting abundant fossil mammal remains, notably belonging to the notoungulate Nesodon. Tournouër observed that the Santa Cruz Formation clearly overlies the marine beds of the Patagonian Formation, a fact already observed by Carlos Ameghino.

Tournouër's third expedition, funded by the French Ministry of Public Instruction and the Paris Natural History Museum, took place from August 1901 to 1903. He collected more Santacrucian fossils, including a large number of mammals, in the "Rio Coylet" (Rio Coyle) area of Santa Cruz province (Vizcaíno *et al.*, 2013). He then moved to the Rio Deseado region, farther north, where he excavated the "*Pyrotherium*" beds (now referred to the Deseadan South American Land Mammal Age). Some of the *Pyrotherium* specimens he collected were deemed so important that he interrupted his stay in Patagonia in 1902 to take them to Paris, where they were eventually described in a posthumous paper by Gaudry (1908). Tournouër's note entitled "*Recherches paléontologiques en Patagonie*", presented at the French Academy of Sciences on 6 October 1902, must have been written during this visit to Paris (Tournouër, 1902). He then returned to the Deseado area in late 1902 and the excavations went on until 1903. This was Tournouër's last expedition to Patagonia. By May 1903 he was back in Paris (on 5 May he gave a talk about his travels at the *Société des Américanistes*: Anonymous, 1904).

Some information about the practical aspects of Tournouër's expeditions is provided by photographs kept in the palaeontology library of the MNHN; they are mounted on cardboard and bear captions written in pencil on the back. Two of the photographs show excavations in the Deseado beds (*Pyrotherium* beds) during the November 1902-February 1903 field campaign, probably at the locality referred to as "La Flecha" by Tournouër (1903) – the name also appears in a letter to Ameghino dated 19 March 1903 (Torcelli, 1936, letter 1919) in which Tournouër mentions that he includes photos of the excavations at that locality (**Fig. 3A, B**). They show several workmen wielding pickaxes in a

Fig. 3 A. Photograph of André Tournouër's excavations in the Deseado beds (probably "La Flecha" locality), taken during his last expedition (1901-1903), kept in the library of the palaeontology department of MNHN. Courtesy of MNHN.

Fig. 3 B. Photograph of André Tournouër's excavations in the Deseado beds (probably "La Flecha" locality), taken during his last expedition (1901-1903), kept in the library of the palaeontology department of MNHN. The man standing on the edge of the excavation may be André Tournouër (?). Courtesy of MNHN.

rather chaotic-looking pit; no fossils are clearly visible. Another photograph, taken at the Deseado camp, shows a mule laden with crates, illustrating how fossils were carried to the coast, 45 km distant (**Fig. 4A**). The difficulty of procuring even basic commodities, mentioned by Tournouër (1922), is illustrated by a photograph showing a mule carrying several containers filled with drinking water (**Fig. 4B**).

A photograph (**Fig. 5**) shows a rugged landscape in Chubut province, the "Colihüe cliffs"

Fig. 4 A, B. Mules carrying fossil specimens to the coast (**A**) and containers for drinking water (**B**) at the Deseado camp, 1901-1903 expedition. Photographs kept in the library of the palaeontology department of MNHN. Courtesy of MNHN.

Fig. 5. Photograph probably taken during Tournouër's first expedition (1898-1899), showing a landscape near lake Colhue Huapi in Chubut province, possibly Gran Barranca, with mules and a member of Tournouër's crew in the foreground. Small crosses indicate significant geological spots in the distance (see text for explanations). Photograph in the library of the palaeontology department of MNHN. Courtesy of MNHN.

near lake "Coli Huapi" [Colhué Huapi] – possibly Gran Barranca. It must have been taken during Tournouër's first expedition of 1898-99, apparently the only time when he worked in that area. It bears at the back a long handwritten explanation which illustrates how some of Tournouër's field observations led him to question some of Ameghino's assumptions. The photograph, taken at a place "*eight days away from the coast with mules*", shows the "*silicified wood stage*", the mountains being "*absolutely full of silicified wood*". A small cross added in ink on the photo shows where Tournouër found bones of "*gigantic dinosaurs*". Two crosses farther to the right indicate geologically higher beds at the top of which remains of *Astrapotherium* and other fossils have been collected and sent to the Paris Museum. The "*Guaranian*" (or *Pyrotherium* stage) is said to be 100 metres thick in that area. Most importantly, the final sentence reads "*Mr Tournouër believes that Mr Ameghino has been misled when he was told that a* Pyrotherium *tusk had been found together with dinosaurs. At lake Colue Huapi the beds with dinosaurs and silicified wood are always below the* Pyrotherium *beds*". Ameghino's belief that the advanced mammals from the *Pyrotherium* beds had been contemporaneous with dinosaurs and were therefore Cretaceous in age was thus shown to be unfounded on the basis of stratigraphic field evidence.

A failed attempt at collecting a *Neomylodon* specimen

A somewhat unusual episode in André Tournouër's expeditions was his encounter with a mysterious creature in a river somewhere in Chubut Province. He described his experience in two brief notes published in esteemed French scientific journals, the *Bulletin du Muséum d'Histoire Naturelle* and the *Comptes Rendus hebdomadaires des séances de l'Académie des Sciences* (Tournouër, 1900; 1901), the editors of which apparently had no qualms about publishing papers that today would fall within the scope of cryptozoology. Gaudry, who thought that giant ground sloths would probably be found alive (Gaudry, 1899), presented Tournouër's note at the Academy of Sciences and certainly supported the publication of his other paper by the Paris Natural History Museum. It should be remembered that at that time the possible survival of giant sloths was seriously discussed in scientific circles, following the discovery of apparently fresh *Mylodon* skin in the Ultima Esperanza cave in Chilean Patagonia in 1895 (Martinic, 1996; Pérez *et al.*, 2018). One of the main contributors to the debate was Florentino Ameghino, who in 1898 had coined the name *Neomylodon listai* for the purported surviving giant sloth, basing his belief in its existence on tales told by local Indians, some osteoderms embedded in a piece of skin collected at an unspecified location in Patagonia and a rather obscure report by the late explorer Ramón Lista, who had told him that, when travelling in Santa Cruz Province, he had seen an animal looking like a hairy pangolin and had unsuccessfully tried to shoot it (see Pérez *et al.*, 2018 for a discussion of the uncertainties about the real origin of the osteoderms and skin described by Ameghino – which in all likelihood came from the Ultima Esperanza cave). Ameghino's report had been republished

in various languages in several countries and had excited much attention. According to Ameghino, the mysterious animal, which had semi-aquatic habits, was called *Iemisch* by the Tehuelche Indians, who were extremely afraid of it (Ameghino, 1899).

According to his reports, Tournouër's encounter with the mysterious animal, which he called Hyimché, took place one evening on the banks of an unspecified river in the interior of Patagonia during his second expedition (September 1899-June 1900). What he saw was the head of an animal emerging from the water. It was round, the size of the head of a puma, dark brown in colour with lighter spots around the eyes and no visible external ears. He tried to shoot it but could not find the body when he looked for it along the river banks. The local Indians confirmed that what he had seen was the *Hyimché*, an animal of which they were much afraid. He was later shown on a sand bank large cat-like footprints, supposedly made by the *Hyimché*. His conclusion was that the *Hyimché* did exist but was probably not Ameghino's *Neomylodon*, because according to the Indians it had large canines, which was incompatible with a sloth (Tournouër, 1900; 1901). As he told Ameghino, he hoped to collect more evidence about that mysterious animal during his next expedition. Tournouër's encounter with the *Hyimché* has been mentioned in various cryptozoology books (e.g. Heuvelmans, 1955; Whittall, 2012). What has escaped most authors, however, is that Tournouër changed his mind about that enigmatic animal (Buffetaut, 2016b). When he gave a talk about his travels in Patagonia at the *Société des Américanistes de Paris* on 5 May 1903, he was asked about the "Néo-Mylodon". He replied that in his opinion it was a legend based on a local species of otter with a very long and flexible tail (Anonymous, 1904) – he presumably meant the southern river otter, *Lontra provocax*. Why he changed his opinion is unclear, but an otter certainly was in agreement with what he had seen swimming in a river. Moreover, the ethnologist Lehmann-Nitsche (1902) had shown that *Iemisch* and similar names such as *Hyimché* were designations for the otter, and this may have influenced Tournouër's interpretation of the mysterious animal.

Funding the expeditions

How Tournouër's expeditions were funded can be reconstructed to some extent, on the basis of published and unpublished documents, the latter kept at the palaeontology library of MNHN.

It appears that the early expeditions were at least partly funded by the sale of fossils collected in Patagonia to the Paris Natural History Museum. A copy of a letter dated 23 August 1900, from Georges Leygues, then minister of public instruction, to the director of the Paris Museum (at that time the zoologist Edmond Perrier), mentions that on the latter's request a sum of 1495 francs, taken from the Serres bequeath (Serres had been a professor of comparative anatomy at the Paris Museum), is made available for the purchase of a collection of fossil bones sold to the Museum by Mr Tournouër. Although it is difficult to estimate reliably what this sum means in terms of modern currency, it clearly was a fairly large amount of money and may have covered a large part of Tournouër's expenses during his first two expeditions. In 1902, with Gaudry's support, Tournouër received the Jérôme Ponti prize of the French Academy of Sciences, for important scientific work. The Ponti prize at that time amounted to 3500 francs. In his report, Gaudry (1902) mentioned that Tournouër's collecting expeditions had been carried out at his own expense. By purchasing the fossils, the Paris Museum refunded at least part of the expenses and that was later complemented by the Ponti prize. In 1904 Tournouër received the Fontannes prize of the French Geological Society, which amounted to 500 francs; however, by that time he had ceased his expeditions to Patagonia.

Tournouër (1922) noted that the 1901-1903 expedition took place "*under the auspices*" of the French Ministry of Public Instruction and the Paris Natural History Museum. This apparently implies that he received financial support from these institutions. This is confirmed by an interesting handwritten letter in the palaeontology library, which provides some evidence about the way the funds were made available to André Tournouër. It was sent to Albert Gaudry by Cécile Tournouër, André's mother, from Le Lude (a castle in the Sologne region of central France), on 8 April of an unspecified year. However, in it she mentions the recent birth (two days before) of her grand-daughter Renée Bastide du Lude, whose mother Suzanne was the daughter of Raoul and Cécile Tournouër and therefore André's sister. As Renée was born in 1902, the letter must have been written

on 8 April 1902. Cécile Tournouër addresses Gaudry as her "*dear friend*", showing that the links between the professor of palaeontology and the Tournouër family went well beyond a mere professional acquaintance. After announcing the birth of her grand-daughter, Cécile Tournouër adds (my translation):

> "*I have a request for money from André and if you can put at my disposal the 2000 frs you provide for him, I have the necessary documents to get them and can be in Paris in the first days of next week. I look forward to seeing the 26 new crates*".

The crates must have contained fossils sent by André, who apparently still was in Patagonia although it is known that he came back to France for some time in 1902 (if he had been in France he would have collected the money himself). The 2000 francs must have been part of the funds allotted to him by the Natural History Museum.

Shipping the fossils to France

Documents in the palaeontology library of the MNHN provide interesting information about the way the specimens collected by Tournouër were shipped to France. They consist of receipts from various shipping and railway companies and document how the crates of fossils found their way to the Paris Natural History Museum after they had been carried to a port somewhere on the Patagonian coast. A receipt from the *Compagnie des Messageries Maritimes* (the steamboat company of the French Mail) thus lists 6 boxes sent from Buenos Aires to Bordeaux on the steamboat *Cordillère* in February 1900, close to the end of Tounouër's second expedition. The boxes were to be delivered to the Natural History Museum and shipping costs were 150 francs. They had been received in Buenos Aires from a Mr Santiago Sorren, probably an agent commissioned by Tournouër.

Not all fossil shipments were sent from Buenos Aires, however. A letter sent by the shipping company Pasinovich and Boisdechêne, based in Punta Arenas, in Chile, dated 4 January 1902, informed the Paris Natural History Museum that a consignment of 3 crates had been sent, by order of Mr A. Tournouër, on board the steamer *Lake Megantic*, which belonged to the British *Pacific Steam Navigation Company*. As shown by a letter from the agent of the company in France, the crates had arrived in France by 10 February 1902. A second consignment of 13 crates from Punta Arenas arrived in France in May 1902 on another steamer of the same company, the *Orellana*.

The 1902 shipments were unloaded at La Pallice, the deep-water port near La Rochelle on the French Atlantic coast. Going through customs at La Pallice was facilitated by the Ministry of Finance on request from the Natural History Museum, as shown by a typewritten letter dated 18 February 1902. Receipts also show that the crates of fossils were sent from La Pallice to Paris by express train.

Why Tournouër chose to ship his fossils from Punta Arenas in Chile rather than from Buenos Aires via one of the ports on the Atlantic coast of Argentinian Patagonia can be explained by the fact that ships to Buenos Aires from these ports were mainly used by the military and travelled at irregular intervals (Irina Podgorny, pers. com.). By contrast, the Punta Arenas port was an important stop on the shipping lines from the west coast of South America to Europe and therefore provided more regular and faster service. How the consignments of fossil specimens were taken from the collecting areas to Punta Arenas is unclear.

The scientific significance of André Tournouër's expeditions to Patagonia

The immediate result of André Tournouër's expeditions was that the Paris Natural History Museum obtained a vast colllection of fossils from Patagonia (Gaudry repeatedly mentioned the very large number of specimens sent to Paris by Tournouër). Lists of taxa collected during the expeditions were provided in several papers (Tournouër, 1902; 1903; 1904; 1906a,b; 1908; 1909). The significance of the finds was clearly appreciated as soon as the fossils reached Paris, as shown by Gaudry's enthusiastic comments. Some of the specimens contributed considerably to a better knowledge of some spectacular taxa that had hitherto been relatively poorly known, a case in point being that of *Pyrotherium* (**Fig. 6**), the remains of which were deemed so important that Tournouër interrupted his field work to bring them himself to Paris. There is no published comprehensive catalogue of the fossils collected byTournouër but the papers on fossils from that collection by various authors, including many published well after the initial

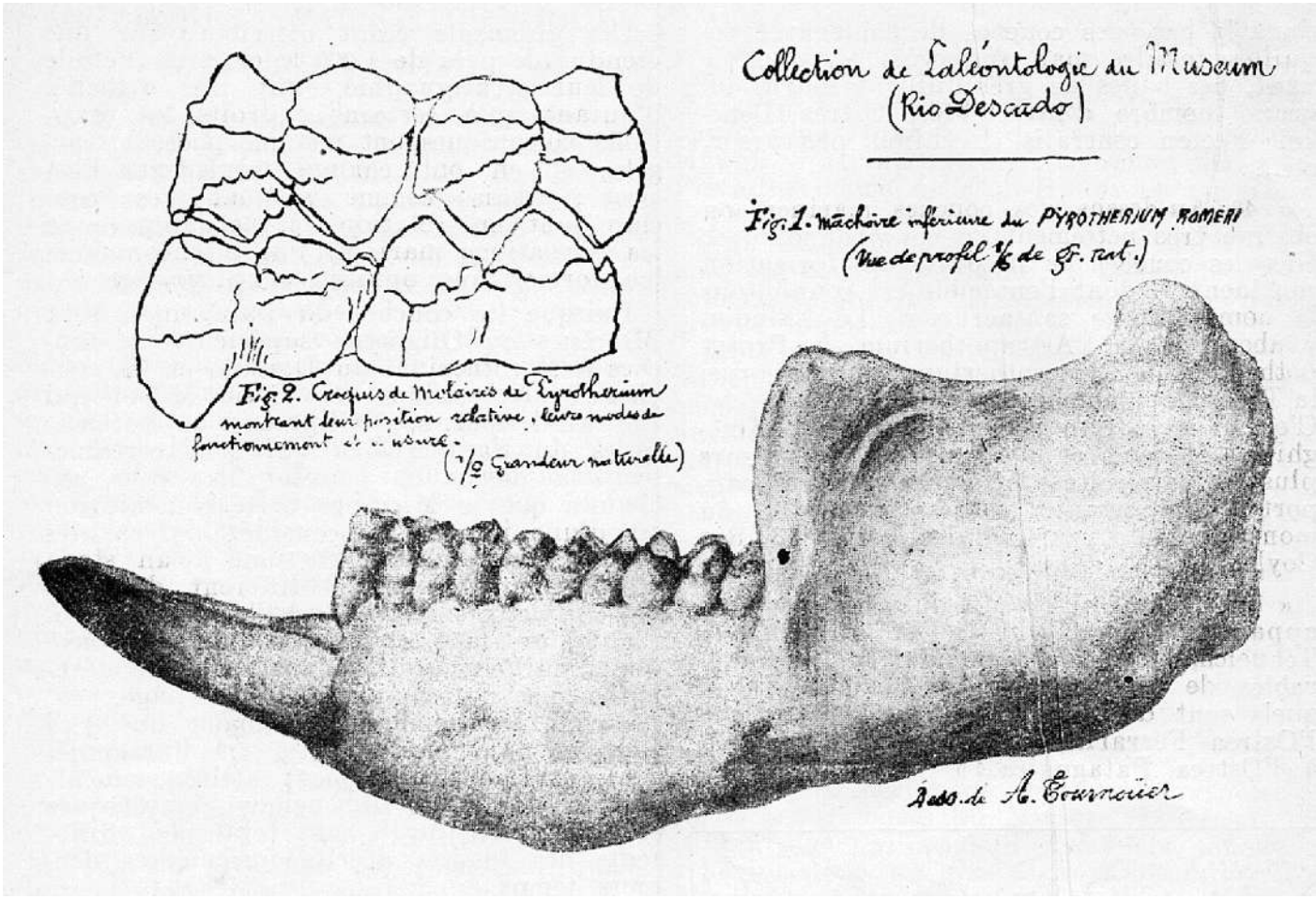

Fig. 6. *Pyrotherium* teeth and lower jaw collected in Patagonia by André Tournouër, in the collections of the palaeontology laboratory of MNHN. Drawing by A. Tournouër, from his 1922 paper.

descriptions by Gaudry and Tournouër himself, testify to its extent and diversity (e.g. Hoffstetter, 1954; Simpson, 1964; Marshall *et al.*, 1984; Billet, 2010; Buffetaut, 2014; Koenigswald *et al.*, 2015; Houssaye *et al.*, 2016; Novo *et al.*, 2018). The Tournouër collection is certainly one of the largest collection of Tertiary vertebrates from Patagonia in Europe. Ameghino himself acknowledged its importance in a letter to Marcellin Boule (Gaudry's successor at the MNHN) dated 22 December 1903 (Torcelli, 1936, letter 1963) in which he asked for casts of fossils collected by Tournouër that were not represented in the collections of the Natural History Museum in Buenos Aires. A detailed analysis of the scientific articles that have dealt with it is beyond the scope of this paper, but is should be mentioned that it is largely on the basis of fossils collected by André Tournouër that Albert Gaudry came to the conclusion that the Tertiary mammal faunas from Patagonia were the result of endemic evolution. This interpretation, which diverged strongly from Ameghino's views, according to which most of the major orders of mammals had originated from Patagonia, has proved correct: the unusual vertebrates from the Tertiary of South America evolved in isolation during the long period when the South American continent was separated from other land masses. As early as 1902, in a short paper in which he praised Tournouër's work in Patagonia, Gaudry emphasized the peculiarities of the Patagonian fossil mammals and suggested that their evolution had taken place on a vast “austral continent” on which faunal development had been different from that of the boreal regions (Gaudry, 1902). He later developed this idea in various papers on the fossils collected by Tournouër (e.g. Gaudry, 1906b; 1907).

André Tournouër's expeditions to Patagonia also allowed him to discover new important fossiliferous outcrops and to clarify the stratigraphic position of several significant fossil-bearing formations (Buffetaut, 2016a). Despite Simpson's claim that they were first explored by Carlos Ameghino (Simpson, 1967), there is strong evidence to show that the outcrops known as Gran Barranca, south of lake Colhue-Huapi, which provide a remarkable section of pre-Santacrucian fossil-bearing formations,

were actually discovered by Tournouër in 1899, as discussed in detail by Madden and Scarano (2010). Another locality discovered by Tournouër was in a gully on the coast of Santa Cruz Province that yielded fossils of Casamayorian (Eocene) age; the Ameghino brothers named it "cañadon Tournouër" (Simpson, 1967).

One of Tournouër's major scientific contributions resulting from his field work in Patagonia was to disentangle the stratigraphic relations between several Cenozoic formations and to help dating them on the basis of biostratigraphic evidence. He was able to confirm Ameghino's views on the succession of major Cenozoic fossil-bearing units, showing, for instance, that the Santa Cruz beds overlie the marine Patagonian Formation, which itself lies above the Deseado beds (this succession had been doubted by American palaeontologists). However, he disagreed with Ameghino about the ages of these formations. It is well known that Ameghino consistently overestimated the age of most of the fossil-bearing beds of Patagonia (e.g. Ameghino, 1902). In addition to his spectacular finds of terrestrial vertebrates, Tournouër collected abundant marine fossils, which he sent to experts in France for identification and dating (Priem for fishes, Canu for bryozoans, Lambert for echinids, Cossmann for molluscs). Several of them published papers on Tournouër's specimens (Lambert, 1903; Canu, 1904). While stressing that Ameghino had been correct about the stratigraphic succession of the various formations, Tournouër (1903) summarised the biostratigraphic results about the Patagonian Formation by stating that its fauna was Miocene, or possibly Oligocene, in age. The *Notostylops* and *Pyrotherium* beds, being overlain by the Patagonian Formation, could not be later than the Late Oligocene and the *Nesodon* beds above it could not be older than Miocene. These biostratigraphical conclusions have proved to be basically correct. Ameghino was pleased to see his conclusions about the succession of the formations validated, but could not accept the ages suggested by the French palaeontologists, which where much too young to his taste (he believed that the Santa Cruz beds and the Patagonian Formation were Eocene and that the *Pyrotherium* beds were Cretaceous: Ameghino, 1902). In a letter to Tournouër of 1st July 1903, he acknowledged that the fossil invertebrates had been submitted to authorities on conchiology in France but despite this he could not accept a Neogene age for the Patagonian Formation and was convinced that the authorities in question were mistaken (Torcelli, 1936, letter 1931). Until the end of his life, Ameghino persisted in overestimating the geological age of the fossil-bearing formations of Patagonia (Ameghino, 1910).

Conclusions: after the expeditions

André Tournouër came back to France in 1903 and there is no evidence that he ever went back to Argentina. His last real research paper, a very brief note on the forefeet of *Astrapotherium*, was published in 1905 in the *Bulletin de la Société géologique de France* (Tournouër, 1905) – his later papers in the *Bulletin de la Société linnéenne de la Seine-Maritime* were a brief review of the fossil vertebrates of Patagonia (Tournouër, 1914) and a short but useful record of his expeditions to Patagonia and their main results (Tournouër, 1922). It therefore appears that Tournouër stopped doing any active palaeontological research soon after his 1905 paper was published. Gaudry (1902) had announced that Tournouër was planning to study the fossils he had collected after his return from his next (and last) expedition. In fact, it was Gaudry himself who published most of the early descriptions of Patagonian fossils collected by Tournouër (Gaudry, 1908). There is no real evidence, however, of a competition between Gaudry and Tournouër about who would describe the material. Both men repeatedly declared their friendship and mutual respect, and the specimens were in such large numbers that they could provide work for more than one researcher. Why Tournouër did not continue his palaeontological activities after 1905 is unclear. Although the papers he published about the geology of Patagonia show that he had a solid background in field geology and stratigraphy, it cannot be excluded that he may have been more interested in collecting fossils than in describing them. One could also suppose that Gaudry's support and encouragement were so important to Tournouër that when his mentor died he did not feel like continuing his scientific researches (Marcellin Boule, who had succeeded Gaudry as professor of palaeontology at the Paris Museum in 1902, does not seem to have been especially interested in Tournouër's fossils beyond the fact they were very welcome additions to the collections). This, however, is not likely because

Gaudry died in November 1908, three years after the publication of Tournouër's 1905 paper on the feet of *Astrapotherium*. As noted above, Tournouër married Isabelle Latham in 1906, and this may have something to do with the end of his research activities, although his move to Le Havre took place some years later. It should also be mentioned that Tournouër, who was never officially employed as a palaeontologist, had other interests besides fossils. One of them was ballooning. It is recorded (Leroy, undated), for instance, that on 20 May 1909, the balloon *Nephtys*, manned by the Count of Castillon, Bastide du Lude (André Tournouër's brother in law) and Tournouër, took 4h55 to fly the 99 km between Saint-Cloud (in the western suburbs of Paris) and Elbeuf, in Normandy. After he settled in Le Havre, opportunities to work on fossils kept at the Paris Museum became curtailed. However, Tournouër never completely lost his interest in Patagonia and the fossils he had collected there, as shown by his two articles in the *Bulletin mensuel de la Société linnéenne de la Seine-Maritime*. There may have been a touch of dilettantism in Tournouër, who apparently switched effortlessly from cattle-raising to palaeontology and then to ballooning – and obviously never lost his upper-class connections and way of life. Be that as it may, his career as an active palaeontologist was brief (less than ten years) but highly productive in terms both of his contribution to the Cenozoic stratigraphy of Patagonia and of the remarkable collections he brought together.

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PALÉONTOLOGIE

Paul Carié, Mauritian naturalist and forgotten collector of dodo bones

Paul Carié, naturaliste mauricien et collecteur oublié d'os de dodo

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Summary: Paul Carié (1876-1930) was a Mauritian industrialist and naturalist of French descent, who was affiliated with various French scientific societies and carried out research on many aspects of the zoology of the Mascarene islands. However, his work on the extinct fauna of Mauritius is now largely forgotten, probably because he published very little on that topic. Nevertheless, Paul Carié collected numerous specimens of extinct vertebrates, including dodo bones, from the famous Mare aux Songes locality, which once belonged to him. In addition, he bought dodo specimens from sites in the mountains of north-eastern Mauritius from Louis Thirioux, another early twentieth-century collector. A forgotten collection of subfossil bones brought together by Paul Carié was rediscovered in France in 2015. Dodo bones presented by Paul Carié and his descendants are now part of the collections of several museums in France and Switzerland and have been the subject of several recent studies.

KEY-WORDS

Paul Carié
Mauritius
Dodo
Collections
Leguatia

Résumé : Paul Carié (1876-1930) était un industriel et naturaliste mauricien d'ascendance française, qui fut affilié à diverses sociétés scientifiques françaises et qui effectua des recherches sur de nombreux aspects de la zoologie des Mascareignes. Cependant, ses travaux sur la faune éteinte de l'île Maurice sont aujourd'hui largement oubliés, probablement parce qu'il publia très peu sur ce sujet. Néanmoins, Paul Carié récolta de nombreux spécimens de vertébrés disparus, y compris des os de dodos, à la Mare aux Songes, site qui à une certaine époque lui appartint. En outre, il acheta des spécimens de dodo provenant de sites dans les montagnes du nord-est de l'île à Louis Thirioux, un autre collectionneur du début du vingtième siècle. Une collection oubliée d'ossements subfossiles récoltés par Paul Carié a été redécouverte en France en 2015. Des os de dodos donnés par Paul Carié et ses descendants appartiennent maintenant aux collections de divers musées en France et en Suisse et on fait l'objet de plusieurs études récentes.

MOTS-CLÉS

Paul Carié
Ile Maurice
Dodo
Collections
Leguatia

Introduction

Although the dodo (*Raphus cucullatus*) survived for about a century after the discovery of its native island of Mauritius by European navigators, much of what we know about it is based on studies of subfossil bones discovered in swamps and caves from the 1860s onward. Early reports on living dodos by 17th century visitors to Mauritius are often vague and sometimes contradictory – no naturalist ever studied the dodo "in the wild" and descriptions of living birds brought to Europe are very brief and not very informative. With a few exceptions, even contemporaneous pictures and paintings of the dodo have turned out to be of limited reliability because of artistic licence and exaggeration (Ziswiler, 1996; Hume, 2006).

Moreover, little was preserved of the few dodos that were brought alive to Europe, the case of the Oxford dodo being a well known example (Pickering, 2010). The work done by a handful of naturalists who collected dodo remains on Mauritius in the late 19th and early 20th centuries is thus of primary importance for our knowledge of many aspects of the anatomy of the dodo. The best known of them certainly is George Clark, who collected a large number of dodo bones from the famous Mare aux Songes locality in the 1860s, a material which formed the basis of several studies on that extinct bird. Other well known dodo collectors were Théodore Sauzier and Louis Thirioux, whose contributions to dodo research are often mentioned (Fuller, 2002; Grihault, 2005; Hume, 2006; Parish, 2013). By comparison, although it does sometimes get mention (Grihault, 2005; Cheke & Hume, 2008; Parish, 2013), the work of Paul Carié (1876-1930) has been relatively neglected. Yet, as the co-owner of the Mare aux Songes in the early 20th century, he brought together a very large collection of subfossil bones (including those of dodos) from that locality, which are now part of European collections. In addition, through his connection with Thirioux, he also acquired dodo remains from a completely different taphonomic setting (viz. caves and screes), which also found their way to European museums. The aim of the present paper is to show how Carié's work was significant for our knowledge of the dodo and therefore deserves to be better acknowledged.

A short biography of Paul Carié

François Joseph Paul Carié (**Fig. 1**) was born on Mauritius on 6 November, 1876 (see biography by Halais, 1941a). He belonged to an old French-Mauritian family that had been established on the island since the 18th century. After inheriting a considerable fortune (including both land on Mauritius and property in Paris) from his uncle Thomy Thierry, he was initially successful as a plantation owner and industrialist. The sugarcane processing plant he ran on his "Mon Désert" estate was at the time one of the most modern on Mauritius. Besides his activities as a naturalist, Paul Carié spent much time and energy lobbying for the retrocession of Mauritius to France. After its discovery by Portuguese navigators in the late 16th century, the island became a Dutch possession, until it was abandoned in 1710. It was then acquired by

Fig. 1. A photographic portait of Paul Carié, wearing a French army uniform, circa 1914 (courtesy of the heirs of Paul Carié).

France in 1715. It was conquered by the British during the Napoleonic wars, and officially transferred to Britain by the Treaty of Paris in 1814. Carié's activities in favour of a retrocession to France began before the First World War. He was mobilised in 1914 and served as translator in London and Paris. In the aftermath of the war, Carié hoped that the negotiations which led to the ill-fated Treaty of Versailles (in 1919) could include a retrocession of Mauritius to France, possibly through an exchange of territories with Britain (Carié, 1919), but this did not happen: Mauritius remained a British colony until its independence in 1968. During the war, Carié's sugar-making business declined and he sold it off and settled in Paris in 1918. There, he continued his scientific activities until his death on 19 December 1930.

Paul Carié's scientific activities

Paul Carié's was involved in many aspects of the natural history of the Mascarene islands, and more generally the Indian Ocean (Crépin, 1931). He was especially interested in entomology and ornithology, as well as in the introduction of foreign species on the islands of the In-

dian Ocean. He was a member of the French Zoological Society, of which he was president in 1923. He became a correspondent of the Muséum National d'Histoire Naturelle in 1914, and then an associate researcher in 1918. He was also general secretary of the *Société des Amis du Muséum d'Histoire Naturelle et du Jardin des Plantes* (Mangin, 1931). In 1910, and again in 1921, he was sent by the Muséum National and the French Ministry of Public Instruction on research trips to the islands of the Indian Ocean. He thus collected thousands of specimens, including living birds and turtles for the zoological garden of the Jardin des Plantes. Altogether, he discovered 125 new species on the Mascarene islands (Crépin, 1931). However, Paul Carié published relatively little on his discoveries (a partial list of his publications was provided by Cheke and Hume, 2008), and his collections were mainly studied by other scientists, sometimes a long time after his death.

Paul Carié and the extinct vertebrates of Mauritius

When he inherited the Mon Désert sugar estate, Paul Carié also became co-owner of the Mare aux Songes, the main subfossil vertebrate locality on Mauritius (Rijsdijk *et al.*, 2009). The swamp deposits there had been made famous in the 1860s by the work of George Clark, the "modest schoolteacher of Mahébourg", as Carié described him (Carié, 1930: 212), who provided the scientific community with the first comprehensive collections of dodo bones. Clark's work had been continued two decades later by Théodore Sauzier, who also collected abundant remains of dodos and the accompanying fauna. Paul Carié conducted excavations there from 1904 to 1907, and again from 1910 to 1913 (Carié, 1930). A large amount of skeletal material was thus collected, most of it being donated by Carié to the Paris Natural History Museum. The squamate remains in that collection were described by Robert Hoffstetter in a series of notes published in the 1940s (Hoffstetter, 1945, 1946a,b). Hoffstetter named an extinct species of blind snake from Mare aux Songes *Typhlops cariei*, in honour of Carié (Hoffstetter, 1946b). Carié himself published very little about the extinct vertebrates of Mauritius. His main contribution on the topic is a critical investigation of *Leguatia gigantea*, a supposed extinct bird species from Mauritius that had been erected by the German naturalist Schlegel (Schlegel,1858). Schlegel had based his work on the description of a large bird - the so-called "Géant" - observed on Mauritius in the 18th century by the French traveller Leguat. Although the reality of *Leguatia gigantea*, described as a giant rail, had been accepted by various authorities on extinct birds, including Rothschild (1907), who published a fanciful reconstruction of it (**Fig. 2**), and Oudemans (1917), Carié (1930) conclusively showed that Leguat's report in all likelihood was based on a misidentification of flamingos, which are occasionally seen on Mauritius, and that the so-called *Leguatia* had never existed (Buffetaut, 2014). Interestingly, despite Carié's convincing demonstration, some recent authors (e.g. Balouet & Alibert, 1989) still list the Géant among the extinct birds of Mauritius.

Fig. 2. An artist's impression of *Leguatia gigantea* Schlegel, the imaginary "giant rail" of Mauritius. Carié (1930) showed that Leguat's report of the "Géant" was in all likelihood based on sightings of flamingos. Chromolithograph by F.W. Frohawk, from Rothschild (1907).

Carié's conclusion about the non-existence of *Leguatia gigantea* was based both on a thorough examination of the reports by Leguat and other early travellers, and on the results of excavations on Mauritius, which had yielded "countless remains" of birds, turtles, lizards and bats, but not a single bone of the "Géant". Carié alluded to excavations at Mare aux Songes, both his own and those of his predecessors, and also to the researches carried out in other parts of the island, notably those of Louis Thirioux (1846-1917). Thirioux was born in France, but emigrated to Mauritius at an early age and became a hairdresser in Port-Louis. In his spare time, he collected living molluscs and subfossil vertebrates in the mountains of the northern part of Mauritius (Montagne du Pouce, Montagne du Corps de Garde). Although Thirioux's contribution to dodo research is occasionally mentioned (Fuller, 2002; Grihault, 2005), few details are usually provided about his activities, beyond the fact that the specimens he collected ended up in the hands of collectors and naturalists who sent them on to Europe (Halais, 1941b). However, the recent description of the exceptional dodo skeletons discovered by Thirioux and kept in Port-Louis and Durban has revived interest in this rather forgotten collector (Claessens & Hume, 2015). Carié himself, in his article on *Leguatia* (1930) noted that Thirioux searched the caves and screes on the mountain slopes, "with an admirable patience and perseverance", and found complete skeletons of the dodo and *Aphanapteryx*, as well as remains of other birds, turtles and lizards. It also appears that Carié was one of the naturalists who acquired Thirioux's finds. In an introductory note to a memoir by Louis Germain on terrestrial and freshwater molluscs from the Mascarene islands, Carié (1921) noted that part of the material described in that work had been collected by Thirioux during his explorations of the mountains of northern Mauritius, in the course of which he also found subfossil bones (**Fig. 3**). In addition, he mentioned that on several occasions he had purchased collections from Thirioux. This explains some aspects of the dodo specimens donated by Carié to European museums.

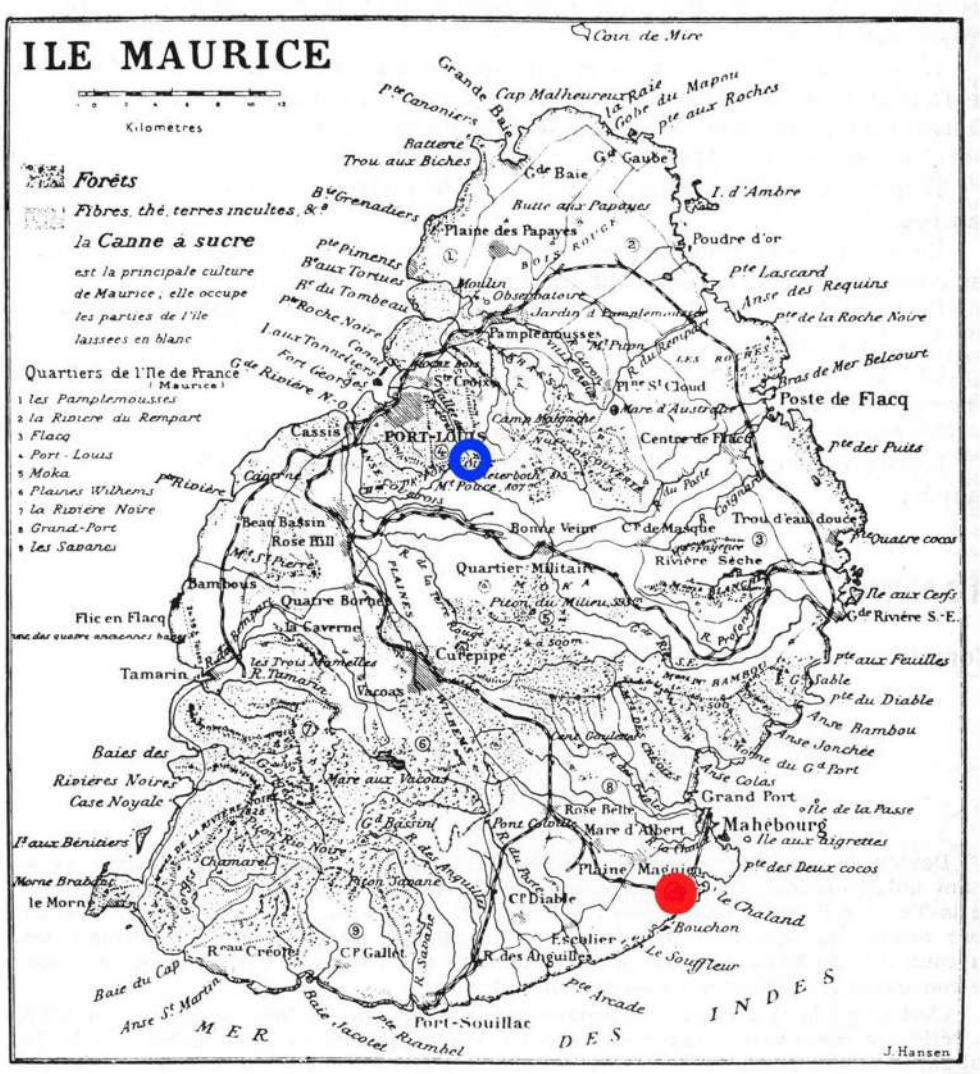

Fig. 3. Map of Mauritius (from Carié, 1919) showing the location of Mare aux Songes (red dot) and of Thirioux's localities (blue circle) in the mountains near Port-Louis.

Paul Carié's dodo specimens

Several museums in Europe hold collections of dodo bones donated by Paul Carié. Not unexpectedly considering Carié's close association with this institution, the National Museum of Natural History in Paris is one of them. Janoo (1996) described a *Raphus cucullatus* skull from the Paris collection, the label of which bears "Vallée aux Prêtres" as geographical origin, as well as Carié's name. Other specimens in Paris apparently were collected by Thirioux. The "light rosewood tint" of the skull is very different from the usual brown colour of Mare aux Songes specimens (Janoo, 1996). The Vallée aux Prêtres is in the mountains just east of Port-Louis, in northeastern Mauritius. The specimen was in all likelihood collected there by Thirioux and then purchased by Carié. There may be more dodo material donated by Carié in the Paris Museum.

A second French museum in which dodo bones donated by Carié are kept is the museum ("Fabrique des Savoirs") at Elbeuf-sur-Seine (Seine-Maritime, Normandy), which holds a large natural history collection, largely brought together in the late 19th and early 20th century in relation with the activities of a local natural history society. Paul Carié donated a set of dodo bones, together with mollusc specimens, to the Elbeuf museum in 1923 (Coulon, 1923; Coulon & Saint-Amand, 1922,1923). A description of the dodo material was published by Angst and Buffetaut (2010). The Elbeuf material includes both specimens showing the typical brownish colour of Mare aux Songes bones and others which are much lighter, almost white (**Fig. 4**). The latter bones are in all likelihood from Thirioux's localities in the mountains of north-eastern Mauritius (see below).

Paul Carié also donated dodo bones to the Musée Cantonal de Géologie in Lausanne, Switzerland (Anonymous, 2007). According to the archives of the museum, the specimens were sent to Maurice Lugeon, who was then professor of geology at the University of Lausanne, in 1907. They comprise about 30 bones, some dark

Fig. 4. Two femora of *Raphus cucullatus* donated by Paul Carié to the Elbeuf Museum in 1923. Above, 8.0.67, a brown-coloured specimen from Mare aux Songes. Below, 9.0.67, a whitish specimen in all likelihood collected by Thirioux.

brown, others whitish in colour, which have been mounted to produce an incomplete composite skeleton. A handwritten note by Carié (kindly communicated by R. Marchant) provides not only a list of the bones sent to Lausanne, but also important information about their provenance. In it, Carié mentions that the white bones come from Mr Thirioux's excavations in the screes and caves in the vicinity of Port-Louis, while the brown ones come from Mare aux Songes (which at that time belonged to Carié). On the basis of this note, it seems extremely likely that the bones donated by Carié to the Elbeuf museum also have this dual origin.

It cannot be excluded that dodo material donated by Paul Carié may exist in other European collections. A composite mounted skeleton, illustrated in Carié (1976), was still preserved by descendants of Paul Carié until recently (J. Carié, personal communication). However, records show that the dodo bones held by the museums of Lyon and La Rochelle were not provided by Paul Carié, but purchased from Natural History dealers.

Discovery of a new collection brought together by Paul Carié

As shown before, the natural history work done by Paul Carié was very important and permitted to increase significantly the number of specimens known from Mauritius. In 2015, this story took a new turn, when the descendants of Paul Carié contacted one of us (D.A.) because they were clearing the old family house close to Paris and had found some old specimens which they thought might be of scientific interest. A rapid investigation of this collection quickly showed that it contained various very interesting specimens. This new collection includes an important number of modern molluscs, insects and eggs. Unfortunately, the exact origin and history of these specimens are unclear and in the absence of documents will be difficult to elucidate . The second part of this collection includes a large number of vertebrate bones. These can be divided into two groups: modern vertebrates including mainly rodents and birds, the origin of which is unknown, and a very large number of subfossil specimens, including mainly bones of giant turtles (*Cylindraspsis*), bats and dodos (**Fig. 5**). The origin of these bones is clearer, the brown ones are from the Mare aux Songes, and the white dodo bones may be from various caves as already explained by Carié himself (see above). Finally, several drawings and written documents are also associated with these specimens. All these specimens have been donated to the Elbeuf Museum, where previous specimens from Paul Carié were already kept. The complete collection is kept together and has been inventoried with collection numbers. Some of the dodo bones were used for the recently published first histological study of dodo bones (Angst *et al.*, 2017; Angst, 2018) and other bones are currently studied by an international team, which shows the importance of this new collection and of the work done by Paul Carié.

Fig. 5. Dodo bones belonging to the collection rediscovered in 2015 and donated by Paul Carié's heirs to the Elbeuf Museum.

Conclusion

Although Paul Carié published very little on the dodo or other subfossil vertebrates from Mauritius (apart from his debunking of *Leguatia*), his contribution to our knowledge of the Mauritian extinct fauna was far from negligible. Like other local naturalists, including George Clark, Théodore Sauzier and Louis Thirioux, he gathered large collections of bones which were mostly sent to European institutions and studied there. As noted above, Carié's collection in the Paris Natural History Museum was the basis for Hoffstetter's descriptions of various hitherto unknown elements of the extinct herpetofauna of Mauritius. By the time Carié presented sets of dodo bones to museums in Paris, Elbeuf and Lausanne, the osteology of *Raphus cucullatus* was already well known, so that this material was mostly used for display purposes rather than as a basis for new descriptions. Nevertheless, dodo specimens in Paris (Janoo, 1996) and Elbeuf (Angst & Buffetaut, 2010) were described a long time after Carié (and Thirioux) collected them, and some of this material has been used for recent studies on the weight of the dodo (Angst *et al.*, 2011), and to do the first bone histological study permitting to distinguish for the first time the males and the females and to observe the moulting events and propose a timing for these events during the year (Angst *et al.*, 2017; Angst, 2018).

In addition to his published papers on the living fauna of the Mascarenes, Paul Carié's achievements as a collector of remains of the extinct vertebrates of Mauritius definitely deserve to be remembered.

Acknowledgments

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PALÉONTOLOGIE

Researchers following the Glossopteris trail: social context of the debate surrounding the continental drift theory in Argentina in the early 20th century

Chercheurs suivant la piste des Glossopteris: le contexte social du débat autour de la théorie de la dérive des continents en Argentine au début du XXe siècle

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Summary: The fossils of the plant genus *Glossopteris* were used as material evidence of the former union of the continents as proposed by the continental drift theory, since it could be found in the continents believed to have once been part of the super-continent of Gondwana. The debate about this theory in the scientific circles in the first half of the 20th century, starting at around 1915 with the publication of Alfred Wegener's "The Origin of Continents and Oceans" involved a number of scientists settled in the Southern Hemisphere, most of them trying to prove it right. One of the activities of these naturalists was the collection, identification and exchange of data concerning *Glossopteris* fossils, creating a network of communication between them. In this context, Argentina had an important role, first as one of the main sites where *Glossopteris* was found, and second as a place where scientists were concerned with the discussion of the continental drift theory. In order to better understand the role of more particularly Argentina, and more broadly, the Global South in the discussion of the continental drift theory in the first half of the 20th century, the focus of this paper was on the exchange of information concerning the *Glossopteris* fossils between scientists in Argentina. The focus in this paper was on the study about *Glossopteris* and the continental drift theory, from Federico Kurtz, Juan Keidel, and Horacio Harrington, as well as on the social contexts at the time, elucidating.

KEY-WORDS

Glossopteris
continental drift theory
scientific network
XXth century
Argentina
Global South

Résumé : Les fossiles du genre végétal *Glossopteris* ont été utilisés comme preuves d'une ancienne union des continents, telle que la proposait la théorie de la dérive des continents. Cela est dû au fait qu'ils ont été trouvés sur les continents qui auraient formé le supercontinent du Gondwana. Le débat autour de cette théorie a démarré au début du XXe siècle dans le milieu scientifique. « La Genèse des Continents et des Océans » d'Alfred Wegener, publié en 1915, est un point de repère important dans cette discussion. Cela a impliqué un certain nombre de scientifiques basés dans l'hémisphère sud, la plupart essayant de prouver que la théorie était correcte. Ces naturalistes se sont consacrés à la collecte, à l'identification et à l'échange de données sur les fossiles de *Glossopteris*, créant ainsi un réseau de communication entre eux. L'Argentine a joué un rôle important à la fois en tant qu'un des principaux sites où le *Glossopteris* a été découvert et en tant qu'un centre de discussion important sur la théorie de la dérive des continents. Dans cet article, l'accent a été mis sur l'étude de Glossopteris et la théorie de la dérive des continents, de Federico Kurtz, Juan Keidel et Horacio Harrington, ainsi que sur les contextes sociaux de l'époque, élucidant la nature sociale de la science.

MOTS-CLÉS

Glossopteris
théorie de la dérive des continents
réseau scientifique
XXe siècle
Argentine
Pays du Sud

Introduction

The idea that the relative positions of the continents are not fixed and that the continents were once connected is now a matter taken for granted. It is common knowledge that a great pan-continent, named Pangea, eventually broke apart and its fragments drifted to form the arrangement we see today. However, the continental drift theory, which proposed these ideas, resulted in a long-lasting polemic in the first half of the 20th century with complex motivations.

In 1915, the German meteorologist Alfred Lothar Wegener (1880-1930) published *Die Entstehung der Kontinente und Ozeane* ("The Origin of Continents and Oceans"), which became very well known in the scientific circles, and marked a symbolic introduction of the continental drift theory discussion among earth scientists. The theory was rejected by most of Wegener's contemporaries, gaining a minority of supporters in Europe and facing strong opposition especially in the United States (Oreskes, 1999). During this long-lasting debate, many naturalists were out searching for evidence in the southern hemisphere to support Wegener's ideas. One such evidence was the distribution of the specimens of a Permian fossil gymnosperm of the genus *Glossopteris*, found in peninsular India and throughout the southern continents. This fossil receives increasing importance in the consecutive editions of Wegener's book as a clue to his proposed former position of the continents. Today, it is accepted that the glossopterid group appeared for the first time in the fossil record around the end of the Carboniferous period, and its first representatives are believed to have existed at the time of the Late Carboniferous glaciations, since they are found in layers followed by and intercalated with glacial deposits in different regions (Goswami, 2014). They had their climax at the beginning of the Permian period and were dominant members of the "*Glossopteris* flora", disappearing from all continents during the Permo-Triassic extinction (McLoughlin, 2011).

The fossils from the *Glossopteris* flora were preserved in the coal-bearing strata distributed worldwide. At the beginning of the 19th century, the study of fossil plants was closely connected with the increase of the demand of mineral coal for the use in the industry and transportation. Therefore, the *Glossopteris* fossils were collected in the field in the explorations expeditions, and they were exchanged between mineralogists and naturalists for identification, description, and comparisons. These studies led to inferences about their puzzling distribution, which was separated by oceans, and this distribution was used to support the continental drift theory that came afterwards. These pieces of evidence represent clear testimony of the kind of exchange of data and objects between scientists connected with this theory.

This paper is part of a broader doctoral project aimed at analyzing the scientific network structure around the study and circulation of *Glossopteris* fossils and the discussion of the continental drift theory in the first half of the 20th century. It focuses on the work related to the discussion of the continental drift theory being produced in Argentina, in particular in the museums of Buenos Aires (est. 1823), La Plata (est. 1884) and Córdoba (est. 1869). In the transition between the 19th to 20th centuries, the exchange of local information between scholars, forming a global scenario, was part of their intent to convey the "unity of science" and synthesize theories of the earth (Lopes, 2011). Therefore, the productions presented here – papers, books, and letters – reveals the exchange of data and objects, as well as the connections between people and institutions that formed the network not only in Argentina, but globally.

The exchange of fossil specimens and information in the form of publications and correspondence between different countries was well expressed in the southern hemisphere (for some examples of Wegener's supporters in South America, see Cingolani, 2015), where this fossil was found, and where there was wider acceptance of the continental drift theory compared to the northern hemisphere at the time. In this research process, the archives of the Museum of La Plata and the Argentinian Museum of Natural Sciences of Buenos Aires were investigated in search of fossil entry books, correspondence, publications, and books indicating the origin of the *Glossopteris* fossils, the relationships between the scientists and their influence in the discussion. In addition, the Jagger Library, in the University of Cape Town in South Africa was also investigated for the analysis of the correspondence of the South African geologist Alexander Du Toit (1878-1948), who was a well-known proponent of the continental drift theory, and an active investigator of the correlations especially between

South America and Africa. In the process of elaborating his thesis, he maintained communication with scientists in South American countries, where he had also been traveling to study the geology at first hand, making observations in the field, and collecting specimens for later indoor analysis (Du Toit, 1927 and 1936).

Glossopteris and the Continental Drift Theory

Alfred Wegener first presented his idea of the displacement of continents in 1912 at a meeting of the German Geological Association at Frankfurt. In 1915 he further developed his ideas in his book "*Die Entstehung der Kontinente und Ozeane*". This book had then later editions in 1920, 1922, 1924, and 1929. Gaining much attention from the earth sciences experts, it was translated into English (1924), French (1924), Spanish (1924), Russian (1924), and Italian (1942). Although many before Wegener had already proposed that the continents had not always had the same configuration (for some examples see Cingolani, 2015), he presented a comprehensive thesis defending the displacement of the continents with evidence from different fields of science, such as biology, meteorology, geology, and physics. This theory generated a long-lasting debate between the specialists, which has already been historically analyzed by many (some examples are: Oreskes, 1999; Frankel, 2012; and Greene, 2015). In the "Preliminary note" of the Spanish version of Wegener's book (2009), Sánchez Ron defends that Wegener's theory challenged the hegemonic ideas of the scientific discourse of his time, which believed in the permanence and contingency of the earth's geography. Moreover, the potency of this theory was the fact that, in nature, "any hope of inevitability is nothing but a vain and unfounded illusion", and this is one of the main messages of science (Sánchez Ron, 2009: 7).

One piece of evidence used by Wegener to support his theory was the geographical distribution of the fossil gymnosperm of the genus *Glossopteris*, a name that can be found already in 1820, in the publication ("*Versuch einer geognostisch-botanischen Darstellung der Flora der Vorwelt*"), by the Czech naturalist aristocrat Kaspar Maria von Sternberg (1761-1838). In this book, the origin of the *Glossopteris* classification is attributed to the French physician and botanist, Adolphe Théodore Brongniart (1801-1876). In his turn, Brongniart presents *Glossopteris* in his books, "*Sur la Classification et la Distribution des Végétaux Fossiles*" (1822), and in his "*Prodrome d'une Histoire des Végétaux Fossiles*" (1828a), where the name "Glossopteris" represents one of the genera of fossil leaves [1] defined by him in the family of the *Fougères* (ferns). These were obtained from coal mines around the world. The *Fougères* family, in its turn, was placed in the class of the vascular Cryptogams (seedless plants) (Brongniart, 1828a: 38). The *Fougères* had been previously classified by Linnaeus and Jussieu, and contained mainly living plants, as well as some fossils (Brongniart, 1828b: 97).

In the time of Brongniart and Sternberg, fossils were labeled and catalogued following the hierarchical classification, descending from classes and orders down through families and genera to species and varieties (Rudwick, 2005: 62). *Glossopteris* was initially considered an artificial, or temporary classification, since it was based exclusively in the analysis of the fossil leaves [2]. Since then, it has changed to the level of a fossil genus in itself. This definition was based on the observation of fragments of compression-impression of sterile leaves, that have a lanceolate, or tongue-shaped form, and a reticulate veination (**Fig. 1A**). These classifications were important for resolving the questions about the similarities of fossil plants observed around the world already at that time. Therefore, the naturalists could conclude if the fossil plants found in Europe were of the same group, and what was the level of similarities with the ones found in South America (Mexico and Brazil are mentioned), India, and New Holland (a historical European name for mainland Australia), as well as other places (Sternberg, 1820: 2-3).

The fossil ferns found in the coal mines in Europe were more similar to the extant tree-like ferns of tropical lands, than to the extant plants of Europe, which had been interpreted by specialists as indicating that the climate in the past had been different, and much warmer (Rudwick, 2005: 263). Already in a publication in 1804, the German mineralogist, Ernst Friedrich von Schlotheim (1764-1832) makes an analogy between the fossil ferns found by him in Germany, and the "*Farnenkräuter*" (ferns) and "*Sumpfp-flanzen*" (swamp plants) from India and Americas (at that time still called: "*West - und Ostindien*") (Schlotheim, 1804: 25).

1. The genus of fossil leaves of the Fougères family, defined by Adolphe Brongniart, were: *Glossopteris, Sphenopteris, Neuropteris, Pecopteris, Odontopteris, Pachypteris, Cyclopteris* and *Anomopteris* (Brongniart, 1828b: 141-288).

2. In the case of living plants, the classification was (and still is) based mainly on the analysis of reproductive organs, however, these were rare in fossils, or were found isolated.

The first specimens classified as *Glossopteris* were described by Adolphe Brongniart (1828a & b), and can still be found in the paleobotanical collection of the Muséum National d'Histoire Naturelle, in Paris. Those were classified as:

Glossopteris browniana Var. : *Australasica foliis minoribus subspathulatis obtusis*; identified from a fossil specimen from Hawkesbury-River coal mines, north of Port Jackson, New South Wales, Australia; received from the Oxfod University Museum, from Mr. Buckland and Mr. Lesson.

G. browniana Var. : *Indica foliis majoribus lanceolatis acutiusculis*; identified from a fossil specimen from the Rana-Gunge coal mines, near Rajmahal, north of India. This species has been changed to *G. indica* (Collection Pentland).

G. angustifolia: identified from a fossil specimen from the Rana-Gunge coal mines, near Rajmahal, India, received from Mr. Voisey (Collection Voisey).

G. phillipsii: identified from a drawing of a fossil received from Mr. Phillips, and from a fossil specimen received from Mr. Murray; from the middle oolitic terrain, in sandstones and upper shales, from Gristhorpe-Cliff, near Scarborough, Yorkshire, United Kingdom.

G. nilsoniana: identified from a fossil specimen already studied before by Mr. Nilson, received from the Lund University Museum, from the Lias Formation (*grès du Lias*), in Höör, Sweden. This specimen is not considered *Glossopteris* anymore.

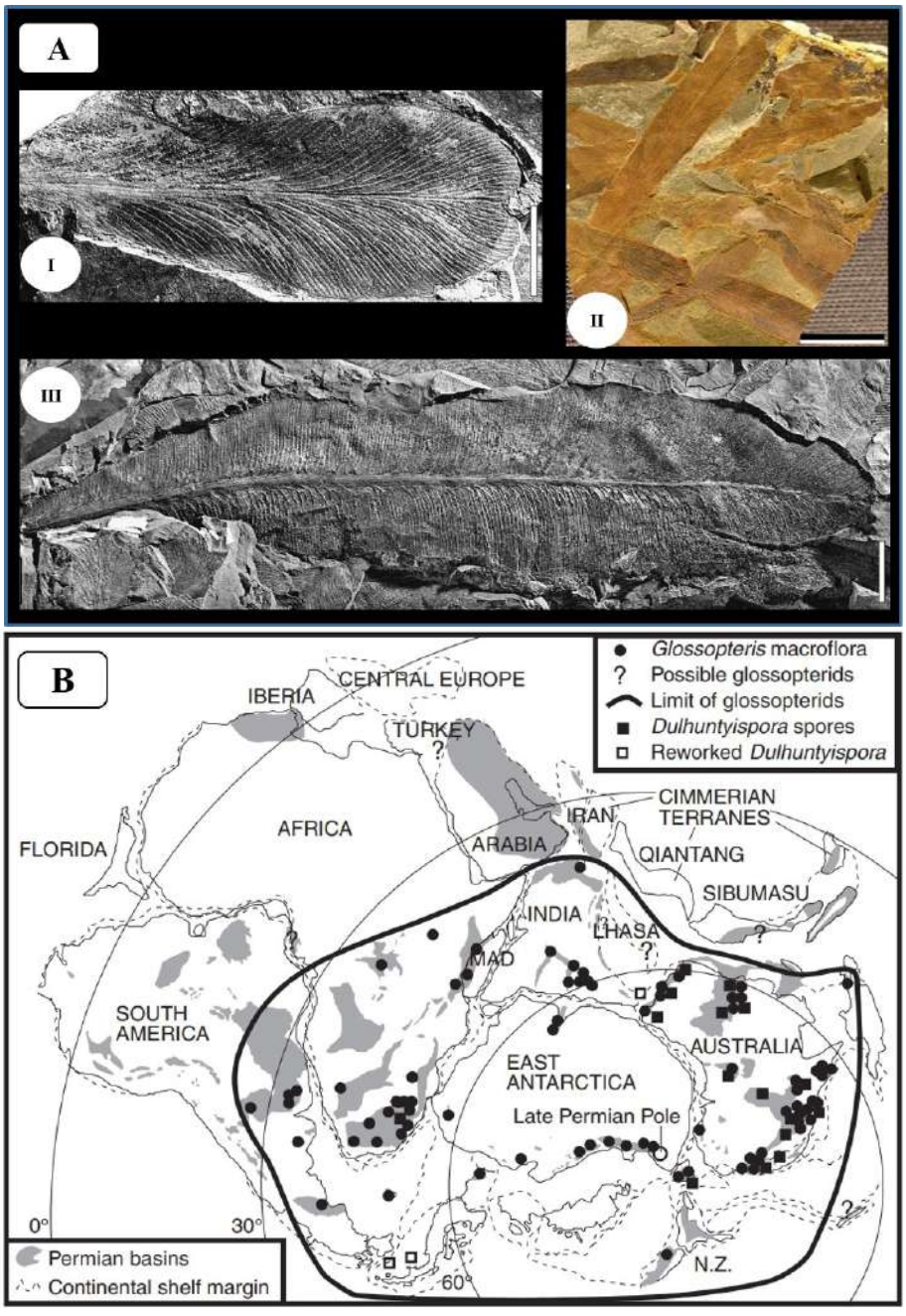


Fig 1. A. Some examples of Glossopteris leaves. I and III: Scale bar = 10 mm.; II: Scale bar = 1 cm. Modified from Prevec et al., 2009 (I and III), and Prevec et al., 2010 (II). B. Distribution of the Permian Glossopteris flora in Gondwana. Modified from McLoughlin, 2001.

In 1905 the British paleobotanist Edward A. Newell Arber (1870-1918) included the genus *Glossopteris* in the class Filicales, in the group of Pteridophyta (vascular Cryptogams). The places where Arber (1905) confirmed the existence of the genus were: India, Persia, Australia, Tasmania, South Africa, Rhodesia, German and Portuguese East Africa, Argentina, Russia and China. He also mentions the names of important collections containing Glossopteris, present in the British Museum in 1905 (p. lxxi-lxxiv) (**Table 1**).

By 1905, *Glossopteris* had been reported from economically explored Carboniferous-Permian coal reserves in all the southern hemisphere continents and India (**Fig. 1B**), which, already in the late 19th century, were proposed to have been united together in the supercontinent of "Gondwana" [3]. The name Gondwana was later

3. First proposed as "Gondwána-Land" by Suess (1885).

Collection	Collector	Other repositories	Provenance	Year of receipt at the British Museum	Reference
Hunter	Rev. R. Hunter	Geological Society of London	Nagpur, India	1897	Hislop & Hunter, 1855; Bunbury, 1861
Odinheimer	Odinheimer		New South Wales, Australia	1858	
Nicol	William Nicol			1867	Nicol, 1831, 1833, and 1835
Royle	Royle		India		Royle, 1833
Strzelecki and Morris	Count Strzelecki; J. Morris	Geological Society of London	New South Wales, Australia	1859 and 1883	Strzelecki, 1845; Morris, 1845
Nathaniel Plant	Nathaniel Plant		Brazil		Plant, 1869; Carruthers, 1869
David Draper	David Draper		Transvaal, Orange River Colony and Natal, South Africa	1890 and 1893	Draper, 1897; Seward, 1897
F. H. Hatch	F. H. Hatch		South Africa	1898	Hatch, 1898; Seward, 1898
A. J. C. Molyneux	A. J. C. Molyneux		Rhodesia (Zimbabwe)	1901	Molyneux, 1903; Arber, 1903
Sankey	Lieut. R. H. Sankey		Nagpur, India	1880	Sankey, 1854
Claussen	P. Claussen		Brazil	1841	
Stephens	T. Stephens		Tasmania	1898	
H. D. Hoskold	H. D. Hoskold		Argentina	1890	
Keene	W. Keene		New South Wales, Australia	1905	Keene, 1862, 1864
Livingstone			South or Central Africa	1884	
Sutherland			Cape Colony, South Africa	1880	Sutherland, 1855
C. W. Wilmot			India	1883	
Capt. Sir. E. Home			New South Wales, Australia	1853, 1859, 1860	
W. L. R. Gipps			New South Wales, Australia	1875	
Sir C. Purdon Clarke			New South Wales, Australia	1889	
W. H. Shrubsole			New South Wales, Australia	1892	
H. F. Collins			New South Wales, Australia	1903	
R. L. Jack			Queensland, Australia	1879	
G. Sweet			Tasmania, Australia	1900	
Prof. T. R. Jones			Cape Colony, South Africa	1884	
D. D. Eraser			Cape Colony, South Africa	1893	
Rev. G. Smith			Natal, South Africa	1876	
The Natal Government			Natal, South Africa	1897	
J. Mawson			Brazil	1894	

Table 1. Collections of fossils containing *Glossopteris*, kept in the British Museum, According to Arber (1905).

adopted by Wegener (1915-1929) in his different proposition for the former union of the southern continents. In his idea, the continents formed a single landmass that has since broken apart, and they continue to move in relation to each other. This was different from the initial idea of "Gondwána-Land", that was believed to be the former union of the static southern continents by land-bridges, which had since sunk. Two strong arguments about the former existence of Gondwana were the widespread occurrence of Carboniferous/Permian glaciations and the *Glossopteris*. Thus, we have a fossil plant genus (*Glossopteris*) described for the first time in the 1820s, which is then being used in different and sometimes competing scientific and technical contexts: as index of coal deposits, as evidence of former continental connections, as evidence of continental drift.

The discovery of these and other fossils in Africa, India and Australia was used as an argument by the Austrian Eduard Suess (1831-1914), when proposing his "Gondwána-Land" already in 1888 [4] (South America was added in 1909). Suess' Gondwana-Land became the former union of: South America, Africa, Syria, Arabia, Madagascar, India and Ceylon (now Sri Lanka) (Suess, English version, 1909: 500). The term "Gondwana" [5] was probably borrowed from the publications of the Geological Survey of India (GSI) [6], that resulted from their expeditions in search of coal (between 1850-90), in which the term "Gondwana Series" (later named "Gondwana System") was already used to designate the coal-bearing formations from the Late Paleozoic of the Satpura basin, in India. *Glossopteris* fossils were often found associated with coal and glacial deposits in these formations (Leviton & Aldrich, 2004).

The members of the GSI had already noted similarities between certain formations in India and South Africa. Two of them, Henry B. Medlicott (1829-1905), together with William T. Blanford (1834-1893), had already suggested in 1879 the former union of India, Australia and South Africa in the Permian and Triassic periods (Leviton & Aldrich, 2004). The term "*Glossopteris* flora" was presented by the Austrian geologist Melchior Neumayr (1845-1890) (Neumayr, 1887 *apud* Arber, 1905: xviii) to describe the flora of the Permian-Carboniferous of the Southern Hemisphere and India. This concept was a renaming of the previous "Gondwana flora", used to refer more generally to the fossil flora of the Gondwana strata in the coalfields of India, and from the similar strata that had already been found on other continents, such Australia, South America, and Africa (p.e. in Suess, 1909: 663). *Glossopteris* got more significance with time. In the same book ("*Erdgeschichte*"), Neumayr also published a paleogeographical map of the world, where he presented his idea of former land connections between South America, Africa, and India, based on the ideas of the British geologists of the GSI. Others, such as Ernst Haeckel (1838-1919) and Philip L. Sclater (1829-1913) also suggested former connections, the most famous being "Lemuria", between Africa, Madagascar and India (De Camp, 1970: 52-54). Their proposed land connection was based mainly on the correlations already made by the geologists of the GSI with fossils (especially *Glossopteris*), and on the distribution of extant mammals, such as lemurs, between Africa and India.

Therefore, *Glossopteris* fossils were an important evidence of the former union of the continents before the elaboration of the continental drift theory. However, back then, most of the plant fossil specialists studying them supported the theory proposed by Suess of the former land bridge connections (Oreskes, 1999: 11), or simply did not fully commit themselves to any point of view for explaining their distribution. Wegener, when commenting on this positioning, accused these scientists of being narrow-minded, and having insufficiently considered other areas of science, such as physics, in order to understand the inconsistency of the land bridges theory (Wegener, [1929] 2009: 200). He also expressed his intention to reconcile the contradictory theories existent at the time, and to reunite the divergent lines of thinking in Earth Sciences (Oreskes, 1999: 55).

Initial studies of *Glossopteris* in Argentina

The European studies about similarities of the fossil plants of the *Glossopteris* flora from coal deposits from different countries in the southern hemisphere and India included explorations made in Argentina. The studies about *Glossopteris* fossils in this country were also part of the base for the development of Wegener's theory. One of the important fossil-bearing coal deposits found there was in the locality of Retamito, in the province of San Juan (Correa & Césari, 2019). The plant fossils

4. This was published in Suess' books, "*Das Antlitz der Erde*" (Vol. I: 1883 and 1885; Vol. II: 1888; Vol. III: 1901; Vol. IV: 1909). In the second part of his Vol. I (from 1885), Suess had already presented "Gondwána-Land" as being a connection of Africa with Madagascar and India by land-bridges. Australia was included in 1888. These books were at that time mandatory references for those studying mountains, continents, and oceans (Lopes, 2011).

5. This term is the Sanskrit for forested land of the "*Gonds*", who were a Dravidian people, native to India's central region (Medlicott & Blanford, 1893: 149).

6. This is the new name of the former Geological Survey of the Coal Formation of India, created in 1840 by the British East India Company, mainly for the exploration of minerals, such as coal, in the colonies of the then called "East Indies" colonies, of which India and South Africa were parts.

found there were collected and sent for their identification to the *Academia Nacional de Ciencias de Córdoba* (National Academy of Sciences of Cordoba, est. 1869) [7], which housed the German botanist Friedrich Kurtz (1854-1921) and the German geologist Wilhelm Bodenbender (1857-1941).

Kurtz had received his doctoral degree in Natural Sciences in 1879 in Berlin, with specialty in botany. In Argentina he entered the National Academy of Sciences of Cordoba. According to Harms (1920), he came to Argentina after two frustrated working positions in Germany, due to disagreements with his superiors – first when working in the Berlin Botanical Garden, then in the Mineralogical Museum of Berlin University –. Thus Kurtz left Europe, and was proposed a job in 1884 as a professor of botany in Córdoba, Argentina. Over the years he undertook exploration travels and created a large herbarium of local plants classified by himself. His interest in fossil plants led him to the discovery of the Permian Gondwana strata in the locality of Bajo de Véliz, which was considered evidence of the presence in South America of the strata formerly described by the GSI in India. Located in the Argentinian province of San Luis, Bajo de Véliz is one of the main fossil deposits in Argentina, assigned today to the Late Carboniferous (286 million years). This region acquired notoriety due to the significant occurrence of mega- and microfloral fossils from Gondwana (Mange, 2015). About this subject, Kurtz maintained communications with other well-known specialists, such the British botanist Edward A. Newell Arber (1870-1918), with whom he also exchanged fossil specimens, drawings and texts (Harms, 1920). Therefore, he could compare and make inferences about the distribution of these fossils. In Kurtz' words:

> *"Fossil floras of a composition similar to that of the Bajo de Véliz are known from the Cape of Good Hope (Ecka-Kimberley-beds), from cisgangetic India (Karharbári-beds), from New Holland (Newcastle-beds, Bacchus -Marsh-sandstone) and Tasmania (Mersey-coalfield). Of all these floras, the most closely affiliated with the ancient vegetation of Bajo de Véliz is that of the Indian layers called "Karharbári-beds" of the lower Gondwana "* (Kurtz, 1895: 133, my translation). [8]

Kurtz alleged his work would contain "all the series of fossil plants from Argentina since the Permo-Carboniferous until the Early Jurassic" ([Kurtz]Hosseus, 1921: 133). The specimens investigated by him came from the Argentinian provinces of San Luis, La Rioja, Mendoza, and San Juan and were collected by many different naturalists. Many scientists from other countries, such as India, Australia, Tasmania, and Germany, helped him in different ways, showing how Kurtz's work is a good example of the collective and mobile character of this kind of research, in which many people, institutions and regions are involved.

In his "*Contribuciones á la Palaeophytología Argentina*" (Contributions to Argentinian Paleophytology, 1895), he refers to the existence of Gondwana strata in Argentina, and mentions the finding of *Gangamopteris* in Bajo de Véliz by Francisco Moreno (1852-1919). This fossil plant is very similar to *Glossopteris*, and today there is still a controversy about whether these two genera should be considered different (Adendorff, 2005: 4). However, they still are, and both are part of the *Glossopteris* flora. The actual *Glossopteris* genus in Argentina was considered to have been first identified by Kurtz, and published by Bodenbender in 1895 (Arber, 1905: lxx-lxxi). White (1908: 347) also claims that this was the first *Glossopteris* specimen identified in South America and also in his report, cites the work of Kurtz in Argentina to emphasize the correlations with his studied regions in Brazil, mostly about Rio Grande do Sul and Santa Catarina states. In this regard, D. White (1908: 349) affirmed:

> *"The stratigraphical relations of the plant-bearing terrains, so far as ascertained in Argentina, are discussed much more fully in an article entitled 'Devono y Gondwana en la República Argentina' published in 1897 by Bodenbender ( ) In this, as in Bodenbender's former papers, the plants were named on the authority of professor Kurtz*".

The similarities between strata from Argentina and from the other countries of the former Gondwana were further complemented by the work of another German scientist, Juan (Hans) Keidel (1877-1954). He arrived in Argentina in 1906, and worked until 1922 at the Argentinian Geological Survey (*Servicio Geológico Argentino*), in the General Direction of Mines, Geology and Hydrology, in the Ministry of Agriculture (Ramos, 2013). There, he had an active role in one of the first petroleum explorations in Argentina (Riccardi, 2015), He was professor of Geology at the Universities of Buenos Aires and La Plata until 1942. During this time, he published a seminal work on the *Sierra de la Venta-*

7. This was created as a scientific and educational institution supported by the government, to form professors of natural and exact sciences (Babini, 1949).

8. Floras fósiles de una composición semejante á la del Bajo de Velis se conocen del Cabo de Buena Esperanza (Ecka-Kimberley-beds), de la India cisgangetica (Karharbári-beds), de la Nueva Holanda (Nowcastle -beds, Bacchus-Marsh-sandstone) y de Tasmania (Merscy-coalfield). De todas estas floras, al mas afiliada á la antigua vegetación del Bajo de Velis es la de las capas índicas llamadas « Karharbári-beds » del Gondwána inferior".

na in Buenos Aires, comparing its composition and structure with the Cape Mountains in South Africa, and finding many similarities between these regions (Keidel, 1916 *apud* Ramos, 2013). This work was mentioned in Wegener's book as one important basic reference for the development of his theory. He was well inserted in the international circle of geologists that were discussing the genesis of continents and oceans, as is revealed by his correspondence with Suess (in 1906) about Gondwana (Ramos, 2013), and by his relationship with the influential South African geologist Alexander L. Du Toit (1878-1948), who was the leading expert on the Karroo System in South Africa, and a strong supporter of the continental drift theory. The two scientists exchanged data, especially about the "Gondwanides", a term coined by Keidel to designate the "mountain system uplifted by the late Paleozoic deformation in several parts of central and southern Argentina" (Ramos, 2007). He also described the distribution of Permian glacial deposits in Argentina (Farro, 2015).

Keidel and Du Toit were important proponents of the former union of South America and Africa. In their respective famous publications (Keidel, 1916; Du Toit, 1927; 1937) they discussed the many similarities between the two continents, and in so doing, used the data on the distribution of fossil plants, such as *Glossopteris*. This can be seen for example in a passage from the doctoral thesis of one of Keidel's pupils, the Argentinian geologist Horacio Harrington (1910-1973), in which he cites Keidel's conclusions on the correlation of Argentina with South Brazil and South Africa when considering their fossil floras:

> "*On the other hand Keidel has admitted that there is in Argentina undoubted associations of the* Glossopteris *flora with some Lycopodiales; but he has expressly noted that it is a 'mixture' perfectly comparable to that which exists in the South of Brazil and in South Africa*" [9] (Harrington, 1933, translated by myself).

In his career, Harrington worked in partnership with his mentor Keidel. He was a Professor at the University of Buenos Aires, first president and founder of the Argentinian Geological Association in 1945, first director of the Institute of Geology and of the Department of Geological Sciences of the University of Buenos Aires in 1947 and 1951. Moreover, he was director of the Overseas Division of the Tenneco Co., in Houston, Texas, in 1957 (Riccardi, 2008). With his focus being Structural Geology, he had a solid knowledge of Paleontology and Stratigraphy. One of his most important works was his doctoral thesis, in which he presented a study of the Sierras Australes [10] in Argentina (Harrington, 1933). In his paleontological research identified the elements of the *Glossopteris* flora in this region and compared with the strata from southern Brazil, Uruguay, India, South Africa, Australia, and Antarctica. In his thesis, Harrington cites Arber (1905) and White (1908) as a basis for the classifications of the *Glossopteris* specimens found, as well as Du Toit, when concerning the correlations with the Cape Mountains in South Africa.

According to Ramos (2007), neither Harrington nor Keidel were entirely convinced of the continental drift theory before 1926, but following the symposium on continental drift sponsored by the American Association of Petroleum Geologists (AAPG) that year, both became active supporters of Wegener's theory. Both of them were in close contact with the ideas and publications of Du Toit about the comparison of strata from South Africa and South America (1927), and Harrington and Du Toit exchanged correspondence about their work to compare the stratigraphy of Argentina and South Africa.

Du Toit was considered a very important field geologists, due to his numerous travels around the world (Oreskes, 1999), and he was also the leading expert on the Karroo formation in South Africa, which was a very important geological piece of evidence in the study of Gondwana. The Karroo was correlated – ever since Suess, and later Wegener – with equivalent sequences in India, Australia and South America. Du Toit was responsible for putting Africa in a central position in the Gondwanan paleocontinent (Frankel, 2012). In his several field expeditions he collected many fossils, and among them was *Glossopteris*. In the early 20th century, coal explorations and studies were just beginning in South Africa, and ever since it has remained the main source of energy in that country. Therefore, the study of *Glossopteris* was significant among geologists and paleobotanists in the country. In 1923 Du Toit received a grant from the Carnegie Institution of Washington to travel to South America. During this trip, he spent five months doing field expeditions to Argentina, Brazil and Uruguay. There he collected and identified many *Glossopteris* fossils. The results of these identifica-

9. "*Por otra parte Keidel ha admitido que existen en la Argentina indudables asociaciones de la flora de* Glossopteris *con algunas Lycopodiales; pero ha hecho notar expresamente que se trata de una 'mezcla' perfectamente comparable a la que existe en el Sud de Brasil y en Sud de Africa*".

10. Also called "Sierras de la Ventana". It is a group of mountains located in the the southeastern section of Buenos Aires province. Its geological structure was defined by Keidel (1916) and Harrington (1933).

tions were published in his work "*A Geological Comparison of South America with South Africa" (1927). His aim was to gather information about the Gondwana deposits of South America "to discover any evidence favorable or adverse to the 'displacement hypothesis*" (Du Toit, 1927: 2).

In his journey to prove Wegener's theory right, Du Toit maintained communication with some Argentinian scientists other than Harrington and Keidel, as can be seen in the introduction of his book from 1927:

> "*Among the numerous other persons to whom I have been particularly indebted are* (...) *Drs. Pablo Groeber, Roberto Beder, Juan Rassmuss, Anselmo Windhausen, Ricardo Wichmann, and Hausen, of the Geological Survey of Argentina, Dr. Juan Keidel, formerly director of that survey, Dr. H. Schiller, of the Museum of La Plata, Dr. C. Hosseus, of the University of Córdoba*" (Du Toit, 1927: 5).

Du Toit's archive in the Jagger Library of the University of Cape Town, South Africa, keeps six letters dated from November 1937 to November 1939 between Du Toit and Harrington, which reveal the exchange of ideas and arguments based on their own field discoveries, classifications and dating of stratigraphical sequences. This was the base for the correlations between the two continents, as has already been pointed out by Cingolani (2008). In the first letter (of November 30th 1937), Harrington cites his findings of *Glossopteris* fossils from the Bonete beds, in what is now known as the *Sierras Australes*, in Buenos Aires province (Pagani, 2000). The next three letters (May 13th 1938; March 14th 1939; and July 19th 1939) are copies of letters from Du Toit to Harrington. These show that Du Toit seemed to have a better communication with Harrington than with Keidel. He asked his questions to Keidel through Harrington. For example, in one of the letters (in March 14th of 1939), Du Toit expresses annoyance with Keidel related to the subject of his published paper, in which he revises another previous publication by Du Toit about his travel to Argentina:

> "*I have not had time to go through Keidel's long paper with care but am a bit puzzled to know whether he is no longer pressing a close relation between South Africa and Argentina or not. It looks as though he admits a general relationship, but not a detailed one stratigraphically or closer one geographically. If such is correct, then I must differ* ( ) *I still see no alternative to the view that South Africa and South Amercia were formerly closer together.*" Adding, "*Keidel has mentioned the finding of marine fossils in the Sierras of Tandil. Have you seen them and can you give any opinion on their age? That region I have always regarded as a key one in our paleogeographical reconstructions*".

In a subsequent letter (July 19th of 1939) he asked for some data about Keidel's dating of Olavarría [11] strata:

> "*I am specially interested because I was thinking of setting down some of the evidence having a bearing on the supposed correlation of the Gondwanides of the Cape & the Sierras of B. Aires. Keidel has curiously seemed to have abandoned his original views & now argues that the foldings on the opposite sides of the Atlantic differ somewhat in age. All the evidence he has now submitted agrees in toto with that out here, & I think that it may be worth while reviewing the problem in the light of the new information, largely as the result of Keidel's work, published in the Rundschau & elsewhere*".

In this passage, Du Toit questions Keidel's change of opinion concerning the correlation between the Gondwanides and the Buenos Aires Mountains. These mountain belts were the main subject of their correlations between South America and South Africa. In his reply (September 17th 1939), Harrington writes: "*As a result of my investigations I am afraid that my ideas have undergone rather important changes and I do not any longer agree with many of Keidel's views, past and present*".

He also summarized his own observations on the geology of the Olavarria region, characterized the sedimentation processes, the fossils found and their probable ages, morphological structures of the different rocks, and his ideas on the correlation of these sequences, as well as their ages and the probable phenomena that occurred to form them. When doing so, he used terms connected to the continental displacement phenomena:

> "*Strong tectonic movements have taken place along the major bedding planes which separate the different lithological horizons of the La Tinta beds.* (...) *They (the movements) are not overthrusts, as Schiller*

11. A region of the Buenos Aires province in Argentina belonging to the mountains of the Tandilia System.

believed, nor clean-cut-thrusts developed from nearly horizontal reverse faults. On the contrary they belong to the 'décollement' type of movements, sesu lato. The different lithological groups have glided differentially one over the other (...)"

And he also sent drawings (**Fig. 2**) to illustrate his ideas on the cause of the observed disposition of the strata investigated. In the last letter from Du Toit, he underlined the importance of fossil findings for the dating of sequences, and for their subsequent correlations:

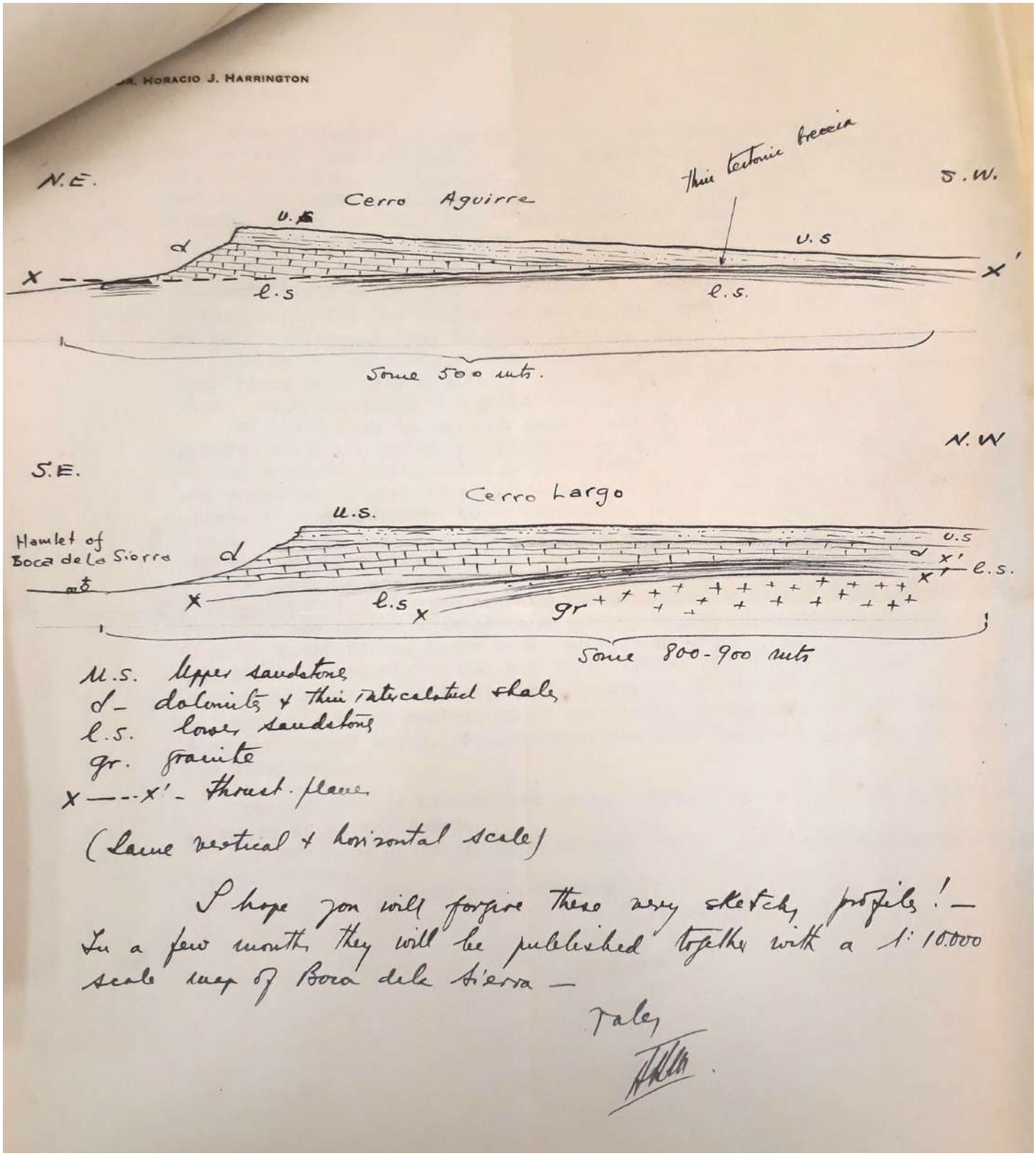
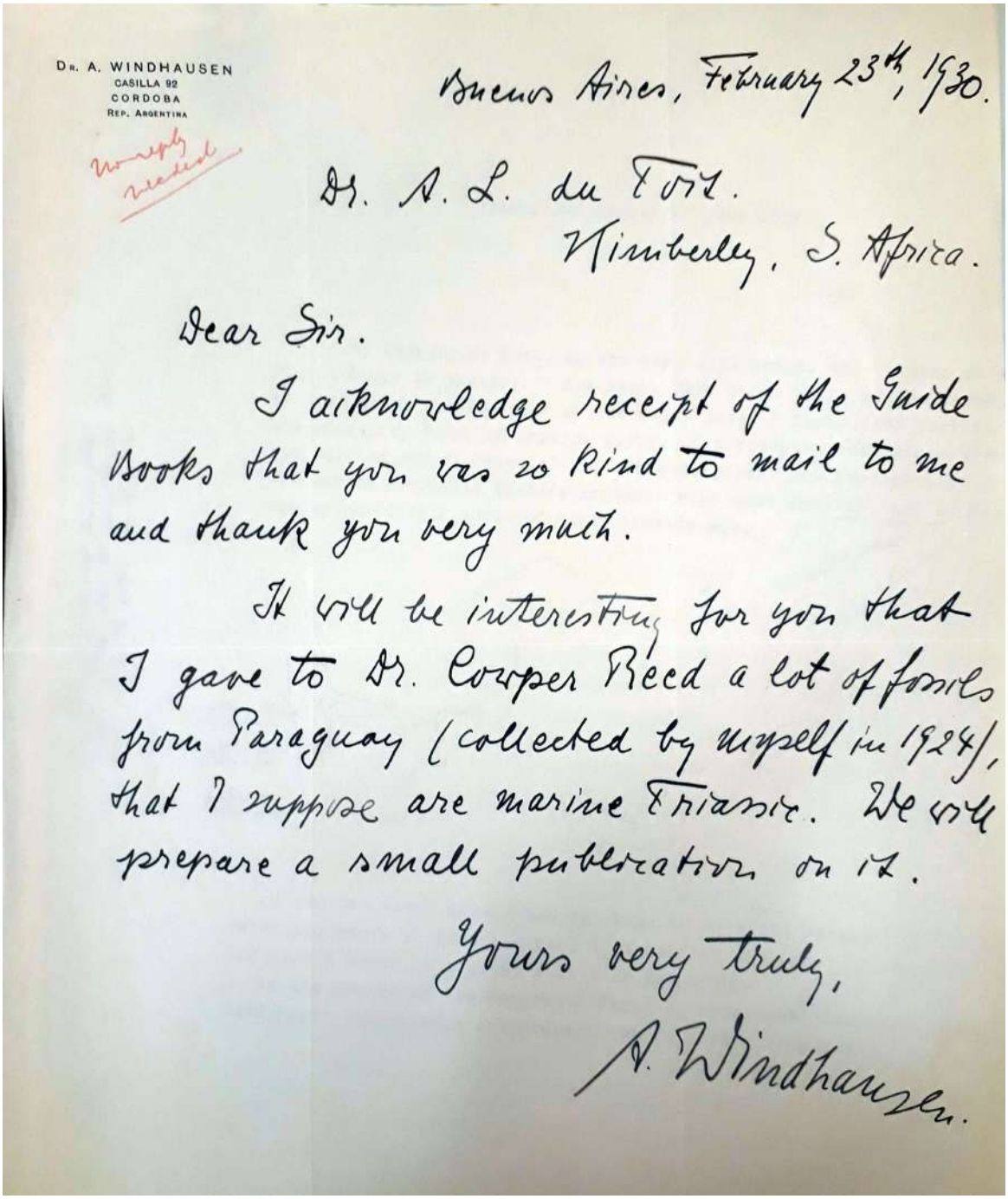


Fig. 2. Sketch drawing made by Harrington, sent with a letter to Du Toit on September 17th, 1939, to illustrate the sedimentary structure of Cerro Aguirre and Cerro Largo, and tectonic movements that happened. Photo taken in March, 2019 in the Jagger Library at the University of Cape Town, South Africa.

"Most interesting was your survey detailed account of the stratigraphy of the Sierras Bayas & the Spiriferina *discovered there. Your argument seems quite sound that those beds must be of pre-tillite age, which in turn suggest that the glacials must be at earliest of Lower Permian age. Whether such limestones & shales may prove the equivalent of our Witteberg is remains uncertain, though not impossible: once more fossils from both countries could settle this point."*

In their correspondence, they mentioned some other Argentina-based scientist, such as Cowper Reed, Pablo Groeber, Augusto Tapia, Walther Schiller and the Scottish geologist working in Uruguay, John D. Falconer, with whom Du Toit also kept correspondence concerning the correlations of Uruguayan terrains with Gondwana. Tapia personally accompanied Du Toit in his travel to Argentina in 1923 (Ramos, 2007).

In a letter from the German-Argentinian Anselmo Windhausen (1882-1932) to Du Toit (**Fig. 3**), one can see mention of an exchange of information ("guide book"), as well as fossils from Paraguay between the two scientists and the British geologist Cowper Reed (1869-1946). In this way they exchanged their specific and local scientific expertise.



Dr. A. WINDHAUSEN
CASILLA 92
CORDOBA
Rep. Argentina

Buenos Aires, February 23th, 1930.

Dr. A. L. du Toit.
Kimberley, S. Africa.

Dear Sir.

I aiknowledge receipt of the Guide books that you was so kind to mail to me and thank you very much.

It will be interesting for you that I gave to Dr. Cowper Reed a lot of fossils from Paraguay (collected by myself in 1924), that I suppose are marine Triassic. We will prepare a small publication on it.

Yours very truly,
A. Windhausen.

Fig. 3. Letter from Windhausen to Du Toit, on February, 1930. Photo taken in March, 2019 in the Du Toit's archive in the Jagger Library at the University of Cape Town, South Africa.

Conclusion

The interesting case of the debate involving Wegener's continental drift theory showed that its rejection was associated with a threat that this theory represented to previously deeply held methodological beliefs and scientific practices at the time (Oreskes, 1999). This controversy went on for decades since the first publication of Wegener's book (1915) until the rise of paleomagnetism in 1950 and plate tectonics around 1960, which helped to present an explanatory mechanism for the movements of the continents (Frankel, 2012; Cingolani, 2015). With the focus on the work done, more particularly in Argentina and more broadly in the "Global South" (see Gray & Gill, 2016) at the end of the 19th and beginning of the 20th century, related to the discussion of the continental drift theory – which was initiated in Europe –, this study was directed to one of the main pieces of evidence, the *Glossopteris* fossils, taking as a compass the study and exchange of these fossils, since this was one of the main pieces of evidence used by specialists to validate the theory of continental drift. The idea is to reflect on the social aspect of science-making, to reveal the relationship between the supposed objective scientific undertaking, with the social context in which it is inserted. This was done through the analysis of the study of *Glossopteris* fossils and the social connections it encompassed.

The study of fossils of previously living organisms involves extra information on the sedimentary horizons in which they are found, this represents important information for the comparison of terranes from different continents. Therefore, the study of *Glossopteris* was a part of the methodology of experimentation used to prove the ancient connection of the now separated continents. The cases of exchange of *Glossopteris* fossils and all the information about this subject, as of other kinds of scientific exchanges in Argentina, were on many occasions determined by the very relationships that were developed between European researchers living in Latin America, and by the characteristics of the natural environments investigated (Lopes, 2000). Sciences such as Geology and Paleontology, are intrinsically global, and the different and distant regional data need to be connected to form an integrated picture. The scientific production is based on field work, and the communication between different scientists worldwide. Paleontology has united people, and strengthened the bonds between museums of natural history and universities in different countries in Latin America and in the world, as shown before (Lopes, 2000; Lopes & Podgorny, 2001; Podgorny, 2008; 2009).

The dynamics of science is based especially on the circulation of objects and of know-how, and knowledge is described universally precisely because it circulates (Nyhart, 2016). Therefore, the analysis of the circulation of objects and of the context they are inserted in is pertinent. It was precisely because of this international exchange of fossils and data, that Wegener and the others discussing continental drift could claim *Glossopteris* as important evidence for the theory. The exchange of data can be measured by the citations that appear in a publication, and their exchanged correspondence. This also reflects who was reading who, and often, a level of personal relationship and esteem.

As stated by Frankel (2012: 264): "*Drift is better observed and studied in the Southern Hemisphere. There are several very clear fragments of Gondwanaland and they each preserve better evidence of their Palaeozoic relations than anything in Laurasia*". The most important characteristics used as evidence were paleontological data and the presence of Paleozoic tillites, which represented the Permo-Carboniferous glaciation in Gondwana. Among specialists in Argentina, Keidel and Harrington were actively engaged in the discussion of the continental drift theory and were trying to prove it right with their own collected evidence, generating a scientific network in Argentina and the world. Kurtz's work with the fossil plants of the coal deposits in Argentina was mentioned by scientists worldwide, and it served as basis for further research and seminal publications in the field, especially when the subject was related to the comparisons of the Gondwanan territories. The communications, specially between Harrington and Du Toit, were very important for drawing conclusions in the transformation and development of the initial Wegener's theory, focusing on the correlation of South America and South Africa.

The role of these Argentinian scientists in the broader discussion of the continental drift theory can be appreciated when analyzing the circulations of their ideas in the scientific circles involved in this matter. This is observed in the network formed by scientists connected

worldwide by citations in their publications, as well as in their communications between each other through letters, in which they exchanged their ideas and the outcomes of their researches, each one contributing with his own insight of the aspects of the globe, tracing together the outlines of an image of the world and how it functions. Even though the research here initiated shows that it was still only a small group of people involved in the debate on the continental drift theory, it also helps to put in evidence the role of Global South countries, more specifically of Argentina. This work will continue with the investigations of this network connected by the exchange of *Glossopteris* specimens and information focusing especially on the countries of the Global South in the first half of the 20th century.

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Natural history collecting by the Navy in French Indochina

Les collectes d'histoire naturelle par la marine en Indochine française

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Lapérouse
Astrolabe
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French Indochina

Summary: The micropalaeontology collections stored in the Muséum national d'Histoire naturelle, Paris, France (MNHN) house collections that paved the way to micropalaeontology. They also contain sea-bottom sediments from marine expeditions that are still poorly documented. Of them, the Lapérouse collection was recently re-discovered. The history of this collection is traced back to the interwar period when three ships of the French Hydrographic Service, *Lapérouse* and its annexes *Astrolabe* and *Octant*, were sailing back and forth along the Indochina coasts to produce navigation maps. Natural history specimens were also collected, from fishes to sponges, most of which are stored in the MNHN. The fate of the ships is described, from their involvement in World War I, their arrival in Indochina to their disappearance during World War II. The contribution of the French Hydrographic Service in Indochina to the natural history collections is described, with a special focus on the MNHN.

MOTS-CLÉS

Muséum national d'Histoire naturelle
Lapérouse
Astrolabe
Octant
Service hydrographique
Indochine française

Résumé : Les collections de micropaléontologie conservées au Muséum national d'Histoire naturelle, Paris, France (MNHN) abritent des collections qui ont ouvert la voie à la micropaléontologie. Elles contiennent également des sédiments de fonds marin provenant d'expéditions maritimes encore mal documentées. Parmi elles, la collection Lapérouse a été récemment redécouverte. L'histoire de cette collection remonte à l'entre-deux-guerres lorsque trois navires du Service hydrographique français, *Lapérouse* et ses annexes *Astrolabe* et *Octant*, naviguaient dans les deux sens le long des côtes indochinoises pour produire des cartes de navigation. Des spécimens d'histoire naturelle ont également été collectés, des poissons aux éponges, dont la plupart sont conservés au MNHN. Le sort des navires est décrit, depuis leur implication dans la Première Guerre mondiale, leur arrivée en Indochine jusqu'à leur disparition pendant la Seconde Guerre mondiale. La contribution du Service hydrographique français en Indochine aux collections d'histoire naturelle est décrite, avec un focus particulier sur le MNHN.

Introduction

The Muséum national d'Histoire naturelle (MNHN) of Paris, France, houses collections of major importance for the history of palaeontology and particularly of micropalaeontology. The contributors to these collections are diverse, from MNHN researchers to institutions such as the Institut Français du Pétrole [French Petroleum Institute] and École des Mines [School of Mines], scientists and explorers such as Théodore Monod, Jean-Baptiste Charcot, Jacques-Yves Cousteau or oceanographic expeditions of major input such as those of the *Travailleur* and *Talisman* ships. They include major historical collections such as, to

mention just a few: the foraminifera of Alcide d'Orbigny, bought by the MNHN in 1858, which led the groundwork for micropalaeontology and biostratigraphy or Charles Schlumberger's collection that contains preparations and sections of foraminifera from around the world, with both scientific and pedagogic significance (Vénec-Peyré & Bartolini, 2010). Others paved the way to modern micropalaeontology such as George Deflandre's collection, who pioneered in the fields of algology, protistology and palaeoprotistology (Deflandre, 1933; 1937; 1938; 1951), or Nicolas Grekoff's material, which is a key contribution to modern ostracodology (Grekoff, 1951; 1962; Grekoff & Deroo, 1956; Grekoff & Krommelbein, 1967). Besides these central collections, others are mysterious as to their origin and their importance can only be understood once this issue is elucidated. Of them, the Lapérouse collection is composed of glass tubes filled with sediments and Bristol boards. The present contribution is the result of an extensive literature and archive investigation: it describes the history of this material collected in 1926 in the Gulf of Tonkin and along the coast of Annam in what was then French Indochina by the vessel *Lapérouse* and its two annexes *Astrolabe* and *Octant*, from the French Hydrographic Service. Their mission was to map and dredge sediments along the Indochina coast to allow the construction of new navigable areas and harbours for intensified commercial exchanges. Pierre Chevey, at the time assistant in the MNHN, was attaché naturalist to the Indochina Hydrographic Mission in 1925 and 1926; he collected various organisms during this journey (Chevey, 1927a; 1927b) which were later described by himself and other experts.

On 25 April 1921, in his speech 'Studies on Ocean' given at the Academy of Science of Washington when receiving the Agassiz Medal that commemorates the work of oceanographers, H.S.H. Albert 1st, Prince of Monaco, expressed the importance of the sea in the history of life by stating:

> "*out of the ensemble of the facts concerning the history of sea-organisms I see more convincing grounds arise for regarding the sea as the cradle of life*" (Albert 1st, 1921a).

The French version of this speech further extends this thought to the importance of exploring and understanding the present and the past of the sea, as well as their relationship:

> « *Et j'ai pénétré aussi loin que j'ai pu dans l'Océanographie où je sentais dormir la solution des grands problèmes de la biologie ; où je voyais se dessiner le domaine le plus puissant des phénomènes physiques et chimiques d'où sont sorties la naissance, la propagation et l'évolution des êtres*. » (Albert 1st, 1921b) [And I went as far as I could into Oceanography where I felt the solution to major issues in biology was sleeping; where I saw the strongest domain of physical and chemical phenomena from which emerged the birth, propagation and evolution of beings.]

His idea that the sea and the birth, propagation and evolution of life are so tightly related that the sea should be considered as the cradle of life, echoes the World Heritage Site Cradle of Humankind in South Africa protected by UNESCO since 1999. This parallel is further accentuated by his strong position for the protection of oceans, mirroring the ongoing loss of diversity related to human-driven climate change (Barnosky *et al.*, 2011; Mouillot *et al.*, 2015). The present article aims at developing the ideas advocated by H.S.H. Albert 1st, Prince of Monaco, among others. Following the recent demonstration on material collected during the HMS *Challenger* voyage around the globe from 1872 to 1876 (Rillo *et al.*, 2019), the sea-bottom sediments stored in the MNHN might provide snapshots to describe the changes related to anthropic influence through time and space. The MNHN preserves material collected by the *Travailleur* and *Talisman* cruises from 1880 to 1882, the *Pourquoi-Pas?* in Rockall and Jan Mayen in 1921, the *Calypso* voyage in the Red Sea in 1952, to cite only a few of them. May these collections and related histories contribute to raise awareness of the beauty and importance of marine environments, in line with so many scientists and explorers.

Description of the Lapérouse collection

The Lapérouse collection was recently rediscovered within the micropalaeontology storage in the MNHN. This material is not mentioned in the entry register and lacks associated archives: it is thus not possible to determine who deposited this material and when. The micropalaeontology collections went through a curatorial vacancy after the death of Charles Schlumberger in 1904: during this pe-

riod, their fate is obscure and they might have been transferred to the invertebrate collections (Vénec-Peyré & Bartolini, 2010). For these reasons, it is difficult to know who dealt with the accession of the Lapérouse collection. The only information at hand is that directly written on the material. The Lapérouse collection consists of:

• Twenty-four glass tubes containing sediments (**Fig. 1**; collection numbers MNHN.F.F62914 to MNHN.F.F62937). All tubes contain a paper label: Lapérouse I, Lapérouse II and 22 bear Astrolabe associated with a number.

• Thirty-four handwritten Bristol boards of 8.5-9 cm long and 5.2-6 cm high (**Fig. 2**; collection numbers MNHN.F.F62938 to MNHN.F.F62971) numbered from 1 to 36 (boards 6 and 35 are lacking). They display longitude referred to Paris, latitude, date ranging from 1 February 1926 (boards 1-4) to 4 February 1926 (boards 32 -36) and *Astrolabe*. Three boards display only geographic information: 'Mouillage Nord de Hon-Me' (board 5), '4 milles dans le S36E de Hon-Me' (board 7), '9.5 milles dans le S36E de Hon-Me' (board 8). Most boards display traces of mud, others are partly burnt.

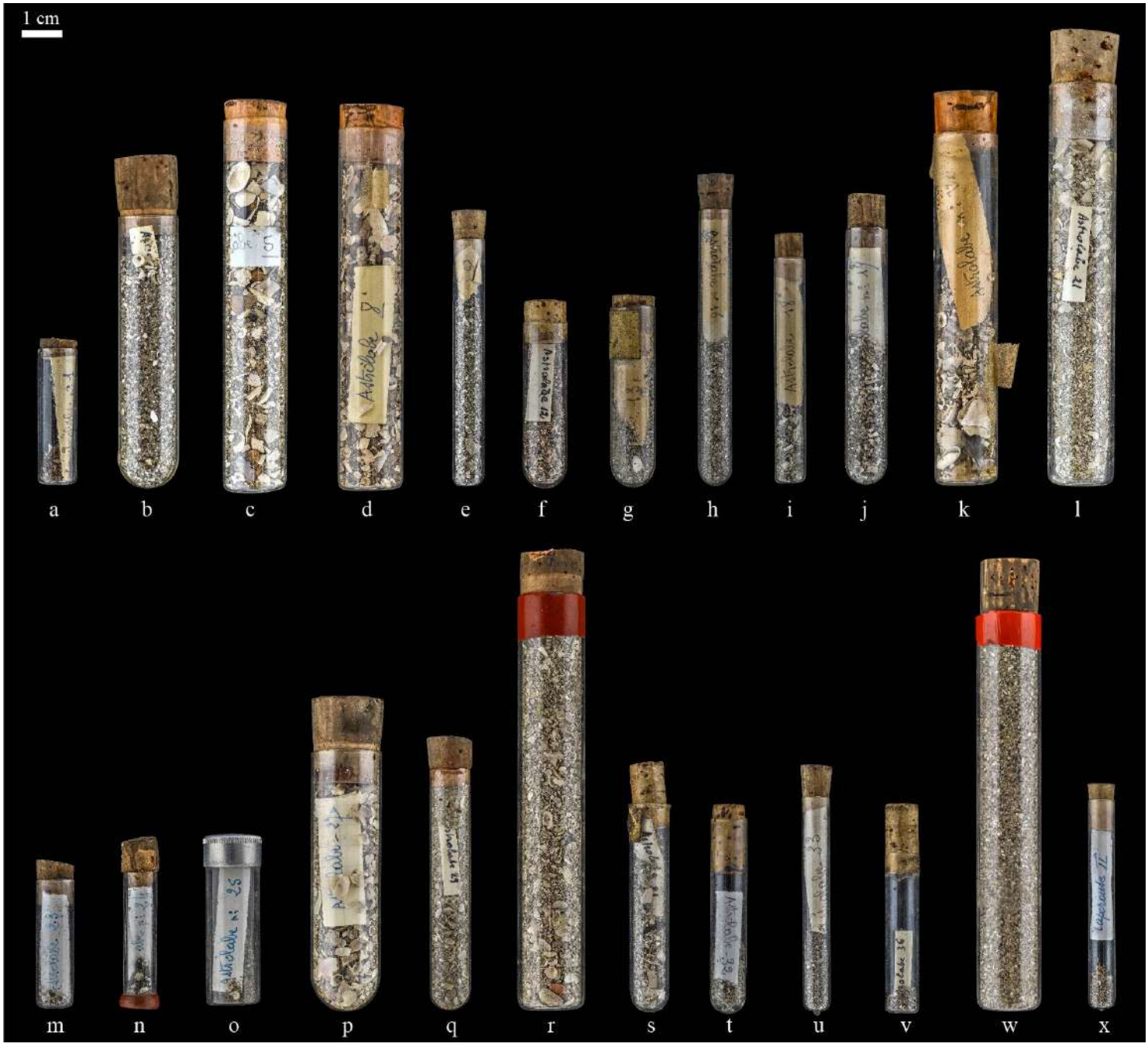


Fig. 1. Sediment tubes of the Lapérouse collection.
(a) to **(l)**: samples Astrolabe 1, 3, 5, 8, 9, 12, 13, 16, 18, 19, 20, 21. (collection numbers from MNHN.F.F62914 to MNHN.F.F62925);
(m) to **(x)**: samples Astrolabe 23, 24, 25, 27, 29, 29, 31, 32, 33, 36, Lapérouse I, Lapérouse II (collection numbers from MNHN.F.F62926 to MNHN.F.F62937).

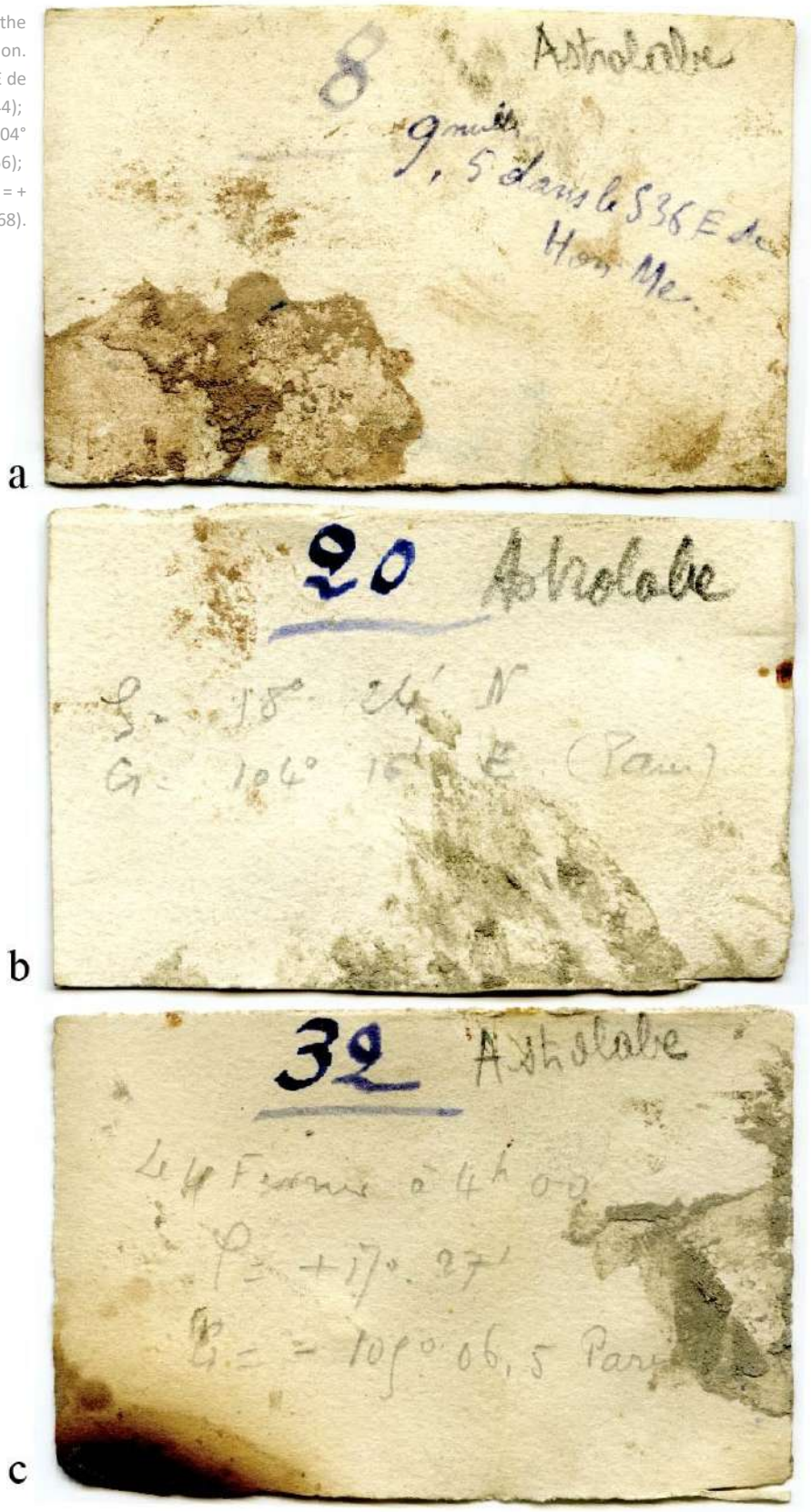


Fig. 2. Bristol boards of the Lapérouse collection.
(a) board 8 Astrolabe, '9.5 milles dans le S36E de Hon-Me' (MNHN.F.F62944);
(b) board 20 Astrolabe, 'ϕ = 18° 24' N ς = 104° 16 E (Paris)' (MNHN.F.F62956);
(c) board 32 Astrolabe, 'Le 4 Février à 4h00 ϕ = + 17° 27' ς = - 108° 06,5 Paris' (MNHN.F.F62968).

It would have been tempting to rename the collection to avoid the inevitable confusion with the voyage of the *Astrolabe* and *Boussole* vessels ordered by King Louis XVI and commanded by comte de La Pérouse that disappeared in the southern Pacific in 1788 (Fremy & Basili, 1990). However, the material of the Lapérouse collection stored in the MNHN contains only two labels referring to *Lapérouse* (sediment samples Lapérouse I and Lapérouse II): the original decision to name this collection Lapérouse implies that the person who received this material was aware of at least a part of its history, which is detailed in

this study. The name Lapérouse is meaningful and the choice is made to keep it. Although information is lacking, it is plausible that Pierre Chevey himself provided the Lapérouse collection to the micropalaeontology division of the MNHN.

Geographical and historical contexts of Indochina

The aim of the present description is not to discuss the history and context of French presence in Indochina but to provide elements about the historical and geographical contexts in 1926 when the Lapérouse collection was gathered (Michel, 1991; Simon, 2001).

Indochina is a vast peninsula located between the Indian Ocean and the China Sea: it encompasses Burma to the west, Siam (nowadays Thailand) to the centre and Malacca to the south. The eastern part of peninsular Indochina is composed of Tonkin (North Vietnam), Annam (Central Vietnam), Laos, Cambodia and Cochinchina (South Vietnam): together they formed the former French Indochina with the Chinese territory of Kouang-Tchéou-Wan (**Fig. 3**). The following geographic description is restricted to Tonkin, Annam and Cochinchina that were visited by the Indochina Hydrographic Mission in 1926. All localities in their denominations formerly adapted to French are gathered in **Figure 3**, which is modified from an historical map of French Indochina and conceived as a geographical guide.

The coasts of French Indochina, thereafter termed Indochina for simplicity, are 2500 km in length. Tonkin is located between China to the north, Laos to the west, Annam to the south, and is bordered by the Gulf of Tonkin to the east. Mountains are present in the northern and western areas and it is drained by the Red River and its tributaries. The north coast of Tonkin is rocky with shallow bays, such as Faï-Tsi-Long and Along, protected by numerous islands. Annam is bounded by Tonkin to the north, Laos and Cambodia to the west and Cochinchina to the south. It is crossed by the Annamite Range that runs parallel to the coast. The eastern slope of the Annamite Range is steep and forms the numerous capes of the Annam coast, such as Cape Padaran. The Annam coast is more than 1200 km in length and is bounded by the South China Sea to the east. Bays are numerous and shallow and many islands are spread offshore. Cochinchina is bordered by Annam to the northeast, Cambodia to the north and bounded by the Gulf of Siam (nowadays Gulf of Thailand) to the southwest and South China Sea to the southeast. It mainly corresponds to the alluvial plain of the Mekong Delta and Donnai Delta.

The first contacts between Europeans and Vietnam, Cambodia and Laos occurred in the 16th century first by Portuguese and Netherlands merchants (e.g. Diogo Veloso in 1582), followed by Portuguese and French missionaries (such as Diogo Carvalho in 1615, Alexandre de Rhodes in 1624, Pierre Lambert de La Motte in 1669, François Deydier in 1682, Joao de Loureiro in 1742, Pierre Joseph Georges Pigneau de Behaine in 1767 (Rhodes, [1994, 3rd part: 78-79]; Briggs, 1950; Lacouture, 1991; Maintienne; 1999). One of the major contributions of this early period is the Dictionnaire annamite-latin-portugais (Rhodes, [1991]), which for the first time used a new writing system derived from the Latin alphabet (known today as quốc ngữ, Jacques, 1998).

Because of the persecution of Catholics, France intervened in Indochina at the end of the 1850's under Napoléon III. The objectives of this intervention were also to prevent England from installing in Indochina, to ensure the French influence in the area and to open a southern terrestrial gate to China for business opportunities. First installed in Saigon (known today as Hô-Chi-Minh-Ville) in 1859, which was at that time a fast-growing fishing harbour, France took rapidly control of the Mekong Delta, the richest area of Cochinchina. This domination extended to the entire Indochinese countries through a series of skirmishes, battles and treatises with local authorities, benefiting from their weaknesses and internal disagreements. In 1863, Cambodia was placed under French protectorate to prevent it from being annexed by Siam. Southern Vietnam provinces, later to become Cochinchina, were occupied in 1867. The protectorate was extended to Northern and Central Vietnam by the Tien Tsin Treatise on 9 June 1885: they respectively became Tonkin (capital city Hanoi) and Annam (capital city Hue). The Indochinese Union was created in 1887, Laos being attached later in 1893. French Indochina was really born during the mandate of Paul Doumer as general governor from 1897 to 1902, with a centralized system, an economic development with the growth of harbours mainly in Saigon, the construction of roads, bridges, railways, and the creation of schools,

Fig. 3. Map of French Indochina (© Vinhtantran 2019, Wikimedia Commons) with localities alluded to in this work.
In red, missions of the *Lapérouse*, *Astrolabe* and *Octant* from January 1926 to February 1927.

universities and scientific institutions such as the École française d'Extrême-Orient or the Institut Pasteur ([1, 2]. In spite of important crises in the 1930s that were repressed by army and police, the military presence of Japanese from 1940 and Pearl Harbour on 7 December 1941, this situation did not change until the Japanese takeover of 9 March 1945. The autonomy of the three countries of Indochina under Japanese protection was declared. It was declared a second time for Vietnam on 2 September 1945 following the defeat of Japan by the Vietminh. In the following years, France tried to recapture Indochina but this war was definitively lost following the Diên-Biên-Phu Battle on 7 May 1954. The Geneva agreements in 1954 declared the autonomy of Cambodia and Laos.

A brief history of French scientific sampling in Indochina

Until the 1860s, Indochina was closed to foreigners: only a few natural history samples mainly gathered by Diard in 1824 and Mouhot from 1854 to 1861 reached Europe at that time. Pierre-Médard Diard (1794-1863) studied anatomy and zoology with Georges Cuvier. Together with Alfred Duvaucel, stepson of Georges Cuvier, they settled in Chandernagor (India) in a house they turned into a museum, mostly storing specimens collected by local hunters. The first parcel they sent to the MNHN in June 1818 contained specimens collected from the Ganges, Tibet or Sumatra. They later settled in Sumatra where they sampled for instance the famous dugong, a drawing and description of which were used by Saint-Hilaire & Cuvier (1824-1842). Diard then left for Cochinchina, visited Annam and Cambodia and was one of the first European who visited Angkor (Diard, 1863; Peyssonnaux, 1935; Broc, 1992). During his stay, he collected numerous specimens still stored in the MNHN: fishes, birds (**Fig. 4A**), insects (**Fig. 4B**), reptiles, and mammals including primates. It is only in 1858 that Henri Mouhot was officially missioned to explore the Mekong Valley, in the context of the establishment of a southern gate to China. He explored the lower basin of the Chao Phraya River in Siam, Cambodia and traced the first itinerary to Laos (Finot, 1908). While exploring Cochinchina in 1859, Henri Mouhot rediscovered Angkor Vat and Angkor Thom: a full description was published in 1863, two years after his death near Luang Prabang (Anonymous, 1863). Some of the insects he collected in Laos and Thailand are stored in the MNHN (**Fig. 4C**).

Later in the 19th century, natural history sampling intensified, especially thanks to diplomats or soldiers commissioned all over Indochina. The MNHN houses numerous geology, zoology, botany, anthropology and palaeontology collections gathered during this period of intense activity. Of them, the 'Mission Pavie' visited Indochina from 1879 to 1895 (Maître, 1912). Auguste Jean Marie Pavie (1847-1925), nicknamed "L'exporateur aux pieds nus" [the bare foot explorer], began his career in Indochina in 1869 as a soldier, a period during which he developed his skills for exploration [3]. In 1888, at a time when Laos was still not part of Indochina, he became the head of an official mission with scientific, geographic and political objectives. During its period of maximum activity, his mission was composed of about 40 people: topographers, scientists, political and commercial agents, soldiers. The MNHN stores numerous specimens collected by the 'Mission Pavie': plants, insects (**Fig. 4D**), crustaceans (**Fig. 4E**), fishes, molluscs, arachnids, reptiles, amphibians, mammals…

Another important contributor to the MNHN collections from Indochina was Colonel Messager, who gathered a major collection of eastern Asian molluscs (Breure & Páll-Gergely, 2019). Louis Gabriel Martin Messager (1852-1915) was stationed as a soldier in Indochina from 1896 to 1900. During this period, he intensively sampled terrestrial molluscs that are abundantly preserved in the MNHN (**Fig. 4F**). Ornithological missions were also organized in Indochina, for instance by Jean Delacour, correspondent of the MNHN, in the course of seven expeditions between 1923 and 1939 (Delacour & Jabouille, 1924; Delacour, 1926; Hennache & Dickinson, 2000; Voisin *et al.*, 2004).

Numerous geological researches were carried out in Indochina by French geologists, mainly related to the Indochina Geological Survey created in 1898 (Lepvrier & Janvier, 2008). The geology and palaeontology collections of the MNHN also contain material collected during different periods of French collecting, all originating from Vietnam (some possibly from Laos): primate remains collected by Jacques Fromaget in 1958 (**Fig. 4G**) and numerous palaeobotanical specimens provided by the Service des Mines du Tonkin [Mining Survey of Tonkin]. In the 1920s, the geologist René-Léon Bourret studied the south Annamite Range,

1. Position Coloniale internationale Paris, 1931. *Le Conseil des recherches scientifiques de l'Indochine*. Indochine française, section des Sciences.

2. Les instituts Pasteur d'Indochine. *La Nature*, 3131 (1st March 1947), pp. 77-78.

3. Archives nationales d'outre-mer, 'Auguste Pavie l'explorateur aux pieds nus'. http://pavie.culture.fr/home.php [accessed 2 May 2019].

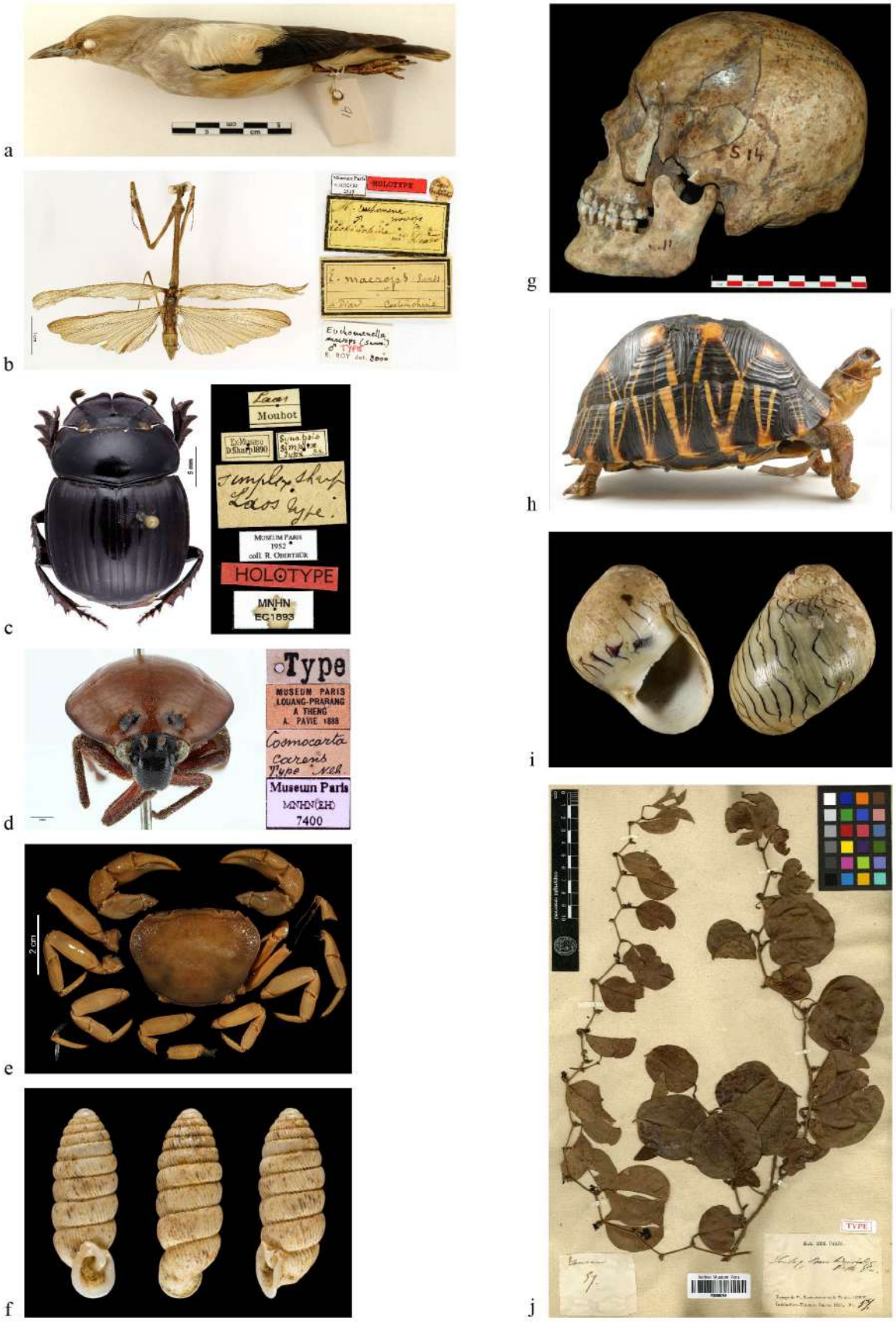


Fig. 4. Material from French expeditions in Indochina stored in the MNHN collections. **(a** and **b)** specimens gathered by Pierre-Médard Diard, **(a)** *Pastor elegans* Lesson, 1834 collected in Cochinchina before 1826 (MNHN-ZO-2010-506, syntype; currently identified as *Sturnia sinensis* (Gmelin, 1788); vernacular name: White-shouldered starling), **(b)** *Euchomenella macrops* (Saussure, 1870) from Cochinchina (MNHN-EP-EP2515, holotype; © Recolnat ANR-11-INBS-0004). **(c)** *Synapsis simplex* Sharp, 1875 collected by Henri Mouhot in Laos (MNHN-EC-EC1893, holotype; © MNHN, Mantilleri, 2010); (**d** and **e)** specimens collected by the Mission Pavie in Luang Prabang, Laos, **(d)** *Cosmocarta carens* Noualhier, 1896 collected in 1888 (MNHN-EH-EH7400, type), **(e)** *Potamon (Potamon) luangprabangensis* Rathbun, 1904 (MNHN-IU-2014-23043, syntype, © Recolnat ANR-11-INBS-0004); **(f)** *Ennea hippocrepis* Bavay and Dautzenberg, 1912 collected by Colonel Messager in Tonkin (MNHN-IM-2000-30948, syntypes, Recolnat ANR-11-INBS-0004); **(g)** skull collected by Jacques Fromaget in Laos, from the Late Palaeolithic (MNHN-HA-20538-1); **(h)** *Astrochelys radiata* (Shaw, 1802) collected in Cochinchina by René-Léon Bourret (MNHN-RA-1948.41; © Recolnat ANR-11-INBS-0004); **(i** and **j)** specimens collected during the voyage of *La Bonite* in 1836 and 1837 in Tourane, Cochinchina; **(i)** *Nerita gaimardii* Souleyet, 1842 (MNHN-IM-2000-32722, syntype, © Recolnat ANR-11-INBS-0004); **(j)** *Smilax bauhinioides* Kunth, 1850 (MNHN-P-P00686764, type; © MNHN Paris Project Mellon).

Laos and northeastern Tonkin. He was also a specialist of modern reptiles: his collection is deposited in the MNHN (**Fig. 4H**). The micropalaeontology department of the MNHN stores an important collection of fusulinids (large Palaeozoic benthic foraminifers) collected by Jean Gubler from 1902 to 1940 from Cambodia, with rock samples, thin sections and field books.

Several voyages of scientific exploration sailed to Indochina in the 19th century. Among them, *La Favorite* travelled twice to the South China Sea (1829-1832 and 1841-1844) where it was missioned to continue the exploration of the Anambas archipelago in Indonesia initiated by Bougainville. Cyrille Pierre Théodore Laplace, commanding *La Favorite* from 1829 to 1832, had to establish commercial and diplomatic links with the visited countries and to identify areas where warships could be gathered in case of conflict. The vessel focused on seas around India and China and explored the coasts of Cochinchina and Tonkin. François-Edmond Pâris, appointed as hydrographer on board *La Favorite*, produced hydrographic observations and drawings (Rieth, 1992; Barron-Fortier, 2015). Natural history specimens were also collected by Joseph Fortuné Théodore Eydoux, onboard naturalist, many of which are preserved in the MNHN including rocks, birds, fishes or anthropological remains (Eydoux & Gervais 1833-1839). *La Bonite* (1836, 1837), commanded by Auguste-Nicolas Vaillant, was appointed for a circumnavigation to accompany consular officers around the globe (Broc, 1995). During this journey, geographical and meteorological observations were performed along the coasts of South America and across the Pacific Ocean, and numerous specimens stored in the MNHN were collected: molluscs (**Fig. 4I**), amphibians, arthropods, fishes, birds, insects, plants (**Fig. 4J**) and seeds (Eydoux & Souleyet, 1840-1866; Souleyet, 1852).

However, as far as is known, no sediments were documented during these early voyages. Sediments were furthermore only rarely collected and analysed by more recent expeditions. Foraminifers have been documented from the area considered here as detailed below, but the sediment samples of the Lapérouse collection are unique.

Origin and history of the Lapérouse collection

Material and methods: contextualisation process

Works by Pierre Chevey (1927a; 1927b) are the only references providing information on samples collected during the *Lapérouse*, *Astrolabe* and *Octant* cruise in February 1926. The archives consulted for the present study are summarized in **Table 1**. When possible, the cited localities are illustrated by postcards and photos taken approximately in 1927 (**Fig. 6 & 11**), which belong to the personal archives of Robert Létang, director of the *Société Indochinoise de charbonnages et de mines métalliques* [Indochinese Society of coal and metal mines] in Tonkin from 1927 to 1934.

	Location	Date	Classification numbers & content
Archives du Muséum national d'Histoire naturelle	Paris France	12 January 2018	**Ms MDP 3.1** (Archives personnelles de Théodore Monod, correspondance amicale)
Archives nationales	Pierrefitte France	16 February 2019	**CP/F/14/18369** (Archives figurées du dépôt des phares, Cartes hydrographiques d'Asie du sud-est; maps 10, 11, 23, 24, 26, 35, 36, 43, 47-49, 50, 53, 55, 62, 63, 74, 75, 81, 82, 89, 90, 95, 100, 103-106, 109, 116)
Service historique de la Défense	Brest	documents scanned	**BR-4E-3867, BR-4E-3868** (Rôle d'équipage, exercice 1926)
Service historique de la Défense	Vincennes France	8 February 2019	**MV9JJ41** (Organisation et préparation des missions hydrographiques 1924-1939) **MV9JJ43** (Archives du service hydrographique et océanographique de la marine 1830-1990) **MV9JJ79** (Missions hydrographiques d'Indochine 1919-1923, 1924-1925, 1926-1927, 1928-1930, 1931-1932) **MV9JJ80** (Missions hydrographiques d'Indochine 1933-1935, 1936-1939, 1947-1948) **MV9JJ329.2** (Historique du service hydrographique de la marine (1914-1970), par M. Covillault : liste des ingénieurs hydrographes, évolution des techniques des travaux hydrographiques, généralités sur les missions hydrographiques ; v. 1970)
Service historique de la Défense	Rochefort France	19 February 2019	**7JJ** (Levés hydrographiques)

Table 1. Archives consulted for the present work.

Results

The pre-Indochina period and the ships' characteristics

From 1865 to the beginning of the 20th century, only limited missions were organized by the French Hydrographic Service along the Cochinchina and Annam coasts. The loss of the cruiser Sully in February 1905, who burst open on a rock at the entrance of the Faï-Tsi-Long archipelago (known as Quảng Ninh) in the Gulf of Tonkin , marked a turning point in the history of hydrographic missions in the area. Topographic studies along the Indochina coasts started all over again from November 1905 to 1914 on the *Manche*, with a special focus on the Along Bay and Faï-Tsi-Long. After an interruption related to World War I (WWI), the mission resumed in 1922 with the arrival of the ships *Lapérouse*, *Astrolabe* and *Octant*. Missions were organized until the beginning of World War II (WWII) in 1939 [4].

Lapérouse, *Astrolabe* and *Octant* began their careers during WWI when they were respectively called *Lapérouse*, *Mauviette* and *Pivert*. *Lapérouse* was built in 1918 in Brest arsenal (France) and launched on 21 November 1919; she was an auxiliary tanker whose aim was to provide the logistic support to a French squadron based in Corfu [5]. She weighed 526 tons, was 51.25 m long and 7.9 m wide, with a draught of 4.2 m, a power of 1100 horses, a speed of 12 knots, 2 boilers, 1 propeller and a capacity of 40 on-board staff. However, the end of WWI intervened before she was ready for operations. *Lapérouse* was then transformed for hydrographic missions: she was extended by 12 m, reaching 63.6 m in length and 8.5 m in width, a weight of 781 tons, a draught of 5.5 m and a speed of 11 knots. She was equipped with hoist, 'White' crafts formerly disposed on battleships and provided large spaces for secondary boats, drawing rooms and a capacity of 104 on-board staff (Roche, 2005). *Lapérouse* was not equipped with satisfying food resources to host an important crew: the crew used to embark living cattle, pigs, ducks or chickens [6].

Seven submarine hunters built during WWI were transformed into hydrographic annexes: originally, these vessels had birds' names that were changed to fit their new mission. Among them, the *Pivert* became the *Octant* and the *Mauviette* became the *Astrolabe* [7]. *Astrolabe* and *Octant* were built at the Forges et Chantiers de la Méditerranée in La Seyne-sur-Mer (France) and launched in 1918. They both weighed 315 tons, were 43.5 m long and 7.3 m wide, with a draught of 3.6 m, a power of 460 horses, a speed of 10 knots, 2 boilers, 1 propeller and a capacity of 32 on-board staff (Roche, 2005; Estival, 2003). They served as annexes for coastal observations and shallow-water dredging.

Lapérouse was originally supposed to be associated with the annexes *Astrolabe* and *Boussole* (Roche, 2005) in reference to the vessels commanded by captain Jean-François de Galaup, comte de La Pérouse, missioned by King Louis XVI to complete the discoveries of Cook and Bougainville in the Pacific Ocean. They sunk in 1788 on the reefs of Vanikoro Island in Santa Cruz archipelago, southern Pacific Ocean (Fremy & Basili, 1990). However, the *Boussole* annex was affected to the North Africa Hydrographic Mission with the *Beautemps-Beaupré* and *Alidade*: she was therefore replaced by the *Octant* to join the Indochina Hydrographic Mission [8]. In February 1921, *Lapérouse*, *Astrolabe* and *Octant* were assigned to the Hydrographic Mission along the Morocco and Algeria coasts until the end of October [9, 10].

Lapérouse, *Astrolabe* and *Octant*: from Toulon to Saigon

In September 1921, *Lapérouse*, *Astrolabe* and *Octant* were appointed to the Indochina Hydrographic Mission [11, 12]. Several newspapers reported the journey of the survey ships on their way to Saigon: the successive ports of call of the three vessels are shown in **Figure 5** and **Figure 6**. The vessels were free to choose the harbours to stop in depending on their refuelling needs, with the aim of reaching Saigon quickly, avoiding stops in Crete or Italian harbours if possible and staying as short a time as possible in Port Said (Egypt) and in the Suez Canal [13]. The ships left Toulon (France) on 10 January 1922 and arrived in Port Said (Egypt) on the January 1922 [14, 15, 16]. They left on 21 January and reached Djibouti on 31 January [17, 18]. They left on 7 February and arrived in Bombay (India) on 20 February [19, 20]. They cast off Bombay on 28 February, reached Colombo (Sri Lanka) that they left on 11 April [21, 22]. They finally left Singapore on 26 April and reached Saigon at 4pm on 29 April 1922 [23, 24, 25] (**Fig. 7**).

Once in Indochina, the objectives of the ships were to recognize Saigon, Tourane, Haiphong,

4. Service historique de la Défense, Vincennes, France, MV9JJ329.2. *Historique du service hydrographique de la marine (1914-1970), par M. Covillault : liste des ingénieurs hydrographes, évolution des techniques des travaux hydrographiques, généralités sur les missions hydrographiques ; v. 1970.*

5. *Idem.*

6. *Idem.*

7. *L'Ouest-Éclair - Caen edition, 7337*, 17 February 1920.

8. Service historique de la Défense, Vincennes, France, MV9JJ79. *Missions hydrographiques d'Indochine 1919-1923, 1924-1925, 1926-1927, 1928-1930, 1931-1932.*

9. Service historique de la Défense, Vincennes, France, MV9JJ329.2. *Historique du service hydrographique de la marine (1914-1970), par M. Covillault : liste des ingénieurs hydrographes, évolution des techniques des travaux hydrographiques, généralités sur les missions hydrographiques ; v. 1970.*

10. *L'Ouest-Éclair - Rennes edition*, 7306, 5 February 1921.

11. Service historique de la Défense, Vincennes, France, MV9JJ79. *Missions hydrographiques d'Indochine 1919-1923, 1924-1925, 1926-1927, 1928-1930, 1931-1932.*

12. *Les Annales coloniales: organe de la "France coloniale moderne"*, 106, 9 September 1921.

13. Service historique de la Défense, Vincennes, France, MV9JJ79. *Missions hydrographiques d'Indochine 1919-1923, 1924-1925, 1926-1927, 1928-1930, 1931-1932.*

14. Le Petit Var, 15.022, 11 January 1922.

15. L'Ouest-Éclair - Caen edition, 7378, 13 January 1922.

16. L'Ouest-Éclair - Caen edition, 7384, 19 January 1922.

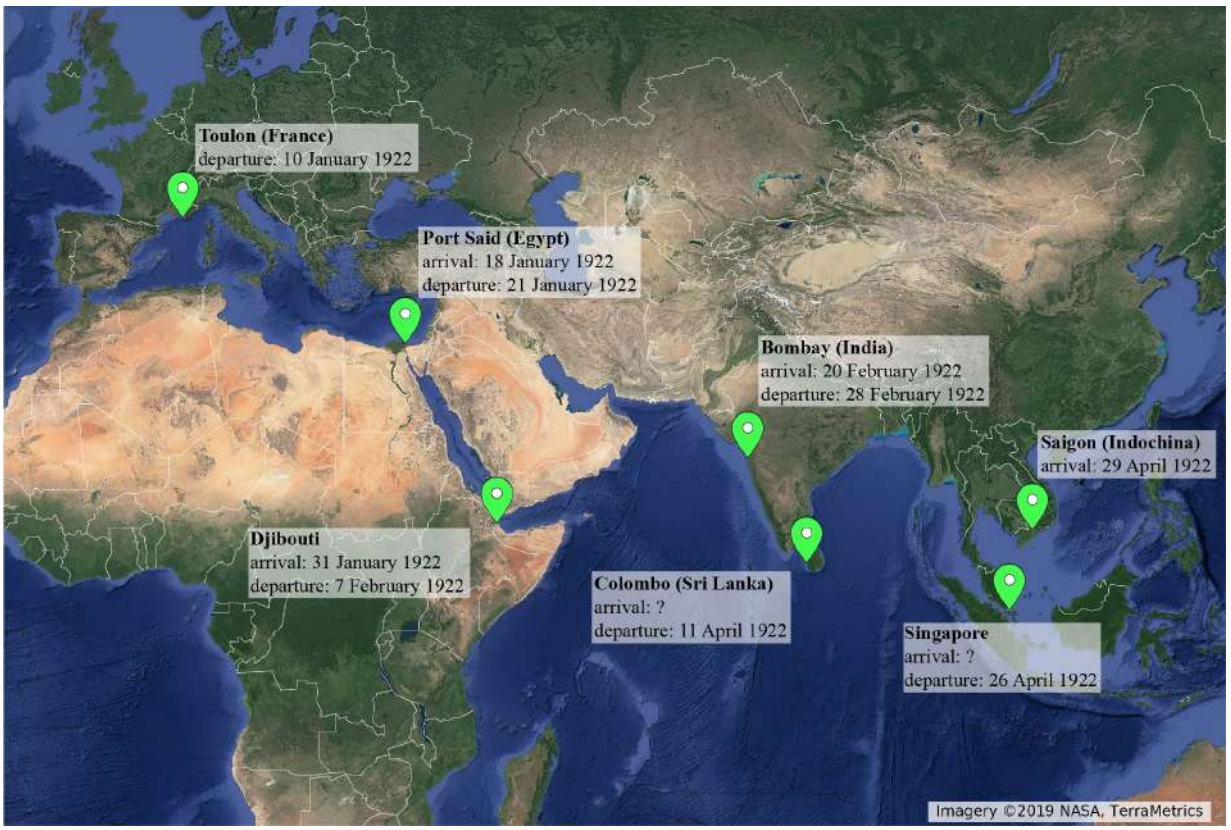


Fig. 5. Reconstitution of the journey of the *Lapérouse*, *Astrolabe* and *Octant* from Toulon to Saigon.

17. L'Ouest-Éclair - Nantes edition, 7389, 24 January 1922.

18. L'Ouest-Éclair - Rennes edition, 7398, 3 February 1922.

19. L'Ouest-Éclair - Caen edition, 7406, 11 February 1922.

20. L'Ouest-Éclair - Caen edition, 7416, 22 February 1922.

21. L'Ouest-Éclair - Caen edition, 7424, 2 March 1922.

22. L'Ouest-Éclair - Nantes edition, 7436, 14 March 1922.

23. Les Annales coloniales: organe de la "France coloniale moderne", 68, 5 May 1922.

24. L'Écho annamite: organe de défense des intérêts franco-annamites, 315, 30 March 1922.

25. L'Ouest-Éclair - Caen edition, 7451, 29 March 1922.

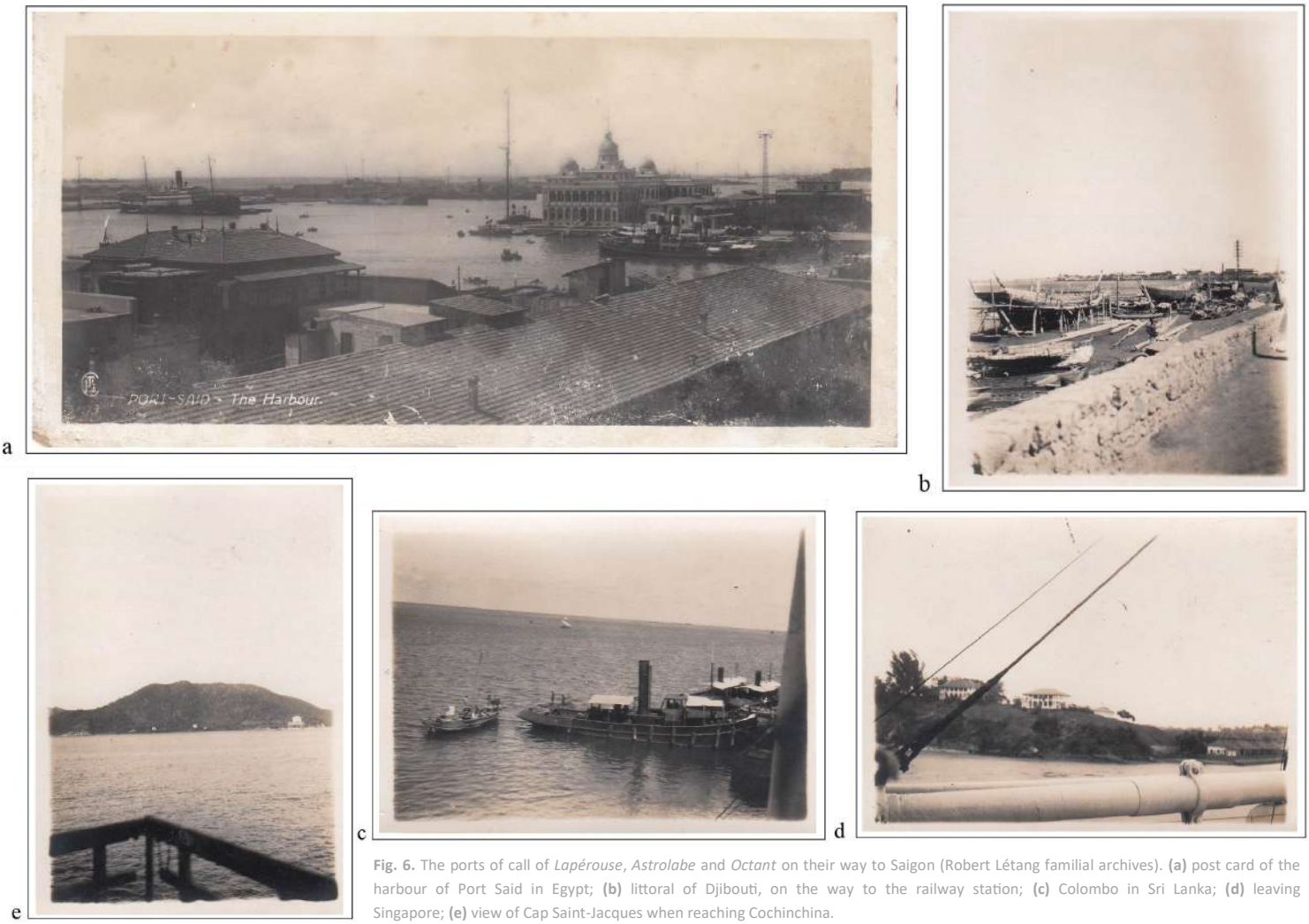


Fig. 6. The ports of call of *Lapérouse*, *Astrolabe* and *Octant* on their way to Saigon (Robert Létang familial archives). **(a)** post card of the harbour of Port Said in Egypt; **(b)** littoral of Djibouti, on the way to the railway station; **(c)** Colombo in Sri Lanka; **(d)** leaving Singapore; **(e)** view of Cap Saint-Jacques when reaching Cochinchina.

La mission hydrographique d'Indochine

Aujourd'hui 29 mars à 16 heures arrive à Saigon la mission hydrographique affectée par le Ministre de la marine aux travaux d'achèvement de l'hydrographie indochinoise, travaux qui avaient été suspendus depuis août 1914.

L'ancien navire hydrographe «*Manche*» ayant fini sa longue carrière a été remplacé par un bâtiment pourvu de tous les perfectionnements modernes. La mission se compose de trois navires :

Le *Lapérouse*, navire hydrographe de 1200 tx, lancé en 1919, longueur 60 m. largeur 9 m. tirant d'eau 5 m., machine de 1100 chevaux, vitesse 10 nœuds.

L'*Octant* et l'*Astrolabe*, chalutiers de 300 tx, destinés à servir d'annexes au navire hydrographe pour les observations côtières et les sondages par petits fonds.

Ces navires ont quitté la France au début de janvier, et ont fait escale à Port-Saïd, Djibouti, Bombay, Colombo, Singapour.

Le programme général des travaux de la mission pour 1922 est le suivant : avril : séjour à Saigon pour réparations.

Mai à août : Côte Est d'Annam. Août à octobre : Tonkin et Faitzilong. Hiver 1922 1923 Poulo-Condor et côte Ouest de Cochinchine et Cambodge.

La mission est commandée par M. le Capitaine de frégate Gaillard.

Fig. 7. 'La mission hydrographique d'Indochine' [The Indochina Hydrographic mission] [32]

Une île apparaît

Situation. — Dimensions. — Prise de possession. — Opérations de sondage

L'île volcanique dont l'apparition fut signalée par télégramme du 9 mars adressé MM. Douglas et Grant, agents du Lloyds' à Saigon, a été reconnue le 15 mars par le chalutier sondeur « *Astrolabe* », de la Mission Hydrographique de l'Indochine

Cette île se trouve à très peu près au point signalé par le télégramme visé plus haut. Autant qu'il a été possible d'en juger, elle a la forme d'un fer à cheval dont l'ouverture, située au Nord-Est, constitue le cratère. Son diamètre est de 400 mètres, sa hauteur de 35 mètres.

L'activité volcanique est continuelle ; elle se manifeste uniquement dans le cratère par des éruptions fréquentes de terres, de cendres et de vapeurs.

La Mission Hydrographique a pu débarquer le 16 mars sur la pointe Sud-Ouest de l'île. Elle a effectué le levé et a procédé à des sondages.

L'île est accore de tous côtés. Un document confirmant la prise de possession a été laissé sur l'île. La température de l'eau à diverses profondeurs a été relevée ; des échantillons du terrain ont été recueillis et de nombreuses photographies ont été prises.

Au point de vue touristique, le spectacle du cratère en activité est très intéressant.

Fig. 8. 'Une île apparaît' [An island appears] [33]

the southern and eastern coasts of Annam, as well as the coasts of the Gulf of Siam [26, 27] (**Fig. 3**). The *Astrolabe* accomplished special missions such as the recognition of a newly accreted volcanic island, called Ile Nouvelle, on 15 March 1923 [28, 29] (**Fig. 8**). She also took part in the rescue of the wreck and survivors of the *Cap-Lay* liner on 16 July 1928, that had collided with a rock at the entrance of Song Lambac, Haiphong river in Along Bay, during a typhoon, killing 49 [30, 31]. During the early 1930s, the ships studied the continental shelf offshore Cochinchina and South Annam and discovered shoals and banks (Joubin, 1836). Among them, the *Bancs de l'Astrolabe*, about 30 miles (about 48 km, **Fig. 3**) from the coastline at a waterdepth ranging from 4.6 to 8.5 m, are still mentioned as dangerous areas in recent sailing recommendations in the South China Sea (National Geospatial-Intelligence Agency, 2017).

Lapérouse, *Astrolabe* and *Octant* missions in 1926

The on-board crew. In 1926, when the Lapérouse collection was gathered, the Indochina Hydrographic Mission was commanded by Commander Dufäy [34] (**Fig. 9**). The hydrograph in chief was 1st class hydrograph engineer Damiani, assisted by sub-lieutenant Gauthier. Lieutenant Joubin was commanding the *Octant* and Lieutenant Morazzani commanded the *Astrolabe*. The officers responsible for the different hydrographic measurements were (Damiani, 1928 ; [35]):

- Sub-lieutenants Gauthier, Gavoille, Guézennec, de Lajarte, Marchand, Rossignol and Vialet onboard *Lapérouse*;

- Sub-lieutenants Fontaine and Grange onboard *Astrolabe*;

- Sub-lieutenants Douguet, Fournage and Le Masson onboard *Octant*.

26. Service historique de la Défense, Vincennes, France, MV9JJ79. *Missions hydrographiques d'Indochine 1919-1923, 1924-1925, 1926-1927, 1928-1930, 1931-1932.*

27. *Les Annales coloniales: organe de la "France coloniale moderne"*, 106, 9 September 1921.

28. L'Écho annamite: organe de défense des intérêts franco-annamites, 453, 20 March 1923.

29. Les Annales coloniales: organe de la "France coloniale moderne", 52, 3 April 1923.

30. Les Annales coloniales: organe de la "France coloniale moderne", 112, 19 July 1928.

31. L'Indochine: revue économique d'Extrême-Orient, 14, 20 September 1928.

32. L'Écho annamite: organe de défense des intérêts franco-annamites, 315, 30 March 1922.

33. L'Écho annamite: organe de défense des intérêts franco-annamites, 453, 20 March 1923.

34. Service historique de la Défense, Brest, France, BR-4E-3867, BR-4E-3868. *Rôle d'équipage, exercice 1926*.

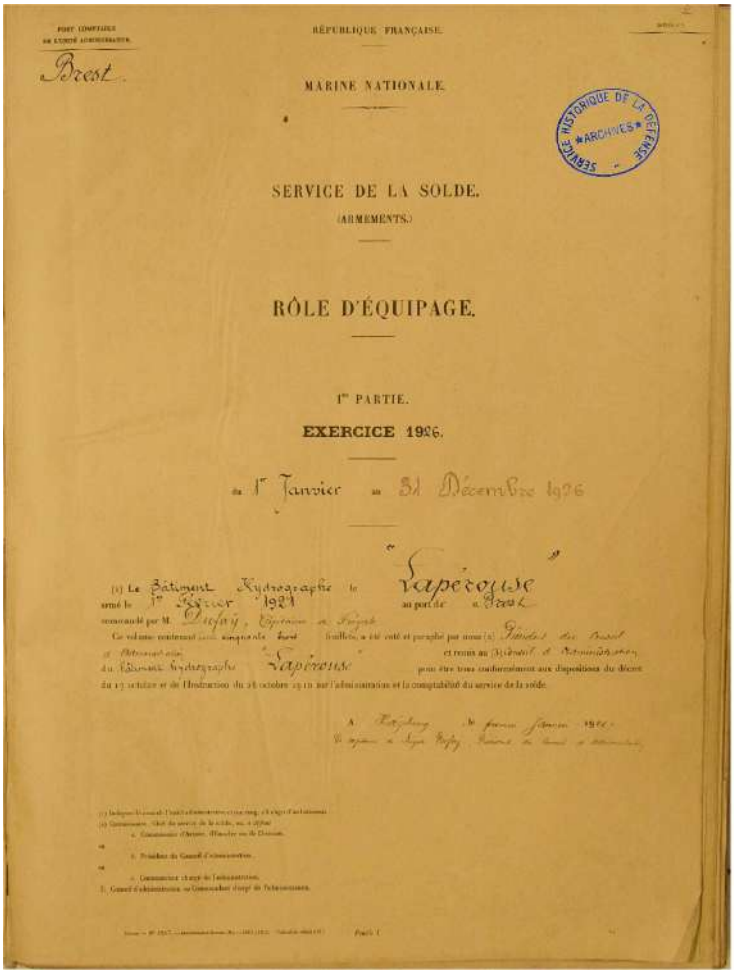
35. Service historique de la Défense, Vincennes, France, MV9JJ79. *Missions hydrographiques d'Indochine 1919-1923, 1924-1925, 1926-1927, 1928-1930, 1931-1932.*

Pierre Chevey, assistant at the MNHN, was attaché naturalist to the Indochina Hydrographic Mission in 1925 and 1926 (Chevey, 1927a; 1927b; [36]). He shared his time between the Indochina Hydrographic Mission onboard the Octant and the Oceanographic Service of the Indochina Fisheries based in Nhatrang in southern Annam, onboard the *De Lanessan* (Chevey, 1927a; 1927b). He later became head of the Oceanographic Service of the Indochina Fisheries in Nhatrang in May 1931 until his death on 13 July 1942 in Saigon (Serène, 1955). During his stay in Nhatrang, he tried to further develop the Oceanographic institute of Nhatrang by inviting several important scientists of the MNHN, including Théodore Monod whom he repeatedly tried to convince, unsuccessfully, to visit Indochina and the institute he was in charge of [37].

The objectives of the mission. In 1926, the objectives of the Indochina Hydrographic Mission were to continue the topographic studies carried out in 1925 [39]. It was planned to operate all year round with the possible support of gunboats *Malicieuse* and *Inconstant* for dredging as well as sloops *Regulus*, *Bellatrix* and *Ville d'Ys* that could have been requested for hydrographic tasks. The journey of the ships from January 1926 to February 1927 was a round-trip leaving from Tonkin during which they had to characterize the topography of (Damiani, 1928 ; [40]):

- Along Bay in Tonkin Gulf in January 1926 (Point 1 in **Figure 3**);
- Padaran Cape (today known as Mui Dinh) in southern Annam in April-May 1926, to localize obstructions and bottom irregularities (Point 2 in **Figure 4**);
- Ream Bay on the margin of Cambodia in the eastern Siam Gulf in April 1926 (Point 3 in **Figure 3**);
- Quinhon (or Quy Nhon, Qui Nhơn), Kumong Bay and Xuanday Bay in central Annam in June -September 1926. The last topographic studies in this area were realized around 1880 and only focused on the inner parts of the bays. The analysis of the bottom nature and topography allowed the discovery of dangerous topographic highs (Point 4 in **Figure 3)**;
- Faï-Tsi-Long archipelago in Tonkin Gulf in October, November 1926 and January 1927, to localize dangerous rocks previously

36. *L'Éveil économique de l'Indochine*, 523, 19 June 1927.
37. Archives du Muséum national d'Histoire naturelle, Paris, France, Ms MDP 3.1. Archives personnelles de Théodore Monod, correspondance amicale.
38. Service historique de la Défense, Brest, France, BR-4E-3867, BR-4E-3868. *Rôle d'équipage, exercice 1926.*
39. Service historique de la Défense, Vincennes, France, MV9JJ41. *Organisation et préparation des missions hydrographiques 1924-1939*.
40. Service historique de la Défense, Vincennes, France, MV9JJ79. Missions hydrographiques d'Indochine 1919-1923, 1924-1925, 1926-1927, 1928-1930, 1931-1932.


RÉPUBLIQUE FRANÇAISE.

Brest

MARINE NATIONALE.

SERVICE DE LA SOLDE.

(ARMEMENTS.)

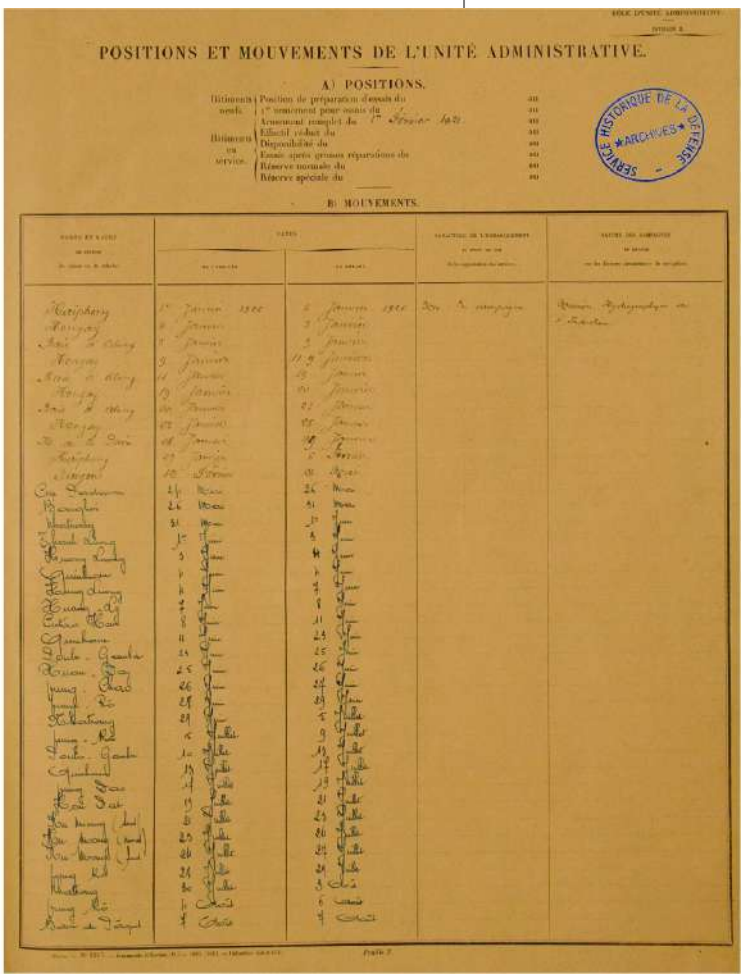
RÔLE D'ÉQUIPAGE.

1re PARTIE.

EXERCICE 1926.

du 1er Janvier au 31 Décembre 1926

Lapérouse


POSITIONS ET MOUVEMENTS DE L'UNITÉ ADMINISTRATIVE.

A) POSITIONS.

B) MOUVEMENTS.

Fig. 9. The crew list and positions of the Lapérouse unit for 1926 [38]

documented by the gunboat *Inconstant* (Point 5 in **Figure 3**);

• Lach-Huyen in Tonkin Gulf in December 1926, to study the possibility of a new channel to Haiphong harbour through Lach-Huyen (Point 6 in **Figure 3**).

For each of these tasks, the crew performed triangulation, water-depth, topographic, currents, tides and magnetic measurements (Damiani, 1928). Triangulation was performed with theodolites using whitewash marks, some of which were previously made by Lieutenant Morazzani (**Fig. 10**). The ships got the support of the Air Force [41]: aerial images were used for topographic studies (Damiani, 1928) but these pictures have not been located. Observations and measurements realised in 1926 improved numerous navigation maps, such as of the littoral around Port Saint-Jacques, of the Tonkin Gulf and Annam coast, of the Tonkin Delta or of the Faï-Tsi-Long archipelago; they also built new maps, for instance of Quinhon [42]).

Collecting natural history samples in 1926

The report of the Indochina Hydrographic Mission from January 1926 to February 1927 provides no information for February and March 1926, when the *Lapérouse* sediments were gathered (Damiani, 1928). Similarly, the field books stored in the Service Historique de la Défense in Rochefort (France) [44] contain no detail for this period. This absence can relate to the loss of archives during WWII. Alternatively, official hydrographic notes and measurements might have been temporarily suspended during the scientific voyage and may have been reported only by Pierre Chevey in his notes. The journey of the ships and position of samples collected in February 1926 can nonetheless be reconstituted (Chevey, 1927a; 1927b): the *Lapérouse* and *Astrolabe* sampled while Pierre Chevey was on-board the *Octant*. Biological samples were collected during the entire trip: foetus of mouflon, reptiles, amphibians, fishes, crustaceans, molluscs, worms,

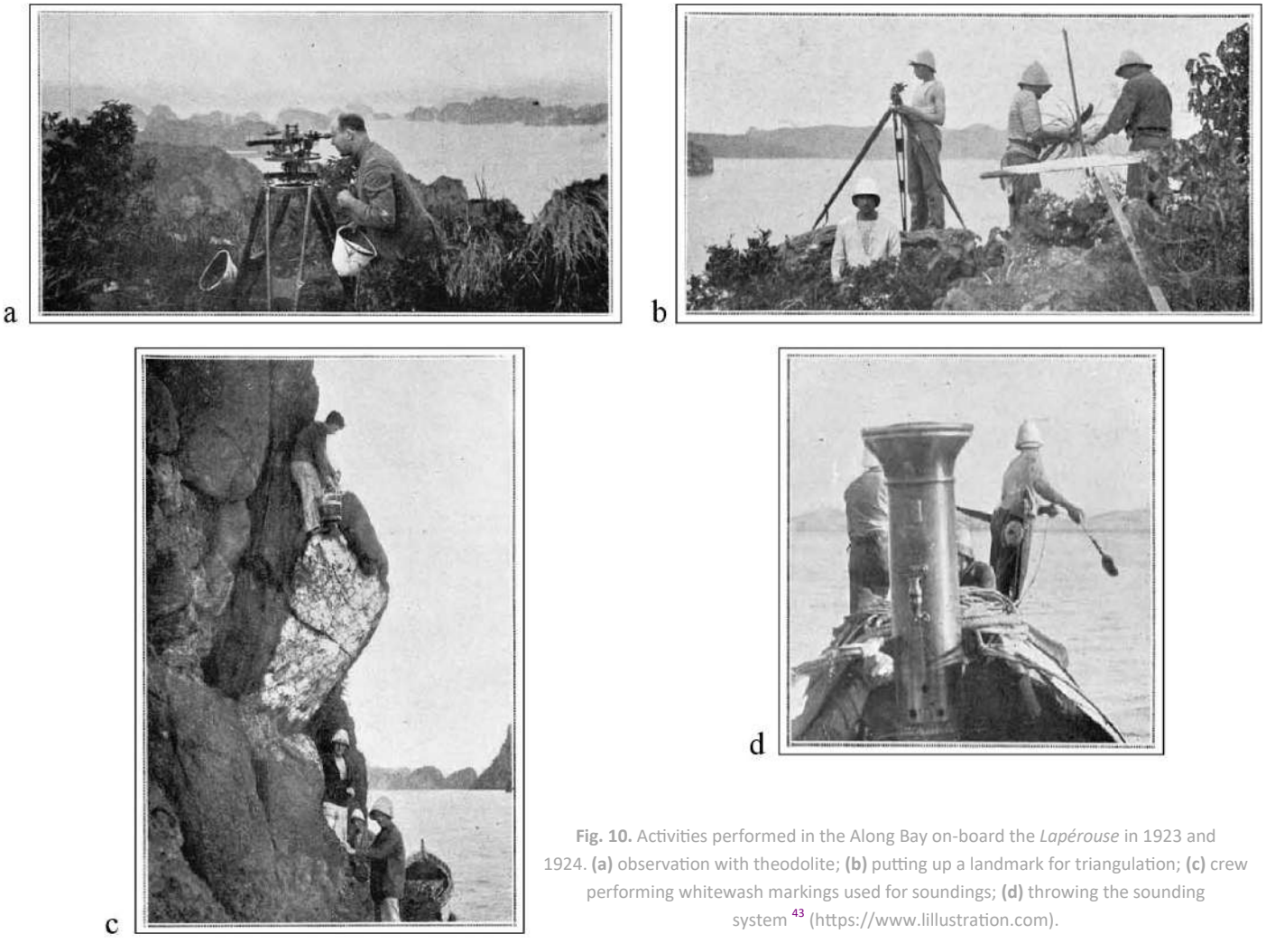


Fig. 10. Activities performed in the Along Bay on-board the *Lapérouse* in 1923 and 1924. **(a)** observation with theodolite; **(b)** putting up a landmark for triangulation; **(c)** crew performing whitewash markings used for soundings; **(d)** throwing the sounding system [43] (https://www.lillustration.com).

41. Service historique de la Défense, Vincennes, France, MV9JJ79. Missions hydrographiques d'Indochine 1919-1923, 1924-1925, 1926-1927, 1928-1930, 1931-1932.

42. Archives nationales, Pierrefitte, France, CP/F/14/18369. *Archives figurées du dépôt des phares, Cartes hydrographiques d'Asie du sud-est*.

43. *L'Illustration*, 4277, 21 February 1925.

44. Levés hydrographiques.

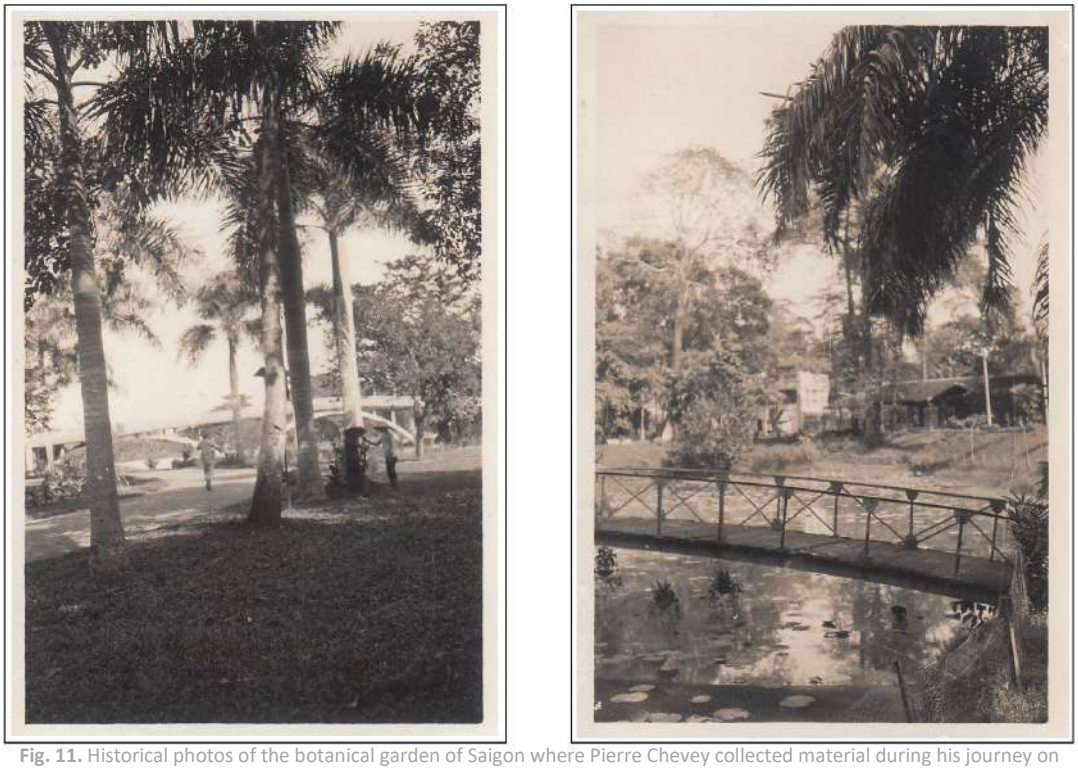


Fig. 11. Historical photos of the botanical garden of Saigon where Pierre Chevey collected material during his journey on Lapérouse, Astrolabe and Octant in 1925 and 1926 (Robert Létang familial archives).

echinoderms, corals, sponges, planktonic organisms from rice fields, offshore areas, mangroves, temporary ponds, rocky shores, markets, reefs, within horseshoe crab sponges, oysters, stomach of birds, by electric light fishing in Tonkin, Faï-Tsi-Long, Saigon, Along Bay, Haiphong, Ream Bay, Annam coast, dockyard gardens in Saigon (today Botanical and Zoological Garden; **Fig. 11**).

Three sets of sediment samples were also collected during this trip (Chevey, 1927a; 1927b): their position is reported in **Figure 12**. On the 1 and 2 February 1926, both *Lapérouse* and *Astrolabe* collected bottom samples. The geographic coordinates indicate that the *Astrolabe* sampled closer to the coastline while *Lapérouse* focused on deeper waters. On the 3 February 1926, only the *Astrolabe* collected bottom samples. They are characterized as follows:

• Four samples were collected in Along Bay and Faï-Tsi-Long, Tonkin Gulf, on the 16, 17 and 21 January 1926. They were labelled SD/A to SD/D and accompanied with only geographic indications, they are not reported in **Figure 12**. They are not part of the Lapérouse collection and have not been located.

• Seven samples were obtained from the Tonkin Gulf by *Lapérouse* on the 1 and 2 November 1926. They are labelled SD/I to SD/VII and are associated with geographic coordinates and water-depth from 32 m (sample I) to 90 m (sample VI). The Lapérouse collection only contains two of them, samples Lapérouse I and II,

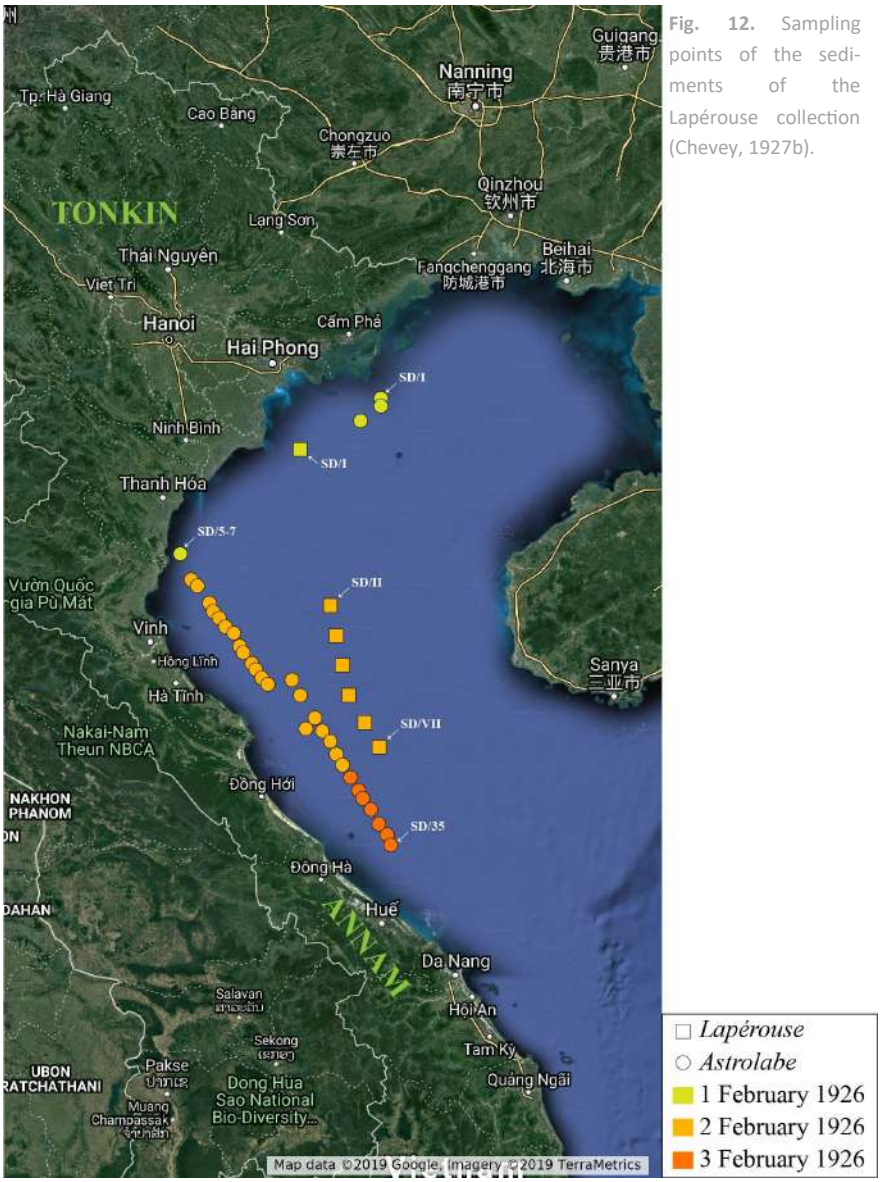


Fig. 12. Sampling points of the sediments of the Lapérouse collection (Chevey, 1927b).

that were collected at 32 and 75 m water depth respectively.

• Thirty-five samples were collected by the *Astrolabe* along the northern Annam coast from 1 to 3 February 1926. They are labelled SD/1 to SD/35 and are associated with geographic coordinates but lack water-depth information. Samples SD/4 to SD/7 are only associated with geographic elements (Mouillage N de Hon-Me; Mouillage S de Hon-Me; 4 milles dans le S36E de Hon-Me; 9 milles dans le S36E de Hon-Me), corresponding to the Bristol boards 5 to 8 of the Lapérouse collection.

WWII, Indochina War and post-conflict periods

Lapérouse, *Astrolabe* and *Octant* worked until 1939 [45]. On 3 November 1939, the general draft came into effect: the Indochina Hydrographic Mission was disarmed and the general staff and crew were dispersed. The archives of the Mission, including geographic and marine maps as well as archives from previous missions, were stored in boxes [46].

Lapérouse was affected to the support of Indochina's dredgers in June 1940. In November 1942, she was engaged in convoy duty between Saigon and Tonkin with the Armand Rousseau, Amiral Charnier, Tahure, Marne and Béryl, to protect commercial ships from being targeted by Japanese torpedoing. Shortly after the Japanese takeover of the 9 March 1945, she was scuttled in Cantho, Cochinchina, on the 11 March 1945. On the 10 March 1945 at 1.30 am, Lieutenant Noel, commander of the group *Lapérouse-Capitaine Coulon*, while at anchor in Vinh-Long (or Vĩnh Long), was informed of the attack of Chaudoc (or Châu Đốc) barracks in the Mekong Delta. He cast off and reached Cantho after sinking two ships including a Japanese rowing boat. Once in Cantho, he, Lieutenant-Commander Mienville commanding the *Marne* and officer Le Rohellec, commanding *Lapérouse*, decided to scuttle the two ships and join the *Marne* crew. This was done on 12 March 1945 at 11.00 pm. The crew of the *Lapérouse*, Capitaine Coulon, Marne, Amiral Charner, two military companies, civil guard squads and volunteers gathered into the 'mixt Transbassac Task Force' created on 14 March 1945 by Lieutenant-Commander Mienville and Lieutenant Noel. They were about 1000 men who fought against Japanese forces until 26 March. Most of them were imprisoned.

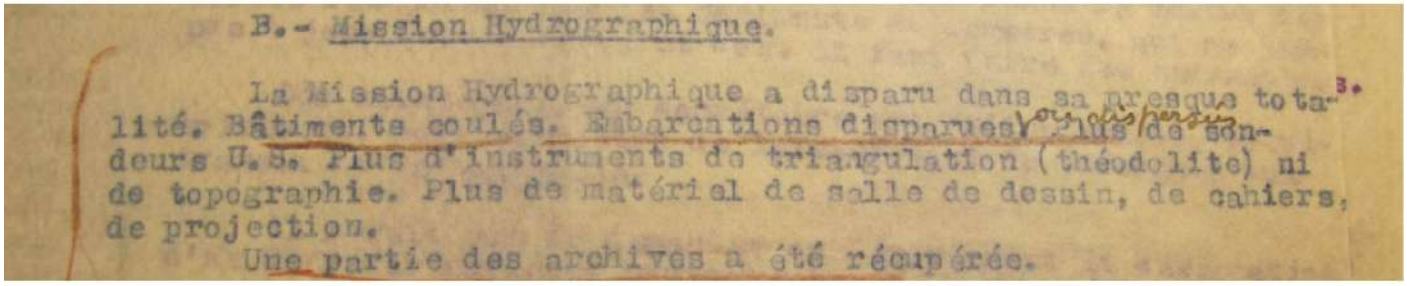
In 1940, *Octant* was affected to the 56th section of Indochina's dredgers and dredged mines in the Tonkin Gulf in November. In May 1943, she was disarmed for boiler renovation. She was sunk while at anchor in Thanh Tuy Ha close to Saigon with the cruiser *Lamotte-Picquet* and the cargo ship *Tai Poo Sek* during the Luçon Battle on 12 January 1945 by US bombers of the Task Force 438. The *Astrolabe* was also affected to the 56th section of Indochina's dredgers in 1940. In 1942, *Béryl*, *Astrolabe* and *Picanon* dredged mines along the littoral of Tonkin. In July 1943, *Astrolabe* was affected to the repression of piracy in Tonkin Gulf with the Commandant Bourdais, Crayssac and Freyzouls. She was sunk on the 26 February 1944 with the *Picanon* and *Guillemoto* during the bombing of Tourane, Annam, by US bombers (Fremy & Basili, 1990; Michel, 1991; Estival, 2003; Vichot, 1967; Dupont & Taillemite, 1995).

Following WWII, hydrograph engineer in-chief Lemiere was missioned to estimate the state of the Hydrographic Mission in Indochina. His letter addressed on 9 November 1945 to the Commodore of the Navy in Indochina concludes that the Hydrographic Mission has quite entirely disappeared, ships have been sunk, crafts have disappeared or have been dispersed, no material was left and only a part of the archives was recovered [47] (**Fig. 13**). The situation in Indochina getting worse after the hostilities in the Pacific, a temporary Mission was created to support war operations in the area. Its aims nevertheless remained ambiguous, either being a support to the needs of

45. Historique du service hydrographique de la marine (1914-1970), par M. Covillault : liste des ingénieurs hydrographes, évolution des techniques des travaux hydrographiques, généralités sur les missions hydrographiques ; v. 1970.

46. Service historique de la Défense, Vincennes, France, MV9JJ80. *Missions hydrographiques d'Indochine 1933-1935, 1936-1939, 1947-1948.*

47. *Idem.*


B.- Mission Hydrographique.

La Mission Hydrographique a disparu dans sa presque totalité. Bâtiments coulés. Embarcations disparues. Plus de sondeurs U.S. Plus d'instruments de triangulation (théodolite) ni de topographie. Plus de matériel de salle de dessin, de cahiers de projection.

Une partie des archives a été récupérée.

Fig. 13. 'Mission Hydrographique' [Hydrographic Mission], extract from the letter sent by hydrograph engineer in-chief to the Commodore of the Navy in Indochina on the 9 November 1945 [49].

the Navy based in Indochina or a true hydrographic mission potentially cooperating to naval operations. In the 1950s, the political situation changed, French navy forces progressively left Indochina and fighting stopped: the situation of the Mission stabilized and regular missions were organized from 1955 to June 1958 when the French Hydrographic Mission in Vietnam was dissolved [48].

Discussion

Indochina Hydrographic Mission and science

In peace time, hydrograph engineers have to establish marine maps, predict tides, improve scientific material, study coastal regimes for the drawing of harbours and improvements of river mouths, and supply the Navy with maps and instruments [50]. In 1924, Jean-Baptiste Charcot voiced the urge for the participation of the French Navy in scientific research in a talk at the Navy Academy (Charcot, 1924). The Lapérouse collection echoes this call and the complaints of Admiral Merveilleux du Vignaux, commander of the Indochina Hydrographic Mission from 1903 to 1905, about the absence of a naturalist onboard. Charcot insisted on the significance of Indochina for natural history collections and oceanographic observations, and hoped that the next 4-years Indochina Hydrographic Mission (1924-1928) would provide a new ground (Charcot, 1924).

The contribution of the Indochina Hydrographic Mission to natural history collections stays poorly documented. Constantin Dawydoff, who worked at the Oceanographic Institute of Nhatrang from 1929 to 1935, collected invertebrates and sands along the Indochina coast that he later sent to various experts including Jean Le Calvez for foraminifer analysis (Le Calvez, 1938; Dawydoff, 1952). During his stay in Nhatrang, he took part in the campaigns of the *De Lanessan*, a ship of the Oceanographic Institute, with the support of the *Astrolabe* and *Alerte* (Dawydoff, 1952). He mentioned a list of foraminifers collected from reefal sand in Tizard Atoll in South China Sea, at 60-80 m water-depth, some of which were previously published (Le Calvez, 1938). Diverse foraminifers were also documented from the Bay of Cauda (Nhatrang) (Lacroix, 1940; Rose, 1955) but they did not benefit from the support of the Indochina Hydrographic Mission. Missions on the *Octant* collected plankton in March 1927 as well as cockroaches that were thriving onboard (Weill, 1929).

The Indochina Hydrographic Mission in 1926

Schedule and aims. Although the scientific schedule for the scrutinized period has not been located, the on-board researches in June to August 1926 and 1927 [51] may provide important information.

The scientific report for June-August 1926 was established by Pierre Chevey onboard the *Octant*, at anchor in Vung-Lam, on 25 August 1926. He indicates that samplings and observations were made further south along the Annam coast and consist of fishes, molluscs, cephalopods, crustaceans, worms collected from reefs, corals, local markets and by electric light fishing. The on-board scientific activities to be performed in 1927 were sampling of plankton and bottom sediments, electric light fishing and visits to markets and fishermen sampans to collect fishes, focusing on mangrove and reefal faunas in Along Bay, Faï-Tsi-Long archipelago and along the Annam coast [52]. The samples collected from June to August 1926 and scheduled for 1927 are very similar to the information at hand for samples collected in February 1926, although still incomplete (Chevey, 1927a; 1927b). The *Lapérouse* material might have been part of a larger scientific effort to characterize the marine geology and biodiversity along the Indochina coast during the 1920s.

The material. All bottom samples collected during the *Lapérouse*, *Astrolabe* and *Octant* cruise in February 1926 were obtained by a Sondeur Léger (Chevey, 1927a; 1927b). The Sondeur Léger, created in 1904, has the structure of a jaw made of copper that is kept open while diving through the water column (**Fig. 14**). Thanks to its sharp borders, it gets into soft, sandy or gravel sediments and closes automatically at the contact with the bottom surface (Richard, 1910; [53]). It was mainly used in shallow waters to collect a mean sample of the sediment surface rather than a core [54]. It has been frequently used, for instance from 1907 to 1909 on-board *Eider* and *Sténo* along Monaco coasts (Richard & Sirvent, 1910), in 1924 during campaigns of investigation of the Atlantic continental platform (Atlantic Slope committee, 1925), during the cruise of the *Tanche* in the Bay of Biscay in 1928 (Belloc, 1929), during the expedition to Terre Adélie from 1948 to 1950 on-board the *Commandant Charcot* (Expédition Antarctique Terre Adélie, 1948-1950), on-board the *Président-Théodore-Tissier* that collected

48. Historique du service hydrographique de la marine (1914-1970), par M. Covillault : liste des ingénieurs hydrographes, évolution des techniques des travaux hydrographiques, généralités sur les missions hydrographiques ; v. 1970.

49. Service historique de la Défense, Vincennes, France, MV9JJ80. *Missions hydrographiques d'Indochine 1933-1935, 1936-1939, 1947-1948*.

50. Historique du service hydrographique de la marine (1914-1970), par M. Covillault : liste des ingénieurs hydrographes, évolution des techniques des travaux hydrographiques, généralités sur les missions hydrographiques ; v. 1970.

51. Service historique de la Défense, Vincennes, France, MV9JJ79. *Missions hydrographiques d'Indochine 1919-1923, 1924-1925, 1926-1927, 1928-1930, 1931-1932*.

52. *Idem*.

53. Les ramasseurs de fonds sous-marins. *La Nature*, 3133 (1 April 1947): 116-118.

54. *Idem*.

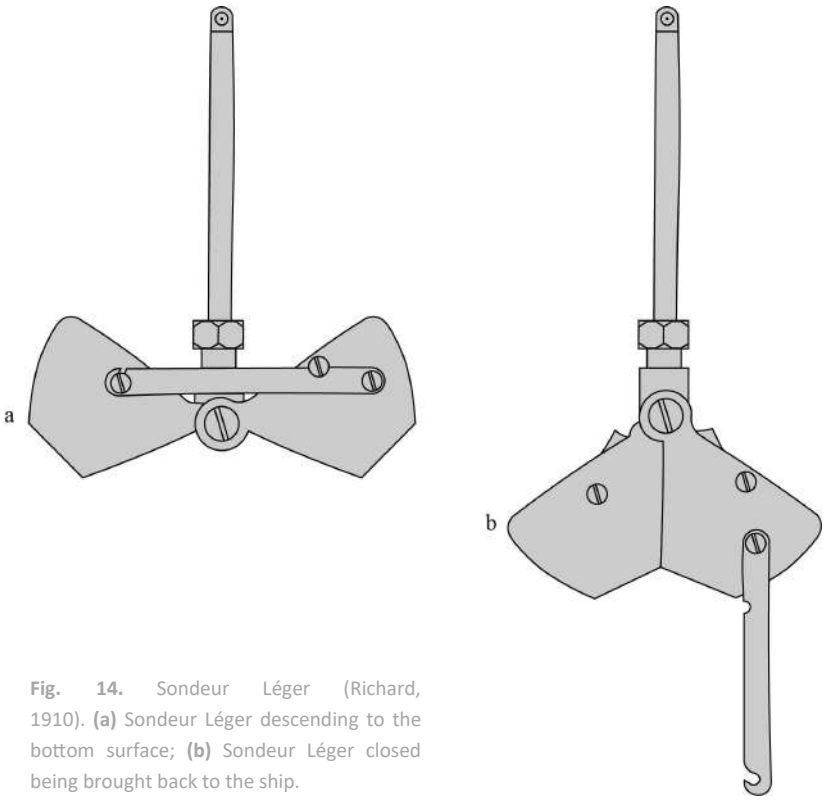


Fig. 14. Sondeur Léger (Richard, 1910). **(a)** Sondeur Léger descending to the bottom surface; **(b)** Sondeur Léger closed being brought back to the ship.

foraminifers in the Celtic Sea in 1948 (Le Calvez, 1958) or on-board the *Faial* in 1957 to study the benthic communities of south Portugal coasts (Pérès, 1959). It was also used on-board the *De Lanessan* to sample sediments along South Annam, Cochinchina, Borneo and Tonkin Gulf from 1925 to 1929 (Institut Océanographique de l'Indochine, 1931).

Results and legacy. The organisms collected by the Indochina Hydrographic Mission in February 1926 include reptiles and amphibians (Angel, 1927) or bivalves (Lamy, 1927), to cite but a few. The fishes preserved in the MNHN include the holotype of *Inimicus joubini* (Chevey, 1927) named in honour of Commandant Paul Joubin, which was bought on the Haiphong market on 24 January 1926 (station number 23240, Chevey, 1927a; **Fig. 15a**). Amphibian collections store six juveniles of *Fejervarya limnocharis* (Gravenhorst, 1829), formerly attributed to *Rana tigrina* (Daudin, 1802), collected by Pierre Chevey in Haiphong rice fields during the same mission (Angel, 1927) (**Fig. 15b**).

As far as is known, sediments and microorganisms collected along the Indochina coast by the three ships in 1926 have never been described. The *Lapérouse* sediments offer unique opportunities to describe the microfauna dwelling in the Tonkin Gulf and along the Annam coast in 1926 as landmarks for comparisons with recent patterns. Most surface sediments collected by historical expeditions such as during the HMS *Challenger* voyage (1872-1876) can satisfactorily be used as pre-1900 baselines for the study of anthropic influence on marine environments (Rillo *et al.*, 2019). Although the early techniques for seafloor samplings (Thomson & Murray, 1891) penetrated below the surface and disturbed the top layer of the sediments, most of these historical samples represent Holocene (surface) rather than Pleistocene, glacial, material (Rillo *et al.*, 2019). Such analysis is still to be performed for the *Lapérouse* collection as the Sondeur Léger (**Fig. 14**), although more modern, also penetrated the sediment surface and might have resulted in Pleistocene contamination. Similar work will be conducted on the entire sea-bottom sediments stored in the MNHN micropalaeontology collections, the scientific potential of which for the study of modern climate and environmental changes is still to be characterized.

Fig. 15. Material collected by Pierre Chevey during his 1925 and 1926 mission on-board the Indochina Hydrographic Mission. **(a)** *Inimicus joubini* (Chevey, 1927) from the Haiphong market in January 1926 (Chevey, 1927a-c) (MNHN-IC-1926-0398, holotype); **(b)** *Fejervarya limnocharis* (Gravenhorst, 1829) from Haiphong rice fields in 1926 (Chevey, 1927a-b; Angel, 1927) (MNHN-RA-1992.5369; G. Doitteau, Recolnat ANR-11-INBS-0004).

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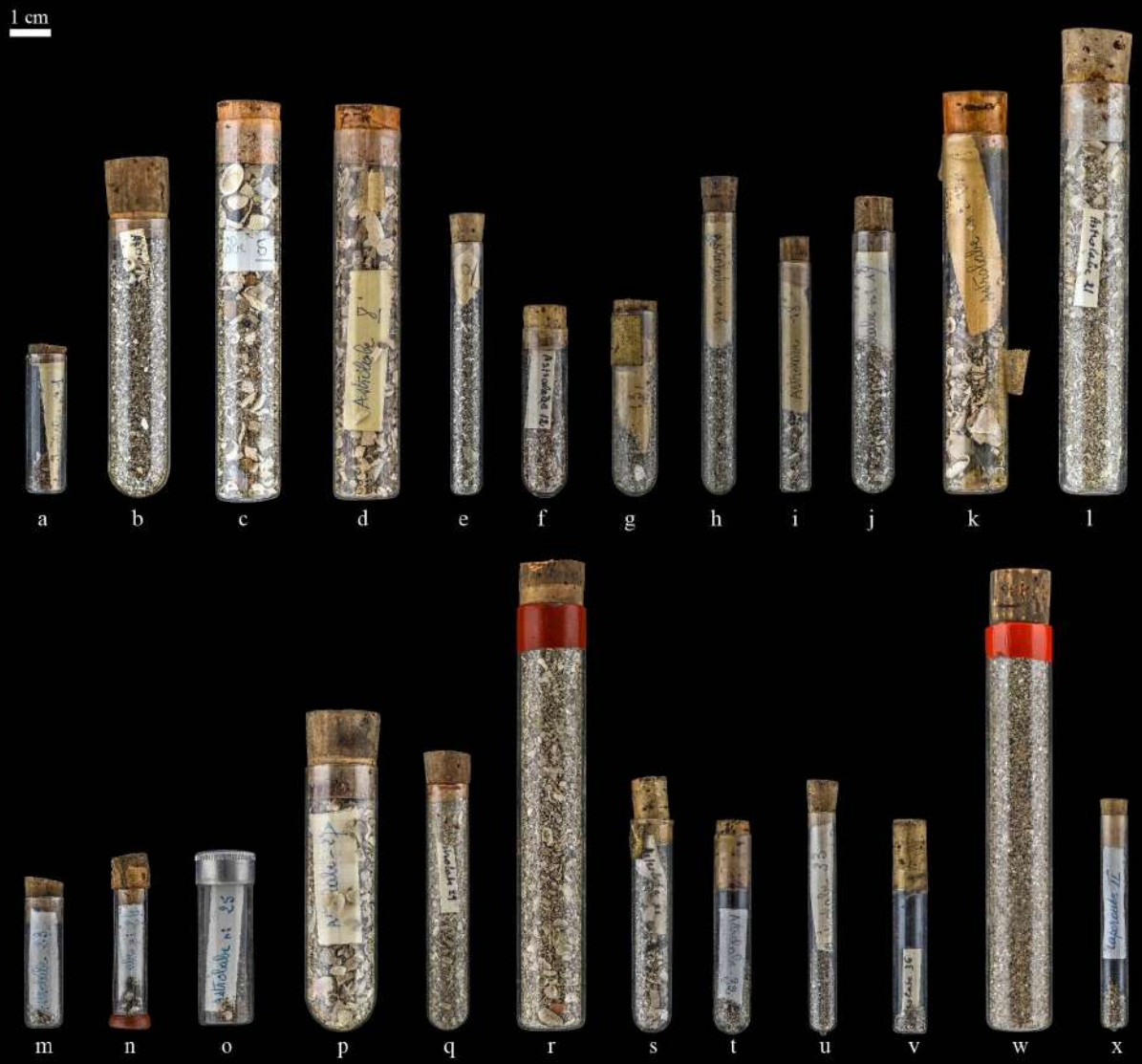

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Image de 4e de couverture : Sediment tubes of the Lapérouse collection (collection numbers MNHN.F.F62914 to MNHN.F.F62937) © Marie-Béatrice FOREL