Henri de Lacaze-Duthiers and the creation of the *Laboratoire de zoologie expérimentale*, Roscoff, France

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Henri de Lacaze-Duthiers and the creation of the *Laboratoire de zoologie expérimentale*, Roscoff, France

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Summary: Sixty-three marine stations were created around the world in the 19th century, mainly starting 1870. The history of most stations is still poorly known, with a few exceptions. The history of the creation of the *Laboratoire de zoologie expérimentale* at Roscoff (Brittany, France), which is now called the *Station biologique*, is presented, focusing on the first five years (1872-1877). The creation of the station is analyzed in relation to the scientific formation of its founder, Henri de Lacaze-Duthiers, and replaced within a broader scientific and historical context. From 1852 to 1870, Lacaze-Duthiers spent most of his summertime doing research in an improvised but functional laboratory that he transported along the coasts of Europe. One of the reasons that prompted Lacaze-Duthiers to open his itinerant laboratory to visitors in 1872 was the necessity to train a new generation of French zoologists. Originally created as an itinerant station, Lacaze-Duthiers's *Laboratoire* was permanently installed in Roscoff in 1876. Also, it is shown that the first and quite unusual name of the station, *Laboratoire de zoologie expérimentale*, was selected by Lacaze-Duthiers to defend a certain vision of zoology against Claude Bernard's praise of experimental physiology. The influence of Auguste Comte's positivist philosophy on experimentation in biology is also discussed. Beyond theoretical debate, it is shown that Lacaze-Duthiers was a pioneer for the study of living animals in their habitat, and that the station at Roscoff played a critical role in the development of marine biology in France: Lacaze-Duthiers's former students created and directed most of the French marine stations in the last quarter of the 19th century. Finally, questions of general interest on the emergence of marine stations starting 1870 are briefly discussed.

Keywords: Auguste Comte; Claude Bernard; experimental physiology; experimental zoology; marine biology; marine stations; natural history.

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Résumé: *Soixante-trois stations marines furent créées dans le monde au XIXe siècle, principalement à partir de 1870. L'histoire de la plupart de ces stations est toujours peu connue, malgré quelques exceptions. L'histoire de la création du Laboratoire de zoologie expérimentale à Roscoff (Bretagne, France), maintenant appelé la Station biologique, est présentée ici, en se concentrant sur les cinq premières années (1872-1877). La création de la station est étudiée en relation avec la formation scientifique de son fondateur, Henri de Lacaze-Duthiers; elle est également replacée dans son contexte historique et scientifique. De 1852 à 1870, Lacaze-Duthiers passa une grande partie de ses étés à faire de la recherche dans un laboratoire improvisé mais fonctionnel qu'il transportait le long des côtes européennes. Une des raisons qui amenèrent Lacaze-Duthiers, en 1872, à ouvrir son laboratoire itinérant à des visiteurs était la nécessité de former une nouvelle génération de zoologistes français. Créé à l'origine comme une station itinérante, le laboratoire de Lacaze-Duthiers fut installé de manière permanente à Roscoff en 1876. L'article montre également que le premier et inhabituel nom de la station, Laboratoire de zoologie expérimentale, fut choisi par Lacaze-Duthiers pour défendre une certaine vision de la zoologie contre l'éloge de la physiologie expérimentale par Claude Bernard. L'influence de la philosophie positive d'Auguste Comte sur l'expérimentation en biologie est discutée. Au-delà de ce débat théorique, il apparaît que Lacaze-Duthiers fut un pionnier pour l'étude des animaux dans leur habitat et que la station de Roscoff joua un rôle essentiel dans le développement de la biologie marine en France: les anciens étudiants de Lacaze-Duthiers créèrent et dirigèrent la plupart des stations marines françaises dans le dernier quart du XIXe siècle. Enfin, des questions d'intérêt général quant à l'émergence de stations marines à partir de 1870 sont brièvement discutées.*

Mots-clés: *Auguste Comte; biologie marine; Claude Bernard; histoire naturelle; physiologie expérimentale; stations marines; zoologie expérimentale.*

Introduction

There are hundreds of marine laboratories worldwide, most of which serve two missions: research and education. Only five marine laboratories existed prior to 1870: Ostend, Belgium (1843); Concarneau, France (1859); Sebastopol, Crimea (1863); Arcachon, France (1867); and Marseille, France (1869).[1] However, many

1 - List of the 63 marine stations created in the 19th century. Africa (2): Algiers, Algeria (1885), then a French territory; False-Bay, South Africa (1898), then in the British Empire. — Belgium (1): Ostend (1843). — Denmark (1): Copenhagen (1890). — England (5): Liverpool (1885); Puffin Island (1887); Plymouth (1888); Port Erin (1892); Jersey (1893). — France (16): Concarneau (1859); Arcachon (1867); Marseille (1869); Roscoff (1872); Wimereux (1874); Luc-sur-Mer (1874); Villefranche-sur-Mer (1880), started in Nice (*circa* 1878) as Herman Fol's personal laboratory; Cette (1881); Banyuls (1881); Tatihou, near Saint-Vaast-la-Hougue (1881); Le Havre (1882); Boulogne-sur-Mer (1884); Les Sables-d'Olonne (1887); Le Portel (1888); Tamaris (1891);

laboratories were founded starting 1870 (58 between 1870 and 1900) due to similar needs: student training in zoology should include the observation of live animals; industrial fisheries required new data; researchers needed live organisms for new questions in embryology and physiology. [2]

The history of most marine stations created at the end of the 19th century is poorly known, except for the Marine Biological Labora-

Dieppe (1894). — Germany (2): Kiel (1871); Helgoland (1892). — Indonesia (1): Batavia –Jakarta– (1885) then in the Dutch East Indies. — Italy (6): Messina by Dorhn and Mikluho-Maclay (1867); Naples (1872); Trieste (1875), then in Austria; Messina, by Kleinenberg (1880s); Rapallo (1889), the only Italian station in Italy; Rovigno (1891). — Japan (1): Misaki (1887). — The Netherlands (1): Helder (1875), remained itinerant until 1889 (1877 at Flushing, 1878-79 at Tershelling, 1880 at Nieuwediep, 1881-83 at Scheldt, 1884 at Flushing, 1886 at Delfzyl, 1887 at Nieuwediep). — New Britain (1): Ralum (1894). — Norway (4): Tromsö (?); Flövedig (1882); Bergen (1892); Dröbak (1894). — Russia (2): Sebastopol (1863); Solovetsky (1881), moved to Alexandrovsk (1899). — Scotland (6): Cowie (1879), remained itinerant until 1884; Granton (1884); Saint-Andrews (1884); Tarbert (1885); Dunbar (1888); Millport (1897). — Spain (1): Santander (1886). — Sweden (1): Kristineberg (1877). — United States of America (12): Woods Hole (1871), as the United States Commercial Fisheries Biological Laboratory, which moved on the East coast from Eastport, Maine (1873) to Noank, Connecticut (1874) and then settled in Woods Hole in 1881; the Anderson School at Penikese, Massachusetts (1873); Salem, Massachusetts (1876); Newport, Rhode Island (1877); Chesapeake Zoological Laboratory (1878), the Johns Hopkins Laboratory remained itinerant and visited several locations (the Bahamas, Jamaica, North Carolina, Maryland, Massachusetts, Virginia); Summer Institute at Cottage City, Martha's Vineyard, Massachusetts (1878); Annisquam Sea-Side Laboratory, Massachusetts (1880) became later the Marine Biological Laboratory at Woods Hole (1888); Nassau, the Bahamas (1887) then in the British Empire, but laboratory run by the Biological School of University of Pennsylvania; Woods Hole, Massachusetts (1888), as the Marine Biological Laboratory; Sea Isle, New Jersey (1891); Bemini Island, the Bahamas (1892), moved to Galveston, Texas (1893); Pacific Grove, California (1892). List compiled from the following sources: *Enquêtes et documents relatifs à l'enseignement supérieur. XIII: Laboratoires maritimes* (Paris: Imprimerie nationale, 1884); René Sand, Les laboratoires maritimes de zoologie, *Revue de l'université de Bruxelles*, 1 (1898), 23-47, 121-151, 203-235, 689-696; Charles A. Kofoid, *The Biological Stations of Europe* (Washington, DC: United States Bureau of Education, 1910); Homer Jack, Biological Field Stations of the World, *Chronica Botanica*, 9 (1945), 1-74; Maurice Caullery, Les stations françaises de biologie marine, *Notes and Records of the Royal Society of London*, 8 (1950), 95-115.

2 - Those reasons were mentioned in various contributions, especially Jack, *op. cit. in* n. 1; Caullery, *op. cit. in* n. 1; Keith R. Benson, Why American marine stations? The teaching argument, *American Zoologist*, 28 (1988), 7-14; Ralph W. Dexter, History of American marine biology and marine biology institutions introduction: Origins of American marine biology, *American Zoologist*, 28 (1988), 3-6; Jane Maienschein, History of American marine laboratories: Why do research at the seashore?, *American Zoologist*, 28 (1988), 15-25; Jean-Louis Fischer, Créations et fonctions des stations maritimes françaises, *La Revue pour l'histoire du CNRS* [en ligne], 7 (2002), mis en ligne le 17 octobre 2006; Raf De Bont, *Stations in the field: A history of placed-based animal research, 1870-1930* (Chicago and London: University of Chicago Press, 2015).

tory at Woods Hole and the Zoological Station at Naples. [3] In France, which hosted the largest number of marine stations at the end of the 19th century, the history of their creation has been largely overlooked, even though studies exist on a few stations. [4] In particular, the creation of the *Station biologique* (Roscoff, Brittany) is still poorly known, although it was founded by Henri de Lacaze-Duthiers (1821-1901), one of the most important French zoologists of the 19th century, who played a key role in the development of marine laboratories in France. [5]

The present study reconstructs historic events and addresses broader questions, such as: What led Lacaze-Duthiers to create a marine station? In which context did this creation take place? Why and when did Lacaze-Duthiers choose Roscoff as a location? Did the station serve research and education as soon as it was created? Who visited the station in its early years? Why did Lacaze-Duthiers name his station the *Laboratoire de*

3 - Information on the history of the Marine Biological Laboratory can be found in (and references therein): Frank R. Lillie, *The Woods Hole Marine Biological Laboratory* (Chicago and London: University of Chicago Press, 1944); Jane Maienschein, *100 years exploring life, 1888-1988: The Marine Biological Laboratory at Woods Hole* (Boston: Jones and Bartlett Publishers, 1988). Information on the history of the Zoological Station in Naples can be found in (and references therein): Christiane Groeben, The Naples Zoological Station and Woods Hole, *Oceanus*, 27 (1984), 60-69; Keith R. Benson, The Naples *Stazione Zoologica* and its impact on the emergence of American marine biology: *Entwicklungsmechanik* and cell-lineage studies, *Journal of the History of Biology*, 21 (1987), 331-341; Antonio Borrelli, Paolo Panceri, Anton Dohrn and the creation of the zoological station in Naples (with an appendix containing letters from P. Panceri to Anton Dohrn and Bertrando Spaventa), *Giornale critico della filosofia italiana*, 20 (2000), 431-447; Christiane Groeben, Impact of travels on scientific knowledge. Ralum (New Britain): A research station (1894-1897) sponsored by the Naples Zoological Station, *Proceedings of the California Academy of Sciences*, vol. 55, suppl. 2 (2004), 57-76.

4 - For a list of the 16 marine stations created in France before 1900, see n. 1. Some information on the history of those stations can be found in the general sources cited in n. 1. Examples of recent studies on specific stations are: Denis Lamy, Marine Robuchon, Lionel Kervran, Bruno Dennetière, Eric Feunteun, Line Le Gall, Dinard Herbarium: History of a Marine Station, *Cryptogamie, Algologie*, 37/1 (2016), 29-45; Christian Bange, La physiologie appliquée dans les stations maritimes françaises de biologie entre 1880 et 1930 et les recherches de Raphaël Dubois à Tamaris, *Bulletin mensuel de la Société linnéenne de Lyon*, 80/1-2 (2011), 13-29.

5 - A complete list of Lacaze-Duthiers's reports on the development of the station can be found in his bibliography published by Georges Pruvot, Henri de Lacaze-Duthiers, *Archives de zoologie expérimentale et générale*, 10 (1902), 1-78. A few articles were specifically dedicated to the history of the station: Yves Delage, Notice sur la station biologique de Roscoff (Finistère), France, *Internationale Revue der Gesamten Hydrobiologie und Hydrographie*, 1 (1908), 282-288; Id., Agrandissements et internationalisation

zoologie expérimentale while most marine stations have always been referred to as marine or zoological stations?

1821-1853: From medicine to zoology

Born on 15 May 1821, Henri de Lacaze-Duthiers was raised in southern France, quite far from the sea. After high-school, he studied medicine in Paris where he also took courses at the *Faculté des sciences* and the *Muséum national d'histoire naturelle*. Lacaze-Duthiers graduated from medical school in 1851 but immediately abandoned the idea of becoming a physician. [6] Two years later, he obtained his *doctorat ès sciences* on the genital apparatus of female insects. [7]

Between 20 June and 20 August 1853, Lacaze-Duthiers joined his friend Jules Haime (1824-1856), a specialist of corals, for a trip to the Balearic Islands, mostly motivated by his interactions with his professor Milne-Edwards: "This is in the lecture halls of the Sorbonne, by listening to such a Master, that I learnt how to love zoology." [8] Henri Milne-Edwards (1800-1885) first joined the *Muséum national d'histoire naturelle* in 1838 where he replaced Jean-Victor Audouin (1797-1841) as professor (*titulaire*) for the "*histoire naturelle des crustacés, des arachnides et des insectes ou des animaux articulés*." Milne-Edwards also was a professor of comparative zoology and phy-

de la station biologique de Roscoff (Finistère), France, *Ibid.*, 2 (1909), 493-497; Pierre Drach, La station biologique de Roscoff, in *La Station biologique de Roscoff en 1950* (Roscoff: Station biologique de Roscoff, 1950), 3-19; Louis Cabioch, Biological station of Roscoff and its role in explorations at bottom of English Channel and Atlantic Ocean, *Cahiers de biologie marine*, 13 (1972), 589-595; Damien Hanriot, Le laboratoire zoologique de Roscoff: Un pas en avant pour la communauté naturaliste, *in* Jean Dhombres (éd.), *La Bretagne des savants et des ingénieurs 1825-1900* (Rennes: Ouest-France, 1994), 143-161. Finally, additional information can be found in more general contributions as well: *Enquêtes…*, *op. cit. in* n. 1; Sand, *op. cit. in* n. 1; Kofoid, *op. cit. in* n. 1; Jack, *op. cit. in* n. 1; Paul Francotte, Les laboratoires maritimes de Naples (station zoologique), de Roscoff, de Banyuls, de Concarneau et de Villefranche à l'exposition de Liège, *Annales de la Société belge de microscopie*, 28 (1907), 1-44.

6 - A biography of Lacaze-Duthiers, including all his academic positions and titles, was published by Pruvot, *op. cit. in* n. 5.

7 - Henri de Lacaze-Duthiers, De l'armure génitale femelle des Insectes en général, *Annales des sciences naturelles, zoologie*, 29 (1853), 215-237.

8 - "*C'est ainsi que, dans les amphithéâtres de la Sorbonne, en écoutant un tel Maître, j'ai appris à aimer la Zoologie.*" (Henri de Lacaze-Duthiers, Discours de M. H. de Lacaze-Duthiers, *Bulletin hebdomadaire de l'Association scientifique de France*, 11 (1885), 320 [my translation].)

siology at the *Faculté des sciences*, Paris, where Lacaze-Duthiers replaced him in 1868. [9]

The book that played a key role in Lacaze-Duthiers's scientific formation was the *Recherches pour servir à l'histoire naturelle du littoral de la France* in which Audouin and Milne-Edwards commented on their field trips on the coasts of Normandy and Brittany (France). [10] Audouin and Milne-Edwards made their first trip to the Chausey Islands (Normandy) in 1826. They traveled along with their wives and children who would join them for tidepooling. [11] In the *Recherches*, they argued that animals should be studied alive, in their natural habitat:

> "The naturalist who explores our coasts is in favorable conditions for interesting research that shall result in important results; the animals that he meets are different enough from one another to provide him with a great diversity of organizations; and, because he decides the localities and the circumstances, he can dedicate himself without obstacles to physiological and anatomical work, study behavior, observe everything freely, and multiply his experiments without neglecting any of the necessary precautions to their success." [12]

Before Milne-Edwards and Audouin, Georges Cuvier (1769-1832) observed many live invertebrates in Normandy, where he lived from 1788 to 1795. [13] Lacaze-Duthiers regarded Cuvier's stay in Normandy as "the starting point of modern studies, today so actively followed and made on living things in the biological condi-

9 - Armand de Quatrefages, Discours prononcé aux obsèques de M. H. Milne-Edwards, le 31 juillet 1885, *Bulletin hebdomadaire de l'Association scientifique de France*, 11 (1885), 305-316.

10 - Jean-Victor Audouin, Henri Milne-Edwards, *Recherches pour servir à l'histoire naturelle du littoral de la France*, 2 vols. (Paris, 1832-1834) [*Research to serve the Natural History of the sea shore of France*].

11 - Quatrefages, *op. cit. in* n. 9, 310.

12 - "*Le naturaliste qui explore nos côtes est placé dans des conditions favorables à des recherches intéressantes et fécondes en résultats importants; les animaux qu'il rencontre sont assez différents les uns des autres pour lui fournir des exemples de presque toutes les modifications principales de l'organisation; et, comme il est libre de choisir les localités et les circonstances, il peut se livrer sans obstacle à des travaux anatomiques et physiologiques, étudier les mœurs, tout observer à loisir et multiplier ses expériences en ne négligeant aucune des précautions nécessaires à leur réussite.*" (Audouin, Milne-Edwards, *op. cit. in* n. 10, vol. 1, iii [my translation].)

13 - Philippe Taquet, *Georges Cuvier* (Paris: Odile Jacob, 2003).

tions where animals are found." [14] Cuvier's primary concern was to collect fresh specimens for anatomical research. Because Audouin and Milne-Edwards were also interested in behavior and development, Lacaze-Duthiers regarded them as the "initiators of a new method of study" because, "through their studies on field sites, they demonstrated all the interest in the knowledge of marine invertebrates, so different alive from when they are in museums." [15]

In 1844, Milne-Edwards explored Sicily with two young followers, Émile Blanchard (1819-1900) and Armand de Quatrefages (1810-1892). Blanchard started working under Audouin as a teenager. Quatrefages moved to Paris two years before Lacaze-Duthiers, in 1840, with already three *doctorats* (mathematics in 1830, medicine in 1832, and *sciences naturelles* in 1840). While a freelance writer and illustrator, he studied invertebrates under Milne-Edwards and became *titulaire* (*i.e.*, professor) of anthropology at the *Muséum* in 1855. Quatrefages was one of the few French scientists who actively studied marine organisms in the field during the second quarter of the 19th century. His trips included the Chausey Islands (1841), Saint-Vaast-la-Hougue (1842, 1849), Bréhat (1843), Biscaye (1847, 1848), Boulogne (1850), and La Rochelle (1852). [16] Lacaze-Duthiers started exploring the seashore approximately when Quatrefages stopped (because of his new responsibilities at the *Muséum*).

As a student and young scientist, Lacaze-Duthiers also interacted with other Parisian zoologists: Henri Ducrotay de Blainville (1777-1850), professor of zoology and anatomy at the *Faculté des sciences* and professor of comparative anatomy at the *Muséum* ; Isidore Geoffroy Saint-Hilaire (1805-1861), professor of birds and mammals at the *Muséum* and who replaced Blain-

14 - *"[…] le point de départ des études modernes, aujourd'hui si suivies et faites si activement sur le vivant dans les conditions biologiques où les animaux se trouvent."* (Henri de Lacaze-Duthiers, Le monde de la mer et ses laboratoires, *Comptes Rendus de l'Association française pour l'avancement des sciences*, 1888 (1889), 364 [my translation].)

15 - "*[…] initiateurs d'une nouvelle méthode d'étude.*" "*Par leurs études faites sur place, ils montrèrent tout l'intérêt qui s'attachait à la connaissance des invertébrés marins, si différents à l'état vivant de ce qu'ils sont dans les musées.*" (*Ibid.*)

16 - Some of his observations on invertebrates and field experiences on the shore can be found in: Armand de Quatrefages, *Souvenirs d'un naturaliste*, 2 vols. (Paris, 1854).

ville at the *Faculté* in 1850. Lacaze-Duthiers defended his thesis before Milne-Edwards and Geoffroy Saint-Hilaire.

1853-1870: Again to sea!

In 1853, Lacaze-Duthiers was ready to do some research in the direction drawn by Audouin and Milne-Edwards two decades earlier, *i.e.*, by observing live animals in the field. From 1853 to 1870, Lacaze-Duthiers visited many coastal localities in France (especially Normandy, Brittany, Mediterranean, and Corsica) and abroad (Balearic Islands, Algeria). Those field trips help understand Lacaze-Duthiers's research goals and how he intended to reach them. In the Balearic Islands, in 1853, Lacaze-Duthiers set up an organization that he kept using in all his field trips and in his laboratory at Roscoff.[17] The next summer, in 1854, Lacaze-Duthiers visited the coasts of Normandy and Brittany for two months, from Caen to Saint-Jacut-de-la-Mer.[18] His laboratory was improvised but efficiently functional:

> "I had a large bedroom on the second floor. As furniture, there were three beds, a few chairs, an immense table; a good window, well oriented, was giving me a nice light. On the ground floor, the owner had left his laundry room for me to enjoy; I could spread water profusely without any fear: it was my aquarium. […] I always learned something through my chats with fishermen. They have peculiar thoughts, but based on positive facts, on exact observations. A fisherman saw so much that he might remember much. It is we who must interpret what he says. […] I shall say that I still remember with pleasure the period when, in this most primitive simplicity, I sometimes so joyfully, always so assiduously and fruitfully, without any worry, worked by the real nature, almost outside civilization."[19]

17 - Lacaze-Duthiers's journal published in Pruvot, *op. cit. in* n. 5, 10.

18 - *Ibid.*, 14.

19 - "*J'avais une grande chambre au premier. Pour tous meubles, il y avait trois lits, quelques chaises, une immense table; une bonne fenêtre, bien orientée, me donnait une belle lumière. Au rez-de-chaussée, le cabaretier m'avait laissé la jouissance de sa buanderie: c'était mon aquarium. […] J'ai toujours appris quelque chose dans mes causeries avec des pêcheurs. Ils ont des idées singulières, mais basées sur des faits positifs, sur des observations exactes. Un marin a tant vu qu'il peut avoir beaucoup retenu. C'est à nous de savoir interpréter ce qu'il nous raconte. […] Vous le dirai-je, je me rappelle encore avec plaisir le temps où dans cette simplicité, la plus primitive, j'ai si gaiement quelquefois, si assidûment et fructueusement toujours, sans souci, travaillé en face de la nature vraie, presque en dehors de la civilisation.*" (Lacaze-Duthiers, *op. cit. in* n. 14, 365-366 [my translation].)

In 1854, Lacaze-Duthiers was appointed professor of natural history at the newly-created *Faculté des sciences,* Lille, which marked the beginning of a long teaching career. [20] In his first lecture, he told his students:

> "Classification is the final goal; but the classification of dead things buried in museums is over. One needs to see first the anatomy and then the physiology. But one must not see one stage only of the life of animals; we cannot ban the study of reproduction and metamorphoses. Finally, to accomplish such studies, one needs to see the animals in their own, natural conditions and study their biology." [21]

Those ideas continued to grow in Lacaze-Duthiers's mind and became the core of his motivation for creating a laboratory at Roscoff. In 1855, Lacaze-Duthiers returned to Saint-Jacut. In 1858, he went on sabbatical to Corsica (April to June), and to the Balearic Islands (June to August). It is in Corsica that he participated in his first dredging, off Bonifacio, and discovered what he called the *engin des corailleurs*, or coral dredge, a wooden cross with nets nailed onto it to catch corals and other benthic animals.

A series of expeditions on coral fishing in Algeria (summer 1860 to summer 1861, fall 1862, summer 1863) provided him with some material for a superb *Histoire naturelle du corail*, in which he described the development of hexacorallians and octocorallians for the first time. [22] In Algeria, Lacaze-Duthiers met a local fisherman, Pierre Lanceplaine, who followed him in most of his field trips and participated in the installation of the laboratory at Roscoff. [23] Lacaze-Duthiers then visited Port-en-Bessin (Normandy) and Saint-Quay-Portrieux (Brittany) in 1864, Arcachon

20 - Lacaze-Duthiers shared some of his personal thoughts on teaching in: Henri de Lacaze-Duthiers, Dix-sept années d'enseignement de la zoologie en Sorbonne: Cours de la Faculté des sciences de Paris, *Revue scientifique*, 37 (1886), 737-748.

21 - "*La classification est le but final; mais la classification des choses mortes et enterrées dans les musées a fait son temps. Il faut voir l'anatomie d'abord et la physiologie ensuite. Mais il ne faut pas voir une période seulement de la vie des animaux; on ne peut pas bannir l'étude de la reproduction et des métamorphoses. Enfin, pour accomplir ces études, il faut voir les animaux dans les conditions qui leur sont propres et en faire l'étude biologique.*" (From Lacaze-Duthiers's journal published in Pruvot, *op. cit. in* n. 5, 32 [my translation].)

22 - Henri de Lacaze-Duthiers, *Histoire naturelle du corail* (Paris, 1864).

23 - They remained close friends and Lanceplaine was Lacaze-Duthiers's executor.

(Atlantic coast) and Cette (Mediterranean – changed to "Sète" in 1927) in 1865, and Roscoff in 1868 and 1869.

In 1863, Lacaze-Duthiers moved to Paris as *maître de conférences* (tenured assistant professor) of zoology at the *École normale supérieure*, where his former student Edmond Perrier (1844-1921) replaced him in 1872. In 1865, he became professor at the *Muséum* (zoology of mollusks, worms, and zoophytes). In 1868, he asked Perrier to join him at the *Muséum*, as *aide-naturaliste*, but immediately left to replace Milne-Edwards as professor of comparative zoology and physiology at the *Faculté des sciences*.

Between 1853 and 1870, Lacaze-Duthiers published 82 contributions, including several monographs. [24] Most articles were published in the *Comptes Rendus […] de l'Académie des sciences* or the *Annales de sciences naturelles*. With the exception of a few articles on insects before 1855, Lacaze-Duthiers specialized in marine organisms, especially cnidarians, mollusks, and tunicates. His writings show his broad interests in anatomy and embryology.

1868: Debate on descriptive *versus* experimental zoology

The main purpose of the *Laboratoire de zoologie expérimentale* and the *Archives de zoologie expérimentale et générale* was to help develop research in "experimental zoology." It was of high importance in Lacaze-Duthiers's mind and what he meant by "experimental zoology" was explained in the long article opening the first volume of the *Archives.* [25]

This article is organized in three parts. In the first part entitled "What zoology must have been primitively" ("Ce qu'a dû être primitivement la zoologie"), Lacaze-Duthiers argued that zoology was originally based on contemplation and description, from primitive human societies up to Linnaeus. This is what he called "pure zoology." In the second part entitled "What zoology still is for many zoologists" ("Ce qu'est encore la zoologie pour beau-

24 - For a complete bibliography, see Pruvot, *op. cit. in* n. 5.

25 - Henri de Lacaze-Duthiers, La direction des études zoologiques, *Archives de zoologie expérimentale et générale*, 1 (1872), 1-64.

coup de zoologistes"), Lacaze-Duthiers argued that many zoologists were still pure zoologists, describing the anatomical parts only, although he acknowleged that some zoologists (such as Geoffroy Saint-Hilaire, Richard Owen, Milne-Edwards, Johannes P. Müller, Pierre-Joseph Van Beneden, Thomas Henry Huxley, Carl Vogt, Quatrefages, Carl Gegenbaur, Rudolf Leuckart, and Ernst Haeckel) had tried to integrate anatomy and embryology. The third and most important part, entitled "What zoology must be and become" ("Ce que doit être et devenir la zoologie"), is a series of comments on a heated debate between Claude Bernard (1813-1878) and Victor Coste (who created the marine laboratory in Concarneau in 1859) at the *Académie des sciences*, prompted by Bernard's (1867) *Rapport sur les progrès et la marche de la physiologie générale en France.*[26] This third part helps understand why Lacaze-Duthiers was so attached to using "*zoologie expérimentale*" for his new laboratory and new journal.

Lacaze-Duthiers, Coste, and Bernard all knew each other. In 1868, Bernard joined the *Muséum* in *physiologie générale*, and left the professorship of *physiologie générale* at the *Faculté*. It also was in 1868 that Lacaze-Duthiers left the *Muséum* to become professor at the *Faculté*. In 1868, both Coste and Bernard applied for the position of *secrétaire perpétuel* (president) of the Physical Sciences (including 36 members divided in six sections) of the *Académie des sciences*. However, the chemist Jean-Baptiste Dumas received 30 votes, ahead of Coste (23 votes) and Bernard (2 votes).[27] In 1868, Lacaze-Duthiers was not a member of the *Académie* (which he joined in 1871), but he knew exactly what was happening there.

Bernard's *Rapport* was a call for new resources to support physiology.[28] Zoologists agreed with the need for more researchers

26 - Claude Bernard, *Rapport sur les progrès et la marche de la physiologie générale en France* (Paris, 1867).

27 - Nominations, *Comptes Rendus hebdomadaires des séances de l'Académie des sciences, Paris*, 1868 (1868), 141.

28 - Recently, in an insightful study, Laurent Loison placed Bernard's *Rapport* and the debate that followed between him and the zoologists of that period within a broader historical context. In particular, Loison showed that Bernard's *Rapport* was one of the foundational pillars of French biology from 1870 to 1930, and that zoologists only approached experimentation as an experimental reasoning while Bernard, on the contrary, approached it as a method. Laurent Loison, Controverses sur la méthode

and laboratories but disagreed with Bernard's claims on the higher status of physiology among biological sciences:

> "Today, that physiology is becoming independent from biological sciences, we must, in defining it, separate it clearly from other diverse sciences with which it may have been confused until now. […] We shall demonstrate that physiology is not a *science naturelle*, but rather an experimental science. […] All *sciences naturelles* are sciences based on observation, that is, contemplative of nature, which can only lead to predictions. All experimental sciences are explanatory, which go farther than sciences based on observation. […] No doubt all biological sciences share the same trunk, since the living being is their common object of study, but […] experimental sciences [*i.e.*, physiology] constitute a more advanced scientific stage than *sciences naturelles*." [29]

At the *Académie des sciences*, in 1868, Coste argued against Bernard that sciences based on observation are as explanatory as experimental sciences and that observation and experimentation should not be separated. [30] In response, Bernard argued that the experimental method implied the use of artificial means to "observe phenomena that are normally hidden to us" because an experiment can be defined as "a provoked observation." [31]

dans les sciences du vivant: Physiologie, zoologie, botanique (1865-1931), *in* François Duchesneau, Jean-Jacques Kupiec, Michel Morange (eds.), *Claude Bernard: La méthode de la physiologie* (Paris: Éditions Rue d'Ulm, 2013), 63-82.

29 - "*Aujourd'hui que la physiologie s'isole du tronc des sciences biologiques pour devenir indépendante, il faut, en la définissant, la séparer nettement des diverses sciences avec lesquelles elle a pu jusqu'alors être plus ou moins confondue. […] Nous établirons tout d'abord que la physiologie n'est point une science naturelle, mais bien une science expérimentale. […] Toutes les sciences naturelles sont des sciences d'observation, c'est-à-dire des sciences contemplatives de la nature, qui ne peuvent aboutir qu'à la prévision. Toutes les sciences expérimentales sont des sciences explicatives, qui vont plus loin que les sciences d'observation. […] Sans doute toutes les sciences biologiques procèdent d'un même tronc, puisque l'être vivant est l'objet commun de leur étude; mais […] les sciences expérimentales représentent un état scientifique plus avancé que les sciences naturelles.*" (Bernard, *op. cit. in* n. 26, 132 and 231 [my translation].) Note that by "*sciences naturelles*" Bernard mostly refers to botany, zoology, mineralogy, and geology (*i.e.*, the expression "*sciences naturelles*" cannot be translated by natural sciences, which also refers to, for instance, physics and chemistry).

30 - Victor Coste, Note sur le rôle de l'observation et de l'expérimentation en physiologie, *Comptes Rendus hebdomadaires des séances de l'Académie des sciences, Paris*, 1868 (1868), 1278-1284.

31 - "*[…] observer des phénomènes qui nous sont naturellement cachés. […] une observation provoquée.*" (Claude Bernard, M. Claude Bernard répond, *Comptes Rendus hebdomadaires des séances de l'Académie des sciences, Paris*, 1868 (1868), 1285 [my translation].)

Lacaze-Duthiers agreed that the experimental method was a guarantee of rigor and progress: "To be experimental: that is what zoology must be from now on." [32] However, contrary to what Bernard claimed, physiology was not the only biological science using experiments and being explanatory. Lacaze-Duthiers's favorite example of an artificially-provoked observation, *i.e.*, an experiment, was the artificial fertilization of eggs provoked in the laboratory for developmental studies. Thus, according to Lacaze-Duthiers, experimentation is possible and necessary in zoology. However, what was then clearly at stake was the definition of experimentation. Thirty years earlier, the philosopher Auguste Comte (1798-1857) had warned scientists that one should not "confuse the observation of an artificial phenomenon with true experiments." [33]

Indeed, when the debate about descriptive *versus* experimental approaches took place at the *Académie* in 1868, scientists had been exposed to new ideas on experimentation for several decades. In particular, the work of Comte deeply marked all the sciences in the 19th century and one needs to go back to Comte's writings to better understand the context in which Bernard and Lacaze-Duthiers debated.

All scientists of that period were familiar with Comte's work. For instance, Lacaze-Duthiers attended Blainville's anatomy and physiology courses in the 1840s and Blainville openly supported Comte's positivist philosophy, "the only philosophy that is truly worthy of our century." [34] Claude Bernard also had close ties to positivism. Most particularly, he was one of the founders of the *Société de biologie* in 1848, in which he served as vice-president,

32 - "*Être expérimentale: tel est le caractère que doit avoir désormais la zoologie.*" (Lacaze-Duthiers, *op. cit. in* n. 25, 17 [my translation].)

33 - "*[…] confondre l'observation d'un phénomène artificiel avec une véritable expérimentation.*" (Auguste Comte, *Cours de philosophie positive*, vol. 3 (Paris, 1838), 321 [my translation].)

34 - "*[…] la seule philosophie qui soit véritablement digne du siècle où nous vivons.*" (Henri Ducrotay de Blainville, *Cours de physiologie générale et comparée*, vol. 1 (Paris, 1833), 52 [my translation].) Blainville and Comte were intimate friends. For instance, Blainville was a great support when Comte suffered of a serious mental crisis in 1826. Comte's imposing *Cours de philosophie positive* was dedicated to Blainville: Auguste Comte, *Cours de philosophie positive*, 6 vols. (Paris, 1830-1842). Comte also acknowledged that his ideas on biology were deeply influenced by Blainville's physiology lectures, which he followed between 1829 and 1832. For the relations between Comte and Blainville: Mary Pickering, *Auguste Comte: An intellectual biography*, 3 vols. (Cambridge: Cambridge University Press, 1993-2009).

a position he shared with Charles Robin, one of Comte's most devoted advocates. The text describing the goals of the *Société de biologie* follows Comte's ideas. As a result, it often was assumed that Bernard was an advocate of positivism too. However, the relations between Bernard and Comte are complex, to say the least. [35]

Comte's ideas on experimentation, as most of Comte's ideas, can only be understood if one keeps in mind that, as the founder of sociology (a term that he coined), he was above all interested in human societies. The two pillars of Comte's positive philosophy, *i.e.*, the law of three stages and the classification of the sciences, were a means to better understand human societies and build a new political system. Comte's law of three stages "consists in that each of our main ideas, each branch of our knowledge, goes through three successive, theoretical stages: the theological or fictive stage; the metaphysical or abstract stage; the scientific or positive stage." [36] Comte's classification of the sciences is a hierarchy of six sciences based on the law of three stages: mathematics, astronomy, physics, chemistry, biology, and sociology. [37] Mathematics first reached its positive stage because, being mostly independent from humans, it is simpler. Sociology reached it last because, being closer to humans, it is the most complex science. However, complexity does not mean superiority and all sciences are of equal value in Comte's mind. [38]

Comte compares all sciences along this hierarchy by evaluating their modes of investigation. For instance, Comte pays special attention to the comparative method which first appears at the level of biology in his hierarchy (and could be used at the next level, *i.e.*, sociology). In fact, the genesis of Comte's classification of the sciences owes much to the biological classification. [39]

35 - Georges Canguilhem, *Études d'histoire et de philosophie des sciences concernant le vivant et la vie* (Paris: Librairie philosophique J. Vrin, 1994); Annie Petit, D'Auguste Comte à Claude Bernard, un positivisme déplacé, *Persée*, 21/22 (1978), 45-62.

36 - "*[Cette loi] consiste en ce que chacune de nos conceptions principales, chaque branche de nos connaissances, passe successivement par trois états théoriques différents: l'état théologique, ou fictif; l'état métaphysique, ou abstrait; l'état scientifique, ou positif.*" (Comte, *op. cit. in* n. 34, vol. 1 (1830), 3 [my translation].)

37 - Annie Petit, Genèse de la classification des sciences d'Auguste Comte, *Revue de synthèse*, sér. IV, vol. 1/2 (1994), 71-102.

38 - Nicolas Verdier, Hierarchy: A short history of a word in western thought, *in* Denise Pumain (ed.), *Hierarchy in Natural and Social Sciences* (Dordrecht: Springer, 2006), 13-38.

39 - Petit, *op. cit. in* n. 37.

Comte and Bernard shared similar views on what experimentation is, but they disagreed on whether experimentation is applicable to organisms and biological phenomena. According to Comte, experimentation is best applicable in physics because physical phenomena are simple. However, it cannot apply in biology because living organisms and organic functions cannot be disturbed for just one factor. [40] Too many other interconnected factors vary when an organism or a function are disturbed, and harmony is then lost. [41] This idea is part of Cuvier's legacy on Blainville's work and, then, through Blainville, on Comte's positive philosophy. [42] Because experimentation cannot be implemented rigorously in biology, observation is the most important mode of investigation. For the first time in the hierarchy of the sciences, observations do involve all our senses. [43]

The importance of observation in Comte's biology relates to the fact that, for Comte, biology is a synthetic science in which significant knowledge emerges after many facts and data have been accumulated and compared. In contrast, for Bernard, experimental physiology is an analytical science in which a bright and brief experiment can teach more than years of observations. [44]

Lacaze-Duthiers and Coste did not use Comte's arguments, *i.e.*, zoology needs observation and comparison, as originally argued by Cuvier. [45] Instead, they argued that physiology did not own experimentation. However, Comte, Lacaze-Duthiers, and Coste all agreed that biology could not be reduced to physiology alone. Bernard himself acknowledged that the different branches of biological sciences pursue different goals:

> "The zoologist and the comparative anatomist see all living beings, and they seek to discover through the study of external and internal characters of those beings the morphological laws

40 - Comte's ideas on biology are exposed in the 40th part of his *Cours de philosophie positive*: Comte, *op. cit. in* n. 34, vol. 3 (1838).
41 - *Ibid.*, 322.
42 - Chris McClellan, The legacy of Georges Cuvier in Auguste Comte's natural philosophy, *Studies in History and Philosophy of Science*, 32 (2001), 1-29.
43 - Comte, *op. cit. in* n. 34, vol. 3 (1838), 313-314.
44 - Petit, *op. cit. in* n. 35.
45 - François Pillon, La méthode en biologie: Cuvier, Blainville, Auguste Comte, *La Critique philosophique*, 7 (1878), 129-138.

> of their evolution [*i.e.*, embryological development] and transformation [*i.e.*, evolution]. The physiologist places himself from a totally different point of view: he is interested in only one thing, the properties of the living matter and of the mechanism of life, under any of its forms. For him, there no longer are genera, species, or classes, but there only are living beings, and if he selects one of them for his studies, it ordinarily is for the commodity of experimentation." [46]

Bernard expresses here clearly his interest in the study of the unity of life, rather than the diversity of life.

The distinction between unity *versus* diversity overlaps with the distinction between experimental *versus* historical biology. Jean-Baptiste Lamarck, Georges Cuvier, Richard Owen or Charles Darwin all attempted to explain life's diversity through the reconstruction of historical events. In the last quarter of the nineteenth century, according to William Coleman, the historical ideal in biology was replaced by the experimental ideal, or "function displaced form as the goal of biological inquiry." [47] Lacaze-Duthiers was at heart a historian of life, by training and interests.

It appears now that the debate between Lacaze-Duthiers and Bernard was meant to remain sterile. First, arguments from both sides would have quickly vanished if the French government had allocated funds to everyone. Second, Bernard was so exclusively interested in the unity of life that he could not understand the importance of studying the diversity of life. Third, Lacaze-Duthiers's defense of zoology implied that his definition of experimentation differed from that of Bernard (and Comte), which did not include "provoked observations." Finally, Lacaze-Duthiers had different views on the role of science in the society. Bernard proudly claimed: "For its importance physiology also deserves

46 - "*Le zoologiste et l'anatomiste comparateur voient l'ensemble des êtres vivants, et ils cherchent à découvrir par l'étude des caractères extérieurs et intérieurs de ces êtres les lois morphologiques de leur évolution et de leur transformation. Le physiologiste se place à un tout autre point de vue, il ne s'occupe que d'une seule chose, des propriétés de la matière vivante et du mécanisme de la vie, sous quelque forme qu'elle se manifeste. Pour lui, il n'y a plus ni genre, ni espèce, ni classe, il n'y a que des êtres vivants, et s'il en choisit un pour ses études, c'est ordinairement pour la commodité de l'expérimentation.*" (Claude Bernard, *Introduction à l'étude de la médecine expérimentale* (Paris, 1865), 194 [my translation].)

47 - William Coleman, *Biology in the nineteenth century: Problems of form, function, and transformation* (Cambridge: Cambridge University Press, 1984), 160.

attention and protection, because it is likely meant to become the most useful science to Humanity, in being the scientific basis for agriculture, hygiene, and medicine, etc." [48] Lacaze-Duthiers fought back, arguing: "I will even with my modest forces always stand up against such a fatal trend that endangers not only the future of zoology, but also that of all pure, theoretical sciences, independent from immediate applications." [49]

1870-1871: Interlude

The war between the Kingdom of Prussia and the French Empire (1870-1871) played a major role in Lacaze-Duthiers's decision to create a marine laboratory. When the war was declared (19 July 1870), Lacaze-Duthiers was about to send out the first fascicle of the *Archives* and the publication had to be delayed. [50] Lacaze-Duthiers then went to Roscoff for the summer for collecting and observing live invertebrates and stayed there during the fall because of phlebitis as well as the circumstances (the war was not over). He was accompanied by his three students Alfred Giard, Perrier, and d'Astre. They stayed at the *Hôtel du Pigeon Blanc.* [51]

The war of 1870 between Prussia and France started because of a diplomatic incident (whether or not the Prince Leopold of Hohenzollern could become the new King of Spain). The deeper cause, however, was the competing domination over the rest of continental Europe. The Prussian army attacked France in August 1870. Paris was besieged for four months, until capitula-

48 - "*Par son importance la physiologie mérite encore qu'on lui accorde intérêt et protection, car elle est certainement appelée à devenir la science la plus utile à l'humanité, en servant de base scientifique à l'agriculture, à l'hygiène et à la médecine, etc.*" (Bernard, *op. cit. in* n. 26, 139 [my translation].)

49 - "*Je ne cesserai dans la faible mesure de mes forces de m'élever contre une tendance aussi funeste qui compromet non seulement l'avenir de la zoologie, mais encore celui des sciences pures, théoriques et indépendantes des applications immédiates.*" (Lacaze-Duthiers, *op. cit. in* n. 25, 63 [my translation].)

50 - Henri de Lacaze-Duthiers, Avertissement, *Archives de zoologie expérimentale et générale*, 1 (1872), v.

51 - Edmond Perrier, Préface, *in* Armand de Quatrefages, *Les Émules de Darwin*, 2 vols. (Paris, 1894), vol. 1, xii.
Because Lacaze-Duthiers's student named d'Astre (or Dastre) does not seem to have published any scientific work or continued on his biological studies, his first name could not be found. In fact, visitors at the station often only wrote their last name on the register of the station and, because some of them were local amateurs or even simply tourists, it happens that their identity could not be determined (in which case only their last name is mentioned).

tion on January 28, 1871. A peace treaty was signed in March. After a violent repression against the revolutionary Parisian people in May 1871, elections were held and the country got organized again in the summer of 1871. Lacaze-Duthiers did not go to the coast in 1871, mainly to make sure that the *Archives* would be sent on time to the subscribers. However, Giard stayed in Roscoff from July to November, to study the development of tunicates. [52] In 1871, Lacaze-Duthiers had not decided to install a laboratory at Roscoff. When, on January 1st, 1872, Lacaze-Duthiers explained that the publication of the *Archives* had been delayed because of the war, he did not mention Roscoff or the creation of a laboratory on the coast. [53]

1872: Creating an itinerant marine laboratory

Shortly after the publication of the first fascicle of the *Archives*, colleagues congratulated Lacaze-Duthiers and informed him about the upcoming creation of a marine laboratory by German scientists, either in Naples or Trieste. [54] In fact, Anton Dohrn created the Zoological Station in Naples in 1872, which officially opened for visitors in 1874. [55] In February 1872, Lacaze-Duthiers immediately requested the French administration to create a similar laboratory in France. The first season of the *Laboratoire de zoologie expérimentale* took place in the summer of 1872 with Lacaze-Duthiers and his student Perrier. Lacaze-Duthiers also mentioned in his Register that his assistant Lemire was in Noirmoutier, on the Atlantic Coast, where he dredged and explored the possibility of organizing an expedition or transport the laboratory there in the future. [56] Indeed, Lacaze-Duthiers's original plan was not to settle permanently in Roscoff.

52 - Alfred Giard, Recherches sur les Ascidies composées ou synascidies, *Archives de zoologie expérimentale et générale*, 1 (1872), 501-704; Id., Étude critique des travaux d'embryogénie relatifs à la parenté des Vertébrés et des Tuniciers, *Archives de zoologie expérimentale et générale*, 1 (1872), 233-288.

53 - Lacaze-Duthiers, *op. cit. in* n. 50, v-vii.

54 - Henri de Lacaze-Duthiers, Création d'un laboratoire de zoologie expérimentale sur les côtes de France, *Archives de zoologie expérimentale et générale*, 1 (1872), l-lii.

55 - Jack, *op. cit. in* n. 1, 50.

56 - In 1872, Lacaze-Duthiers started a Register ("*registre*") in which all visitors of the laboratory had to sign. The Register is held in the Archives of the *Station biologique*. Its content, greatly informative, is analyzed here for the first time (names of visitors, visit length, title and affiliation, research interests and studies). Here I wish to gratefully thank M. André Toulmond, former director of the *Station biologique*, for giving me access to Lacaze-Duthiers's Register.

When creating his laboratory, Lacaze-Duthiers's main goal was to help support what he called "the reawakening of the intellectual movement in France." [57] According to Lacaze-Duthiers, it was critical that France, defeated militarily, would not be defeated in science and education. Lacaze-Duthiers wished to offer to a large number of students and young researchers the possibility to work hard and do research in zoology in good, modern conditions, including complete intellectual freedom. [58]

The decision of installing a laboratory at Roscoff was taken early in 1872, but the installation was not ready for visitors until June 1873. Lacaze-Duthiers's goal was that visitors could find all they needed to perform efficient studies: housing, laboratory space, equipment, ship time, and skilled fishermen. Everything was free of charge, except meals. That was one of Lacaze-Duthiers's strong commitments, which helped support and attract students over the years. In contrast, the "tables" at Dohrn's Zoological Station in Naples were rented by different countries. The laboratory was installed in a rental house by the sea.

After so many years of experience, Lacaze-Duthiers knew exactly how to organize a functional laboratory: [59] one side of the house faced the south for the light; aquariums were on a deck protected by a roof; on the first floor, were two rooms used as offices or laboratories and a living room where visitors could meet and find a variety of common items (thermometers, balances, histological material, maps, books, tide schedule); upstairs, six bedrooms served also as lab space; in each bedroom, visitors could find small aquariums, jars, tide-pooling and fishing tools, nets, buckets, alcohol and fixatives, a box of anatomical tools (scopes with camera lucida, scalpels, forceps, syringes, pencils, paper, colors). Visitors could quickly go get fresh water and live animals; water was also available in a large tank, where it was freshly replaced at every high tide by two local fishermen. In those early years, two boats were available:

57 - "*Le réveil du mouvement intellectuel en France […]*" (Lacaze-Duthiers, *op. cit. in* n. 50, v [my translation]).

58 - Lacaze-Duthiers, *op. cit. in* n. 54, li.

59 - Henri de Lacaze-Duthiers, Le Laboratoire de zoologie expérimentale de Roscoff, *Comptes Rendus hebdomadaires des séances de l'Académie des sciences, Paris*, 79 (1874), 1455-1463; Id., Leçon d'ouverture du cours de zoologie à la Sorbonne (cours 1873-1874), *Archives de zoologie expérimentale et générale*, 3 (1874), 1-38.

la Molgule and *la Pentacrine d'Europe*. As for dredging, Lacaze-Duthiers used the equipment he had discovered in Algeria. Pierre Lanceplaine participated in setting up the laboratory and teaching local fishermen how to use the dredge.

Lacaze-Duthiers only used local housing at Roscoff because he did not plan to install a permanent laboratory there:

> "My desire is not to establish a definitive laboratory or zoological station at Roscoff. I would like, in collaboration with young and zealous workers, travel along the coasts of France. […] I would like to move from one station to another with all the equipment installed in a way so that it could be easily carried. […] My project would be to produce a currently-missing history of the fauna of our coasts, by dividing among ourselves the animal kingdom." [60]

However, Lacaze-Duthiers was well aware of the advantages that Roscoff offered:

> "I chose Roscoff, in Finistère, by the English Channel, for several reasons, and this despite the fact that it is a little bit far from Paris. The richness of its beaches is extreme, the area of the shore covered and uncovered by the tides is impressive, which is most valuable when searching for animals." [61]

1872-1876: Visitors of the laboratory

Information on visitors (name, title, affiliation, length of visit, studies) was established based on Lacaze-Duthiers's Register for the station, now in the archives of the station.

60 - "*Mon désir n'est pas d'établir un laboratoire, une station zoologique définitive à Roscoff. Je voudrais, en m'entourant de jeunes et zélés travailleurs, parcourir successivement toutes les côtes de France. […] Je voudrais, avec tout le matériel disposé de façon à pouvoir être facilement transporté, aller de station en station. […] Mon projet, en nous partageant le règne animal, serait d'établir une histoire de la faune de nos côtes, inexistante à ce jour.*" (Lacaze-Duthiers, *op. cit. in* n. 59, *Archives…*, 7 [my translation].) De Bont (*op. cit. in* n. 2, 45) mentioned other initiatives of itinerant laboratories in the last quarter of the 19th century, including inland for exploration of the terrestrial and freshwater faunas. Also, De Bont made an interesting connection between the emergence of those itinerant laboratories with that of the deep-sea expedition ships, the most famous of which being the British HMS *Challenger* (1874-1876).

61 - "*J'ai choisi Roscoff, dans le Finistère, sur les côtes de la Manche, pour plusieurs raisons, et ce bien qu'il soit un peu éloigné de Paris. La richesse de ses plages est extrême, l'étendue des grèves que couvrent et découvrent les marées est considérable, ce qui est précieux pour la recherche des animaux.*" (Lacaze-Duthiers, *op. cit. in* n. 59, *Comptes Rendus…*, 1456 [my translation].)

In 1872, only Lacaze-Duthiers and his student Perrier were at Roscoff. Perrier worked on comatules.[62] His assistant Lemire explored the coast around Noirmoutier.

In 1873, the station hosted four workers. Émile Baudelot (1834-1875), professor of comparative anatomy and zoology at the *Faculté des sciences* (Nancy), stayed in August and September. From 1858 to 1865, Baudelot had worked with one of Lacaze-Duthiers's close colleagues, Blanchard. During his stay, Baudelot worked on the nervous system and scales of fishes.[63] Alfred Giard (1846-1908), who had just been appointed *professeur suppléant* at the *Faculté des sciences* (Lille), also visited the laboratory in August and September. As Lacaze-Duthiers's *préparateur* in Paris, from 1869 to 1872, Giard worked on the development and relationships of tunicates.[64] However, something happened in 1873 because Lacaze-Duthiers wrote on his Register: "Through a conduct that his former master does not wish to comment on, he [Giard] demonstrated clearly his intentions. All relationships were interrupted." This might explain that Giard created in 1874 a marine laboratory in Wimereux, south of Calais.[65] While at Roscoff, Giard worked on tunicates, including their parasites.[66] Lacaze-Duthiers's *préparateur*, Lemire, stayed from June to September and worked on mollusks, bryozoans, and hydrozoans. Finally, Lacaze-Duthiers supervised the installation from April up to the end of July, and left for a cruise off Algeria.

In 1874, the laboratory remained opened from March to October and hosted nine visitors. François Viault, a Parisian physician who held a *licence ès sciences naturelles*, stayed from 15 May to 17 June and studied the nervous system of fishes.[67] Eugène Rochefort, physician in the French Navy, stayed in May and June in order to get ready for a cruise to Saint-Paul with the

62 - Edmond Perrier, Recherches sur l'anatomie et la régénération des bras de la *Comatula rosacea*, *Archives de zoologie expérimentale et générale*, 2 (1873), 29-86.

63 - Émile Baudelot, Recherches sur la structure et le développement des écailles des poissons osseux, *Archives de zoologie expérimentale et générale*, 2 (1873), 87-244, 429-480.

64 - Giard, *op. cit. in* n. 52.

65 - *Enquêtes…*, *op. cit. in* n. 1, 77.

66 - Alfred Giard, Contributions à l'histoire naturelle des Synascidies, *Archives de zoologie expérimentale et générale*, 2 (1873), 480-514.

67 - François Viault, La structure des centres nerveux des Plagiostomes, *Archives de zoologie expérimentale et générale*, 5 (1876), 441-529.

captain Ernest Mouchez (who came as a tourist on 15 August). Aimé Schneider, *licencié ès sciences naturelles*, stayed in May and June, and worked on gregarines (apicomplexan protists) which parasite marine animals.[68] Alfred Villot, hired as *préparateur*, stayed from May to 25 July to study nematode development.[69] Herman Fol (1845-1892), professor in Geneva and former student of Ernst Haeckel, stayed from 28 July to 18 August and studied the development of the cephalopod *Sepiola* and the sea slug *Elysia*. Edmond Perrier, *maître de conférences* at the *École normale supérieure* and *aide-naturaliste* at the *Muséum*, stayed from 1 July to 15 August to study the regeneration of comatulid arms and blood circulation in sea-urchins.[70] Lemire stayed from 24 September to 16 October to study bryozoan anatomy. Finally, a few persons visited the laboratory for a short period: Anatoli Bogdanov and Alexis Korotneff, from Moscow (7 July); Carl Vogt, chancellor of the University of Geneva, and Charles Reinwald, publisher of the *Archives de zoologie expérimentale* (7 to 12 September).

In 1875, Lacaze-Duthiers stayed at Roscoff from 20 March to 1st October, to supervise the installation of larger aquariums and continue his work on the local fauna. Some of the nine visitors had already come in the past. Vogt came with his family and assistant Monnier (July to September) to study crustacean parasites, worms, and bryozoans.[71] From 5 July to 8 September, Korotneff (1876), then still a student, studied *Lucernaria* (Stauromedusae). Schneider studied the geographic distribution of annelid species (22 June to 7 September). Villot studied parasitic and free-living worms, especially trematodes (15 April to 12 September). The laboratory also hosted newcomers. Soyez, one of Baudelot's students, studied hydroid cnidarians (12 June to 21 August). James Murie, lecturer on comparative anatomy and zoology at the College of Surgeons (London), studied cling-

68 - Aimé Schneider, Sur quelques points de l'histoire du genre *Gregarina*, *Archives de zoologie expérimentale et générale*, 2 (1873), 515-533; Id., Contributions à l'histoire des grégarines des invertébrés de Paris et de Roscoff, *Archives de zoologie expérimentale et générale*, 4 (1875), 493-604.

69 - Alfred Villot, Recherches sur les Helminthes libres ou parasites des côtes de la Bretagne, *Archives de zoologie expérimentale et générale*, 4 (1875), 451-492.

70 - Edmond Perrier, Recherches sur l'appareil circulatoire des oursins, *Archives de zoologie expérimentale et générale*, 4 (1875), 605-643.

71 - Carl Vogt, Sur le Loxosome des phascolosomes (*Loxosoma phascolosomatum*), *Archives de zoologie expérimentale et générale*, 5 (1876), 305-356.

fishes (*Lepadogaster*) and sponges (16 August to 23 September). Charles Martins, professor of natural history at the *Faculté de médecine* (Montpellier), stayed for the first two weeks of September. Finally, Lucien Brun, student, worked on foraminiferans (20 July to 4 September). At least 13 additional visitors came for a day, out of curiosity or to meet with one of the researchers: Paul Petit, Parisian pharmacist, and Dr Duguet, Parisian physician (25 June); Theodor Jarkinsky, University of Kiev (13 August); Abraham D. Bartlett, superintendent of the Zoological Society's Gardens (London) (29 August); Simon Sirodot, chancellor of the *Faculté des sciences* (Rennes), and his collaborator Jules Gallée, amateur naturalist (3 September); Paul Topinard, professor at the *Institut anthropologique de Paris* (14 August); René David (9 August), from the *École pratique des hautes études* (philology); Bonafy, surgeon in the French Navy (sometime in September 1875); Hesse, from Brest; Denis Mounnic, from the University of Geneva; Albert Tissandier; and Nivet.

In 1876, the laboratory was opened from the end of May until the beginning of October. Vogt arrived in mid-June and stayed until 10 October to work on loxosomes and parasites of fishes and tunicates. Brun also came back. Sirodot and Gallée made 1,100 algal preparations representing 180 species in 42 days. Lucien Joliet, hired as *préparateur*, studied bryozoans (5 August to 5 October) for his doctorate. Léon C. Cosmovici, one of Lacaze-Duthiers's Romanian students, studied the local fauna (7 to 27 July). Camille Viguier worked on the "skeleton" of sea stars (20 August to 22 September). Abel Soreau, teacher in a boarding school at Mantes, near Paris, studied hydroid cnidarians for three weeks. Léon Fredericq, professor at the University of Ghent (Belgium), studied the histology of muscles of sea urchins (10 July to 28 August). Finally, as in previous years, at least eight individuals visited the laboratory for a day (such as a student from Lausanne and some representatives from the nearby town of Morlaix).

In only five years, Lacaze-Duthiers's laboratory was successful at attracting many researchers, including from foreign countries (Belgium, England, Russia, and Switzerland). Several visitors decided to come back after their first visit. Visitors included stu-

dents, young investigators, as well as established scientists. It is noteworthy that, because training of the next generation of professors and researchers was an important goal for Lacaze-Duthiers, many of the visitors were students (about 50 % on average each year).

Most studies done at Roscoff were published in the *Archives*, at least during the first years. However, the *Archives* were targeting a broader authorship and 33 of the 45 articles in the first five volumes (1872-1876) were not linked to the station. [72] Most articles in the *Archives* were zoological and embryological studies. [73] Systematic revisions were also published, but not necessarily based on Roscoff material. [74] More importantly, the first volumes of the *Archives* contained few faunistic studies, even though Lacaze-Duthiers wished to publish a Fauna of the French coasts, [75] which was well known among his followers and colleagues:

> "I hope to contribute to the fauna of the coasts of France, of which Mr. the professor de Lacaze-Duthiers has so fortunately conceived the plan, and for which he generously called upon young naturalists of our country." [76]

72 - Josquin Debaz dedicated his PhD thesis (2005) in history at the École des hautes études en sciences sociales (EHESS) to the periodicals of the French marine stations ("Les Stations françaises de biologie marine et leurs périodiques entre 1872 et 1914"). It can be read for a comparison between the *Archives* and other periodicals in that period. It is available (June 2016) online at: https://hal.archives-ouvertes.fr/.

73 - Some studies were already cited here, such as: Perrier, *op. cit. in* n. 62; Baudelot, *op. cit. in* n. 63; Perrier, *op. cit. in* n. 70. Additional studies can be cited as well, such as: Henri de Lacaze-Duthiers, Développement des Corailliaires, Premier mémoire, *Archives de zoologie expérimentale et générale,* 1 (1872), 289-396; Léon Frédéricq, Contributions à l'étude des Échinides, *Archives de zoologie expérimentale et générale*, 5 (1876), 429-440.

74 - Edmond Perrier, Révision de la collection de Stellérides du Muséum d'histoire naturelle de Paris, *Archives de zoologie expérimentale et générale*, 4 (1875), 265-450; Id., Révision de la collection de Stellérides du Muséum d'histoire naturelle de Paris, *Archives de zoologie expérimentale et générale*, 5 (1875), 1-104, 209-304.

75 - Schneider (1875), *op. cit. in* n. 68; Henri de Lacaze-Duthiers, Les Ascidies simples des côtes de France, *Archives de zoologie expérimentale et générale*, 3 (1874), 118-174, 257-330, 531-656.

76 - "*J'espère contribuer ainsi à la* Faune des côtes de France, *dont M. le professeur de Lacaze-Duthiers a si heureusement conçu le plan, et pour l'exécution de laquelle il fait généreusement appel aux jeunes naturalistes de notre pays.*" (Villot, *op. cit. in* n. 69, 453 [my translation].)

1876: Settling down permanently in Roscoff

Lacaze-Duthiers decided to settle permanently in Roscoff in 1876:

> "When I decided to create the laboratories of experimental zoology, I had a well-defined goal that I had to revise since then, without abandoning it completely though. Originally, indeed, I wished to transport the laboratory from one locality to another, after having published a local fauna in each of them. […] Not everything worked out as desired in this direction." [77]

Lacaze-Duthiers changed his mind for several reasons. 1/ Most of the studies accomplished at Roscoff focused on development or anatomy, and few studies on the local fauna. 2/ Lacaze-Duthiers probably did not expect that his laboratory would be so satisfactory to visitors. However, the installation planned by Lacaze-Duthiers was the result of two decades of experience and provided perfect conditions to do good work; the fact that it was entirely free of charge certainly helped its success, especially among the young generation. 3/ Lacaze-Duthiers confessed that he dedicated a great deal of time and energy in the installation of the laboratory. [78] So, why leave Roscoff and spend more time and energy moving the laboratory? 4/ Finally, as pointed out by Fredericq, "because we keep records of the localities and discoveries, newcomers benefit from the experience acquired and save a great deal of precious time." [79]

When Lacaze-Duthiers thought that he should settle permanently in Roscoff, a villa was for sale just across the street from the house rented for the laboratory. At his request, the French government purchased the villa in 1876, which became the new, permanent *Laboratoire de zoologie expérimentale*. The

77 - "*[…] à l'époque où j'ai décidé de fonder les laboratoires de zoologie expérimentale, j'avais un but bien défini, que j'ai dû modifier depuis sans cependant l'abandonner complètement. À l'origine, je désirais en effet transporter de localité en localité le laboratoire, après avoir publié une faune de chacune d'elles. […] Tout n'a pas marché comme je le souhaitais.*" (Henri de Lacaze-Duthiers, Le laboratoire de zoologie expérimentale de Roscoff: Compte-rendu des améliorations et des travaux de 1874 à 1878, *Archives de zoologie expérimentale et générale*, 6 (1877), 312 [my translation].)

78 - *Ibid.*, 320.

79 - "*Comme on consigne les localités et les trouvailles, les nouveaux venus profitent de l'expérience acquise et gagnent ainsi un temps précieux.*" (*Ibid.*, 318 [my translation].)

laboratory was moved in 1877, which marked an important turning point in the history of the station.

The *villa Corbière* (so named because it was bought from the Corbière family) undeniably is a special place, not only because of all the research and teaching that took place there starting 1877, but also for all it reminds us of the Corbière family, especially Édouard Corbière (1793-1875), a wealthy ship owner and author of several popular novels, and his son the poet Tristan Corbière (1845-1875), posthumously famous for *Les Amours jaunes*. The Corbière family lived in Morlaix and spent time at Roscoff occasionally. Tristan Corbière was known for his eccentric personality: dressed as a pirate, he would simulate boarding of local fishing boats. [80] Because he is now regarded as a great poet, a plaque on a wall of the station commemorates that he lived at the villa before it became part of the station. Maybe Lacaze-Duthiers saw him while he was at Roscoff.

For a few years, the laboratory consisted of the villa and the rental house, which still hosted the aquariums. Lacaze-Duthiers thus requested funds to add a new wing to the villa. A fish tank was built in 1881, followed by new aquariums in the new wing in 1882 (all still in place). On the second floor of the new wing, ten individual work spaces were dedicated to research (bedrooms were in the villa).

The *Association française pour l'avancement des sciences* (French Association for the Advancement of Science) made two donations to Lacaze-Duthiers: a new boat, *Le Dentale*, which could dredge up to 100 meters depth, and a scaphandre, or deep-sea diving suit, designed to collect animals up to 3 meters depth. A few people were instrumental in helping Lacaze-Duthiers get funding from the *Association*, especially Armand de Quatrefages, Adolphe Wurtz, Adolphe d'Eichtal, all founders of the *Association* in 1872 and past presidents in 1873, 1874, and 1875, respectively. [81]

80 - Among the many studies dedicated to Tristan Corbière and his poetry: Katherine Lunn-Rockliffe, *Tristan Corbière and the poetics of irony* (Oxford: Clarendon Press, 2006); Pascal Rannou, *De Corbière à Tristan. Les Amours jaunes: Une quête de l'identité* (Paris: Honoré Champion, 2006).

81 - Henri de Lacaze-Duthiers, Les progrès de la station zoologique de Roscoff et la création du Laboratoire Arago à Banyuls-sur-Mer, *Archives de zoologie expérimentale et générale*, 9 (1881), 551.

In the winters of 1875 and 1876, Lacaze-Duthiers hired a local fisherman (using funds from the *Association*) to send fresh animals to universities: some specimens were sent to Clermont-Ferrand, Poitiers, and Paris. [82] In 1877, a fisherman was hired by the *Faculté des sciences* (Paris), to guard the laboratory, maintain the equipment, and start an official service of free delivery of fresh animals during the winter. Recipients only had to pay for shipping and send back jars and boxes. Between 1877 and 1891, 1,099 boxes were shipped with an average of two or three jars per box in France (Lyon, Grenoble, Besançon, Nancy, Clermont-Ferrand, Rennes, Lille, Poitiers, Bordeaux, Caen, Paris, Toulouse) and foreign countries (Geneva, Edinburgh, Moscow, Ghent). [83]

Until 1877, the laboratory was exclusively dedicated to research. No courses were taught. All students worked on research projects. In 1877, Lacaze-Duthiers decided to invite a few of his undergraduates at Roscoff. Lacaze-Duthiers legitimately thought that those students would be better-prepared professors as they would teach from their personal observations. [84] One of them, Yves Delage (1854-1920), became director of the station at Lacaze-Duthiers's death, in 1901.

It is between 1877 and 1881, while the laboratory was being permanently installed, that it acquired its dual mission of education and research:

> "The efficient preparation to the highest ranks of education, along with the research necessary to the progress of zoology, constitute now [1881] the two goals of the station." [85]

However, it is only in the summer of 1881 that students started coming to Roscoff to take formal courses: nine students from the *Faculté* came to get ready for their *licence ès sciences naturelles*; five students from the *École normale supérieure* came to prepare for the *agrégation de sciences naturelles* (biology and geology),

82 - Lacaze-Duthiers, *op. cit. in* n. 77, 345.

83 - Henri de Lacaze-Duthiers, Les laboratoires maritimes de Roscoff et de Banyuls-sur-Mer en 1891, *Archives de zoologie expérimentale et générale*, 9 (1891), 286.

84 - Lacaze-Duthiers, *op. cit. in* n. 81, 546.

85 - "*La préparation effective aux grades élevés de l'enseignement supérieur, à côté des recherches nécessaires aux progrès de la zoologie, voilà le double but que se donne maintenant la station.*" (*Ibid.*, 546 [my translation].)

which had just been created by Edmond Perrier and the botanist Gaston Bonnier (1853-1922).[86] The *agrégation* is a competitive examination allowing top students to teach in high schools, preparatory schools, and, occasionally, universities.

In 1881, the *Laboratoire de zoologie expérimentale* became officially part of the *Faculté des sciences* (Paris), and the construction of a new station began in Banyuls-sur-Mer, by the Mediterranean. Lacaze-Duthiers needed a marine laboratory for the winter: the first 18 visitors (including three Americans and one Swiss) came in 1883.[87]

Discussion

1872-1881 : The visitors of the station

From 1872 to 1881, the station hosted 132 visitors (for 95 invididuals because 20 people came more than once), excluding one-day visits: 1872 (1), 1873 (3), 1874 (9), 1875 (9), 1876 (9), 1877 (9), 1878 (15), 1879 (20), 1880 (26), and 1881 (31). Of those 95 visitors, 77 were French (Parisian students from Romania and Greece are regarded here as French residents). Seven other nations were represented: Switzerland, with Fol (1874), Vogt (1874, 1875, 1876), Monnier (1875), Émile Yung (1878, 1879, 1881), and Maurice Bedot (1880); Belgium, with Fredericq (1876, 1878), Julien Fraipont (1879), Varem (1879), and an unidentified researcher (1881); the Netherlands, with Herbert (1879), Christiaan Loman (1879), and William John Vigelius (1881); England, with Murie (1875) and Frank Evers Beddard (1880); Scotland, with Patrick Geddes (1878, 1880) and an unidentified professor (1880); Russia, with Korotneff (1875, 1878); and the United States of America, with William A. Silliman (1881). The station was international, but French visitors were a majority every year (e.g., only 4 of the 26 visitors in 1880 were foreigners).

Also, every year, at least half of the visitors did not hold a doctorate or a faculty position. Most were students, but a few amateurs worked at the station, such as L. Mourmichez, retired physician, in 1881. Until 1881, students came to the station to do research. Most students held a *licence*, which allowed them to pursue a doctorate. Among the graduates from this first decade were:

86 - Lacaze-Duthiers, *op. cit. in* n. 81, 545.
87 - Lacaze-Duthiers, *op. cit. in* n. 14, 371.

Schneider (1876), professor of zoology and botany at the *Faculté des sciences* (Poitiers); Joliet (1877), professor of zoology at the *Faculté des sciences* (Paris); Viguier (1879), founder of a zoological station at Algiers in 1879; Cosmovici (1880), professor of zoology in Romania; Delage (1881); Joyeux-Laffuie (1882), professor of zoology at the *Faculté des sciences* (Caen). Lacaze-Duthiers's system was clearly efficient and fruitful as he clearly trained many of the professional zoologists of the next generation. [88]

Lacaze-Duthiers's Register for the station also provides us with invaluable information on the life at the station. On average, people stayed for a month and a half. People emphasized the freedom, nice atmosphere, and great conditions. Many workers thanked the *préparateur* (laboratory assistant) who had to make sure that everything was working smoothly (successively Lemire, Villot, Joliet, Delage, and Camus). Also, many workers thanked the fishermen of the station for getting good material. Back then, the station was a fairly familial community: in fact, some scientists, such as Vogt, came with their family.

Towards community-based marine laboratories

The laboratory traditionally regarded as the first marine station was not opened to the community. The laboratory created in 1843 in Ostend by Pierre-Joseph Van Beneden, professor of zoology at the University of Louvain, consisted of a single room mainly used by him and later his son Édouard. It was not officially opened to guest investigators even though a few scientists visited him. [89]

The first marine laboratory truly opened to visitors was created in 1859, by Victor Coste, in Concarneau. [90] Mainly dedicated to

88 - Not only Lacaze-Duthiers worked extremely hard at providing students with opportunities to do research in good conditions, at Roscoff and later at Banyuls-sur-Mer, but he also supported them for getting faculty positions early in their career, as shown in his correspondence with Léon Fredericq: Marcel Florkin, Jean Théodoridès, Henri de Lacaze-Duthiers et Léon Fredericq: Correspondance (1876-1900), *Archives internationales de physiologie et de biochimie*, 90 (1982), 1-94.

89 - Sand, *op. cit. in* n. 1, 126. A biography of Van Beneden was published by Adolphe Kemna, *P. J. Van Beneden: La vie et l'œuvre d'un zoologiste* (Anvers, 1897).

90 - Coste himself provided interesting historical information on his laboratory in Concarneau: Victor Coste, Histoire naturelle: Études sur les mœurs et sur la génération d'un certain nombre d'animaux marins, *Comptes Rendus hebdomadaires des séances de l'Académie des sciences, Paris*, 1858 (1858), 45-51; Id., *Voyage d'exploration sur le littoral de la France et de l'Italie*, 2nd edition (Paris, 1861); Id., M. Éd. Van Beneden fait présenter par M. Coste une note sur un scolex de cestoïde trouvé

fish farming (there were 70 tanks with running sea water), it was also opened for non-applied research:

> "Several naturalists, French or international, already came to this laboratory and engaged, in complete freedom, in the research that pleased them. Mr Coste offers the same hospitality to all the people who wish to benefit from it." [91]

Among the visitors were: Armand Moreau (1861), Charles Robin (1866, 1867), and Édouard Van Beneden (1870). The laboratory at Concarneau is the oldest one in the world still in use (Van Beneden's laboratory was abandoned in 1895).

Although Coste's marine station opened in 1859, it is only starting 1870 that stations were created worldwide with the specific goal of being opened to the scientific community (15 stations were founded between 1870 and 1879). [92] Lacaze-Duthiers's laboratory illustrates well that transition. The observations that he made between 1853 and 1870 in his itinerant, marine laboratory yielded dozens of publications. However, before 1870, he was alone in his laboratory. What suddenly changed in 1872 was that he decided to open his laboratory to others.

The last few decades of the 19th century marked the golden era of scientific societies. [93] Although marine laboratories differ from scientific societies, they reflect a similar trend: communities of people getting together to share knowledge and practice science. In fact, Raf De Bont made the very interesting remark that "natural history societies and biological stations shared one prototypical activity: the excursion." [94] Indeed, an excursion

chez un dauphin, *Revue et magasin de zoologie pure et appliquée*, 20 (1868), 464-465. Additional information can be found in: *Enquêtes…*, *op. cit. in* n. 1, 38; Sand, *op. cit. in* n. 1, 137; Kofoid, *op. cit. in* n. 1, 88.

91 - "*Déjà plusieurs naturalistes, français ou étrangers, sont venus s'installer dans ce laboratoire et s'y sont livrés, en toute liberté, aux recherches qu'il leur a plu d'entreprendre. M. Coste offre la même hospitalité à tous ceux qui sont disposés à en profiter.*" (Louis Figuier, Le laboratoire vivant de Concarneau, créé par M. Coste, *L'Année scientifique et industrielle*, 12 (1868), 332 [my translation].)

92 - For a list of those stations, see n. 1.

93 - One of the best analyses of scientific societies in France was published by Jean-Pierre Chaline, *Sociabilité et érudition: Les sociétés savantes en France* (Paris: Comité des travaux historiques et scientifiques, 1995). French botanists and their botanical societies were studied by Benoît Dayrat, *Les Botanistes et la flore de France, trois siècles de découvertes* (Paris: Muséum national d'histoire naturelle, 2003).

94 - De Bont, *op. cit. in* n. 2, 44.

required for people to get together and go into the field in order to observe living organisms in their habitat, a goal which is the core of the early marine laboratories.

Lacaze-Duthiers's central role in the development of marine stations and marine zoology in France

France was the country in which the most stations (16) were created before 1900. Although it was not the first one, the laboratory at Roscoff was the most influential in France. The three laboratories created before 1872 in France had a limited impact. In its early years, Coste's laboratory at Concarneau was significantly less visited than Roscoff. The use of the laboratory at Arcachon, managed by the *Société scientifique*, was limited before 1881; it briefly hosted the physiologist Paul Bert in 1867 but was abandoned in 1870.[95] The *Laboratoire de zoologie marine* opened in Marseille in 1869 was for local professors and students.[96]

Reconstructing the network of connections among French stations and visitors should be the object of an independent study. Only the most obvious links with Lacaze-Duthiers are indicated here, which clearly show that Lacaze-Duthiers and especially his laboratory at Roscoff played a key role in the development of new marine stations in France.

The marine laboratory at Wimereux (1874) was created by Giard, one of Lacaze-Duthiers's students, who worked at Roscoff in 1870, 1871, and 1873.[97] Delage, also a student of Lacaze-Duthiers, first went to Roscoff in 1877, obtained his doctorate in 1881, and became the director of the marine laboratory at Luc-sur-Mer in 1883. He became the director of the station at Roscoff at Lacaze-Duthiers's death.[98] Most of his work performed at Luc-sur-Mer was published in the *Archives de zoologie expérimentale et générale*. The next director of the station at Luc-sur-Mer, Jean Joyeux-Laffuie, was also a student of Lacaze-Duthiers and worked at Roscoff from 1877 to 1881.[99]

95 - Sand, *op. cit. in* n. 1, 138; Kofoid, *op. cit. in* n. 1, 81.
96 - *Enquêtes…*, *op. cit. in* n. 1, 58; Sand, *op. cit. in* n. 1, 151; Kofoid, *op. cit. in* n. 1, 56.
97 - *Enquêtes…*, *op. cit. in* n. 1, 77; Sand, *op. cit. in* n. 1, 127; Kofoid, *op. cit. in* n. 1, 126. The laboratory at Wimereux also is one of the two marine stations (with Naples) compared in detail by De Bont, *op. cit. in* n. 2.
98 - *Enquêtes…*, *op. cit. in* n. 1, 51; Sand, *op. cit. in* n. 1, 131; Kofoid, *op. cit. in* n. 1, 116.
99 - *Enquêtes…*, *op. cit. in* n. 1, 1.

Herman Fol, who created marine laboratories at Nice (1878) and Villefranche-sur-Mer (1880), worked at Roscoff in 1874. Fol's laboratory in Villefranche-sur-Mer, abandoned in 1882 due to cholera, was replaced by a new station under Jules Barrois, which Fol joined in 1886. Korotneff, who worked at Roscoff in 1876, installed another station in Villefranche-sur-Mer in 1882.[100] The *Laboratoire Arago* was created at Banyuls (1881) by Lacaze-Duthiers himself.[101] The marine station at Tatihou was created in 1881 by Perrier as a laboratory attached to the *Muséum national d'histoire naturelle.*[102] Perrier was one of Lacaze-Duthiers's closest students: they were the only two people in Roscoff in 1872. The laboratory of Cette created in 1881 by Armand Sabatier, professor at the *Faculté des sciences* (Montpellier), does not seem to be directly linked to Lacaze-Duthiers. However, Vogt and Fol, who both worked at Roscoff, also did some research in Cette.[103] The marine laboratory at Le Havre (1882) was attached to the *Laboratoire de physiologie expérimentale* of the *Faculté des sciences* (Paris), under the direction of Paul Bert and was closed at his death in 1886.[104] The *Station aquicole* created by the municipality at Boulogne-sur-Mer (1884) primarily targeted fisheries.[105] A marine laboratory was created in the Sables-d'Olonne in 1887. In the 1890s, its director was Amédée Odin, mayor of the Sables-d'Olonne, pharmacist, and a naturalist involved in scientific societies. It was primarily intended for fisheries.[106] A laboratory was created at Le Portel (1888) by Paul Hallez when Giard's laboratory at Wimereux became part of the *Faculté des sciences* (Paris) (because Giard transferred to Paris). Before he became professor at Lille, Hallez was Giard's *préparateur* and was thus indirectly linked to Lacaze-Duthiers.[107] The Mediterranean marine laboratory at Tamaris (1891) was created by the zoologist Raphaël Dubois, professor at the *Faculté des sciences* (Lyon). Although it

100 - *Enquêtes…*, *op. cit. in* n. 1, 66; Sand, *op. cit. in* n. 1, 205; Kofoid, *op. cit. in* n. 1, 49.
101 - Sand, *op. cit. in* n. 1, 145; Kofoid, *op. cit. in* n. 1, 67.
102 - Sand, *op. cit. in* n. 1, 131; Kofoid, *op. cit. in* n. 1, 109; Lamy *et al.*, *op. cit. in* n. 4.
103 - *Enquêtes…*, *op. cit. in* n. 1, 33; Sand, *op. cit. in* n. 1, 150; Kofoid, *op. cit. in* n. 1, 60.
104 - *Enquêtes…*, *op. cit. in* n. 1, 43; Sand, *op. cit. in* n. 1, 130; Kofoid, *op. cit. in* n. 1, 143.
105 - Sand, *op. cit. in* n. 1, 128; Kofoid, *op. cit. in* n. 1, 123.
106 - Séverine Béchet, Le laboratoire zoologique maritime des Sables-d'Olonne (1887-1913), in *La Nature pour passion* (Paris: Somogy éditions d'art, 2014), 96-101.
107 - Sand, *op. cit. in* n. 1, 128; Kofoid, *op. cit. in* n. 1, 120; Paul Hallez, Le laboratoire maritime de zoologie du Portel, Pas-de-Calais, *Revue internationale d'enseignement*, 34 (1897), 293-298.

is not directly linked to Lacaze-Duthiers, the station inherited Fol's equipment from Villefranche-sur-Mer.[108] Finally, the *Station de botanique et de zoologie maritime* created at Dieppe (1894) by Constant Houlbert (1857-1947), high-school teacher, was abandoned in 1896. It was part of the *Collège de France*.[109]

This brief review of the creation of the marine stations in France in the 19th century shows the central role of Lacaze-Duthiers, and especially the key importance of his laboratory at Roscoff. Creating a marine laboratory at Roscoff in 1872 was probably one of his most brilliant decisions and Lacaze-Duthiers's legacy lies in the numerous marine stations that he and his students created in the last quarter of the 19th century. Those stations not only instilled passion for marine life in generations of students, but also provided generations of researchers with invaluable research facilities. As one of the first marine zoologists in France, Lacaze-Duthiers played a major role in promoting marine zoology, a new form of zoology that needed to take place on the seashore.

Studies on the early history of marine stations around the world

Detailed historical information is available only for a handful of the 60 marine stations created in the second half of the 19th century. Additional historical studies on each marine station would help understand the factors that led to their emergence starting 1870. Historical data on individual stations should ideally address similar questions so that stations can be compared, such as: the original sponsoring institution, the background of individual founders and first directors, the original purpose (teaching, research), funding, criteria used for selecting a location, administrative organization, facilities, equipment, personnel, visitors, guest capacities and logistics, instruction, research, and whether the station is still in use.

Once such questions are addressed for more stations, one could start answering questions of broader interest, such as: What were the features shared by all stations? Did some stations have unique characteristics? What was the relative importance of local *versus* global factors in the emergence of stations starting

108 - Sand, *op. cit. in* n. 1, 202; Kofoid, *op. cit. in* n. 1, 55; Bange, *op. cit. in* n. 4.
109 - Sand, *op. cit. in* n. 1, 130.

1870? Are there reasons that could explain why some stations have been maintained, and why some other stations have been abandoned? Was there a communication network among stations and people visiting them? Did connections among scientists play any role in the rapid multiplication of marine stations starting 1870?

Jack drew a diagram representing a genealogy of United States Biological Stations, with lines originating from two top names: Anton Dohrn and Louis Agassiz.[110] Connections proposed by Jack are simple because he considered only a few scientists and a few stations. However, our vision of the development of marine stations at the end of the 19th century would certainly become much more complex if many stations and people were taken into account: Sir E. Ray Lankaster at Plymouth, William A. Herdman at Liverpool, Ernst Ehrenbaum at Helgoland, Fridtjof Nansen and JØrgen Brunchorst at Bergen, Sven Lovén at Kristineberg, Ambrosius Hubrecht in the Netherlands, José Rioja Martin at Santander, and Alexandre Kowalevsky at Sebastopol. And many additional names of people and places could be cited. If we were to consider the many scientists who worked in marine stations worldwide, we would undoubtedly obtain a complicated network of connections, instead of simple genealogical lines. It is thus essential that the history of other stations be studied for us to better understand the early development of marine stations around the world.

110 - Jack, *op. cit. in* n. 1, 64.