Belgium and the Early Development of Modern Oceanography, Including a Note on A.F. Renard

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1 Introduction

Our knowledge of the oceans has expanded gradually. At first seamen almost exclusively gathered geographical information. Charts were drawn and explorations were planned in conjunction with economic and naval interests. During the golden ages of the 16th and early 17th centuries, Flemish geographers were famous: Mercator (1512-1594), Ortelius (1527-1598), Plancius (1552-1622). Flemish sailors took part in the discovery of unknown parts of the oceans. Examples are Simon de Gordes (?-1600; Strait of Magellan), Lemoine (1545-1625; Cape Horn), Pancius (1552-1622; Indonesia) and Jan Seghers who wintered in Spitzbergen in 1666. Following this period, the Flemish stayed away from the development of maritime activities because of religious wars and political instability. During the 18th and 19th centuries, in the maritime nations, population increase, food requirements, colonial politics, and overseas trade induced growing interest in ocean sciences. Specialized expeditions were sent out to gather geographical, physical, chemical and biological data. Besides the navy, these expeditions were also supported by academies and scientific societies.

After the independence of Belgium (1830), renewed maritime activities became possible. The reconstruction of Antwerp harbor some years earlier by Napoleon, who used it as an important military base for the invasion of England, helped greatly. But most of the exploration and scientific activities overseas were devoted to the African continent where, at the end of the century, Belgium established an important and rich colony.

During the 19th century the need for scientific knowledge increased at universities as well as at academies and scientific societies; such institutions became

the centers of education and research. In Belgium, fundamental research was devoted to the marine environment. The fame of some Belgian scientists gave them the opportunity to be associated with foreign oceanographic expeditions. Scientists worked also in biological marine stations, at the Belgian coast or abroad. All these research activities at universities, scientific institutions and by individual endeavor, some at the level of international scientific collaboration, provided an important and fundamental basis for progress in our knowledge of the oceans.

The aim of this paper is to describe the contributions of Belgium to the early development of ocean sciences.

2 Belgium and the History of Modern Oceanography

Much of the progess in oceanography is promoted by international organizations. In oceanography, as in meteorology, international cooperation is necessary for a better understanding of global systems. Matthew Fontaine Maury (1806-1873), head of the Naval Observatory (United States), had in 1839 started to compile meteorological and oceanographical data from the logbooks of navy and merchant ships. From these data he deduced surface currents and winds from which he drew charts. In exchange for raw data he provided cooperating ships' captains with his charts, which the sailors could use to select better courses and save sailing time. To handle all the data, and to achieve a better areal coverage and precision, Maury organized the first bank for environmental parameters. Increased efficiency, however, was only possible through international cooperation. Therefore he organized the "First International Science Conference on Oceanography" in Brussels in 1853 to stimulate cooperation, exchange and standardization of weather and oceanographical data. This meeting is commonly accepted as an important turning point in oceanography.

3 The Development of Zoology and the Marine Sciences in Belgium

Research on marine life was at first based on preserved specimens collected on the shore. Scientists concerned with descriptive and experimental work, especially at a time when techniques like microscopy became popular, were more and more attracted by field work and by aquaria where freshly collected or dredged specimens could be kept alive. Many biological stations were established along the European coasts during the second half of the 19th century. The first was established on the Belgian coast at Ostend in 1843 by Pierre Joseph Van Beneden (1809-1894), a promotor of zoology in Belgium. Pharmacist and medic, he turned to zoology and studied in Paris with Cuvier. Although he specialized in crustaceans, both fossil and recent, he also worked on many other invertebrates (hydroids, bryozoans, molluscs, annelids, platyhelminths, ascidians) of the Belgian coast in his self-financed laboratory at Ostend, which was located near

an oyster farm and close to the fishing harbor. Thus specimens as well as information about the sea and the seabed were gathered by professionals. The Ostend laboratory very soon became famous. Van Beneden welcomed many leading foreign scientists of the time: Ehrenberg, Johannes Müller, Max Schultze, Quatrefages, Liebig, Greef and Lacaze-Duthiers. (Lacaze-Duthiers, some years later (1872), founded on behalf of the Sorbonne of Paris, the Station Biologique de Roscoff in Brittany on the coast of the English Channel; and some time later, the laboratory at Banyuls on the Mediterranean coast.)

Among the pioneer works on living marine specimens, P. J. Van Beneden demonstrated the life cycle of a cestode and thus refuted the Aristotelian dogma of spontaneous generation, a theory which was also criticized by Pasteur some years later.

A student of Van Beneden, G. Gilson (1859-1944), at the Catholic University of Louvain continued the work at the North Sea coast after Van Beneden's death. He organized, also using his own money, a laboratory at Ostend where, about 1900, he started the systematic exploration of the Southern Bight of the North Sea which he called the Flemish Sea. Dredgings, plankton, fishing and basic hydrology (temperature, salinity, currents, etc.) were carried out. Later, when he became director of the Musée Royal d'Histoire Naturelle in Brussels, the Ostend laboratory was taken over by the museum (1927) and renamed Institute d'Etudes Maritimes. Material collected during the exploration of the Belgian coast was added to the collections of the museum. Through Gilson's work Belgium became active in North Sea research and therefore closely associated with the establishment of the Interntional Council for the Exploration of the Sea (ICES) in Copenhagen.

A son, Edouard Van Beneden (1846-1910), also a zoologist, succeeded the first professor of zoology at the University of Liège, an entomologist called Lacordaire. There he developed a renowned school of embryology working mainly with tunicates and cerianthids dredged along the Belgian coast. The students of E. Van Beneden visited different marine laboratories—such as Wimereux, Roscoff and Banyuls in France and Naples in Italy. Among them were: Charles Julin (1857-1930) studying tunicates, Paul Cerfontaine (1864-1917) who was concerned with the embryology of *Amphioxus* and also published a posthumous work of Van Beneden on cerianthids, and Désiré Damas (1877-1959).

The work of Damas on appendicularians led him to the biological stations of Helgoland in Germany and Dröbak and Bergen in Norway. When in Dröbak, Damas met the Norwegian oceanographer, Johan Hjort, and sailed with him on the *Michael Sars*. He then turned tc biological oceanography and contributed well recognized papers on the copepods of the Norwegian Sea (1905), on the micro- and mesoplankton distribution (1909), on fish eggs and fish growth, and on the biology of the Gadidae (1909), the most fished species in the northeast Atlantic. In 1905, Damas also participated in an expedition of the Duc d'Orléans in the North Atlantic, an expedition led by A. de Gerlache (see below). At the end of his long stay in Norway (1904-1909) Damas became assistant and later professor at the Bergen Institute of Oceanography whose director at that time was Helland-Hansen. Back in Belgium, Damas helped Gilson for some time in his

investigation of the southern North Sea, but very soon left because of disagreements. The death of E. Van Beneden in 1910 gave Damas the opportunity to join the University of Liège where he managed to continue work on the marine fauna at the Belgian coast. He kept a small trawler at Blankenberghe, where he had a maritime laboratory. When the boat was put up in Liège for the winter, he undertook limnological work in the Meuse River. This led him to start a career in limnology. In 1922 Damas representing the University of Liège participated in a cruise organized by Helland-Hansen in the northeast Atlantic down to the African coast.

At the State University of Ghent, at the time of its foundation in 1835, the professor teaching zoology and anatomy, François-Joseph Cantraine (1801-1863) had studied in Holland with Temminck. He may be considered the first marine zoologist in Belgium. After having travelled through all Europe, he focused his interests on the Mediterranean Sea. He described a new species of fish and produced a memoir on Mediterranean malacology (1840) which included some ecological and ethological observations. At the University of Ghent, further development of the biological sciences was almost exclusively in physiology. Among the more typical marine works were Victor Willem's (1866-1952) field observations and Omer Van Der Stricht's (1862-1925) studies on the fertilization and maturation in sea planarians.

At the Free University of Brussels, the early development of zoology was entirely in the hands of medics until one of them, E. Yseux, included on his staff former students from Brussels like Brachet, Francotte, Lameere and de Selys Lonchamps who went to Liège to specialize with Van Beneden.

Another zoologist, a graduate of the University of Brussels, Georges Albert Boulenger (1858-1937) joined Louis Dollo (1857-1931) who is well known for his works on dinosaurs, at the Musée Royal d'Histoire Naturelle. In close contact with the Englishman Moseley, he was very much influenced by the *Challenger* discoveries. He contributed to the ichthyology of Antarctic waters when studying collections from the Belgian Antarctic Expedition on the *Belgica* (see below). He discussed zoogeographical theories concerning the cold water fauna and refuted the bipolarity theory proposed by Pfeffer (1890) and Murray (1896). Boulenger, who became a specialist of African ichthyology, went to London to work with Gunther at the British Museum and stayed there for the rest of his life. He published 876 papers devoted to herpetology and ichthyology, especially their systematics. For fish alone he described no fewer than 1096 species, chiefly from African fresh water.

On returning from Liège, A. Brachet set up a very fine school of embryology in Brussels while Auguste Lameere (1864-1942), helped by Francotte and de Selys Lonchamps, developed the zoological sciences. Lameere, an excellent professor and gifted zoologist, was mostly concerned with the land and freshwater faunas and entomology. His few marine works at the Station Biologique de Roscoff were on dicyemids, parasites of cephalopods. Later Lameere paid more attention to freshwater biology when he became director of the Station Biologique d'Overmeire, founded by Rousseau and located near the lakes of the

Scheldt valley. His masterpiece was the *Manuel de la Faune de Belgique*, with the first volume appearing in 1895. The marine and littoral fauna of Belgium is extensively described for the first time. The material had been assembled during collecting parties organized with the botanist Jean Massart (see below). Lameere's assistant, Marc de Selys Lonchamps, worked on tunicates and phoronids and contributed monographs on those groups to the famous *Fauna und Flora des Golfes von Neaples* (1903). He collaborated too in handling the zoological specimens from the *Belgica* Antarctic Expedition.

One cannot ignore the enormous contributions of the well-known malacologist Pelseneer, who was, according to many people, the most prominent zoologist there has ever been in Belgium. Certainly he was the most "marine" one. Born in a middle-class, well-educated family, the primary education of Pelseneer was enriched by studying music and painting with artist friends of his parents. With them too he took pleasure in collecting plants and exploring the Belgian coast during holidays. A young marine biologist was born. At the Athénée, the public secondary school, his science teacher, himself, a botanist and a malacologist, stimulated the enthusiasm of his pupil. At the age of 17 Pelseneer accumulated a very fine shell collection from the Belgian coast for the Malacological Society. During the following years he published many papers dealing with the littoral fauna and organized dredgings in order to add to his faunistic data. Like Lameere whom he met as a student at the University of Brussels, Pelseneer was familiar with the theories of Lamarck and Darwin which were then strongly resisted in Belgium. After getting his doctorate (1884), Pelseneer completed his training by visiting the laboratory of Alfred Giard in Lille (France) and University College in London where he worked with Ray Lankester and met Thomas Huxley, both strongly Darwinist. They taught him morphology and phylogeny with an evolutionary outlook. The relations of Pelseneer with Giard and his school were deep and permanent. During his summer he joined them at the laboratory of Wimereux where soft and rocky shores provide a rich research area. His contacts with his English mentors were also excellent. Thomas Huxley associated him with his works on *Spirula* and Ray Lankester asked him to write the volume on molluscs for his well known "Treatise on Zoology" (1907). In contrast with his extremely well recognized scientific activities, much appreciated abroad, his career and research facilities in Belgium were more limited. After having occupied the provisional position of stagiaire at the Musée Royal d'Histoire Naturelle, where he was never appointed, he left for the Zoological Station at Naples to prepare his thesis at the University of Brussels in 1888 where he then started two courses: biological oceanography and biology of molluscs. For financial reasons, the University could not afford to pay for a second professor in zoology. Pelseneer left the University and, waiting for better days, found a job as teacher of chemistry in a secondary school. In both state universities of Ghent and Liège, each time a position became vacant in zoology, the Catholic government rejected his candidacy because of his philosophical opinions. Supported by the numerous prizes, doctorate *honoris causa* and affiliations to many academies and scientific societies, and in spite of his low rank in the Belgian education

system, he was nominated in 1919 to the position of *secrétaire perpétuel* of the Académie Royale de Belgique.

To summarize the scientific contributions of Pelseneer is a difficult and long task. Most of his work is devoted to the molluscs, covering morphology, phylogeny, ethology, ecology, zoogeography and even genetics. All groups of molluscs were examined. The studies in biology led him to analyze the relations of animals with the environment, a way of thinking relatively new for the period. His ecological contributions concerned temperature and salinity adaptations, estuarine life, larval dispersion by currents, etc. His analysis of molluscs taken on the worldwide expeditions of the *Challenger*, of the *Siboga* in the Far East and of the *Belgica* in the Antarctic gave him material to understand their world distribution. He took part in the major zoogeographical discussions of the times; he argued about the Weber line between Asia and Australia, discussed the origin of the freshwater and lake fauna, and refuted the theory of bipolarity of Pfeffer and Murray for which he proposed an alternative theory. Among his numerous titles and honors, Pelseneer was also elected as member of the Council of the Institut Océanographique in Paris.

4 The Development of Botany and the Marine Sciences in Belgium

The study of marine algae started with the *Flore cryptogamique complète des deux Flandres* by Jan Kickx (1803-1864), professor of botany at the University of Ghent. At the same time, Charles Morren (1807-1858), from the University of Liège showed some interest in algae. An early study on marine plankton included the observations of L. F. Verhaeghe on the phosphorescence of *Noctiluca* which he communicated to the Academy in 1848. The main contribution of Belgian botany to early oceanography was produced by a rich "autodidact," a talented microscopist from Antwerp called Henri Ferdinand Van Heurk (1838-1909). He accumulated an enormous number of plankton samples from the North Sea for diatom studies. The nicely illustrated *Synopsis des Diatomées de Belgique* (1880-1885) and the *Traité des Diatomées* remain classical reference books. Alphonse Meunier (1857-1918), professor at the University of Louvain, also contributed to the knowledge of phytoplankton in the North Sea with four voluminous memoirs illustrated with abundant plates. He also analyzed plankton samples taken in Arctic waters by the *Belgica* Expedition of the Duc d'Orléans.

The macroalgae received some attention from E. de Wildeman (1866-1947), a student of Léon Errera at the University of Brussels. When he joined the State Botanical Garden, he took charge of the department of cryptograms. He published a flora including the Belgian algae and carried out some work on overseas algae among which were those collected in the Antarctic by the *Belgica* Expedition. Another important algologist was Jean Chalon (1846-1921), a secondary school teacher from Manur, who studied the macroalgae from the rocky shores of Brittany (France) especially at the Station Biologique de Roscoff. It is interesting to note that Chalon was one of the first and most generous donors to support financially this young station. Thanks to his initiative Belgian scientists

started to visit and use more and more regularly the facilities available at Roscoff. Since then and with the financial help of the Belgian government, a research table is available there for Belgian scientists.

At the University of Brussels, Jean Massart (1865-1925) professor of botany, associated with the zoologist A. Lameere and some other collaborators such as the medic and botanist Jean De Meyer, the geographer Hegenscheidt and the entomologist G. Severin, organized field explorations throughout the country, the *laboratoire ambulant.* They explored also in detail the Belgian coast where there are soft bottom shores, dunes and saltmarshes. This systematic herborization provided Massart with abundant material for a phytogeographical analyses which led to the publication of his masterpiece, *Esquisse de la Géographie botanique des districts littoraux et alluviaux de Belgique* (1907), in which he defined geomorphological and phytosociological environments such as the "slikke" and the "schorre" terms still in use today to describe mudflats. Together with Blommer, Massart also published in 1904 a huge photographic album describing the typical phytosociological patterns of vegetation in Belgium including dunes and saltmarshes. Familiar with the Wimereux laboratory, Massart took part in shore exploration and participated in the recognition of zonation patterns of algae on the rocky shores. During World War I, a large part of the lowlands along the Belgian coast in the vicinity of the estuary of the Yser River near Nieuwpoort were flooded by the sea when dikes and sluices were destroyed. After the war, Massart installed a botanical laboratory at Nieuwpoort for organizing the reclamation and recolonization of plants in the battlefields where the environment remained salty for many years.

5 Belgian Deep-Sea Expeditions

Except for some local and limited fishing and dredging cruises off the Belgian coasts, there was no participation in the exploration of the oceans until the Belgian Antarctic Expedition at the end of the 19th century (1897-1899). This expedition was proposed and organized by Adrien de Gerlache de Gomery (1866-1934). Deeply attracted by the sea de Gerlache left the university (he was a student in applied sciences at the University of Brussels) and started to sail, in 1883, on world-wide trading ships. Back in Belgium in 1890 he settled down for a while and became lieutenant on the state-owned ferries of the Ostend-Dover line. Willing to live more actively, he offered his services, but without success to King Leopold II and to Stanley at the time they organized the exploration of the Congo. He then asked the Norwegian Nordenskjold whether he could join his expedition to the Antarctic, but was not accepted. Influenced by numerous efforts in polar research developed in other European countries such as Holland, Denmark, Norway and Sweden, he started thinking about organizing a Belgian Antarctic expedition. He set forth his plans before the Société Royal Belge de Géographie and collected enthusiastic support from its members and also from other scientists such as Van Beneden, Pelseneer and Renard. The project was finally accepted at the end of 1894 and immediately de Gerlache started with his

preparations. For training he sailed on fishing boats to Jan Mayen and Spitzbergen. He visited also a specialist in Arctic navigation and oceanography, Nansen. In 1896 funds having been raised by subscription, with some governmental help (but with no support from the Crown) and especially from private donors (among them E. Solvay, Lady Osterrieth, Errera, Brugmann, the Baron Lambert . . .) a three masted barque, an ex-Norwegian seal hunter, was purchased. She was 30 m long with a tonnage of 336 tons and equipped with a 35 HP engine. Arriving in Antwerp in July 1897, she was renamed *Belgica* and sailed for the Antarctic one month later after a short refit. The crew was international. The first mate was the Belgian G. Lecointe (1869-1929) and the second mate was Norwegian Roald Amundsen (1872-1928) who became famous after reaching the South Pole in 1911. The surgeon and photographer, an American, Frederick Cook, joined during the *Belgica*'s call in Rio. The scientific party was composed of the Belgian Emile Danco (1869-1898), a physicist, the Romanian E. Racovitza, a naturalist, and the Poles A. Dobrowolski and H. Arctowski, geologists and meteorologists. Initially, the program was scheduled to last for two years with a return to Melbourne during the winter . . . Caught in the ice, they escaped further south but remained trapped for the entire winter. This was the first winter man ever spent in the Antarctic. During the drift with the ice which took 13 months and covered about 2000 km, the southernmost position reached was 71°36'S and the lowest air temperature recorded was minus 43.1°C. Freed from the ice on 14 March 1899, the *Belgica* sailed immediately back to Belgium where she arrived on the 5th of November. Although shortened by this unintended wintering, the expedition could not continue longer because of a shortage of funds, but nevertheless it brought back very valuable material. The scientific results dealing with physics, meteorology, oceanography, geology, botany and zoology were contributed by more than 80 scientists and have been published in a huge series called *Expedition antarctique Belge, Résultats du voyage du S.Y.* Belgica *en* 1897-1898-1899 *sous le commandement de A. de Gerlache de Gomery,* nine volumes appearing between 1901 and 1949.

Shortly after his return, de Gerlache delivered well-received lectures and wrote in 1902 a narrative of the expedition, a fine literary work, which received an award in France from the Académie Française. At the same period de Gerlache proposed many projects for deep-sea expeditions, some scientific, others commercial (export, fishing, whaling). In 1901 he sailed in the Persian Gulf commanding a Belgian 500-ton sailing yacht called *Selika.* The scientists on board were French, among them Charles Perez who later became director of the Station Biologique de Roscoff. De Gerlache also joined the Frenchman Jean Charcot who organized the first French Antarctic Expedition. However, after disagreements he left Charcot's ship *Le Français* in Brazil.

After his banishment from France in 1866, the Duc d'Orléans emigrated to England. He dreamed about oceanographic expeditions in Arctic waters. He engaged de Gerlache with his now famous ship *Belgica* in 1905 for a cruise along the east coast of Greenland to latitudes never before reached. After this first cruise in 1905 the Duc d'Orléans bought the *Belgica* which, still under the Belgian flag and with de Gerlache commanding, sailed in 1907 to explore the Kara Sea,

resulting in eleven scientific memoirs. A third polar expedition designed by the Duc d'Orléans and de Gerlache was launched in 1909 to visit the east coast of Greenland, Spitzbergen and François Joseph Land.

With all these Antarctic and Arctic activities in Belgium, it is not surprising that the First International Congress for the Study of Polar Regions was organized in Brussels (1906) and also the International Polar Commission was founded in 1908 with its headquarters there. However, de Gerlache, less appreciated in official circles in Belgium, did not become the Belgian delegate to this Commission until 1909. Abroad de Gerlache's fame was great. Sir Ernest Shackelton received much help from him when preparing the *Endurance* Expedition. In France, Charcot always declared that "he sailed in de Gerlache's wake" and Nansen, in Norway, was in close correspondence. Although he was never proposed for membership in the Académie Royale de Belgique, de Gerlache became a member of the Comité National de Géodésie et de Géophysique in 1920 and of the Comité National de Géographie in 1922. On the occasion of the 25th Anniversary of the *Belgica* Antarctic Expedition, the Société Géographique de France decorated him; and in 1929 he was elected a corresponding member of the French Académie des Sciences. De Gerlache, who became expert in maritime affairs for the Belgian government, died in 1934 after having given to Belgium a modern merchant navy school and a three-masted training ship. However, Belgium never gave him the opportunity to stimulate or develop deep-sea expeditions and oceanic research.

6 Belgium and the *Challenger* Expedition

The *Challenger* Expedition (1872-1876) initiated the era of modern oceanography. Much has been written on it at the occasion of the Second International Congress on the History of Oceanography held during the centenary of the *Challenger*. A tremendous amount of material collected world-wide and down to the greatest depths ever sounded became available to scientists. This global scale also generated evidence to support findings and theories on an ocean-wide scale; it represents a fundamental step in the evolution of science especially at a time when theories such as Darwin's were postulated as being universal.

The exploitation of the data and samples of the *Challenger* was also the first large-scale scientific program ever planned and completed. The geological and biological samples obtained from the 180 dredging or trawling stations represent a huge amount of material to be worked up. Not less than 7000 odd biological specimens were sorted, preserved and classified into the main systematic groups and given to specialists for study. About half of the species collected by the *Challenger* appeared to be new to science. Specialists for particular systematic groups, from many countries in the world were solicited. This intelligent policy developed by the organizer of the *Challenger* Expedition, Sir Wyville Thomson and later Murray, made possible the rapid and qualified analysis of all this unique and priceless material. Great names of non-British scientists were the Germans,

Haeckel, Hertwig, Kölliker, Selenka, Schultze, Von Ledenfield, Von Linstow, and others from France, Italy, Netherlands, Norway, Russia, United States, etc., such as: Agassiz, Hoek, Sars . . . Two Belgian scientists were among them. They both undertook a large part of *Challenger*'s work. P. Pelseneer took charge of all the molluscs. The other was A. F. Renard, a geologist and mineralogist, who studied all the deep-sea bottom deposits and the rocks collected on islands during shore parties.

Renard edited together with J. Murray, the most fundamental work on the deep ocean, "Report on Deep-Sea Deposits, based on the specimens collected during the voyage of the *Challenger*" published in 1891. Before the *Challenger* practically nothing was known about the deep ocean. This study on bottom deposits, with their mineralogical analysis, the identification of their origin, their distribution and the general classification of all ocean's deposits, is one of the most original and fundamental of the *Challenger*'s reports. It still remains a classic to which modern oceanographers frequently refer. The recent volume on "Oceanography, Concepts and History" edited by M. B. Deacon 1978 and devoted to the most prominent emergence of concepts leading to the development of modern oceanography, includes the paper by Murray and Renard "On the Nomenclature, Origin and Distribution of Deep-Sea Deposits." The basic distribution of the deposits and their classification is still in current use with only some minor changes and additions dealing mostly with coastal terrigenous and glacial sediments. It is interesting to note that Renard also analyzed among the huge *Challenger* material, the strange and locally abundant nodules containing such metals as manganese. These data on the deep sea answered most of the questions asked when the *Challenger*'s project was planned. They also brought to the attention of oceanographers, geologists and biologists information on the relationships between the physical and chemical environment and living organisms. The contribution of Murray and Renard may thus be considered as a fundamental step towards the emergence of modern oceanography, if not geochemistry and even ecology. Nowadays, very often, when referring to the *Challenger*'s deposits, only Murray's name is given; Renard's name is very seldom mentioned except when bibliographical references are quoted. Explanation for this could be that Murray's name is commonly associated with the deep sea among English speaking scientists since he published with the Norwegian J. Hjort another famous book on the subject called "The Depths of the Oceans" (1912). Murray (Merriman 1972) was also a central and important figure of the *Challenger* organization. Sir Wyville Thomson engaged him as naturalist while studying at Edinburgh. He took part in setting up the expedition and during the cruise he collected and observed the bottom deposits, the pelagic organisms, the vertebrates and the protozoans. After the cruise he helped Thomson in organizing the data and specimens and in publishing the results. When Sir Wyville died in 1882, Murray continued all these tasks including the publication of the results.

In Belgium too, although Renard was a fine geologist and mineralogist, his name is not very often mentioned. He became professor of geology and mineralogy at the University of Ghent. Some biographical notes, more or less detailed,

published during his life (1886), shortly after his death (1903, 1913), and later in 1953, shed some light on his education, research teaching and philosophic evolution. Although his contributions to geology and mineralogy, not to mention the *Challenger* work, were important and abundant (87 scientific titles), in the *Florilège des Sciences en Belgique* (a masterpiece published by the Académie Royale de Belgique of about a thousand pages devoted to the history of Sciences in Belgium during the 19th and early 20th centuries), the chapter dealing with the earth sciences give neither biographical information on Renard, nor an explanation of his scientific work! Just a few scattered sentences record that Renard published a chart of the ocean bottom in collaboration with Murray (p. 424), an allusion to other works in mineralogy (p. 425), and mention of a textbook written by him (p. 428). Today, three-quarters of a century after Renard's death, his name and work are ignored by many. In recognition of the importance of his contributions to the fields of marine geology and oceanography and the many consequences of his fundamental *Challenger* work, we will give a short biographical note on Renard with the intention of explaining how he became such an expert in mineralogy that Sir Wyville Thomson called him to Edinburgh to analyze the *Challenger* samples.

7 A. F. Renard, a Major Contributor to the Early Development of Marine Science

Education

Alphonse Françoise Renard, born in Renaix in 1842, was the son of a modest carpenter. At the age of 12 he worked in a factory. Two years later a Jesuit, noticing his intellectual ability, arranged for him to join the college (secondary school). In 1863 he became a Jesuit novice and in 1865 a priest. He worked then, from 1866 to 1870, as a teacher of German and English in a Jesuit college. At this time he started to study the sciences on his own. While staying at the Maria Laach Abbey in the Eifel, a volcanic region of Germany, he became interested in geology. There he obtained permission to continue studying science and went to the University of Vienna to specialize in chemistry and mineralogy. When Bismark expelled the Jesuits from the German empire (1872), Renard came back to Belgium and taught chemistry at the Jesuit college in Louvain. He combined religion, teaching and research in geology. This latter activity increased progressively and soon became his main occupation. This turning point in Renard's career transformed him from a young open-minded fellow with a strict Jesuit education, into one of the most eminent geologists of the 19th century.

Research

While studying in Germany and in Vienna, Renard came into close contact with leading personalities in mineralogy such as F. Zirkel. The latter was the founder of modern petrography and developed the microscopic examination of thin

sections in polarized light, a technique proposed for the first time some years before by the English Sorby (1862). Soon after Renard's return to Belgium, he became associated with Charles de la Vallée Poussin to study the eruptive rocks of Belgium and northern France. Renard carried out all the mineralogical observations while his associate was in charge of the stratigraphy. This work, commended by the Academy (1874) and published in 1876 is his first (during his career he produced 87 scientific titles contributing to the progress of geology, mineralogy, crystallography and oceanography). By the extensive use of tools like microscopy and microchemistry, Renard could undertake detailed analyses of rocks and, from their composition, deduce their origins and mechanism of formation and evolution. Renard's scientific work in geology is explained in some details in Buttgenback's notice published by the Académie Royale de Belgique in 1953. However, in the *Florilège des Sciences* published by the same Academy, very curiously, Fourmanier made almost no mention of Renard's works and influences on the development of geological sciences in Belgium and abroad. At that time Renard was fully involved with science. After July 1877 he was curator at the Musée Royal d'Histoire Naturelle in Brussels, a position that he kept until his voluntary resignation in November 1888. More and more active in research, Renard took little part in religious tasks. He left the Compagnie de Jèsus in 1883 but remained an ordinary secular priest. The aim of Wyville Thomson, when he called Renard to Edinburgh in 1878, was to get the help of a mineralogist to assist Murray in the examination and description of the marine deposits collected by the *Challenger*. Renard's career was already well advanced (12 titles) and well appreciated, especially in mineralogy and microscopy. The amount and the importance of Renard's work was such that it was arranged that a report on all available samples of deep sea deposits should be published conjointly by Murray and Renard. In 1881 and 1882, Renard spent several months in Edinburgh where he sorted and made preliminary examination of the samples. Descriptions and conclusions, including a discussion of the origin of the deposits and their universal classification, a huge amount of work, were issued in the penultimate volume of the official *Challenger* Reports in 1891. For Murray, this contribution ended a 20-year involvement with deep-sea deposits. For his part, Renard worked about 13 years on the project (1878-1891). He contributed to the entire volume (583 pages) except for Chapter IV. The introduction states that "Renard thinks it should be stated that the chapter IV dealing with the material of organic origin has been written wholly by M. Murray." In the field of deep-sea deposits, Renard produced seven other papers among which is a notice on the classification, formation and distribution of deep-sea sediments published in 1884 in the *Proceedings of the Royal Society of Edinburgh* and a similar paper in French, also in 1884, appeared in the *Bulletin du Musée Royal d'Histoire Naturelle de Belgique*. While working on the *Challenger*'s deep-sea samples, Renard was also given the responsibility of examining all the rocks collected from oceanic islands during the expedition. He started with a "Report on the Petrology of St. Paul Rocks" in the first volume of the narratives of the cruise published in 1882. Later he produced a concluding paper in the *Challenger*

Reports (1888) and no less than 18 others dealing with particular islands or rock formations.

Shortly after the Krakatoa eruption in 1883, Renard examined the ashes produced by this volcanic explosion. He explained their formation and their ability to disperse in the air to great distances. This contribution published in 1883 helped in understanding the deep-sea sediments of volcanic origin.

Some time later, when the Antarctic Expedition of the *Belgica* (1897-1899) returned to Belgium, he analyzed together with the geologist on board (Arctowski) all the bottom samples collected off the Antarctic continent. Renard describes them as terrigenous.

Academic Career

Most of the *Challenger* work of Renard occurred during the time he was curator at the Museum. In 1888 he left and became, after some controversy, professor at the State University of Ghent. Although he had left the Jesuits five year earlier but remained a priest, he met much antagonism among both Jesuits and Liberals, a powerful anticlerical political party in those days. Renard's teaching was of high quality in geology, mineralogy, crystallography, paleontology and physical geography including oceanography. His personal experience and numerous concontacts developed both with German and British scientists were a great help. His ideas for teaching at the university were very modern. Among other reforms he favored the intensive use of practical work, field work and personal research done by students. Renard also took part in officially recognizing a new science in Belgian universities: geography.

Renard's scientific activities led him to be elected correspondent of the Académie Royale de Belgique in 1882 and full member in 1898.

Many things were changing in science and philosophy at the end of the 19th century. Renard felt that his religious convictions became incompatible with his scientific beliefs. He became familiar with the growing theories and explanations on the origin and development of the earth and of life through his studies in geology (metamorphism . . .) and paleontology. These theories were opposed to numerous dogmas of the Catholic church.

Renard left the church completely in 1900, some time after his mother's death. He got married in London in 1901 and joined a free thinking society. He never took part, in these years, in politics although he supported free thinking. He managed to avoid personal involvement in the controversy related to his defection from the church. Some tried to get him out of his academic positions. Many newspapers in Belgium published very critical articles about him and his family.

These years were very hard for Renard since besides his philosophical conflicts, he suffered a long and painful illness. He used his last energies to translate into French one of Darwin's famous titles, "Geological Observations on the Volcanic Islands," explored during the *Beagle* expedition. This translation was published in 1902.

In July 1903, after a four-month-long agony, Renard died protected against an antagonistic work by his wife and close friends, among them Ernest Solvay and Adrien de Gerlache.

Belgium last one of its greatest scientists from the end of the 19th century, a great geologist and an oceanographer too.

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