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# A survey on the history of freshwater bryozoology in Belgium and Luxembourg

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## **1. B.C. Dumortier, a pioneer of bryozoology**

Belgian freshwater bryozoology began in 1835 when Barthélemy Charles Joseph Dumortier (1797-1878) (Figure 1) published in the 'Bulletin de l'Académie royale des Sciences et Belles-Lettres de Bruxelles' his '*Recherches sur l'anatomie et la physiologie des polypiers composés d'eau douce*'.<sup>1</sup>

According to G.J. Allman's<sup>2</sup> formulation in his *Monograph of the fresh-water Polyzoa*



Figure 1. Barthélemy Charles Dumortier (1797-1878) (from G. Lebrun, *Grandes figures de la Belgique indépendante*, Bruxelles, 1936).

(1856) it was 'a memoir on the "Polype à Panache" of Trembley'.<sup>3</sup> Dumortier had found this animal in 1834 near Brussels in the plain of Mon-Plaisir,<sup>4</sup> in the canal between Brussels and Ruppel.<sup>5</sup> And he had created a new genus and a new specific name for it: *Lophopus crystallinus*.

The reasons were summed up by Allman:

'This Polyzoon, which had been previously confounded with *Alcyonella*<sup>6</sup> and *Plumatella*, was believed by Dumortier to be sufficiently distinct to render it the type of a new genus, which he accordingly constituted, under the name of *Lophopus*. In consequence of using lenses of too low a power, Dumortier persuaded himself of the absence of cilia on the tentacula, and made this supposed fact the principal character in his new genus. Notwithstanding, however, the erroneous observation on which Dumortier thus relied, the separation of the "Polype à Panache" from the other fresh-water Polyzoa was an important step, and is fully borne out by its general structure.'

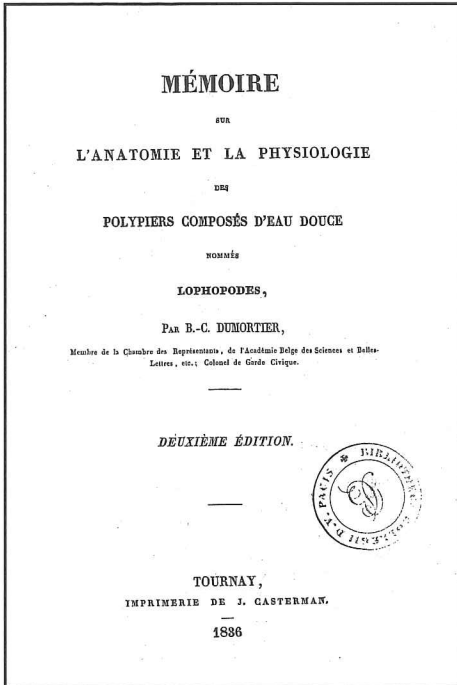


Figure 2. Second edition of Dumortier's memoir on the anatomy and physiology of the composed freshwater polyps called lophopods (1836).

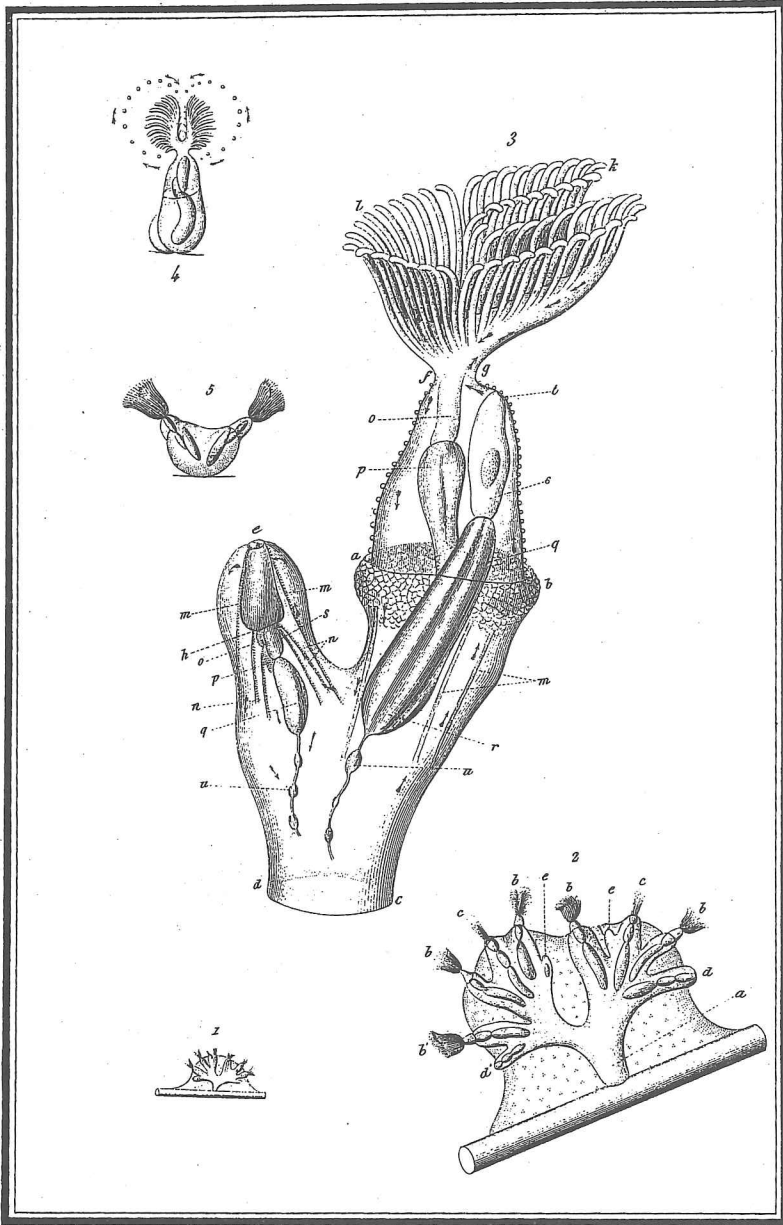
Later on Dumortier tried to justify his assertion concerning the alleged absence of tentacular cilia: due to the low power of his lenses he would not have seen the cilia themselves but however the effect they produced in the water.<sup>7</sup> In fact, in 1835 he had stated clearly that he had never seen any cilia: '*je n'ai jamais vu l'apparence de cils vibratiles*'.<sup>8</sup>

Eventually Allman emphasizes the general significance of Dumortier's work:

"The memoir of Dumortier is chiefly valuable as giving us the most complete account of the anatomy of the Polyzoa which had up to his time been published.<sup>9</sup> To him is due the honour of having been the first to demonstrate a distinct nervous system in these animals; and he describes the cutaneous, circulatory, respiratory, manducatory, digestive, muscular, and reproductive systems, with much detail, and with a correctness which makes us the more surprised that he should have committed so grave an error respecting the tentacular cilia."

In the 'Bulletin Zoologique' of the same year,<sup>10</sup> Paul Gervais<sup>11</sup> made an analysis of the memoir of Dumortier, and contended against the right of the 'Polype à Panache' to assume the position of a distinct genus, insisting on its representing nothing more than a *Plumatella*. Dumortier tried to refute Gervais' arguments in the second and enlarged edition of the memoir he published in 1836 (*Mémoire sur l'anatomie et la physiologie des polypiers composés d'eau douce nommés Lophopodes*) (Figure 2)<sup>12</sup> and to demonstrate





B. C. Dumortier del.

Lich. de Degobert Bas de la Saëlonnière à Brax.

J. Vandenaelen. Sculp.

*Lophopus crystallinus*. Dumort.

Figure 3. *Lophopus crystallinus*: plate from Dumortier (1835).

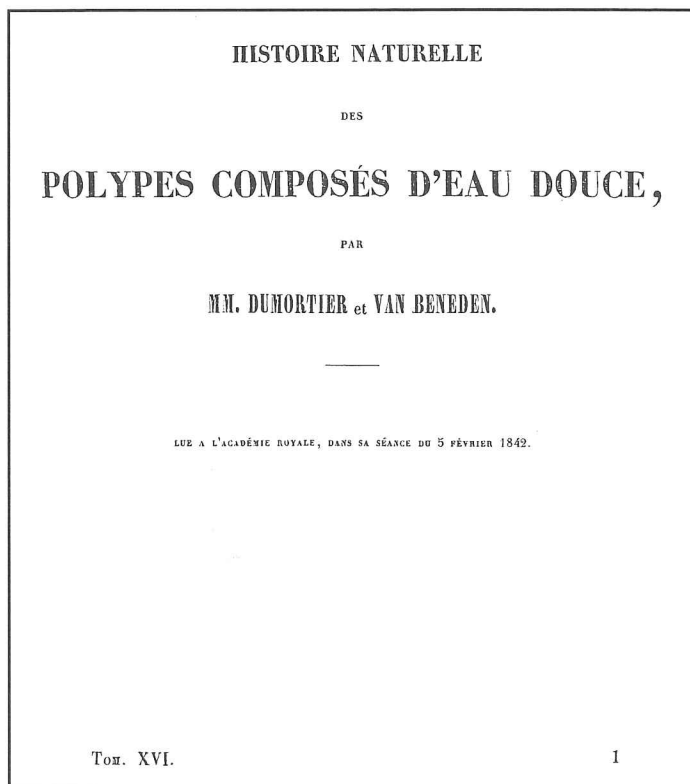


Figure 4. Dumortier and Van Beneden's *Natural History of the composed freshwater polyps* published in 1843 in the *Nouveaux Mémoires de l'Académie royale de Belgique* (Volume 16).

that Gervais was wrong.<sup>13</sup>

Dumortier assembled in his newly created 'Lophopodes' (Lophopoda) all the bryozoan species with a U-shaped tentacular crown known at that time, including Blumenbach's *Tubularia sultana*,<sup>14</sup> which he placed in the genus *Plumatella* (*P. sultana*) in spite of its circular tentacular crown. A complete key to the genera and the species (with synonymy) was included in the second edition of his 'Mémoire'.<sup>15</sup>

Dumortier made a distinction between two *Lophopus* species, *L. cristallinus* (sic) (= Trembley's Polype à Panache) and *L. campanulatus*, the last one allegedly known from standing waters in Germany. Dumortier had only seen and studied the first one.

In 1843 the first part of the *Histoire naturelle des polypes composés d'eau douce* by Dumortier with P.J. Van Beneden as joint author came out (Figure 4).

The second part followed in 1850, illustrated with six plates.<sup>16</sup> In this work it was stated

that *Lophopus crystallinus* ('lophopier de Trembley') had 'eggs' (i.e. statoblasts) that were oval and lacking spines, whereas *Lophopus campanulatus* ('lophopier couronné') had orbicular 'eggs' with spines.<sup>17</sup> It was even mentioned that Turpin had taken these 'eggs' for those of *Cristatella mucedo*,<sup>18</sup> but obviously Dumortier and Van Beneden did not share this opinion.

It is one of these spiny eggs that is shown in plate VI, with a caption referring to *L. crystallinus*. But it clearly is a statoblast of *Cristatella mucedo*. This was stressed by Allman in 1856 and Jullien in 1885,<sup>19</sup> however, who did not discuss the question of *L. campanulatus*, which on the ground of its 'eggs' should thus correspond to *Cristatella mucedo*.

## 2. The publications of Pierre-Joseph Van Beneden

In 1839 Pierre-Joseph Van Beneden (1809-1894) published in the 'Bulletin' of the Royal Academy of Sciences in Brussels some observations on the freshwater 'polyps', his first note on freshwater bryozoans.<sup>20</sup> This preliminary note to a larger research Van Beneden was busy with, was discussed later on by Allman<sup>21</sup> who did not agree with Van Beneden's statement that the sexes are separated in *Alcyonella*, which was in contradiction to his own observations. As far as the rest of the article was concerned, Allman made the following summary:

'He describes also a circulation of fluid in various parts of the body, and he supposes it due to the action of cilia, which he affirms to exist on the exterior of the alimentary canal as well as on the skin. This motion of the fluid in the interior had been, (...) already noticed by Trembley; and M. Van Beneden now for the first time refers it to its true cause by showing its dependence on vibratile cilia, though he incorrectly describes the external surface of the alimentary canal as ciliated. He believes he has seen at the base of each tentacle an aperture, which he regards as an aquiferous mouth ("bouche aquifère"), destined to give admission to the external water; though in a subsequent memoir he admits that this appearance is deceptive. He describes the great supraoesophageal ganglion, and mentions the existence of locomotive ciliated embryos in *Alcyonella*. He mentions having found, along with M. Gervais, the *Fredericella* and *Paludicella*; and *in fine* he shows how the form of *Alcyonella* is varied by accidental circumstances influencing its growth.'

In the following years Van Beneden who wrote in 1840<sup>22</sup> that during the last six years he had been gathering material on the genera *Alcyonella*, *Plumatella*, *Cristatella* and *Fredericella*, published a series of minor notes with observations on freshwater bryozoans such as observations on *Alcyonella*<sup>23</sup> and considerations on its 'so-called mobile eggs',<sup>24</sup> the development of *Tubularia* (1844),<sup>25</sup> the classification of bryozoans (1850).<sup>26</sup>

In 1848, Van Beneden published his *Recherches sur les Bryozoaires fluviatiles de Belgique*.<sup>27</sup> Allman (1856) called it 'a very valuable memoir on the fresh-water Polyzoa

of Belgium', adding the following appreciation: 'The author here enters into important details of the anatomy and classification of the fresh-water Polyzoa, and gives excellent descriptions and copious synonyms of the several species. After the lapse of nearly a century, he restores to the *Alcyonella stagnarum* of Lamarck the specific name *fungosa* originally bestowed on it by Pallas. This is but an act of justice to its discoverer, and ought to be followed by subsequent systematists. Van Beneden also makes the addition of a second species of *Alcyonella*, which he describes under the name of *A. flabellum*.<sup>28</sup> K. Kraepelin considered it as an important new work for its time, with bibliography, synonymy, and discussion of the various systems of organs.<sup>29</sup> For Nelson Annandale (1876-1924), superintendant and trustee of the Indian Museum of Calcutta, founder-director of the Zoological Survey of India, one of the contributors to *The Fauna of British India*, it was 'the first really important work of comprehensive nature', even though it was 'superseded by Allman's *Monograph of the Fresh-Water Polyzoa*' (1856).<sup>30</sup>

Van Beneden studied also the marine bryozoans, and his publications gave quite a good survey on the bryozoan fauna of the Belgian coast,<sup>31</sup> including some entoprocts.<sup>32</sup>

### 3. Dumortier and Van Beneden as joint authors

As previously mentioned Dumortier, the elder and the more influential of both, had had Van Beneden joining him in his work on freshwater bryozoans. On 5th February 1842 they read before the Royal Academy of Brussels a first paper on the freshwater 'compound polyps'. This *Histoire naturelle des Polypes composés d'eau douce* was published in 1843 and consisted entirely of a historical introduction to the subject.<sup>33</sup> Allman (1856) considered it as 'most elaborate and learned'.<sup>34</sup>

The second part of this work was submitted to the Royal Academy of Sciences of Brussels on 9th May 1848; it was printed in 1850 in Brussels by Hayez, the official printer of the Academy.<sup>35</sup> Pointing out its scientific and iconographic qualities and discussing its main results Allman (1856) was quite enthusiastic about this 'very important memoir':

'This memoir is occupied with the anatomy of the genera *Paludicella*, *Fredericella*, *Alcyonella*, and *Lophopus*, and accompanied by numerous well-executed figures. It contains extensive and careful anatomical details of all the genera treated of in the memoir. It describes and figures with much minuteness the development of the bud in *Paludicella*, and mentions the occurrence of a peculiar winter bud in this Polyzoan, occupying the position of the ordinary buds, but destined to remain during the winter months in an undeveloped state. The structure of the testicle in *Alcyonella* is examined, and the spermatozoa, with their vesicles of evolution, demonstrated; but these cells are not sufficiently distinguished from the contained spermatozoon. The ciliated embryos of *Alcyonella* are also described and figured, but the authors do not pursue their development into much detail, while they consider them as identical with statoblasts in a particular stage of evolution, and deprived of their external shell. The statoblasts themselves in *Alcyonella* and *Fredericella* are described, but the essential structure of an ovum is attributed

to them, while some confusion has arisen with regard to the statoblast of *Lophopus crystallinus*, the body described as such being manifestly the statoblast of *Cristatella*.<sup>36</sup> A statement formerly made by M. Dumortier, that the tentacula of *Lophopus crystallinus* are deprived of cilia, is repeated here; it is asserted that, instead of ciliary vibrations, the tentacula of this Polyzoon present a moniliform current, which ascends one side and descends the other of each tentacle; the appearance of these currents is compared to that of an endless chain in uninterrupted motion, and attention is drawn to the analogy of this phenomenon with that of the decomposition of water by the galvanic battery. I have no doubt, however, that the phenomena thus described is truly a case of ciliary vibration, and that the cilia have merely escaped the observer in consequence of some defect in the microscope employed in their investigation. I have repeatedly had under my own observation a species of *Lophopus*, which I do not hesitate to refer to M. Dumortier's species, and yet I found the cilia in all cases perfectly distinct. An opinion previously expressed by M. Van Beneden, when he thought he had seen apertures ("bouches aquifères") for the admission of water into the perigastric space, is here given up, and the source of the error pointed out. Further, M. Van Beneden, now finding a testicle in the same cell with the statoblasts, modifies his previous views as to the unisexualism of *Alcyonella*, and, comparing this Polyzoon to the plants belonging to the twenty-third class of Linnaeus, he suggests that male, female, and hermaphrodite individuals may all coexist in the same coenocium. On the whole, this memoir of the learned Belgian naturalists, though in some respects incorrect, must be regarded as the most important, in an anatomical point of view of any which had as yet appeared.<sup>37</sup>

Kraepelin shares this opinion some twenty years later when he writes that 'in respect to bibliography, anatomy and systematics' this second part of the *Histoire naturelle des Polypes composés d'eau douce* 'is the most important earlier work on freshwater bryozoans, together with Allman's monograph'. He stresses that the fidelity of the figures outstrips by far those of Allman's work.<sup>38</sup>

So it may be concluded that in the first half of the 19th century Belgian bryozoology enjoyed an excellent reputation worldwide and has made an outstanding contribution to the research on freshwater bryozoans. Hence the high opinion they were held in by fellow researchers such as Allman who made the following statement in 1850: 'Among those who now most materially advanced our knowledge of the freshwater Polyzoa, must be especially mentioned MM. Gervais, Dumortier and Van Beneden. To Gervais we are indebted for the first complete zoographic view of the subject, the determination and diagnosis of the genera and their systematic distribution, while Dumortier and Van Beneden have both contributed most important information on the anatomical structure of certain species. Van Beneden moreover has given us a complete memoir on the whole of the species inhabiting the freshwaters of Belgium, a memoir, which, both in a zoographical and zootomical point of view, is certainly the most valuable we possess.'<sup>39</sup>

#### 4. Biographical sketch of B.C. Dumortier

Barthélemy Charles Dumortier (Du Mortier)<sup>40</sup> was born on 3rd April 1797 in Tournai

where he died on 9th July 1878. He studied the classics in Paris under the direction of a priest. Once returned to Tournai he married Philippine Rutteau in 1816. The couple had eight children.

Very active as a scientist and as a politician, Dumortier is known above all as a botanist. As a child he began collecting plants and from 1816 on he made numerous botanizing tours through the various regions of Belgium, also visiting Holland and the Rhine Provinces. In 1823 he was in Luxembourg where he discovered in the sandstone region of Mullerthal the filmy-fern *Hymenophyllum tunbrigense* an Atlantic species whose presence in this part of Europe was quite sensational and linked to the special microclimate of the sandstone gorges of the Mullerthal.<sup>41</sup> In 1822 his first publication came out: *Commentationes botanicae*; herein he attacked Linné's sexual system insisting on the necessity of introducing a more natural classification, rejecting at the same time Jussieu's system which in his opinion lacked 'symmetry'. A next step in developing an own system was made in his *Analyse des familles des plantes* in 1829.

Dumortier was a renowned specialist of liverworts. In 1822 he had published a monograph of the Jungermanniae (Hepaticae); a much more complete work on the subject was to be published in 1874: *Hepaticae Europae: Jungermannideae Europae post semiseculum recensitae*, often considered as his most important contribution to botany.

His *Florula belgica* was published in 1827. His other botanical publications were devoted to the grasses (*Observations sur les Graminées*, 1823; *Etude agrostographique sur le genre Michelaria et la classification des Graminées*, 1868), to the willows (1825, 1862), and to a new classification of the fruits (1835).

In 1832 he published his *Recherches sur la structure comparée et le développement des animaux et des végétaux*. Although the conclusions of this comparative study of the structure and the development of animals and plants rapidly appeared quite inaccurate, the paper remains interesting from a historical point of view because it contains the description of the multiplication of cells by formation of a partitioning wall which Dumortier had observed in filamentous freshwater algae. In their biographical note Wildeman and Hauman emphasize that this was prior to the description of the plant cell division made in 1835 by Hugo von Mohl (1805-1872)<sup>42</sup> and that the fatherhood of the discovery of cell division by formation of a partition should be attributed to Dumortier rather than to von Mohl.<sup>43</sup>

It is striking that after 1838 there was a long interruption in Dumortier's botanical publishing which he resumed only when he was nominated chairman in 1862 of the newly founded Belgian botanical society ('Société royale de Botanique').

In the meantime he had turned to zoology, where he distinguished himself above all by

his research on bryozoans, the object of his first zoological publication, *Recherches sur l'anatomie et la physiologie des Polypiers composés d'eau douce* (1835), soon followed, as we have seen, by the *Histoire naturelle des Polypiers composés d'eau douce* (1843, 1850) written in collaboration with P.J. Van Beneden. The subjects of his other zoological publications were the development of the embryo of gastropods (1837), some remarks on the 'merle roselin' (1837) (i.e. *Sturnus roseus*, rose-coloured starling, a migrant bird not often invading our regions), on the modifications of the skull of the orang-utan (*Pongo pygmaeus*) (1838), on a North Sea beaked whale,<sup>44</sup> stranded at Ostend (1839).

Dumortier was also interested in history and archaeology. He wrote papers on two ancient manuscripts discovered in the library of Tournai (1830), on the cathedral of Tournai (1837, 1841, 1845, 1851), on the birthplace of Pierre-Paul Rubens (1861, 1862), on Constantine the Great whom he thought born in Tournai (1866), and on the identity of the holy image called Notre-Dame-la-Brune (1873).

Finally Dumortier wrote quite a number of political pamphlets, articles, speeches and reports as a result of the political activity he began with at the end of the 1820s. As an ardent patriot he was one of the leaders of the anti-Dutch movement in Tournai, and in 1830 he participated actively in the Belgian Revolution. In September 1831 he entered the parliament of the newly independent Belgium. He was to remain a member of this assembly for the rest of his life, and he played an important role in the politics of his country. He was even nominated minister of state.

The Belgian Academy of Sciences admitted Dumortier in 1829. From 1870 to 1878 he was the chairman of the board of trustees of the National Botanical Garden, whose creation was greatly due to him. He was a member of more than forty Belgian and foreign scientific societies. King Leopold II (1835-1909) rewarded him with the title of a count, but Dumortier had concealed this distinction from his family, so that his son didn't know anything about it in his father's lifetime.

His biographers insist that Dumortier was a very committed catholic and that his creationist convictions were never shaken by any Darwinistic ideas.

## 5. Biographical sketch of P.-J. Van Beneden

Pierre-Joseph Van Beneden (Figure 5) was born at Mechlin, Belgium, on 19th December 1809; he died at Louvain on 8th January 1894.<sup>45</sup> Having finished his secondary studies, Van Beneden was apprenticed to Louis Stoffels (1764-1853), a well-known Mechlin pharmacist and a great collector, especially of minerals and fossils, who had transformed his house into a kind of natural history museum. He aroused Van Beneden's interest in natural sciences. In 1830 Van Beneden took part in the Belgian Revolution, which broke out during his apprenticeship. Later on he recalled that while fighting the Dutch in front



Figure 5. Pierre-Joseph Van Beneden (1809-1894) (from G. Lebrun, *Grandes figures de la Belgique indépendante*, Bruxelles, 1936).

of the walls of Antwerp, he more than once was holding a fossil shell in one hand and a cartridge in the other.

Encouraged by Stoffels, Van Beneden decided to study medicine at the University of Louvain and he got his M.D. in 1832. Then, more interested in zoology than in practicing medicine, he left Belgium in order to complete his scientific education at the Muséum d'Histoire Naturelle in Paris where his remarkable dissecting skills made a great impression.

In 1835 he tried without any success to get a professorship at the newly reopened official universities of Gand or Liège, so that he was quite glad to accept an invitation by the 'rector magnificus' of the Catholic University of Louvain. On 10th April 1836 he was nominated professor of zoology and comparative anatomy. Later on palaeontology was added to these matters. His first lecture, which took place on 23rd April 1836, was a big success. Very popular among his students, Van Beneden continued teaching in Louvain during the next 57 years, until his death.



Throughout his life he was a most diligent worker, and the list of his contributions to scientific periodicals, which starts in 1835, amounts to some 350 papers. A good deal of these were published in the *Bulletins or Memoirs of the Academy of Sciences of Brussels* which he had belonged to since his nomination as a corresponding member in 1836; he became a full member in 1842.

In the earlier part of his career he directed his attention especially to marine molluscs, then to other marine invertebrates, which he studied during many vacations spent at Ostend, where he established in 1843, at his own expense, a marine laboratory and an aquarium for the further prosecution of these studies. This institution was one of the earliest, if not actually the first example of a place of study of marine zoology in any part of the world. Van Beneden's ambition was to make a complete survey of the animals of the Belgian coast. The results were outstanding publications on Coelenterata, various groups of Worms, Bryozoa, Crustacea, Tunicata, Fishes and Cetacea of the North Sea. Besides the purely faunistic aspects, Van Beneden was keen on considering the anatomy and embryology of his material.

Associated with this part of his work were his classical studies in connection with parasitic worm-like animals, the linguatulids and the so-called tetrarhynchids. Starting in 1847, Van Beneden investigated their development, transformation, and life histories. The linguatulids (Pentastomida, tongue worms) are endoparasites of the respiratory organs of Amniota especially reptiles (lungs), more rarely mammals (nasopharynx) and marine aquatic birds (air sacs). At the beginning of 1848 Van Beneden had the opportunity of studying fresh linguatulids (including eggs and embryos) he found in the lung of a boa received from the Antwerp Zoo. He recognised that these parasites were not worms and did not belong to the trematodes or to the cestodes. His conclusion was that in the light of their anatomical and embryological characteristics they had to be arthropods. He ranged them into the Lernean Crustaceans; later on the linguatulids or Pentastomida were considered as a subphylum of the Arthropoda<sup>46</sup> or an arthropod group of uncertain position (Arthropoda incertae sedis),<sup>47</sup> or as a separated 'pararthropod' or 'proarthropod' phylum. Recently they have been again replaced in the Crustacea by some authors,<sup>48</sup> but the discussion on their systematic position seems not yet closed.<sup>49</sup>

The so-called tetrarhynchids were known as parasites of teleosts; their body shows no annulation and its anterior part bears four retractile proboscides. Van Beneden noticed that typical tetrarhynchids were only hosted by teleosts and that they had no sexual organs. In skates and dogfishes, however, he found cestodes resembling to tetrarhynchids but differing from them by the presence of segments in the posterior part of their body and by the presence of sexual organs revealing that these were adult individuals. Van Beneden's intuition was that possibly the tetrarhynchids of the teleosts represented an immature developmental stage that could continue its development in the alimentary canal of the elasmobranchs feeding on their hosts. Thus the tetrarhynchids were no longer independent

species, but an element of the life cycle of cestodes. The zoological group 'cystic worms' had to be dropped. Van Beneden first mentioned his results in May 1847 in a foot note in the article *Un mot sur la reproduction des animaux inférieurs*, then in January 1849 in a more explicit report on the development of the tetrarhynchids (*Note sur le développement des Tétrarhynches*) and finally in October 1849 in his article *Les Helminthes cestoides, considérés sous le rapport de leurs métamorphoses, de leur composition anatomique et de leur classification*.<sup>50</sup>

Van Beneden did not hesitate to generalize his results proclaiming that the 'cystica' are in fact 'incomplete tenioids'. This was quite a revolutionary explanation of the cysticerci, coenuri and echinococci of higher vertebrates and especially mammals, no longer considered as independent species but as larval stages of tapeworms. Van Beneden's views were soon experimentally confirmed by the German physician Friedrich Küchenmeister (1821-1890).<sup>51</sup> In order to convince some French opponents to his theory Van Beneden infested with cysticerci two dogs belonging to a lot of four, and demonstrated in April 1858 in Paris that *Taenia serrata*, the dog-tapeworm, was only present in the experimentally infested animals and not in the two control dogs.<sup>52</sup>

The elucidation of the life cycle of the intestinal worms stroke a blow at the idea still alive at that time that cestoid worms could be the result of a spontaneous generation. It was now up to Pasteur to give the ultimate demonstration that abiogenesis did not exist in bacteria either.

In 1853 Van Beneden was awarded the "Grand prix des sciences physiques" of the Institute of France for his work on the cestodes. In 1875 he published his famous vulgarising work *Les commensaux et les parasites dans le règne animal* (Commensals and parasites in the animal kingdom), which was translated into English and German. In 1859 he had published a medical zoology (*Zoologie médicale*) written in collaboration with his friend Paul Gervais.

Another direction in which Van Beneden's activities found a vent was connected with the vertebrate division of the animal kingdom. During the excavations rendered necessary by the fortifying of Antwerp a number of bones of fossil whales were exposed to view. These attracted Van Beneden's attention and led him to undertake a detailed study of the group, whose characteristics were at that time very imperfectly known. On the subject of the Cetacea, living and extinct, he published a number of papers and several large works. The most important of these is his *Ostéographie des cétacés vivants et fossiles* (The osteology of cetaceans, living and fossil), which was written in collaboration with Paul Gervais and published between 1868 and 1880. His papers on the extinct species found near Antwerp were published in the *Annales du musée royal d'histoire naturelle de Bruxelles*, and with them was incorporated a description of the fossil seals which were discovered in the same neighbourhood. But it must be said that as a whole the excavations

of Antwerp were rather deceiving and Van Beneden stated later on that he had the feeling of having lost some twenty years of his life in this undertaking.

Van Beneden was a foreign member of the Royal Society and also of the Linnaean, Geological, and Zoological Societies of London. He was a corresponding member of the French Academy of Sciences in 1866 and an associated foreign member in 1892. He was president of the Royal Belgian Academy in 1881, and was created Grand Officer of the Order of Leopold on the occasion of his professorial jubilee.

*'He was always a devout and convinced adherent of the Catholic Church — wrote the Catholic Encyclopaedia — though, as the writer of his obituary for the Royal Society particularly states, always exhibiting "the widest toleration for the views of others"'. So it was Van Beneden who in 1859 pointed out to the Belgian Academy Darwin's work on the origin of species. Still a convinced fixist at that time, he later on changed gradually to a more transformist speech in his works on cetaceans.*

Van Beneden was married to Rose Valcke, daughter of an Ostend citizen enriched by trading with the Far East. They had six children, five daughters and one son, Edouard, the eldest of the children. Edouard Van Beneden (1846-1910), professor at the University of Liège, was a distinguished biologist and zoologist. His greatest achievement was the discovery of the meiosis and the centrosome.<sup>53</sup>

## 6. Henri Milne-Edwards, a Frenchman born in Belgium

In 1843 Dumortier and Van Beneden wrote that their 'learned compatriot' Milne-Edwards (they spell it 'Milne Edwars')<sup>54</sup> had written several beautiful works on marine 'polyps'.<sup>55</sup> We are moreover told that in 1839 he wrote a report on a memoir of Gervais, and that he pretended in this report that the 'eggs' of *Plumatella* are equipped with hooks just as those of *Cristatella*.<sup>56</sup> A blatant error, of course!

Henri Milne-Edwards<sup>57</sup> is traditionally considered as a French naturalist although he was born in Bruges (Belgium) on 23rd October 1800. (From 1795 to 1814 Belgium was a part of the French Republic, which had annexed the country). He was the 27th of the 28 (certain sources say 29) children of the Englishman William I. Edwards, who had been a planter and colonel in the militia in Jamaica. His mother was Elizabeth Vaux, Williams second wife, and Henri was her second child (so she was just responsible for a few of the many children). Henri's parents returned from Jamaica to England, but moved soon to Bruges, Belgium, where Henri was born, passed his childhood and started his studies.

Then he left the country and was brought up in Paris by his older brother William Edwards,<sup>58</sup> a well-reputed physiologist, because his father had been imprisoned for several years, having helped some Englishmen to get out of Belgium during the war. After

the fall of Napoleon, the father was released and then the rest of the family also moved to Paris. It seems that Henri Milne-Edwards was naturalized in 1831.<sup>59</sup>

Henri took a M.D. in 1823. He was, however, more interested in zoology and became a disciple of Georges Cuvier (1769-1832). In 1823, the same year his father died, he married Laura Trézel,<sup>60</sup> who bore him nine children and also assisted him by illustrating several of his works. Henri was appointed Professor of hygiene and natural history in 1832 (the year after he became a French citizen)<sup>61</sup> at the 'Ecole Centrale des Arts et Manufactures'. He moved to the Chair of Entomology at the Paris Muséum in 1841, after the death of his predecessor, friend and joint author Audouin.<sup>62</sup> In 1862 he was transferred to the mammological chair, which had long been vacant after the decease of Geoffroy Saint-Hilaire (1772-1844), and he also became professor of the 'Faculté des Sciences'.

Henri Milne-Edwards published numerous publications on zoological subjects. During more than fifty years he was the editor of *Annales des sciences naturelles*. He died in Paris in on 29th July 1885.

Henri was the father of Alphonse Milne-Edwards (1835-1900), who was director of the Paris Natural History Museum during the last decade of the 19th century. Alphonse studied medicine (M.D. in 1860) and biology (Dr Sci. in 1861) and was appointed assisting naturalist at the Paris Muséum in 1862. In 1864 he was appointed Professor of Zoology of the School of Pharmacy (Ecole supérieure de Pharmacie) in Paris, but succeeded his father at the division of Mammalia and Aves at the Muséum in 1876; member of the Academy of Sciences in 1879 and of the Academy of Medicine in 1885, he eventually became director of the Muséum in 1892.<sup>63</sup>

The name Milne was originally one of Henri's first names, but Henri put it to his family name in order to be discriminated from all his relatives. He usually did not use a hyphen between Milne and Edwards, but his son Alphonse always did and in literature references (including taxon authorship) the name of both father and son is most often hyphenated.

## 7. Remarks concerning Gérard-Daniel Westendorp

In 1843 Gérard-Daniel Westendorp, a military physician born in The Hague on 8th March 1813 and who died in Termonde on 31st January 1868, published an article on his researches on the marine bryozoan fauna of Belgium with special reference to the coast of Ostend: *Recherches sur les polypiers flexibles de la Belgique et particulièrement des environs d'Ostende*, Bruges, F. De Pachtere, 1843, 48 p, 1 plate. This was reprinted from *Annales de la Société médico-chirurgicale de Bruges*, t. IV.<sup>64</sup>

In 1853 he published on the same subject a booklet with eight pages and 32 plates with mounted specimens: *Polypiers flexibles de la Belgique. Collection des bryozoaires*,

*sertulaires, flustres et spongiaires qu'on rencontre en Belgique, et particulièrement aux environs d'Ostende*, published in Courtrai by Beyard-Feys.<sup>65</sup>

## 8. Karel Loppens and his research on bryozoans

At the beginning of the 20th century Karel Loppens began publishing a series of minor notes on marine, brackish and freshwater bryozoans of the Belgian coast. His first paper published in 1903 dealt with a variety of *Membranipora membranacea* and some other animals living in brackish water. In 1905 he first mentioned a phylactolaemate, *Plumatella repens*, that he had found in the slightly brackish water of the old canal of Veurne. In his *Contributions à l'étude des Bryozoaires de Belgique* (1906) he gives a list of the Belgian freshwater bryozoans: *P. repens*, *P. repens* var. *fungosa*, *P. lucifuga*,<sup>66</sup> *Fredericella sultana*, *Lophopus crystallinus*, *Cristatella mucedo* and the gymnolaemate *Paludicella ehrenbergi* = *Paludicella articulata*; the same paper also gives the list of the marine ecto- and entoprocts.

In the same year he published the paper *Bryozoaires marins et fluviatiles de la Belgique* (1906). It was followed in 1908 by *Les Bryozoaires d'eau douce*, in which he made a general analysis of the systematic problems linked to the freshwater bryozoans hitherto described; moreover he gave a complete survey of the bryozoans worldwide noted in freshwater, including ctenostome species such as *Paludicella*, *Victorella*, *Potsiella*, *Arachnidium*, and cheilostomes such as *Hislopi*a, *Norodonia*, *Membranipora*. In 1909 Loppens published a catalogue of the freshwater bryozoans with a note on *Victorella pavid*a, essentially a summary of the preceding paper. And so was his next publication, *Les Bryozoaires d'eau douce d'Europe* (1910), which however gave some additional hints on the preparation and conservation of bryozoans, as well as a dichotomic key with extensive synonymy of the species.

Figure 6. K. Loppens's last publication on bryozoans (1948).





*K. Loppens*

Figure 7. Karel Loppens (1875-1962) in his 40s. (from P. Van Oye, Karel Loppens, onbekend pionier van het brakwateronderzoek. 1963).

After an interruption of several decades, Loppens published in 1948 a second and revised edition of his *Bryozoaires marins et fluviatiles de la Belgique* (Figure 6).

## 9. Biography of Karel Loppens

Charles (Karel) Pierre Jean Loppens (Figure 7)<sup>67</sup> was born on 1st January 1875 in Diksmuide (Western Flanders) as the son of a postmaster, who died when the child was two years old. Karel's widowed mother, Marie Louise Gommers, took him to Nieuwpoort, where he would spend most of his life. After an apprenticeship with one of his uncles, Karel Loppens established himself as a watchmaker in his mother's house in Nieuwpoort. But more attracted by natural sciences, he gave up watch-making and devoted himself to

geology, physical geography and zoology, later on he turned more and more to local archaeology and history. In both fields Loppens was a self-made man.

His mother died in 1898. In 1912 he married Elisa Vandenbroecke from Ramskapelle who quickly adapted herself to his way of life and helped him in his works. The couple made numerous trips through Belgium, the Netherlands, Switzerland and France; during World War I they left for Exmouth (Devonshire), in south-western England.

From 1919 to 1920 Loppens lived with his wife in Ostend; in March 1921 he established himself in Coxyde where he remained until the end of his life. He died on 26th May 1962 in Veurne, aged 87 years old.

Before World War I, Loppens had worked for some time in the Museum for Natural History in Brussels, in the laboratory of Gustave Gilson (1859-1944),<sup>68</sup> the director of the museum, and in the laboratory of Overmeire directed by Ernest Rousseau (1872-1920).<sup>69</sup>

In the zoological field Loppens started as a malacologist, and his first communication in the annals of the *Société zoologique et malacologique de Belgique* was a note on *Petricola pholadiformis*, the American piddock, whose occurrence on the Belgian coast he was the first to report in 1902. There were some other papers, all of just regional importance. He soon concentrated on bryozoans, where his contribution to the knowledge of the marine bryozoans (fauna of the Belgian coast) clearly towered above his achievements in freshwater bryozoology.

Paul Van Oye<sup>70</sup> insisted on the value of Loppens's planktological work, ranging him with the great hydrobiologists of Belgium. His study *Contribution à l'étude du microplankton des eaux saumâtres de la Belgique* was the first of that kind in Belgium. It did not only contribute to a better understanding of the ecology of the brackish water, but revealed quite a number of species not yet recorded in Belgium. Whereas, the *Faune de Belgique* (1895) had reported 28 species of Rotatoria for the whole country, Loppens had found 34 different species alone in the brackish water of Nieuwpoort.

Loppens wrote also some vulgarising articles on biological subjects. At last he published quite a number of papers concerning the history and the archaeology of his home region.<sup>71</sup>

## 10. Paul Brien's work on bryozoans

In 1932 Paul Brien (1894-1975) (Figure 8)<sup>72</sup> published a two-page note on the asexual reproduction of the Phylactolaemata (in collaboration with M. Aen den Boom).<sup>73</sup> The next step were two reports published in 1934, the first on his studies of the statoblast development of *Fredericella sultana* and the second on the artificial regeneration in *F.*





Figure 8. Paul Brien (1894-1975) (from M. Poll and H. Herlant-Meewis, Paul Brien, 1894-1975. in *Florilège des sciences en Belgique, II*, 1980).

*sultana* after cutting off the first cystids and polypids derived from a statoblast. In 1936, it was a more important contribution to the study of the asexual reproduction of the phylactolaemates. Then there was a long break, and Brien resumed his work on the bryozoans only at the beginning of the 1950s with as a result a paper on the affixing to the substratum and the metamorphosis of phylactolaemate larvae (*Plumatella fungosa*, *F. sultana*) in 1952. In 1954 Brien published his *Etude sur les Phylactolémates*, an important comprehensive study on bryozoans where he included the results of his own long research on topics such as: zooecial evolution and colony growth by polypidal budding, budding of the statoblast, embryogenesis and astogeny, and multiple ontogenesis (development of



a new individual as a result of polypidal budding, or statoblast budding, or embryogenesis). The studied genera were: *Fredericella*, *Plumatella*, *Lophopus* and *Cristatella*.

The next papers were consecrated to general considerations on phylactolaemates (1954) or more specific subjects such as the relationship between sexual and asexual reproduction (1955), the formation and the metamorphosis of the larvae (1956). Then followed some pages on the bryozoan cystid and the colony growth (1958).

In 1960, Brien was one of the collaborators in Grassé's<sup>74</sup> monumental *Traité de Zoologie* where he was in charge of the chapter 'class of the Bryozoa', which he divided in the two sub-classes Phylactolaemata and Gymnolaemata. In 1959 he had already written the chapter concerning the Entoprocta or Kamptozoa. Prior to his contribution to Grassé's treatise Brien had discussed the budding of the Entoprocta and their phylogeny (1956), comparing entoprocts and ectoprocts in this respect in 1960. In 1970 he concluded with phylogenetic considerations concerning the lophophorates.

Brien was one of those who insisted on separating the entoprocts from the ectoprocts, putting them into two different phyla. In his opinion entoprocts are neotenic forms of annelids that have become aberrant as a consequence of their sessile life, whereas ectoprocts are far more advanced in their evolution and should be placed near the Phoronida.<sup>75</sup>

Brien was less interested in marine bryozoans. Except for his contribution to Grassé's treatise (1960) Brien had published just one article on marine bryozoans, in 1937, a study on the growth and the budding of the stolon of the Stolonifera (*Bowerbankia*), with Graziella Huysmans as joint author.<sup>76</sup>

## 11. Biography of Paul Brien

Paul Brien was born in the village Hannut (province of Liège) on 24th May 1894; he died at Watermael-Boitsfort, on the outskirts of Brussels, on 19th February 1975.<sup>77</sup>

The son of a primary school teacher, Paul Brien went to the teacher training school ('Ecole normale') of Nivelles, and eventually became teacher in his native village, from 1915 to 1918. Once the war was over, he decided to go to the 'Université Libre de Bruxelles' (ULB) in order to study natural sciences. He was a student of the renowned zoologist Auguste Lameere (1864-1942),<sup>78</sup> an excellent professor and an avant-gardist of the evolutionist ideas. Brien got his Ph.D. in 1922 with a thesis on the embryology of *Salpa maxima* (Tunicata) and he became assistant in the zoological service of Lameere. In 1926 he was charged with a biology course at the Faculty of Social Sciences, in 1928 he taught animal physiology at the science faculty, in 1930 he got a nomination as ordinary professor. When Lameere retired in 1934, Brien was put in charge of lower level courses

(first and second year): elements of zoology, compared anatomy, animal biology. From 1937 on, he taught animal biology and systematic zoology (including compared anatomy and histology) to students preparing a 'licence en zoologie' (third and fourth year). Brien stayed with the ULB until his retirement in 1964.

In 1926 Brien had married Emilie Gavage, doctor of natural sciences of the ULB, and professor at the 'Athénée royal' (secondary school) of Ixelles. Their son Jean-Pierre was born in 1928.

From 1922 to 1975, Brien produced 342 scientific publications, the first one on *Salpa maxima*.<sup>79</sup>

Brien continued his research on the Tunicata studying biological phenomena such as regeneration and budding. He was particularly keen on the question of germplasm and somatoplasm. Noting that during budding a whole organism could be reconstituted by somatic cells alone, without intervention of the germplasm, Brien concluded that the duality of germplasm and somatoplasm, such as postulated in 1893 by August Weismann (1834-1914) in his theory of the continuity of the germplasm, does not exist in metazoans.

In 1929 Brien began studying sponges, their morphogenesis and their embryogenesis, and also, of course, their extraordinary regeneration power. So he entirely dissociated sponge cells by filtrating fragments of *Ephydatia fluviatilis* through a fine-meshed cloth, and these cells were able to fall into small spherical groups or aggregates developing in entire new sponges (somatic embryogenesis). Brien studied also the sexual reproduction of sponges.

He was then attracted by the Bryozoa and afterwards by the Hydrozoa. There his idea that there is no immortal germinal line was confirmed.

Principally an invertebrate zoologist, Brien had nevertheless the occasion to make an important contribution to the knowledge of the vertebrates, especially dipnoans. During an expedition to Katanga in 1937 he discovered a hitherto unknown dipnoan, *Protopterus brieri*, and he studied the estivation of these lungfishes. In 1957 he participated in a mission to Leopoldville, and there he had the luck to find a *Protopterus* still in its nest, so that he could describe the ethology of the reproduction of the African *Protopterus dolloi*.

Brien was the author of quite a number of successful books, among these his *Eléments de zoologie et d'anatomie comparée* with a first edition published in 1938, and a second edition in 1951 (Volume 1) and 1961 (Volume 2). Many students have appreciated his *Guide des travaux pratiques* (first edition 1938). He wrote numerous biographical or necrological notes, and in 1968 he outlined the history of zoology and animal biology in

Belgium during the 19th century and the beginning of the 20th (in *Florilège des sciences en Belgique*, edited by the Académie royale de Belgique, Classe des Sciences, Brussels) A complete list of Brien's publication is given by Poll and Herlant-Meewis (1979).

Brien was a free thinker highly interested in the problems of evolution. Fighting for the right of free expression for all, he was known in Belgium as a defender of French culture and French language.

## 12. A.W. Lacourt and the Belgian bryozoans

Paul Brien was not immediately involved in faunistic research on the Belgian bryozoans, Loppens's publications were outdated, so good luck would have it that the Dutch specialist Adrianus Willem Lacourt looked into the freshwater bryozoans of the neighbouring country. In 1949 he published a new survey on the phylactolaemates of Belgium: *Les Bryozoaires d'eau douce (Phylactolaemata) de la Belgique* essentially based on the examination of the collection of the Royal Institute of Natural Sciences of Belgium and some literature research. Lacourt noted the occurrence of the following eight species in Belgium: *Fredericella sultana*, *Plumatella fruticosa*, *P. emarginata*, *P. repens*, *P. fungosa*, *P. (Hyalinella) punctata*, *Lophopus crystallinus*, and *Cristatella mucedo*. Concerning the rare *P. fruticosa* (which he had not seen himself) he remarks that the occurrence of this species remains uncertain. This situation was due to Loppens who, for what in his opinion was the same species, used either the name *P. emarginata* or *P. lucifuga*, which he considered both as synonyms of *P. fruticosa* Allman. So one or the other of his *P. emarginata* or *P. lucifuga* specimens could possibly correspond to *P. fruticosa*.

It may be remarked that in 1948 Lacourt had published a note 'On two freshwater Bryozoa (Phylactolaemata) from Belgian Congo'.<sup>80</sup>

Adrianus Willem Lacourt was born on 6th June 1910 in Leiden where he would remain for all his life.<sup>81</sup> As a young man he worked for one and a half year as a volunteer in the Museum of Natural History of Leiden (Rijksmuseum van Natuurlijke Historie), where he was busy with birds, especially their skulls and skeletons.

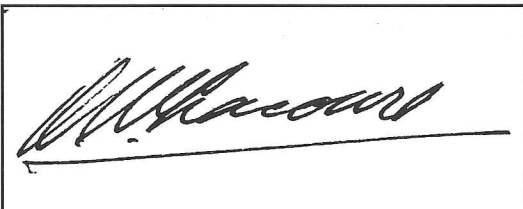


Figure 9. Signature of Adrianus Willem Lacourt (1910-1987).

Then he got a job in the Pathological Laboratory of the University of Leiden, where he was working at the beginning in the annexed museum. Some ten years later he was gradually involved in the administration of the laboratory. He finished his career as a high-ranking administration official after 53 years of service. Unfortunately his health left much to be desired, as he suffered from angina pectoris.

Lacourt was a very active member of the Dutch Malacological Society (Nederlandse Malacologische Vereniging, N.M.V.) Indeed, since he was sixteen he had been interested by shells, then he gave himself up to the study of brachiopods, bryozoans, crustaceans, cephalopods and egg-capsules of rays and skates (mermaid's purses). He published on all these fields, in periodicals such as: *Zoölogische Mededelingen* (Leiden), *Basteria*,<sup>82</sup> *Het Zeepaard*,<sup>83</sup> *Correspondentieblad van de Nederlandse Malacologische Vereniging*.<sup>84</sup> After his retirement he was nominated honorary scientific collaborator of the Rijksmuseum.

As far as the molluscs were concerned, Lacourt confined himself above all to the taxonomy of marine species that he collected along the coast of the Netherlands, Great Britain, Ireland and Western France (especially Arcachon and its surroundings). Lacourt is most famous for his monograph of freshwater bryozoans he published in 1968.

Lacourt died on 2nd February 1987. In the obituary notice published by the N.M.V., we are told that Lacourt was rather lonesome, very formal, reserved and taciturn, hiding his emotions, pugnacious, not very keen on making friends, on the whole a somewhat odd character. Once as he was due to be operated for an inguinal hernia on his left side, he decided that there was too great a risk of being operated on the wrong side. So he saw to it that prior to his entering the operating theatre he had a clear inscription on his belly indicating where the operation should be done.

Of course there have been bryozoological studies and publications in Belgium after Brien and Lacourt. Our approach being historical we do not intend to make the complete list of what has been done in the last decades. In the 1970s Pierre Job initiated studies about the role of bryozoans in pollution and self-purification;<sup>85</sup> B. Goethals, V. Henry, C. Brene and others followed him in the 1980s.<sup>86</sup> But there were also studies about topics such as the chemical composition of the ectocyst and the capsule of statoblasts.<sup>87</sup>

### 13. Bryozoan studies in the Grand-Duchy of Luxembourg

The first record of a freshwater bryozoan in Luxembourg was made in 1901. At the monthly meeting of the Société des Naturalistes luxembourgeois that took place on 14th July 1901 the physician Dr Eugène Bricher<sup>88</sup> exhibited a bryozoan he had found in the Alzette in Pulvermühl, a suburb of the city of Luxembourg, encrusting a rusty spade in a two and a half meter's depth. He identified it as *Plumatella fungosa* Pall. (Bryozoa); astonishingly it is called a freshwater sponge (!) in the report (written by Bricher

himself!).<sup>89</sup>

In 1956 Professor Jos Hoffmann (Figure 10)<sup>90</sup> encountered a colony of *Cristatella mucedo* in the Wark River near Warken, but did not publish it. From 1958 to 1959 Erik Mauch,<sup>91</sup> a German hydrobiologist, studied the benthos of the Moselle River, from Coblenz (Germany) to Schengen (Luxembourg). In the Luxembourg part he reported three species: *Plumatella fungosa*, *P. emarginata* and *Fredericella sultana*. His results were recorded in his doctoral thesis submitted in 1961 (University of Frankfurt), and which was published in 1962 and in 1963.<sup>92</sup> In 1978 and 1979 Mauch made a control examination of the Moselle between Palzem and Grevenmacher; he noted a strong regression of *P. fungosa*.<sup>93</sup>

A complete faunistic survey of the freshwater Bryozoa of the Grand Duchy was given in the scientific dissertation *Les Bryozoaires (Lophophoriens, Ectoproctes) du Grand-Duché de Luxembourg*,<sup>94</sup> which Gaby Geimer (Figure 10)<sup>95</sup> submitted in 1975. This was part of the examination giving access to the secondary school teacher career in Luxembourg at the end of one's practice period. The fieldwork had been done from 1974 to 1975 and had been supervised by Professor Jos Hoffmann, a former student of Paul Brien. The list of the Luxembourg freshwater Bryozoa was enlarged and included now the following



Figure 10. Looking for bryozoans in Luxembourg (1974): Jos Hoffmann (left), Gaby Geimer (centre).

species: *Fredericella sultana*, *Plumatella emarginata*, *P. fruticosa* (new record), *P. repens*, *P. fungosa*, *Hyalinella punctata* (new record), *Cristatella mucedo*, and *Paludicella articulata* (new record). The results were presented during the meeting of the section of sciences of the grand-ducal Institute of 18th February 1976.

The dissertation was not published, but was used as the basis of a new survey of the bryozoans of Luxembourg and the close Belgian, French and German borderland: *Les Bryozoaires du Grand-Duché de Luxembourg et des régions limitrophes*<sup>96</sup> published in 1986 by Gaby Geimer and Jos Massard.<sup>97</sup> A total of 172 sites had been investigated from 1983 to 1985. *Plumatella casmiana* could be added to the list of Luxembourg bryozoans. The description of the different species was completed by a SEM study of the statoblasts and hibernacula. Criteria for separating *P. repens* and *P. fungosa* by means of SEM study of the floatoblasts were given.<sup>98</sup> The possible confusion between hyaline forms of *P. repens* and *Hyalinella punctata* was discussed. The distribution of the species was illustrated by grid-maps, and a key to the European freshwater bryozoans was added. In the following years the same authors completed the survey and understanding of the Luxembourg bryozoan fauna.<sup>99</sup> And they also studied these astonishing animals in some other parts of the world.<sup>100</sup>

## 14. Acknowledgments

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### Appendix 1. List of the publications on Bryozoa by Karel Loppens

#### (1) Publications concerning only marine bryozoans:

- ‘Sur une variété de *Membranipora membranacea* L. et sur quelques animaux vivant dans l’eau saumâtre’, *Annales de la Société royale zoologique et malacologique de Belgique*, 38 (1903), CXLII-CXLIII.
- ‘Bryozoaires et Cnidozoaires nouveaux pour la faune belge trouvés pour la plupart pendant l’année 1903’, *Annales de la Société royale zoologique et malacologique de Belgique*, 39 (1904), XLV-XLVII.
- ‘Animaux marins vivant dans l’eau saumâtre’, *Annales de la Société royale zoologique et malacologique de Belgique*, 40 (1905), VII-VIII [mentions: *Farella repens*].
- ‘Bryozoaire nouveau pour la faune belge’, *Annales de la Société royale zoologique et malacologique de Belgique*, 40 (1905), XXII [concerns: *Schizoporella hyalina*].
- ‘Rapide multiplication de quelques Bryozoaires et Hydroïdes’, *Annales de la Société royale zoologique et malacologique de Belgique*, 40 (1905), bull. séances, XXII-

XXIII [concerns: *Flustra foliacea* and other bryozoans].

- 'Bryozoaire nouveau pour la faune belge', *Annales de la Société royale zoologique et malacologique de Belgique*, 40 (1905), XLIX [concerns: *Alcyonidium mamillatum*].
- 'Sur quelques variétés de *Membranipora membranacea* vivant dans l'eau saumâtre', *Annales de biologie lacustre*, 1 (1906), 3 p. [separatum].
- 'Sur les caractères distinctifs entre *Alcyonidium gelatinosum* et *Alc. hirsutum*', *Annales de la Société royale zoologique et malacologique de Belgique*, 42 (1907), 169-174.
- 'Influence du milieu sur la composition chimique des zoécies des Bryozoaires marins', *Annales de la Société royale zoologique et malacologique de Belgique*, 51 (1920), 91-110.

## (2) Publications concerning freshwater and brackish water or marine Bryozoa:

- '*Plumatella repens* L. vivant dans l'eau saumâtre', *Annales de la Société royale zoologique et malacologique de Belgique*, 40 (1905), bull. séances, XLIX-L.
- 'Contributions à l'étude des Bryozoaires de Belgique', *Annales de la Société royale zoologique et malacologique de Belgique*, 41 (1906), 130-136 [list of Entoprocts, Ectoprocts including Phylactolaemates and *Paludicella* (Gymnolaemates)].
- 'Bryozoaires marins et fluviatiles de la Belgique', *Annales de la Société royale zoologique et malacologique de Belgique*, 41 (1906), 286-321, figs 1-50.
- 'Contribution à l'étude du micro-plankton des eaux saumâtres de la Belgique', *Annales de Biologie lacustre*, 3(1908-1909), 16-53 [Bryozoa: p. 17 (*P. repens* f. *fungosa*), p. 25ss (statoblasts of *P. repens*)].
- 'Les Bryozoaires d'eau douce', *Annales de biologie lacustre*, 3(1908-1909), 141-183.
- 'Bryozoaires', *Annales de biologie lacustre*, 3 (1909), 428-430 [review of articles on freshwater bryozoans written by Annandale, Braem, Kraepelin, Oka, Rousselet, Sollas, Weltner, Wesenberg-Lund].
- 'Catalogue des Bryozoaires d'eau douce avec une note sur *Victorella pavida*', *Annales de la Société royale zoologique et malacologique de Belgique*, 44 (1909), 97-110.
- 'Fauna aquatica europaea. Les Bryozoaires d'eau douce d'Europe', *Annales de biologie lacustre*, 4 (1910), 139-161.
- 'Bryozoaires marins et fluviatiles de la Belgique', *Bulletin des Naturalistes belges*, 29 (1948), 54-63, 121-128, 138-144, 3 pl. [id. *Extrait du Bulletin des Naturalistes belges* 1948, 27 p.].

## Appendix 2. List of Paul Brien's publications on Bryozoa and Entoprocta

- 'Reproduction asexuée chez les Phylactolémates', *Association française pour l'avancement des sciences, congrès de Bruxelles, comptes rendus de la 56e session* (1932), 278-279 (joint author: M. Aendenboom).
- 'Développement des statoblastes des Phylactolémates (*Fredericella sultana*). Loi



- d'apparition des bourgeons d'accroissement', *Comptes rendus des séances de la Société de Biologie, Société belge de Biologie, séance du 14 juillet, CXVII* (1934), 214-217.
- 'Régénération artificielle, après section antérieure, des premiers cystides et polypides de *Fredericella sultana*, issus d'un statoblaste', *Comptes rendus des séances de la Société de Biologie, Société belge de Biologie, séance du 14 juillet*, 117 (1934), 217-219.
- 'Régénération et régulation', *11e Congrès national des Sciences, Bruxelles, 19-23 juin 1935* (1935), 1086-1091.
- 'Contribution à l'étude de la reproduction asexuée des Phylactolémates (Origine des bourgeons polypidiiaux et des cystigènes statoblastiques)', *Mémoires du Musée royal d'histoire naturelle de Belgique*, 2e série, fasc. 3 (1936), 569-625.
- 'La croissance et le bourgeonnement du stolon chez les Stolonifera (*Bowerbankia* Fabre). Evolution du stolon et de la zoécie chez les Bryozoaires', *Annales de la Société royale zoologique de Belgique*, 68 (1937), 13-40 (joint author: P.G. Huysmans).
- 'Fixation et métamorphose des larves de Phylactolémates (*Plumatella fungosa*, *Fredericella sultana*), *Comptes rendus des séances de l'Académie des Sciences de Paris*, 235 (1952), 1435-1437.
- 'Etude sur les Phylactolémates', *Annales de la Société royale zoologique de Belgique*, 84 (1953), 301-440 [published in 1954].
- 'A propos des Bryozoaires Phylactolémates', *Bulletin de la Société zoologique de France*, 79 (1954), 203-239.
- 'Les Endoproctes et la classe des Bryozoaires', *Annales de la Société royale zoologique de Belgique*, 85 (1954), 59-87.
- 'Relations entre les reproductions sexuée et asexuée. A propos des Phylactolémates', *Annales de la Société royale zoologique de Belgique*, 86, fasc. 2 (1955), 169-188 (joint author: C. Mordant).
- 'Le bourgeonnement des Endoproctes et leur phylogénèse', *Annales de la Société royale zoologique de Belgique*, 87, fasc. 1 (1956), 27-43.
- 'Formation et métamorphose des larves de Phylactolémates', *Proceedings of the XIVth International Congress of Zoology, Copenhagen* (1956), 519-520.
- 'La signification du cystide des Bryozoaires et la croissance de la colonie', *Académie royale de Belgique, Bulletin de la Classe des Sciences*, 44, 5e série (1958), 750-766.
- 'La reproduction sexuée', *Année biologique*, 34, fasc. 5-6 (1958), 242-297 [II. Bryozoaires].
- 'Classe des Endoproctes ou Kamptozoaires', in P.P. Grassé (éd.), *Traité de Zoologie*, vol. 5, fasc. 1 (1959), 927-1007 (joint author: L. Papijn).
- 'Classe des Bryozoaires', in P.P. Grassé (éd.), *Traité de Zoologie*, vol. 5, fasc. 2 (1960), 1054-1392.
- 'Le bourgeonnement et la phylogénèse des Endoproctes et des Ectoproctes. Réflexions sur les processus de l'Evolution animale', *Académie royale de Belgique, Bulletin de la Classe des Sciences*, 46, 5e série (1960), 748-766.
- 'Kamptozoaires. Lophophoriens', *Encyclopaedia Universalis* (1969), 309-312.
- 'Considérations phylogénétiques à propos des Lophophoriens', *Académie royale de*



*Belgique, Classe des Sciences, séance du 6 juin*, 46 (1970), 565-579.

### Appendix 3. List of some of A.W. Lacourt's publications on Bryozoa

- 'Bryozoa van Nederland', *Handelingen van de Hydrobiologische Club, Amsterdam*, 6 (1943), 22-23.
- 'On two Freshwater-Bryozoa (Phylactolaemata) from Belgian Congo', *Rev. Zool. Bot. Afr.*, 40 (4) (1948), 229-234.
- 'Les Bryozoaires d'eau douce (Phylactolaemata) de la Belgique', *Bull. Inst. Roy. Sci. Nat. Belg.*, 25(19) (1949), 1-9.
- 'Bryozoa of the Netherlands', *Archives néerlandaises de Zoologie*, 8(3) (1949), 289-321.
- 'Bryozoaires', *Rés. Sci. Explor. Hydrobiol. Lac Tanganyika (1946-1947)*, 3 (1951), 21-25.
- 'Some remarks on *Plumatella philippinensis* Kraepelin', *Hydrobiologia*, 7(3) (1955), 261-263.
- 'Freshwater Bryozoa (Phylactolaemata) from Curaçao, Aruba and Bonaire', *Studies on the Fauna of Curaçao and other Caribbean Islands*, 27 (1955), 86-88.
- '*Lophopodella pectinatelliformis* nov. spec. (Bryozoa, Phylactolaemata)', *Zool. Meded.*, 36 (17) (1959), 273-274.
- 'Histochemical investigation of *Pectinatella magnifica* (Leidy, 1851)', *Proceedings of the Koninklijke Nederlandsche Academie van Wetenschappen*, serie C, 69 (1966): 22-23 (joint author: A.G.D. Willighagen).
- 'A monograph of the freshwater Bryozoa. Phylactolaemata', *Zoölogische Verhandelingen, Leiden*, 93 (1968), 1-159.
- 'De nederlandse mariene mosdiertjes, Bryozoa (Ectoprocta, Gymnolaemata)', *Wetenschappelijke mededelingen van de Koninklijke Nederlandse Natuurhistorische Vereniging*, 129 (1978), 21 p.
- 'Handleiding voor het projekt Bryozoa van binnenwateren', *Instructies voor medewerkers EIS-Nederland, Leiden*, 7 (1982), 11 p.

### Notes

- 1 B.C. Dumortier, *Bulletin de l'Académie royale des Sciences et Belles-Lettres de Bruxelles*, 2 (1835), 421-56, pl. V-VI.
- 2 George James Allman (1812-1898), Irish botanist and zoologist, childhood in Cork, educated at Belfast, studied at the Trinity College in Dublin, 1844 professor of botany in Dublin, then professor of natural history in Edinburgh from 1855-1870; curator at the department of invertebrate zoology at Harvard University, U.S.A. (in 1873); president of the Linnean Society of London (1874-1883). His most important work was his investigation into the morphology of the Coelenterata and the Polyzoa. See: *Proceedings of the Royal Society of London*, 75 (1905), 25-7 (obituary notice signed S J H). — The dictionary of national biography, 'The concise dictionary, part 1, from the beginnings to 1900' (Oxford, 1953, reprint), 19. — Ilse Jahn, *Geschichte der Biologie* (Jena 1998), 763. — H.G. Hansson, *Biographies of marine*

- taxonomists and their friends*, <http://www.tmbi.gu.se/libdb/taxon/personetymol.1.html>. Allman established the fundamental separation of the bryozoans into Gymnolaemates and Phylactolaemates. See: J.L. d'Hondt, 'Histoire et chronologie des recherches sur les bryozoaires', *Bulletin d'Histoire et d'Épistémologie des Sciences de la Vie*, 2(1) (1995), 103.
- 3 G.J. Allman, 'A monograph of the fresh-water Polyzoa, including all the known species, both British and foreign', Ray Society London, 17 (1856), 66. Trembley discovered this animal in April 1741 in freshwater near The Hague, a lobed jelly-like mass, from which protruded numerous polypoid bodies, each characterized by the possession of an elegant crown of tentacula borne on the margin of a crescent-shaped disc. Because of this striking tentacular plume, Trembley naturally supposed this new kind of animal to be intimately related with the polyps; so he called it 'Polype à Panache' in his '*Mémoires pour servir à l'histoire d'un genre de Polypes d'eau douce, à bras en forme de cornes*' (Leide, 1744). — Abraham Trembley (1740-1784), born at Geneva (Switzerland), best known for his studies on the *Hydra*; he made his chief discoveries between 1739 and 1747 while tutor to two boys at The Hague (*Encyclopaedia Britannica* 1969, vol 22: 213).
  - 4 B.C. Dumortier and P.J. Van Beneden, 'Histoire naturelle des Polypes composés d'eau douce', *Nouveaux Mémoires de l'Académie Royale des Sciences et Belles-Lettres de Bruxelles*, 16 (1843): 8.
  - 5 P.J. Van Beneden, 'Recherches sur les Bryozoaires fluviatiles de Belgique', *Nouveaux Mémoires de l'Académie Royale des Sciences et Belles-Lettres de Bruxelles*, 21 (1848), 22; B.C. Dumortier and P.J. Van Beneden, 'Histoire naturelle des Polypes composés d'eau douce, IIe partie', *Nouveaux Mémoires de l'Académie royale des Sciences et Belles-Lettres de Bruxelles*, 16 (complément) (1850), 65.
  - 6 According to Allman, note 3, p. 92, the genus *Alcyonella* is characterized by the 'coalescence of the tubes into a common mass'.
  - 7 Dumortier and Van Beneden, note 4, p. 27.
  - 8 Dumortier, note 1, p. 6.
  - 9 In his monograph on the German freshwater bryozoans K. Kraepelin (1887) rallied this point of view [K. Kraepelin, 'Die Deutschen Süßwasserbryozoen. I. Anatomisch-systematischer Teil', *Abhandlungen aus dem Gebiete der Naturwissenschaften, Naturwissenschaftlicher Verein Hamburg*, 10 (1887), 1-168 (page 10)]. — Karl Kraepelin (1848-1915), German zoologist and botanist, studied natural sciences at the universities of Göttingen and Leipzig (Dr. phil. in 1873), secondary school teacher in Leipzig (1873), than at the 'Johanneum' in Hamburg (1878-1889), where he was appointed professor in 1887; director of the Natural History Museum of Hamburg (1889-1914); member of the council of professors of the Colonial Institute in Hamburg (1908). Kraepelin was a wellknown pedagogue who had written some greatly appreciated botanical and zoological schoolbooks. As a zoologist he is most known as a specialist of Tarantulidae, Uropygi, Scorpions, Scolopendrida, Palpigradi, Solifugids, etc. Karl was the brother of Emil Kraepelin (1856-1926), a wellknown psychiatrist. Ref. I. Jahn, note 2, p. 877; H. Weidner, 'Karl Kraepelin', in *Neue Deutsche Biographie*, 12 (1980), 640-641.
  - 10 *Bulletin zoologique*, 2e section, 1835, p. 123 (cf. Dumortier and Van Beneden, note 4, p. 28).
  - 11 Paul Gervais (1816-1879), French palaeontologist and zoologist, obtained doctorates in science and medicine, studied palaeontology as assistant to H.M.D. de Blainville (1777-1850), Cuvier's successor as professor of comparative anatomy in the Muséum National d'Histoire Naturelle (Paris). Gervais served as professor of zoology and comparative anatomy at

- Montpellier (1845-1865), and in 1865 as professor of anatomy, comparative physiology and geology at the Sorbonne, in 1868 as professor of comparative anatomy in the Muséum (*Encyclopaedia Britannica*, 1969, vol. 10, 368).
- 12 B.C. Dumortier, 'Mémoire sur l'anatomie et la physiologie des polypes composés d'eau douce nommés *Lophopodes*, 2e édition' (Tournay, 1836), 84 p., 2 pl (p. 5-7).
- 13 cf. Dumortier and Van Beneden, note 4, p. 28, and Allman, note 3, p. 66.
- 14 Presently known as *Fredericella sultana*, a name created by Gervais in 1838 (with the orthograph *Fredericilla*) as an homage to the deceased Frédéric Cuvier (1773-1838), the director of the menagerie of the Muséum in Paris, member of the Academy of Sciences, the elder brother of Georges Cuvier [cf. P. Tort (dir.) 'Dictionnaire du darwinisme et de l'évolution' (Paris, 1996), vol. 1 (A-E), 747-8]. In his 'Monographie des bryozoaires d'eau douce' (Bulletin de la Société Zoologique de France, 10, Paris, 1885), p. 1, the French physician and zoologist Jules Jullien (1842-1897) insists that concerning his *Plumatella sultana* Dumortier was right or at least getting close to the truth. In fact, Jullien is persuaded that this form is nothing else but a monstrosity of what he calls *P. lucifuga* (which essentially corresponds to *P. fruticosa*) (cf. Jullien 1885, p. 121ss, G. Geimer and J.A. Massard, 'Les Bryozoaires du Grand-Duché de Luxembourg et des régions limitrophes', *Travaux Scientifiques du Musée d'Histoire Naturelle de Luxembourg*, 7 (1986), 1-187, p. 30). Biographical details on Jullien are given by Jean-Loup d' Hondt, 'La destinée singulière d'un naturaliste original, Jules Jullien. 112e Congrès National des Sociétés savantes, Lyon, 1987', *Histoire des Sciences et des Techniques*, 1 (1987), 181-190. Jullien's role in French marine bryozoology is dealt with by J.L. d'Hondt, 'Contributions des chercheurs français à la connaissance des Bryozoaires actuels', *Histoire et Nature*, 26-27 (1985), 3-26; and J.L. d'Hondt, 'Histoire et chronologie des recherches sur les bryozoaires', *Bulletin d'Histoire et d'Épistémologie des Sciences de la Vie*, 2(1) (1995), 98-111.
- 15 Dumortier, note 12, p. 20-4.
- 16 See hereafter.
- 17 Dumortier and Van Beneden, note 5, p. 78.
- 18 Turpin, 'Étude microscopique de la Cristatelle', *Annales des Sciences naturelles*, 7, 2e série (1836). — Pierre Jean François Turpin (1775-1840), French botanist, one of the foremost botanical painters of his day; collaborated with von Humboldt; after about 1820 he devoted his energies to the study of microscopic plants and plant organs. See: *Biographie universelle (Michaud) ancienne et moderne*, nouvelle édition, t. 42, 296, See also: M. Rix, 'The art of botanical illustration' (New York 1990), p. 141.
- 19 Allman, note 3, p. 71; Jullien, note 14, p. 149-50.
- 20 P.J. Van Beneden, 'Quelques observations sur les polypes d'eau douce', *Bulletin de l'Académie Royale des Sciences de Bruxelles*, 6 (9) (1839), 276-9. The same text was published in: *Annales des Sciences Naturelles (Paris)*, 2e série, 14 (1840), 222-4; it was also reprinted in the report on the October 5, 1839 meeting of the Belgian Academy by *L'Institut, journal général des sociétés et travaux scientifiques de la France et de l'étranger (Paris)*, 1ère section, t. 8 (1840), 153-4 (Zoologie: Polypes d'eau douce).
- 21 Allman, note 3, p. 68.
- 22 'Histoire naturelle: M. Van Beneden, correspondant de l'académie, présente trois mémoires de sa composition', *Bulletin de l'Académie royale des sciences et Belles-Lettres de Bruxelles*, 7 (2) (1840): 163-4 (concerns: freshwater bryozoans, development of cephalopods, development of slugs).

- 23 P.J. Van Beneden, 'Polypes d'eau douce', *Journal de l'Institut* 1840, 153-4.
- 24 P.J. Van Beneden, 'Recherches sur la structure de l'oeuf dans un nouveau genre de Polype (genre Hydractinie)', *Bulletin de l'Académie royale des sciences et Belles-Lettres de Bruxelles*, 6 (1) (1841), 89-93, 1 pl. In this article on the structure of the egg of *Hydractinia* (Hydrozoa), Van Beneden included a remark concerning *Alcyonella* and its so-called mobile eggs (pp. 90 and 93, fig B). Normally the term 'egg' was used for a 'statoblast'. Van Beneden's so-called 'mobile eggs' correspond to the ciliated larvae; this is clearly shown by the figure and the commentaries he inserted in this note in order to react to an objection made by Dumortier in December 1840.
- 25 P.J. Van Beneden, 'Mémoire sur le développement des Tubulaires, etc.', *Mémoires de l'Académie des Sciences de Bruxelles*, 17 (1844).
- 26 P.J. Van Beneden, 'Sur la classification des Bryozoaires', *Journal de l'Institut*, 18 (1850).
- 27 P.J. Van Beneden, 'Recherches sur les Bryozoaires fluviatiles de Belgique', *Nouveaux Mémoires de l'Académie royale de Belgique*, 21 (1848), 1-33, pl. VI-VII.
- 28 Allman, note 3, p. 70.
- 29 Kraepelin, note 9, p. 12.
- 30 N. Annandale, Freshwater sponges, hydroids and polyzoa, in *The Fauna of British India*, London: I-VIII, 177.
- 31 'Recherches sur l'organisation des Laguncula et l'histoire naturelle des différents Polypes Bryozoaires qui habitent la côte d'Ostende' (Bruxelles, Hayez impr., 1845), 29 p., 3 pl. (Extr. des Mémoires de l'Académie des Sciences, t. 18) [*Laguncula* = *Laguncula repens* = *Farella repens*, a Ctenostome Bryozoan].  
 'Recherches sur l'anatomie, la physiologie et le développement des Bryozoaires qui habitent la côte d'Ostende' (Bruxelles, 1845), 8 p.  
 'Recherches sur l'anatomie, la physiologie et le développement des Bryozoaires qui habitent la côte d'Ostende' (Bruxelles, 1845), [3]-8,89,[13] p., X pl. (a reprint of three articles from Nouveaux Mémoires de l'Académie royale des Sciences et Belles-Lettres, t. 18 and 19, with an introduction) (reference: The National Union Catalog Pre-1956 Imprints, vol. 46, 158).  
 'Recherches sur l'anatomie, la physiologie et le développement des Bryozoaires qui habitent la côte d'Ostende' (Bruxelles, Hayez impr., 1845) (Extr. des Mémoires de l'Académie des Sciences, t. 19).  
 'Recherches sur les Polypes Bryozoaires de la Mer du Nord' (Bruxelles, 1848), 16 p., 1 pl. (Extr. des Bulletins de l'Académie des Sciences de Bruxelles, t. XV, 67-82).  
 'Recherches sur les Polypes Bryozoaires de la Mer du Nord (suite) et projet d'une classification des animaux de ce groupe' (Bruxelles, 1849), 15 p., 2 pl. (Extr. des Bulletins de l'Académie des Sciences de Bruxelles, t. XVI).
- 32 'Recherches sur l'anatomie, la physiologie et le développement des Bryozoaires qui habitent la côte d'Ostende: Histoire naturelle du genre *Pedicellina*', *Nouveaux Mémoires de l'Académie royale des Sciences de Bruxelles*, 19 (1845), 31 p., pl. I and II. Cf. A. Kemna, 'P.-J. Van Beneden. La vie et l'oeuvre d'un zoologiste' (Anvers, 1897), p. 105; P.J. Van Beneden and Hesse, 'Recherches sur les Bdellodes (Hirudinées) et les Trématodes marins', *Mémoires de l'Académie royale des Sciences et Belles-Lettres de Bruxelles*, 34 (1) (1864), 1-150 [discovery of the entoproct *Cyclatella annelidicola* = *Loxosoma annelidicola*, first considered as a trematode (p. 83-4, pl. XII); cf. M. Prenant and G. Bobin, 'Bryozoaires. Première partie. Entoproctes, Phylactolèmes, Cténostomes', *Faune de France*, 60 (1956), p. 34-6; and K. Nielsen, 'Entoproctes', *Synopses of the British Fauna (New Series)*, 41 (1989), 78].

- 33 B.C. Dumortier and P.J. Beneden, 'Histoire naturelle des Polypes composés d'eau douce', *Nouveaux Mémoires de l'Académie Royale des Sciences et Belles-Lettres de Bruxelles*, 16 (1843), 1-33.
- 34 Allman, note 3, p. 69.
- 35 B.C. Dumortier and P.J. Beneden, *Histoire naturelle des Polypes composés d'eau douce, IIe partie. Descriptions. (Séance du 9 mai 1848). Mémoire servant de complément au tome XVI des Mémoires de l'Académie royale des sciences et belles-lettres de Bruxelles* (Bruxelles, 1850), 96 p. — Both parts of this memoir were published in one volume entitled: *Histoire naturelle des Polypes composés d'eau douce, ou des Bryozoaires fluviatiles* (Bruxelles, Impr. Hayez, 1850), 130 p. (National Union Catalogue 151, p. 490).
- 36 We have seen that years later Jullien was still strongly annoyed by this gross error (see: note 19).
- 37 Allman, note 3, p. 71.
- 38 Kraepelin, note 9, p. 12.
- 39 G.J. Allman, 'On the present state of our knowledge of the freshwater Polyzoa', *Reports of the British Association for the Advancement of Science*, 19 (1850), 306. — When writing this statement, Allman seemingly did not yet have the second part of Dumortier and Van Beneden's memoir which is not cited in the references.
- 40 F. Crépin, Notice biographique sur Barthélemy-Charles-Joseph Du Mortier, président de la Société Royale de Botanique de Belgique, *Bulletin de la Société royale de Botanique de Belgique*, 18 (1879), 7-49. — E. de Wildeman and L. Hauman, 'Barthélemy-Charles-Joseph Du Mortier', in *Biographie Nationale de Belgique*, 30, supplém., t. 2 (1959), col. 611-28. — G. Lebrun (dir.), *Grandes figures de la Belgique indépendante*, 3e éd. (Bruxelles, 1936), 309-10. — A. Lawalrée, 'Barthélemy Dumortier, 1797-1878', in *Florilège des sciences en Belgique (II)*, Académie royale de Belgique, classe des sciences (Bruxelles 1980), 541-58. — T. Denoël, *Le nouveau dictionnaire des Belges* (Bruxelles, 1992), 269.
- 41 F.L. Lefort, 'Contribution à l'histoire botanique du Luxembourg', *Bulletin de la Société des Naturalistes luxembourgeois*, 54 (1949), 116-8. — A. Lawalrée (1980), 545 (see note 40). — J.A. Massard, 'Historisch-naturwissenschaftlicher Streifzug durch den Kanton Echternach', *Nos Cahiers*, 19 (2-3) (1998), 367-70. — J.A. Massard, 'Aspects historiques de l'histoire naturelle du Mullerthal et de ses environs', *Annuaire de la Ville d'Echternach*, 2001, p. 41-3.
- 42 cf. Jahn, note 2, p. 312 (where Dumortier is cited in the first place in the chronology of the observation of cell division, then Morren and finally von Mohl). Hugo von Mohl (1805-1872) was a German botanist, professor for physiology at the university of Bern in 1832; professor of botany at Tübingen 1835-1872 (I. Jahn et al., [1985], 312 and 905. — *Encyclopaedia Britannica*, 15 [1969], 647). Charles Morren (1807-1858) was born in Ghent; he was professor of botany and agronomy at the university of Liège; this compatriot of Dumortier had seen the cell division in 1832 and he published his observation in 1836 in his '*Mémoires sur les Clostéries*' (I. Jahn et al. [1985], 312 and 906). See: J. Lebrun, 'Esquisse d'une histoire de la botanique et des botanistes belges pendant le XIXe siècle et le début du XXe, in: *Florilège des Sciences en Belgique* (Bruxelles 1968), 595-634 (p. 600).
- 43 de Wildeman and Hauman, note 40, p. 614.
- 44 B.C. Dumortier, 'Mémoire sur le delphinorhynque microptère échoué à Ostende', *Académie royale des Sciences, des Lettres et des Beaux-Arts de Belgique, nouveaux mémoires*, 12 (1839), 13 p. *Delphinorhynchus micropterus* (F. Cuvier, 1836) is nowadays called *Mesoplodon bidens* (Sowerby, 1804). Dumortier's article is cited by V.V. de Buffrénil, '*Mesoplodon bidens*

- (Sowerby, 1804) - Sowerby-Zweizahnwal', in J. Niethammer and F. Krapp: *Handbuch der Säugetiere Europas*, Bd. 6, Teil 1B (Wiesbaden, 1995), 546, 559.
- 45 References for the biblio-biographical data: WHF, 'Obituary notice: P.-J. Van Beneden', *Proceedings of the Royal Society*, 57 (1894-95), XX-XXI. — Ad. Kemna, 'P.-J. Van Beneden. La vie et l'oeuvre d'un zoologiste' (Anvers, 1897), 137 p. — Dictionnaire des Ecrivains belges, 'Pierre-Joseph Van Beneden', *Bibliographie Nationale: Dictionnaire des Ecrivains belges et Catalogue de leurs publications, 1830-1880*, vol. 4 (1910), 20-30. — G. Lebrun (dir.), 'Grandes figures de la Belgique indépendante', 3e éd. (Bruxelles, A. 1936), 319-320. — A. Lameere, 'Pierre-Joseph Van Beneden', *Biographie nationale publiée par l'Académie royale des sciences, des lettres et des beaux-arts de Belgique*, 26 (1936-1938), 184-91. — P. Brien, 'Pierre-Joseph Van Beneden', in *Florilège des sciences en Belgique*, Académie royale de Belgique, classe des sciences (Bruxelles 1968), 824-51. — T. Denoël, 'Le nouveau dictionnaire des Belges' (Bruxelles, 1992), 701. — B.C.A. Windle (transcribed by M.T. Barrett), 'Pierre-Joseph Van Beneden', *The Catholic Encyclopaedia, Online edition* (1999), <http://www.newadvent.org.cathen/15266a.htm> (The Catholic Encyclopaedia, vol. XV, R. Appleton Company 1912). — P. Tort, Patrick (dir.), 'Dictionnaire du darwinisme et de l'évolution' (Paris, 1996), vol. 3 (O-Z), 4402-3.
- 46 cf. S.P. Parker (ed.), 'Synopsis and classification of living organisms', vol. 2 (New York, 1982), 726.
- 47 R. Siewing, (ed.), 'Lehrbuch der Zoologie, Bd. 2: Systematik, 3. Aufl. (Stuttgart, 1985), 761.
- 48 cf. C. Nielsen, 'Animal evolution. Interrelationships of the living phyla', (Oxford, 1995), 164.
- 49 cf. Nielsen, note 48.
- 50 cf. Kemna, note 32, p. 84-5.
- 51 Friedrich Küchenmeister (1821-1890), German physician in Zittau (Saxony) since 1846, then from 1859 on in Dresden; he published on cestodes (1853) and on human parasites (1855) (Jahn, note 2, p. 879).
- 52 Kemna, note 32, p. 82-3. Cf. G. Theves, 'Helminthologie vétérinaire', *Annales de Médecine vétérinaire*, 139 (1995), 241-8.
- 53 See G. Hamoir, 'La découverte de la méiose et du centrosome par Edouard Van Beneden', *Académie royale de Belgique, Mémoire de la Classe des Sciences, Collection in-octo*, 3e série, tome 8 (1994), 1-128. For biographical data on Ed. Van Beneden see: R. de Winiwarter, 'Edouard-Joseph-Louis-Marie Van Beneden', *Biographie nationale publiée par l'Académie royale des sciences, des lettres et des beaux-arts de Belgique*, 26 (1936-1938), 174-184.
- 54 Dumortier and Van Beneden, note 4, p. 30.
- 55 Published in the *Annales des Sciences naturelles*: Mémoire sur les Alcyonides (1835); Recherches anatomiques, physiologiques et zoologiques sur les Escharres (1836); Sur les Polypes du genre Tubulipore (1837); Sur la nature et le mode de croissance des Polypes (1838).
- 56 H. Milne-Edwards, Rapport sur un mémoire de M. Gervais, intitulé: Observations pour servir à l'histoire naturelle des Polypes d'eau douce, fait à l'Académie des Sciences, le 8 avril 1839, *Annales des sciences naturelles*, 2e série, 11 (1839), 179-185 (p. 182). — P. Gervais, Observations sur les Polypes d'eau douce, *Ann. franç. et étrang. Anat. Physiol.*, 3 (1839), 129-176.
- 57 *Nouvelle biographie générale depuis les temps les plus reculés jusqu'à 1850-60 publiée par MM. Firmin Didot frères*, XXXV-XXXVI (Copenhague, 1968, reprint), 551-2. Patrick Tort (dir.), *Dictionnaire du darwinisme et de l'évolution*, vol. 2 (Paris, 1996), 2957-60. H.G. Hansson, *Biographical etymology of marine organism names*, <http://www.tmbi.libdb/>



taxon/personetymol./petymol.a.html

- 58 William-Frédéric Edwards (Jamaica 1777 - Paris 1842), after a number of years in Bruges, he had left for France during the Revolution; doctor of medicine in Paris (1815), important research work on anatomy, pathological physiology and compared anatomy; member of the Institut de France (1832); founding member of the 'Société ethnologique' (1839, father of French ethnology. Cf. *Nouvelle biographie générale depuis les temps les plus reculés jusqu'à 1850-60 publiée par MM. Firmin Didot frères*, XXXV-XXXVI (Copenhagen, 1968, reprint), 552-3.
- 59 Hansson, note 57.
- 60 Daughter of general Camille Alphonse Trézel (1780-1860), who had participated in Napoleon's campaigns in Spain and Russia. Under Louis-Philippe he successfully fought in Algeria (victory of Macta in 1835), and was later on Minister of War and Governor of Paris (*Dictionnaire Encyclopédique Quillet*, volume 6, 1958, p. 5512).
- 61 cf. Hansson, note 57.
- 62 Jean-Victor Audouin (1797-1841), French naturalist, born in Paris, where he studied medicine, natural history and pharmaceutics; disciple of Cuvier, assistant at the Muséum National d'Histoire Naturelle in Paris (1825), professor of entomology at the Muséum in 1833.
- 63 Year indicated by P. Tort and by d'Hondt (1990); other authors indicate 1890 or 1891.
- 64 Bibliographie Nationale, '*Dictionnaire des Ecrivains belges et Catalogue de leurs publications, 1830-1880*' (Bruxelles, 1910), 4: 339-40.
- 65 The National Union Catalog Pre-1956 Imprints, vol. 657, 479.
- 66 = *P. emarginata* and/or *P. fruticosa*. See chapter about Lacourt.
- 67 H.R. Berquin, 'Op bezoek bij Karel Loppens', *Bachten de Kupe, Heemkundig tijdschrift*, 1 (1959), 3-6, Nieuwport (includes an autobiographical note by Loppens: 'Korte levensbeschrijving'). — H.R. Berquin, 'In Memoriam Karel Loppens', *Bachten de Kupe, Heemkundig tijdschrift*, 4 (1962), 62-67. — P. van Oye, 'Karel Loppens, onbekend pionier van het brakwateronderzoek', *Mededelingen van de Koninklijke Vlaamse Academie voor Wetenschappen, Letteren en Schone Kunsten van België. Klasse der Wetenschappen*, 25 (7) (1963): 1-34, Brussel.
- 68 See about Gilson: P. Brien, Esquisse d'une histoire de la zoologie et de la biologie animale en Belgique durant le XIXe siècle et le début du XXe, in: *Florilège des sciences en Belgique, Académie royale de Belgique, classe des sciences, Bruxelles*, p. 757-8.
- 69 Ernest Rousseau (1872-1920), physician, entomologist, hydrobiologist, curator of the Museum of natural history, founder of '*Les Annales de Biologie lacustre*', founded the limnological station of Overmeire (station de biologie lacustre) with the financial support of Charles Torley (†1926), an industrialist interested in natural sciences. See Brien, note 68.
- 70 Paul van Oye (Ostende, 1886-1969), professor at the university of Ghent; he was a member of honour of the 'Société des Naturalistes luxembourgeois' (*Bulletin de la Société des Naturalistes luxembourgeois*, 71-75 (1966-1970), 157).
- 71 A list of these publications is given by van Oye, note 67, p. 28.
- 72 See: M. Poll and H. Herlant-Meewis, 'Notice sur Paul Brien, membre de l'Académie', *Annuaire de l'Académie royale de Belgique*, vol. 145 (1979) (notices biographiques), 39-141. — M. Poll, 'Paul Brien', *Nouvelle Biographie nationale, Acad. r. Belg.*, 2 (1990), 55-58. — Mme Henriette Herlant-Meewis: doctor of natural sciences, 'chef de travaux' at the University of Brussels, associated member of the Belgian zoological society in 1932 [*Annales Soc zool Belg.*, 84 (1953), 489]. Max Pol: see hereafter.

- 73 In 1933 M. Aen den Boom published some thirty pages on this subject: 'Contribution à l'étude de la reproduction asexuelle chez les Bryozoaires d'eau douce', *Recueil de l'Institut zoologique Torley-Rousseau*, 4 (1933), 165-195. (The Zoological Institute Torley-Rousseau was a foundation directed by Lameere; his successor was Brien. Cf. Poll and Herlant-Meewis, note 72, p. 44.). — In 1933 Marcelle Aen den Boom, then a zoology student, got married to Max Poll; later on she became biology teacher at the 'Ecole Normale Berckendael' at Brussels. Max Pol (1908-1991), was an assistant of Lameere and Brien; he entered the 'Musée du Congo' at Tervuren (now Royal Museum of Central Africa), where he became head of the zoology department in 1948; he retreated in 1973; he was known as the best specialist of freshwater fishes of Black Africa; also professor at the ULB (P. Basilewsky, 'Max Poll', <http://angelicus.netliberte.org/articles/celebrities/poll.htm>, © 1999 Angelicus, 7 p.).
- 74 Pierre-Paul Grassé (Périgueux 1895 - Carlux 1985), French zoologist, professor at the Sorbonne, worked on protozoans and termites, as well as on evolution (including man); internationally known for his '*Traité de Zoologie*' (first volume published in 1948).
- 75 Poll and Herlant-Meewis, note 72, 64-5. The systematic and phylogenetic position of the Entoprocts is still a controversial topic. For more details see: J.L. d'Hondt, 'Progrès récents dans la connaissance des "Lophophoriens" (sensu lato)', *Bulletin de la Société Zoologique de France*, 107 (1982), 179-183. P. Emscherman, 'Les Kamptozoaires: Etat actuel de nos connaissances sur leur anatomie, leur développement, leur biologie et leur position phylogénétique', *Bulletin de la Société Zoologique de France*, 107 (1982), 317-344. P. Emschermann, 'Kamptozoa', in *Süßwasserfauna von Mitteleuropa*, 1 (2+3) (1995), 119. C. Nielsen, 'Animal evolution. Interrelationships of the living phyla' (Oxford, 1995), 182-191. C.C. Emig, 'Les Lophophorates constituent-ils un embranchement?', *Bulletin de la Société Zoologique de France*, 122 (1997), 279-288. C. Nielsen, 'The phylogenetic position of Entoprocts and Ectoprocts', Proceedings of the 11th International Bryozoology Association Conference, Panama (2000), 66-73 (in this paper Nielsen concludes that the phylum Bryozoa has a phylogenetic position close to the base of the spiraliens, and that it is possible that the two phyla, i.e. ectoprocts and entoprocts, are sister groups, such that the old classification, with Bryozoa consisting of Entoprocta and Ectoprocta, could be reinstated).
- 76 cf. *Annales de la Société zoologique de Belgique*, 84 (1953), 486: Graziella Bresseur-Huysmans, licenciée en sciences zoologiques, La Louvière, associated member in 1936.
- 77 Poll and Herlant-Meewis, note 72, 39-141. — M. Poll, 'Paul Brien', *Nouvelle Biographie nationale*, Académie royale de Belgique, 2 (1980), 55-58. — M. Poll and H. Herlant-Meewis, 'Paul Brien, 1894-1975', in *Florilège des sciences en Belgique (II)*, Académie royale de Belgique, classe des sciences (Bruxelles 1980), 641-52.
- 78 Auguste Lameere (Ixelles, 1864 - Brussels, 1942); Belgian zoologist, author of '*Manuel de la Faune de Belgique*' (3 vol., 1895-1907) and '*Précis de Zoologie*' (7 vol., 1927-1942). See: P. Brien, 'Auguste Lameere', in: *Biographie nationale de Belgique*, 31, suppl. t. III, fasc. 1 (1961), 529-37. - P. Brien, 'Auguste Lameere', in *Florilège des sciences en Belgique*, Académie royale de Belgique, classe des sciences (Bruxelles 1968), 879-906.
- 79 'Recherches sur l'embryogénie de *Salpa maxima*', *Bulletin de la classe des sciences de l'Académie royale de Belgique, séance du 4 novembre*, pp. 616-27.
- 80 *Rev. zool. bot. Afr.*, 40 (1948), 229-234.
- 81 A. Verduin, 'In memoriam: A.W. Lacourt (6.6.1910 - 19.2.1987)', *Correspondentieblad van de Nederlandse Malacologische Vereniging*, 236 (1987), 263-265. We would like to thank Dr Maya Borel Best (Nationaal Natuurhistorisch Museum, Leiden) for sending us a copy of this



- obituary, and extend these thanks to Drs W. van Weiten, general director of the museum.
- 82 Scientific journal of the Dutch Malacological Society; issued twice a year.
- 83 Organ of the coast working group (Strandwerkgemeenschap) of the Royal Dutch Natural History Society (*Koninklijke Nederlandse Natuurhistorische Vereniging, K.N.N.V.*)
- 84 A bimonthly journal for and made by members of the Dutch Malacological Society.
- 85 P. Job, 'Intervention des populations de *Plumatella fungosa* (Pallas) (Bryzoaire Phylactolème) dans l'autoépuration des eaux d'un étang et d'un ruisseau', *Hydrobiologia*, 48 (3) (1976), 257-261.
- 86 B. Goethals, 'Les *Plumatella* (Bryozoaires d'eau douce): quelques aspects de leur morphologie, de leur composition chimique et leur incidence écologique en rivières polluées', *Univ. Liège, Mém. Lic. Sci. zool.* (1982), 84 p.; V. Henry, *Bryozoaires de la Meuse liégeoise: biomasse et réactions vis-à-vis de certains polluants*. Univ. Liège, Mém. Lic. Sci. zool. (1984), 55 p; C. Brene, *Contribution à l'écologie des Bryozoaires Phylactolèmes et application au problème de l'entretien des aëroréfrigérants d'une centrale électrique*. Mémoire de licence en sciences zoologiques, Univ. de Liège (1988), 1-45.
- 87 B. Goethals, M.F. Voss-Foucart and G. Goffinet, 'Composition chimique et ultrastructurale de l'ectocyste et de la coque des statoblastes de *Plumatella repens* et *Plumatella fungosa* (Bryozoaires Phylactolèmes)', *Ann. Sic. nat. Zool.*, Paris, 13, 6 (1984), 197-206.
- 88 Eugène Bricher (1875-1937): born in Weimerskirch in the outskirts of Luxembourg-City on February 6, 1875; qualified as a doctor in Luxembourg in November 1898; practice in Luxembourg-City; died in Kehlen on 17th December 1937. He was secretary of the Société des Naturalistes luxembourgeois from 1901 to 1905 Cf. H. Kugener, '*Die zivilen und militärischen Ärzte und Chirurgen in Luxemburg* (Luxemburg, 1995), 97-9. — J.A. Massard, 'La Société des Naturalistes Luxembourgeois du point de vue historique', *Bulletin de la Société des Naturalistes luxembourgeois*, 91 (1990), 158.
- 89 Eugène Bricher, 'Sitzung vom 14. Juli 1901', *Bulletin de la Société des Naturalistes luxembourgeois*, 11 (1901), 285.
- 90 Joseph Hoffmann, born on 12th December 1911 in Reckange (Mersch), professor of zoology and biology at the 'Cours universitaires' in Luxembourg-City, author of numerous publications on the Invertebrates of Luxembourg, one of the leading 20th century zoologists in Luxembourg, died in Luxembourg on December 16, 2000, aged eighty-nine. J.A. Massard and G. Geimer, 'Les professeurs de sciences et leur oeuvre', in: *Festschrift 150 Joër Iechternacher Kolléisch (1841-1991)*, Luxembourg, 1992, 475-6.
- 91 Erik Mauch, born in 1934 in Mannheim (Germany); biological studies at the University of Frankfurt/Main, Ph.D. in 1961; hydrobiologist in the water management administration ('*Wasserwirtschaftsverwaltung*') in Baden-Württemberg, then in Bavaria, where he was active in river quality mapping, with special devotion to saprobic classification and fundamental aspects of biological analysis of waters; retreat in 1999; author of numerous articles; since 1989 editor of the limnological journal '*Lauterbornia*'.
- 92 E. Mauch, '*Untersuchungen über das Benthos der deutschen Mosel unter besonderer Berücksichtigung der Wassergüte*', Bundesanstalt für Gewässerkunde (Koblenz, 1962), 335 p. Anl. 1-6 [hectogr.]. [Bryozoa: 231-235]. [Diss. Frankfurt/M. (1961)]; E. Mauch, 'Untersuchungen über das Benthos der deutschen Mosel unter besonderer Berücksichtigung der Wassergüte', *Mitt. Zool. Mus. Berlin*, 39 (1963): 3-172.
- 93 E. Mauch, 'Der Einfluß des Aufstaus und des Ausbaus der deutschen Mosel auf das biologische Bild und den Gütezustand,' *DVWK-Schriften*, 45 (1981), 39-137 [Bryozoa: 75-6, tab. 3, p. 53-

- 54].
- 94 G. Geimer, '*La faune des Bryozoaires (Lophophoriens ectoproctes) du Grand-Duché de Luxembourg*', (Luxembourg, 1975), 104 p., 29 pl. (Mémoire scientifique).
- 95 Gaby (Gabrielle) Geimer, born in Luxembourg on 29th June 1950; secondary school teacher (biology) in Echternach. See: International Biographical Centre, '*International Who's Who of Intellectuals*', 10th Edition 1993/94 (Cambridge, 1993), 158. — International Biographical Centre, '*Dictionary of International Biography*', 24th edition 1996 (Cambridge, 1995), 111; and 25th edition 1997 (Cambridge, 1997), 131.
- 96 Geimer and Massard, note 14.
- 97 Jos. A. Massard, born at Tétange (Luxembourg) on 3rd December 1944, secondary school teacher in Echternach (biology) and part-time lecturer at the University Centre of Luxembourg (history and philosophy of sciences, history of medicine). See: International Biographical Centre, '*International Who's Who of Intellectuals*', 10th Edition 1993/94 (Cambridge, 1993), 314. — *International Biographical Centre, 'Men of Achievement'*, 16th edition (Cambridge, 1995), 293; 17th edition (Cambridge, 1997), 331. — International Biographical Centre, '*Dictionary of International Biography*', 24th edition 1996 (Cambridge, 1995), 221; and 25th edition 1997 (Cambridge, 1997), 261.
- 98 See also: G. Geimer and J.A. Massard, 'Note sur les caractères distinctifs de *Plumatella repens* (Linné, 1758) et de *Plumatella fungosa* (Pallas, 1768) (Bryozoa, Phylactolaemata)', *Archives de l'Institut Grand-Ducal de Luxembourg, section des sciences*, N.S., 40 (1987), 41-46.
- 99 Other publications of J.A. Massard and G. Geimer concerning the freshwater bryozoans of Luxembourg: 'Notice sur les Bryozoaires du lac d'Echternach et du lac de la Haute-Sûre ainsi que sur la présence de l'Hydrozoaire *Cordylophora caspia* (Pallas, 1771) dans la centrale nucléaire de Cattenom', *Bull. Soc. Nat. luxemb.*, 90 (1990), 163-168. — 'Note sur les Bryozoaires d'eau douce trouvés en diverses stations luxembourgeoises et belges, avec des considérations sur la bryozoofaune de la Sûre et des remarques concernant les statoblastes de *Hyalinella punctata* (Hancock, 1850)', *Bull. Soc. Nat. luxemb.*, 92 (1991), 131-148. — 'Signalement du Bryozoaire d'eau douce *Plumatella casmiana* Oka, 1907 (Phylactolaemata) en Lorraine', *Bull. Soc. Nat. luxemb.*, 98 (1997), 237-238. — 'Découverte de *Plumatella fungosa* (Pallas, 1768) (Bryozoaires, Phylactolémates) dans le <lac> d'Echternach (Luxembourg)', *Archs Inst. g.-d. Luxemb. Sect. Sci. nat. phy. math.*, NS 44 (2002), 101-105.
- 100 Publications of J.A. Massard and G. Geimer concerning freshwater bryozoans of other countries: 'Note on the freshwater Bryozoa of Israel (Phylactolaemata)', in: F. Bigey (ed.) and J.L. d'Hondt (collab.): *Bryozoaires actuels et fossiles : Bryozoa living and fossil*. — *Bull. Soc. Sci. nat. Ouest Fr.*, Mém. HS 1 (1991), 243-253. — 'Note on the freshwater Bryozoa (Ectoprocta, Phylactolaemata) of Tenerife', *Vieraea*, 19 (1990), 327-338. — 'Additional note on the freshwater Bryozoa of Tenerife (Phylactolaemata)', *Bull. Soc. Nat. luxemb.*, 92 (1991): 149 -157. — Additional note on the fresh and brackish water Bryozoa of Israel (Phylactolaemata, Gymnolaemata)', *Bull. Soc. Nat. luxemb.*, 93 (1992): 199-214 (joint authors: H.J. Bromley and C. Dimentman). — 'Distribution of freshwater and brackish-water Bryozoa (Phylactolaemata, Gymnolaemata) in Israel', in: P.J. Hayward, J.S. Ryland and P.D. Taylor: *Biology and Palaeobiology of Bryozoans* (Fredensborg, 1994), 117. — 'Das Moostierchen *Fredericella indica* kommt in Bayern vor (Bryozoa, Phylactolaemata)', *Lauterbornia*, 20 (1995): 99-101. — 'On the occurrence of *Fredericella*

*indica* Annandale, 1909 (Phylactolaemata) in Europe', in: D.P. Gordon, A.M. Smith and J.A. Grant-Mackie: *Bryozoans in space and time* (Wellington, 1996), 187-192. — 'Freshwater bryozoans of New Zealand: a preliminary survey', *New Zealand Journal of Marine and Freshwater Research*, 32 (1998), 639-648 (authors T.S. Wood, L.J. Wood, G. Geimer and J. Massard). — 'Occurrence of *Pectinatella magnifica* (Leidy, 1851) (Bryozoa, Phylactolaemata) in the German-Luxembourg border region near Bech-Kleinmacher (Luxembourg) and Nennig (Germany)', *Archs Inst. g.-d. Luxemb. Sect. Sci. nat. phys. math.*, NS 44 (2002), 107-120. — 'Phylactolaemates of St Stephen's Green in Dublin (Ireland)', *Archs Inst. g.-d. Luxemb. Sect. Sci. nat. phys. math.*, NS 44 (2002), 121-126. — 'Note on the occurrence of the freshwater bryozoan *Plumatella casmiana* Oka, 1907 (Bryozoa, Phylactolaemata) in Norway', *Archs Inst. g.-d. Luxemb. Sect. Sci. nat. phys. math.*, NS 44 (2002), 127-143 (joint authors: K.A. Økland & J. Økland).