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An unknown archive of German A. Kluge: a bryozoan collection in the Museum of Invertebrate Zoology at Perm State National Research University

Andrei V. Grischenko

*Department of Invertebrate Zoology and Aquatic Ecology, Biological Faculty, Perm
State National Research University, Bukirev Street 15, Perm 614990, Russia*

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1. Introduction

The scientific activity of the prominent Russian bryozoologist German Avgustovich Kluge (1871–1956), who described over a hundred new species of bryozoans from the Arctic and other regions, and who wrote the monumental volume “Bryozoa of the Northern Seas of USSR” (Kluge, 1962), appears to be so multifaceted that its impact will still be felt many decades from now and can be detected in rather unexpected places.

As Head of the D.M. Fedotov and D.E. Kharitonov Museum of Invertebrate Zoology associated with the Department of Invertebrate Zoology and Aquatic Ecology of Perm State National Research University (Perm City, Western Ural, Russia), I recently found six old jars containing numerous bryozoan colonies fixed in ethanol, lying forgotten in a storeroom. A small sticker glued on each jar bore the inscription “*Bryozoa. Identified by G. Kluge*”. Some jars contained labels with species and locality names, hand-written by



Figure 1. German Avgustovich Kluge

Kluge, mixed up with the colonies. According to these labels, most of the specimens were collected in Kola Bay, in the Barents Sea. Sorting and subsequent taxonomic identification of the material revealed 33 bryozoan species, including a couple of cyclostomes and 31 cheilostomes. Although specimens of the five species identified by Kluge had been displayed in the Museum's exhibition hall for decades, their significance was not evident until this recent discovery of the additional material.

Considering this unexpected find in a provincial university, distant both from the place where Kluge did most of his research (*Murmanskaya* Biological Station, Barents Sea) and from the present location of most of his specimens (Zoological Institute Russian Academy of Science, Saint Petersburg), I investigated how his bryozoans got to Perm State University. I present the results of this investigation herein.

2. German A. Kluge and his research at the *Murmanskaya* Biological Station of the Saint Petersburg Society of Naturalists

The life of German Avgustovich Kluge (Figure 1) is well known through recollections by his colleagues, scientific successors, and other authors (Ushakov, 1957; Ushakov, Androsova, 2002). Kluge was born on 27 May 1871 in Radomskaya Province (now in Poland). Soon after graduation from Kazan' University in 1896, he took a job at the *Solovetskaya* Biological Station of the Saint Petersburg Society of Naturalists (Solovetskiye Islands, White Sea), where he began his academic focus on bryozoology. In 1901, he traveled to the Naples Biological Station, Italy, where he continued his studies on marine bryozoans. His fluency in several foreign languages (German, English, and French) helped him meet and communicate freely with colleagues, and allowed him wide access to bryozoan literature. From 1904 to 1907, Kluge traveled abroad, working at zoological museums in Germany, Sweden, Denmark, and England, where examined bryozoan collections from all over the world. In 1908, he took a position in the Zoological Museum of the Imperial Academy of Science, Saint Petersburg, and proceeded to study extensive bryozoan collections that had been made in the Russian Arctic.

In 1908, Kluge was elected Head of the *Murmanskaya* Biological Station of the Saint Petersburg Society of Naturalists; the station was situated near the port of Alexandrovsk (currently Polyarnyy Town) on the shore of Kola Bay. Successor to the *Solovetskaya* BS, the *Murmanskaya* BS had been established in 1899, primarily through the efforts of Professor Konstantin M. Derjugin (1878–1938). Kluge headed the *Murmanskaya* BS for

Figure 2. Dmitri Mikhailovich Fedotov during his time at Perm State University, 1916–1922 (photograph courtesy of Perm State National Research University)



nearly 25 years, during which period the station became a real scientific institution, recognized both nationally and internationally, and attracting up to 50 biological researchers every field season.

In August 1908 and during the summer of 1909, Professor K.M. Derjugin conducted the first intensive faunal investigation of Kola Bay (also known as Murmansk Fjord; ca. 57 km long and up to 7 km wide) from the schooner *Alexander Kovalevsky* (see Derjugin, 1915). All material collected was delivered to researchers at the *Murmanskaya* BS for detailed identification. Kluge sorted and identified bryozoan specimens obtained on the Derjugin Expedition of 1908–1909, and also by his colleagues from the *Murmanskaya* BS during the 1899 and 1903–1904 seasons. This study allowed him to compile a list of 146 species (Kluge in Derjugin, 1915). Kluge described ten new species from Kola Bay, including four cyclostomes (*Proboscina gracilis*, *Oncousoecia polygonalis*, *Tubulipora minuta*, *T. murmanica*) and six cheilostomes (*Eucratea arctica*, *Callopora derjugini*, *Bugula tricuspis*, *Dendrobeatia murmanica*, *Scrupocellaria minor*, and *Pseudoflustra hincksi*). Only one paper had previously been published on this region (Smitt, 1879), from material collected by the Lieutenant H. Sanderberg (1877) Expedition, reporting only the 15 most common species (Derjugin, 1915: 11–12). After the publication of Kluge’s list, Kola Bay became (Derjugin, 1915: 392) “one among the most examined regions in the world” in terms of the bryozoan fauna. Kluge later included all these taxa in his monograph *Bryozoa from Russian Arctic Seas* (Kluge, 1962).

The material from this region identified by Kluge was subsequently shipped to the Zoological Museum of the Imperial Academy of Science (currently Zoological Institute of the Russian Academy of Science), Saint Petersburg for cataloguing and permanent storage. A small part of this and some other of Kluge’s material, however, ended up at Perm State University, Perm City, Western Urals, far from both the *Murmanskaya* BS and the Zoological Museum. It has become clear that this was due to the scientific activity of another prominent Russian zoologist, D.M. Fedotov.

3. Activities of Dmitri M. Fedotov

Dmitri Mikhailovich Fedotov (1888–1972) (Figure 2) was a honoured academic figure in the USSR. He published almost two hundred papers during his 60-year scientific career, covering comparative morphology, phylogeny, systematics, and palaeontology

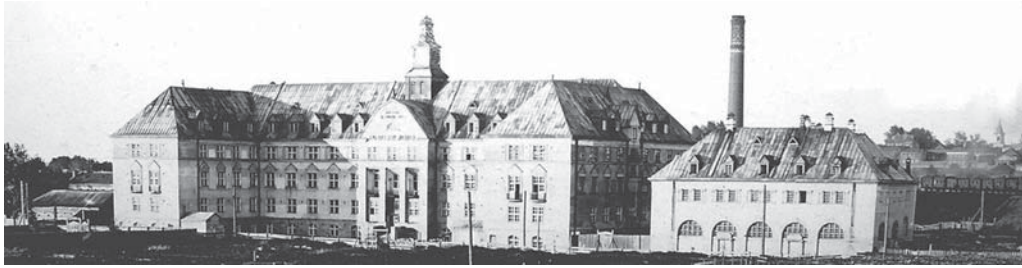


Figure 3. Buildings of Perm University, a day before opening in October 1916 (photograph courtesy of Perm State National Research University)

(Beklemishev, 1959; Markevitch, 1959; Rumyantseva, 1959; Svetlov, 1968; Arnoldi et al., 1973; Boguta, 1976; Smirnov, 2011). His scientific achievements are so numerous that they exceed the scope of present paper. Suffice it to say that his monograph *Evolution and Phylogeny of Invertebrate Animals* (Fedotov, 1966) was a standard reference for evolutionary zoologists.

Fedotov was born in Saint Petersburg but grew up in Warsaw. In 1906 he graduated from the 1st Warsaw Men's Gymnasium and entered the Natural Department of the Physico-Mathematical Faculty of the Saint Petersburg University. He studied under the guidance of such prominent zoologists as V.T. Shevyakov and V.M. Shimkevitch. Fedotov's early research interest was spider taxonomy and biology. After graduating in 1910, he stayed on at the university to prepare for a professorship. For several years beginning in 1910, he worked every summer season at the *Murmanskaya* BS, where he studied marine invertebrates.

After obtaining his Master's degree in 1916, Fedotov was elected a privat-docent in the Department of Zoology and Comparative Anatomy at Petrograd University. The same year, at age 28, he was invited to head the Department of Zoology and Comparative Anatomy in the newly opened Perm Branch of the Petrograd University (Figure 3), which was shortly afterward reorganized into an autonomous educational institution, Perm State University (currently Perm State National Research University).

Accepting this invitation, Fedotov launched enthusiastic activity in the Department. In only two years, during a hard period of civil war and devastation, he set up a well-equipped zoological laboratory by importing expertise and equipment from Germany and Japan. In 1918, Fedotov invited a group of talented zoologists, including V.N. Beklemishev, A.A. Lyubischev, D.E. Kharitonov, and others (Figure 4) to assist him. Fedotov and his team built up a biological station on the right bank of the Kama River, where intensive biocoenological studies began.

Fedotov's research on echinoderm morphology and taxonomy at Perm State University (1916–1922) laid the groundwork for further achievements (Fedotov, 1934, 1951) that eventually brought him global fame.



Figure 4. Photograph of the staff of the Department of Zoology and Comparative Anatomy, Perm State University, March 1922. Front row, left to right: V.N. Beklemishev, A.O. Tausson, D.M. Fedotov, N.Ya. Oparina, A.A. Lyubischev. Back row, left to right: A.E. Plakhina, V. Baskina, G.M. Fridman, B.V. Vlastov, D.E. Kharitonov, P.G. Svetlov, unknown person (photograph courtesy of Perm State National Research University)

4. Museum of Invertebrate Zoology of Perm State University

Thanks to D.M. Fedotov's efforts and the support of his assistant D.M. Dyakonov, a zoological facility was established in October 1916, during the early days of Perm State University. This facility later became the Museum of Invertebrate Zoology in the Department of Zoology and Comparative Anatomy. Initially, specimen exhibits were borrowed from the collections of Petrograd University and the Zoological Museum, Petrograd.

Fedotov's trip to the *Misaki* Marine Biological Station, Japan, in 1917 played an important role in providing specimens for the Museum; see Spencer Jones et al. (2011) for the significance of the *Misaki* MBS in early biodiversity studies. In the course of his hydrobiological investigations in Sagami Bay and the Seto Inland Sea (Seto Naikai), Fedotov collected a huge number of benthic and pelagic animals, which were later moved to the Museum and made up the core of the material on display in the exhibition hall. The Museum's resources were further augmented by collections of mollusks from V.N.

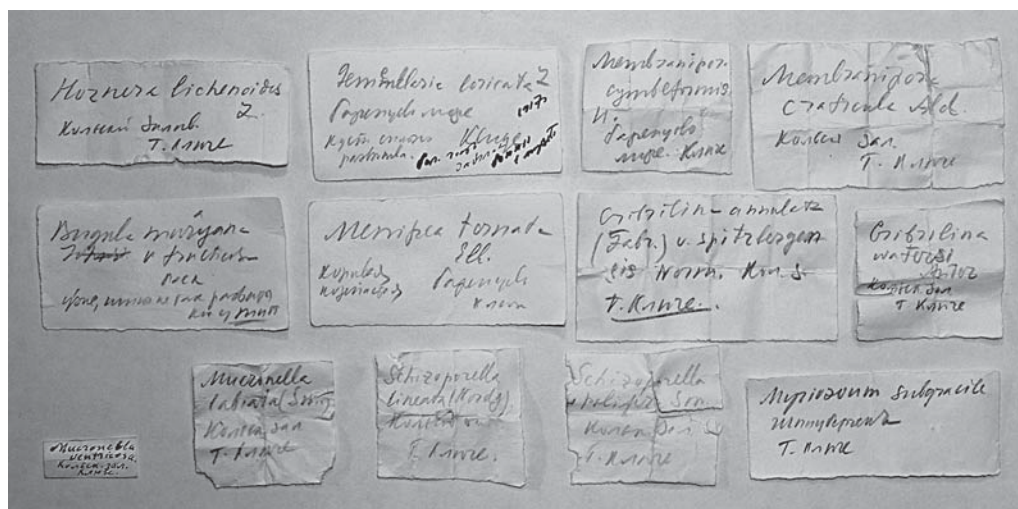


Figure 5. Specimen labels, written by Kluge, from the newly discovered bryozoan collection

Beklemishev (1890–1962); beetles and butterflies from D.E. Kharitonov (1896–1970); spiders from D.E. Kharitonov, including over 3200 prepared slides; and, in the 1950s–1960s, more spiders from Central Asia, deposited by A.S. Utochkin (1924–1992).

Other academics also contributed to the Museum's collections. Docent V.A. Lykov (1933–2009) donated part of his impressive, 30-year collection of gastropod shells (about 400 species). The arachnid collection begun by D.E. Kharitonov is growing continuously. Along with the Ural material, it contains collections of spiders and Opiliones from various Palearctic areas. The spider collection of Perm State University is one of four public collections in Russia and contains type material described by D.E. Kharitonov and his successors, including A.S. Utochkin, S.L. Esyunin, and V.E. Efimik. In addition, G.Sh. Farzalieva has built a myriapod collection from the Urals and Kazakhstan. The oldest instructor in the Department, Docent K.N. Beltyukova (1914–2008), spent more than ten years (1980s–1990s) thoroughly restoring many of the taxonomical and thematic collections, helping to create a modern Museum.

Currently the Museum of Invertebrate Zoology is named after D.M. Fedotov and D.E. Kharitonov, and is associated with the Department of Invertebrate Zoology and Aquatic Ecology of the Biological Faculty of Perm State National Research University. It is organized into exhibition, scientific, and academic divisions. The exhibition hall covers 80 m², and specimen exhibits display 1530 items, including 292 boxes of insects and 1238 additional separate specimens, fixed in 70% ethanol or dry. Despite its rather limited space, the Museum houses representatives of most main taxa of invertebrate animals, and it is one of the oldest depositories in the Ural region (Grischenko, 2012).

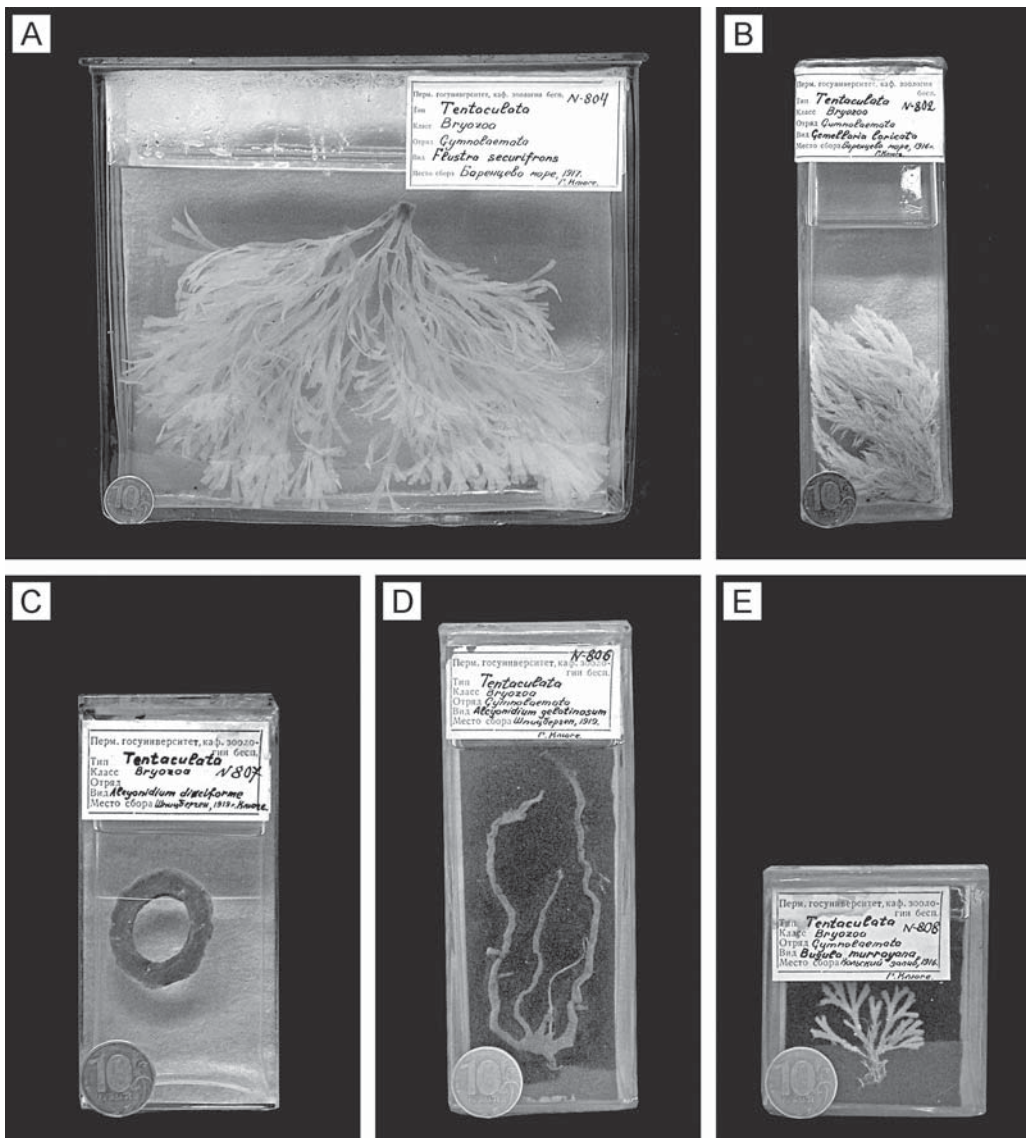


Figure 6. Specimens from the Kluge Collection of Bryozoa on exhibition in the Museum of Invertebrate Zoology, Perm State National Research University. A, *Securiflustra securifrons*, PSU 804. B, *Eucratea loricata*, PSU 802. C, *Alcyonidium disciforme*, PSU 802. D, *Alcyonidium gelatinosum*, PSU 806. E, *Dendrobeania murrayana*, PSU 808. A 10-ruble coin (2012, diameter 22 mm) is shown for scale

5. Collection of Bryozoa in the Museum of Invertebrate Zoology

Though official historical and biographical documents contain no information about contacts between G.A. Kluge and D.M. Fedotov, there is reason to believe that Fedotov obtained bryozoan material during his regular research visits to *Murmanskaya* BS in the period 1910–1916, prior to his work at Perm State University. He may also have obtained some additional material later (labelled 1917 and 1919), either mailed directly or transported to Perm City by colleagues of Kluge or Fedotov.

The bryozoan collection presented by Kluge to the Museum of Invertebrate Zoology, contains 37 species, including two cyclostomes (*Hornera lichenoides*, *Disporella hispida*), two ctenostomes (*Alcyonidium disciforme*, *A. gelatinosum*), and 33 cheilostomes (Appendix 1). Large colonies of five species from this collection (*Alcyonidium disciforme*, *A. gelatinosum*, *Eucratea loricata*, *Securiflustra securifrons*, and *Dendrobeatia murrayana*) are exhibited in the Museum (Figure 6). Six jars recently discovered in the storeroom contain 33 species, including two cyclostomes (*Hornera lichenoides* and *Disporella hispida*) and 31 cheilostomes (Figures 7–12). Among these newly found bryozoans, only thirteen species (including *Eucratea loricata*, already in the exhibition) had been identified and labelled (Figure 5); the other 21 species had not been sorted or identified (all taxa lacking label details in Appendix 1).

Since the inventory register contains no records of receipt of these additional materials, they were likely initially intended for research. The specimens, however, show no trace of close examination, and look untouched and undamaged; it thus appears that they were never used for research or student practica. At the time there were no identification keys or well-illustrated publications about Arctic bryozoans in Russian, and Kluge's (1929, 1946, 1962) papers and identification manual had yet to appear. It is quite possible that because the colonies of different species were mixed up in the jars, mostly unlabeled, nonspecialists in the group simply ignored them, and they sat ignored in the Museum's storeroom.

Labels dated 1919 indicate that specimens of two ctenostomes (*Alcyonidium disciforme* and *A. gelatinosum*) and *Myriapora subgracilis* were collected near Spitzbergen. The labels for another four species (*Eucratea loricata*, *Cauloramphus cymbaeformis*, *Securiflustra securifrons*, *Tricellaria ternata*) indicate "Barents Sea", without further details. The labels on another nine species indicate the locality as Kola Bay, Barents Sea (Appendix). The collection localities of the remaining 21 species of cheilostome bryozoans remained unknown. To determine whether these specimens might have been collected in Kola Bay, I compared a list of them with the species reported by Kluge in Derjugin (1915). Fifteen of the 21 unlabeled species (including *Dendrobeatia fessa*, preliminarily identified as *Bugula murrayana* var. *fruticosa*; see Kluge in Derjugin, 1915: 379) had been recorded in Kola Bay. In other words, specimens of 24 (65%) of the 37 species represented in our Museum's collection might have come from Kola Bay.

Five of the species (*Flustra foliacea*, *Dendrobeatia pseudomurrayana*, *Arctonula arctica*, *Escharoides bidenkapi*, *Reteporella watersi*) are not mentioned in Kluge in

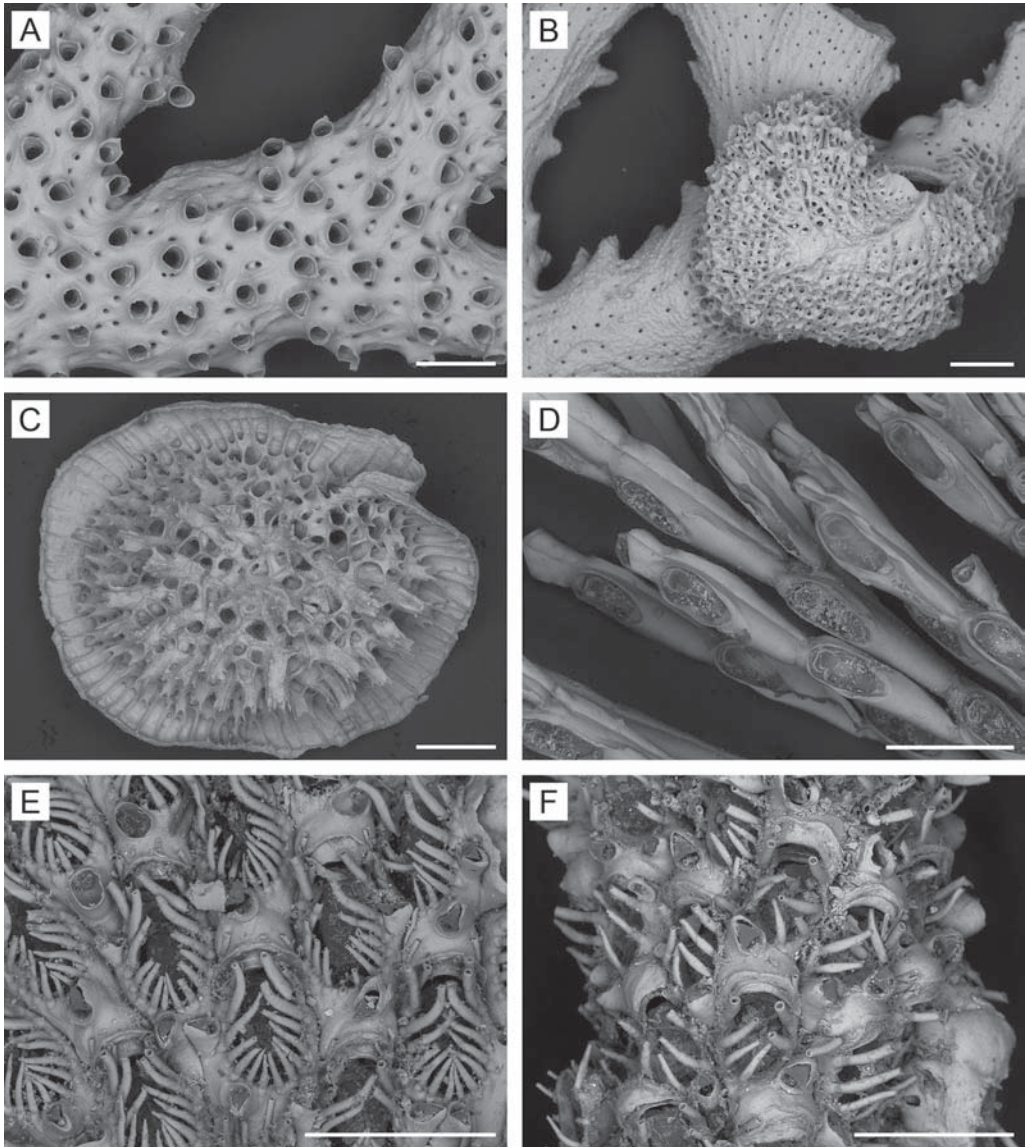


Figure 7. Scanning electron micrographs of specimens in the Kluge Bryozoan Collection. A, B, *Hornera lichenoides*, PSU 810.01. C, *Disporella hispida*, PSU 810.02. D, *Euratea loricata*, PSU 810.03. E, *Callopora craticula*, PSU 810.04. F, *Callopora lineata*, PSU 810.05. Scale bars: 0.5 mm

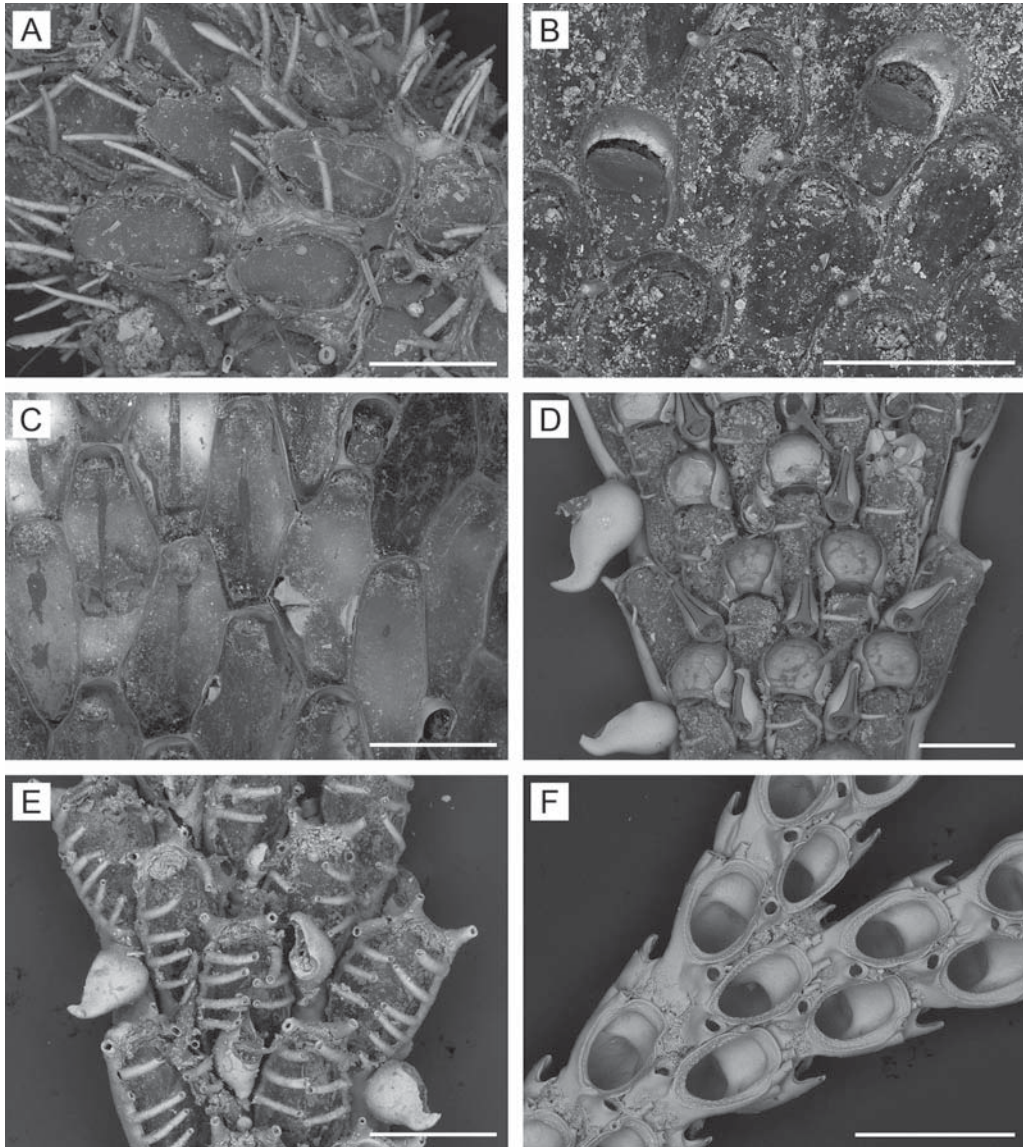


Figure 8. Scanning electron micrographs of specimens in the Kluge Bryozoan Collection. A, *Cauloramphus cymbaeformis*, PSU 810.06. B, *Flustra foliacea*, PSU 810.07. C, *Terminoflustra membranaceotruncata*, PSU 810.08. D, *Dendrobeania fessa*, PSU 810.09. E, *Dendrobeania pseudomurrayana*, PSU 810.10. F, *Caberea ellisi*, PSU 810.11. Scale bars: 0.5 mm

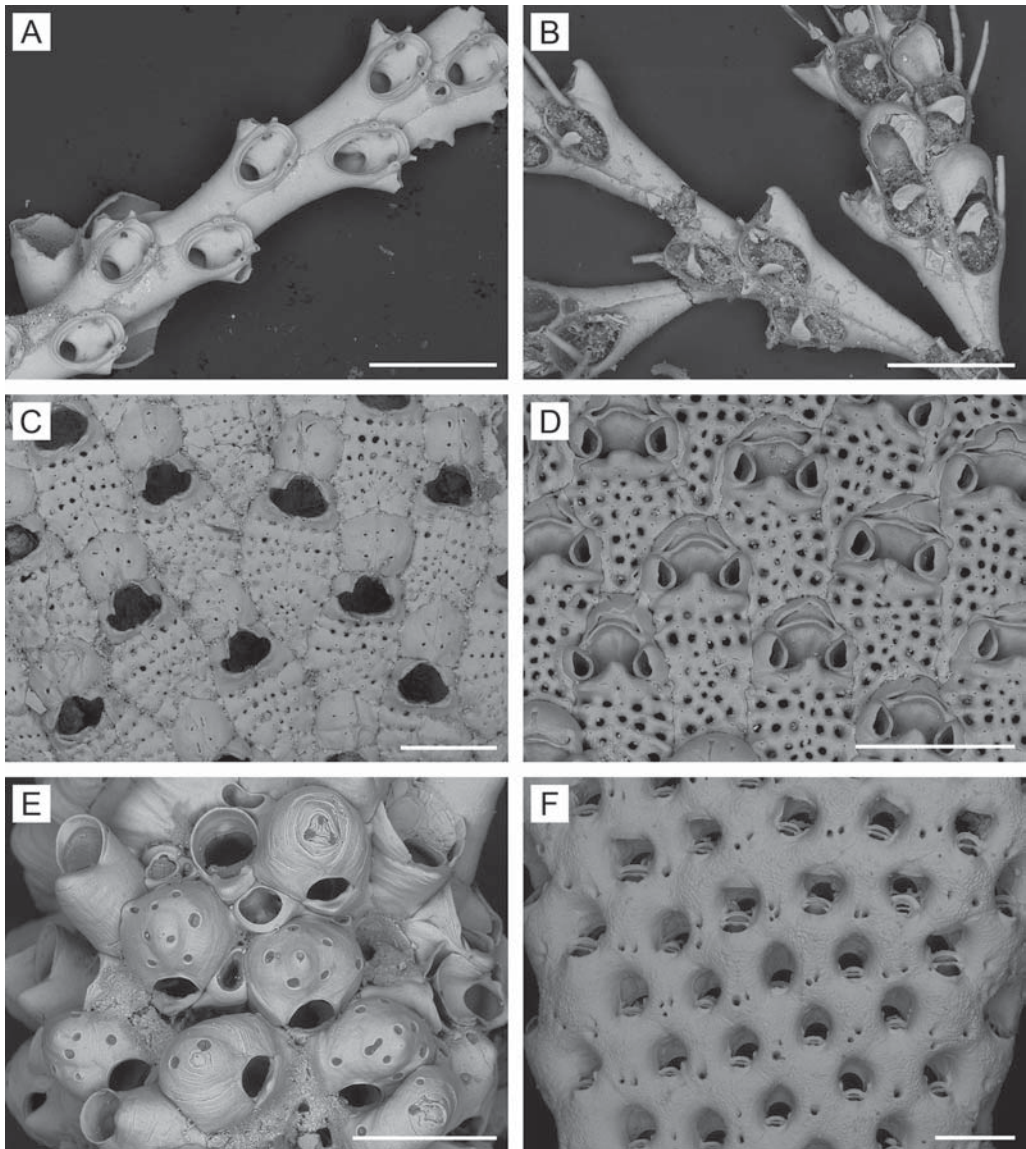


Figure 9. Scanning electron micrographs of specimens in the Kluge Bryozoan Collection. A, *Tricellaria gracilis*, PSU 810.12. B, *Tricellaria ternata*, PSU 810.13. C, *Cribrilina spitzbergensis*, PSU 810.14. D, *Cribrilina watersi*, PSU 810.15. E, *Celleporella hyalina*, PSU 810.16. F, *Cystisella saccata*, PSU 810.17. Scale bars: 0.5 mm

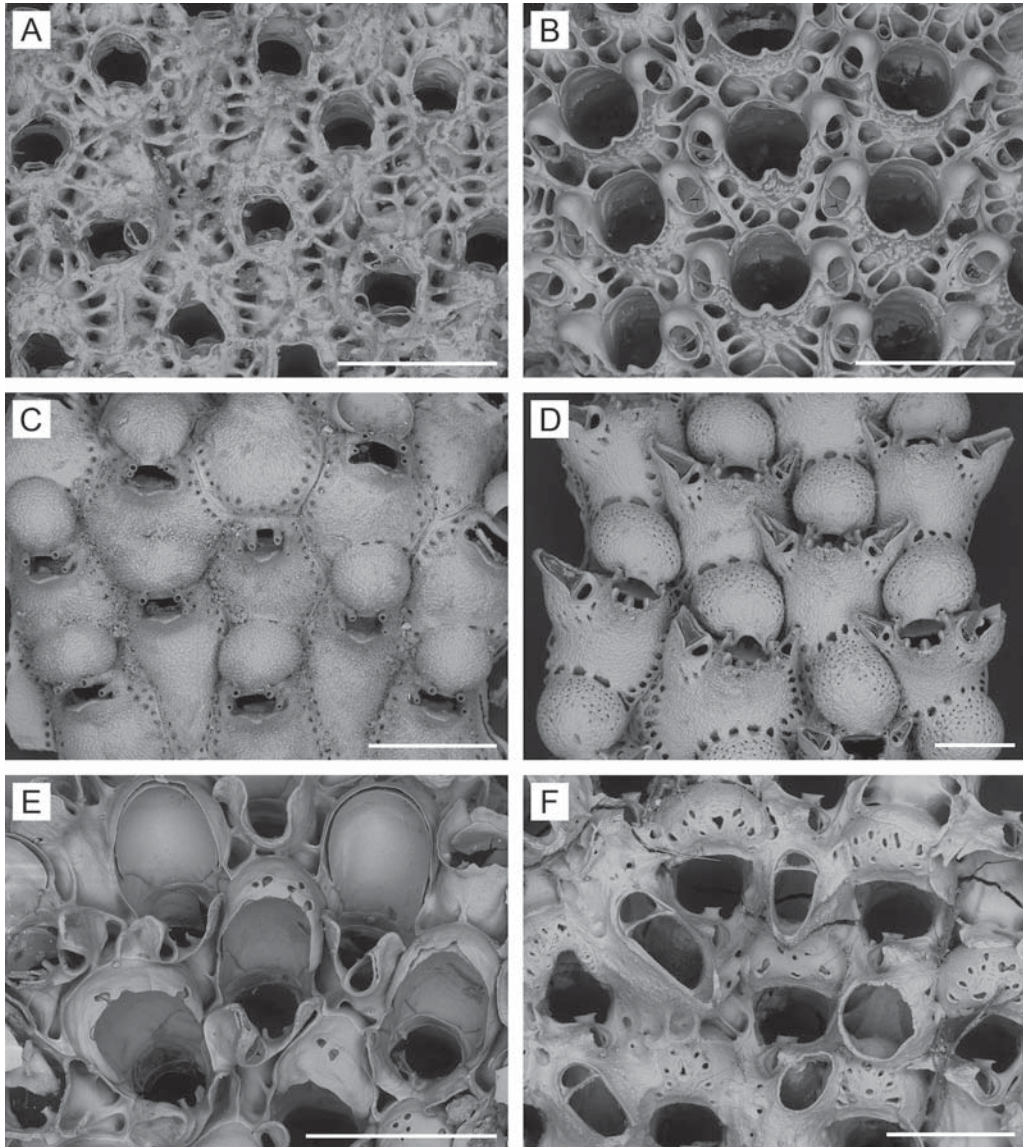


Figure 10. Scanning electron micrographs of specimens in the Kluge Bryozoan Collection. A, *Porella smitti*, PSU 810.18. B, *Arctonula arctica*, PSU 810.19. C, *Escharella ventricosa*, PSU 810.20. D, *Escharoides bidenkapi*, PSU 810.21. E, *Rhamphostomella bilaminata*, PSU 810.22. F, *Rhamphostomella costata*, PSU 810.23. Scale bars: 0.5 mm

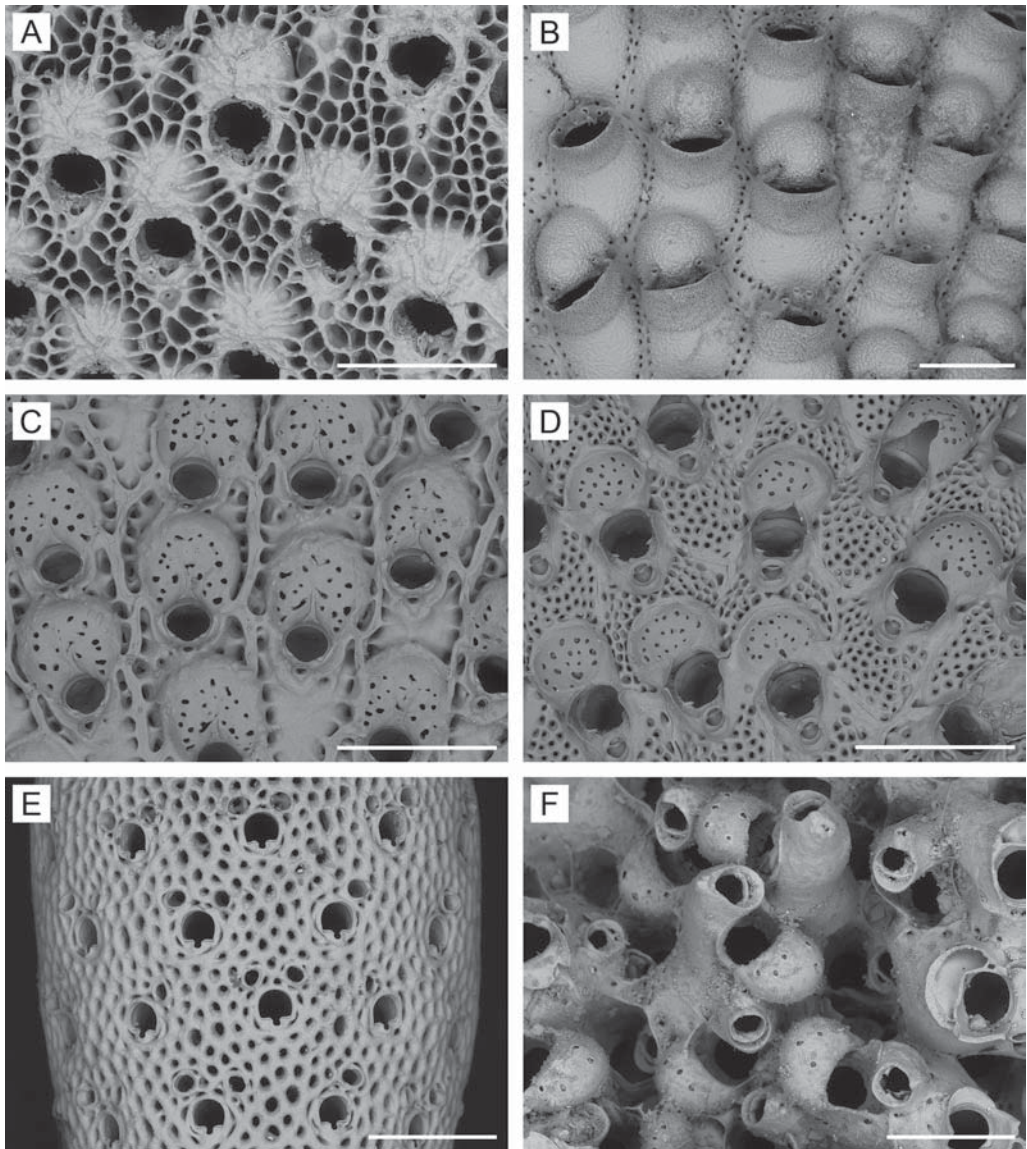


Figure 11. Scanning electron micrographs of specimens in the Kluge Bryozoan Collection. A, *Rhamphostomella ussowi*, PSU 810.24. B, *Phylactella labiata*, PSU 810.25. C, *Parkermavella lineata*, PSU 810.26. D, *Schizomavella porifera*, PSU 810.27. E, *Myriapora subgracilis*, PSU 810.28. F, *Cellepora nodulosa*, PSU 810.29. Scale bars: 0.5 mm

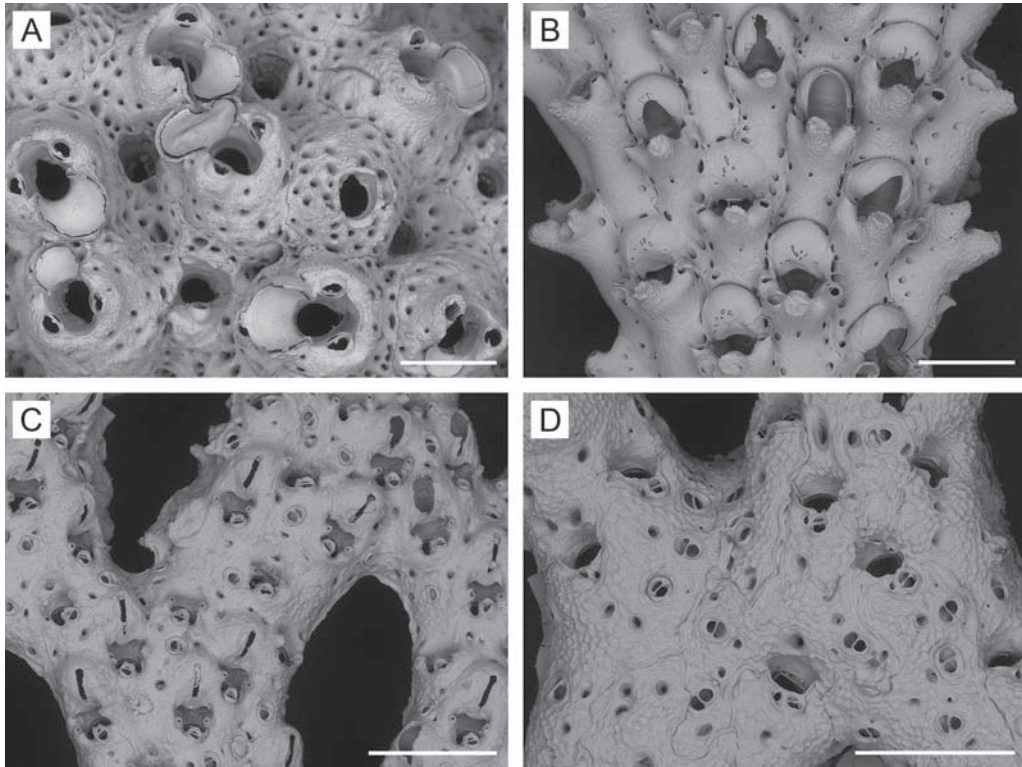


Figure 12. Scanning electron micrographs of specimens in the Kluge Bryozoan Collection. A, *Celleporina ventricosa*, PSU 810.30. B, *Palmicellaria tridens*, PSU 810.31. C, *Reteporella beaniana*, PSU 810.32. D, *Reteporella watersi*, PSU 810.33. Scale bars: 0.5 mm

Derjugin (1915) for Kola Bay, but are widely distributed in the Barents Sea (Kluge, 1962), and except for *R. watersi* occur in the southwestern part (Denisenko, 1990). This strongly suggests that, except for the three bryozoans labeled ‘Spitzbergen’, the major part of the collection (34 species) was gathered near the *Murmanskaya* BS, either by the station staff or by Kluge himself.

Most of the bryozoans in the Kluge collection in Perm are well-known species widely reported from the Arctic and from numerous Atlantic and Pacific Boreal localities (Osburn, 1950, 1952, 1953; Kluge, 1962; Hayward, 1985; Hayward, Ryland, 1998, 1999; Gontar, Denisenko, 1989). At the same time, roughly a third of these species has never been illustrated by scanning electron microscopy (SEM). To remedy this, I provide SEM images of all species in the newly discovered collection (Figures 7–12). Colonies of cyclostome and cheilostome species were cleaned in sodium hypochlorite solution, rinsed with tap-water and air dried. Dried, uncoated colonies were examined at 15 kV accelerating voltage with a Hitachi TM3000 scanning electron microscope with a back-scattered electron detector. All images were stored electronically as TIFF files at a resolution of 600 pixels in⁻¹. Colonies of species displayed in Museum exhibits were photographed with a Nikon–D100 digital camera at 300 pixels in⁻¹ resolution.

The collection of Bryozoa described herein is deposited in the D.M. Fedotov and D.E. Kharitonov Museum of Invertebrate Zoology, Department of Invertebrate Zoology and Aquatic Ecology, Biological Faculty, Perm State National Research University. The collection is registered under inventory number 810, with each species numbered separately (01–33) (Appendix).

6. Conclusions

German Avgustovich Kluge left an impressive scientific heritage, having described over 100 new species, eight new genera, and five new families of bryozoans. In all, he detected nearly 500 bryozoan species (Ushakov, Androsova, 2002) in the Arctic and Far Eastern Russian seas. His taxonomic reference “Bryozoa of the Northern Seas of the USSR” (Kluge, 1962), translated into English in 1975, has been a standard reference book for several generations of bryozoologists. In addition, the approximately 50,000 specimens he identified, which are now housed in the Zoological Institute, Russian Academy of Science, Saint Petersburg, are a primary resource for further research on bryozoans in the Arctic, North Pacific, and several other regions.

It is not surprising that unpublished material has turned up after Kluge’s death. Some of his unknown bryozoan illustrations, based on Arctic specimens as far back as 1916, were published for the first time 74 years after Kluge drew them, in a survey of the Arctic bryozoan fauna (Gontar, Denisenko, 1989). Likewise, literally nothing was known about Kluge’s material in the Urals, though this material arrived at the Museum of Invertebrate Zoology of Perm State University 94–97 years ago, between 1916 and 1919. After this discovery of his collection, an exhibit of the Arctic heritage of G.A. Kluge will occupy a prominent place in the Museum, and the scanning electron micrographs of bryozoans from Kola Bay and the Barents Sea presented here (Figures 7–12) will supplement the paper Kluge in Derjugin (1915).

7. Acknowledgements

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Appendix

*Kluge Bryozoan Collection in the D.M. Fedotov and D.E. Kharitonov Museum
of Invertebrate Zoology, Department of Invertebrate Zoology and Aquatic
Ecology, Perm State National Research University.*

Registration Revised No. PSU	identification	Kluge's identification	Label details
810.01	<i>Hornera lichenoides</i> (L., 1758)	<i>Hornera lichenoides</i>	Kola Bay
810.02	<i>Disporella hispida</i> (Fleming, 1828)		
807	<i>Alcyonidium disciforme</i> Smitt, 1872*	<i>Alcyonidium disciforme</i>	Spitzbergen
806	<i>Alcyonidium gelatinosum</i> (L., 1767)*	<i>Alcyonidium gelatinosum</i>	Spitzbergen
802, 810.03	<i>Eucratea loricata</i> (L., 1758)	<i>Gemellaria loricata</i>	Barents Sea
810.04	<i>Callopora craticula</i> (Alder, 1856)	<i>Membranipora craticula</i>	Kola Bay
810.05	<i>Callopora lineata</i> (L., 1767)		
810.06	<i>Cauloramphus cymbaeformis</i> (Hincks, 1877)	<i>Membranipora cymbaeformis</i>	Barents Sea
810.07	<i>Flustra foliacea</i> (L., 1758)		
804	<i>Securiflustra securifrons</i> (Pallas, 1766)*	<i>Flustra securifrons</i>	Barents Sea
810.08	<i>Terminoflustra membranaceotruncata</i> (Smitt, 1868)		
810.09	<i>Dendrobeatia fessa</i> (Kluge, 1955)	<i>Bugula murrayana</i> v. <i>fruticosa</i>	
808	<i>Dendrobeatia murrayana</i> (Johnston, 1847)*	<i>Bugula murrayana</i>	Kola Bay
810.10	<i>Dendrobeatia pseudomurrayana</i> Kluge, 1955		
810.11	<i>Caberea ellisi</i> (Fleming, 1818)		
810.12	<i>Tricellaria gracilis</i> (Van Beneden, 1848)		
810.13	<i>Tricellaria ternata</i> (Ellis, Solander, 1786)	<i>Menipea ternata</i>	Barents Sea
810.14	<i>Cribrilina spitzbergensis</i> Norman, 1903	<i>Cribrilina annulata</i> v. <i>spitzbergensis</i>	Kola Bay
810.15	<i>Cribrilina watersi</i> Andersson, 1902	<i>Cribrilina watersi</i>	Kola Bay
810.16	<i>Celleporella hyalina</i> (L., 1767)		
810.17	<i>Cystisella saccata</i> (Busk, 1856)		
810.18	<i>Porella smitti</i> Kluge, 1907		
810.19	<i>Arctonula arctica</i> (M. Sars, 1851)		
810.20	<i>Escharella ventricosa</i> (Hassall, 1842)	<i>Mucronella ventricosa</i>	Kola Bay
810.21	<i>Escharoides bidenkapi</i> (Kluge, 1946)		
810.22	<i>Rhamphostomella bilaminata</i> (Hincks, 1877)		
810.23	<i>Rhamphostomella costata</i> Lorenz, 1886		
810.24	<i>Rhamphostomella ussowi</i> (Kluge, 1908)		
810.25	<i>Phylactella labiata</i> (Boeck in Smitt, 1869)	<i>Mucronella labiata</i>	Kola Bay
810.26	<i>Parkermavella lineata</i> (Nordgaard, 1896)	<i>Schizoporella lineata</i>	Kola Bay
810.27	<i>Schizomavella porifera</i> (Smitt, 1868)	<i>Schizoporella porifera</i>	Kola Bay
810.28	<i>Myriapora subgracilis</i> (d'Orbigny, 1852)	<i>Myriozoum subgracile</i>	Spitzbergen
810.29	<i>Cellepora nodulosa</i> Lorenz, 1886		
810.30	<i>Celleporina ventricosa</i> (Lorenz, 1886)		
810.31	<i>Palmicellaria tridens</i> (Busk, 1856)		
810.32	<i>Reteporella beaniana</i> (King, 1846)		
810.33	<i>Reteporella watersi</i> (Nordgaard, 1907)		

* Displayed only at the Museum exhibition hall