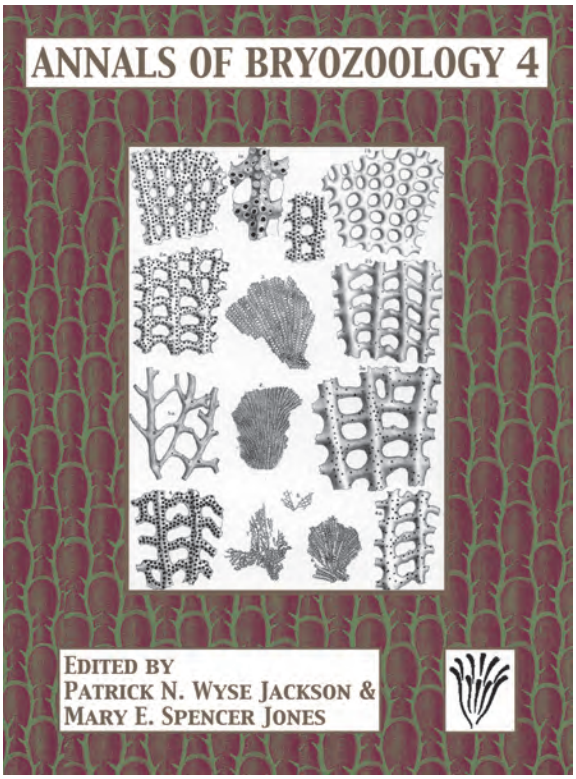

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Cleaning and conservation of fossil bryozoan cavity slides of the William Dickson Lang Collection at the Natural History Museum, London

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1. Introduction

The Natural History Museum, London, holds one of most significant collections of fossil bryozoans, collected by William Dickson Lang (1878-1966), who was one of the most important proponents of the theory of orthogenesis[1] and a Keeper of the Department of Geology at the British Museum (Natural History). There are more than 2,800 specimens in cavity slides that date from the first half of the 20th century and include numerous type and figured Cretaceous cribrimorphs. The material is important in illustrating Lang's ideas about the orthogenetic[2] evolution of this group of cheilostomes. 86% of the specimens are types (1210), figured (297), described or only cited in the 131 publications of Lang. It is therefore one of the most important bryozoan fossil slide collections of published specimens. 86% of his specimens originate from England, 12% are from Europe and 2% are from USA (see Figure 9).

Lang's slide collection comprises small fragments of colonies mounted in wooden cavity slides and stained with blue paint. This paint forms a thick coating on the surfaces of the colonies, obscuring details vital to the identification of the bryozoans. The paint was originally applied to emphasize morphological features, such as spines and pores, which are difficult to see in these very white specimens from the Chalk. Unfortunately, when coated specimens are studied using a scanning electron microscope spots of paint pigment

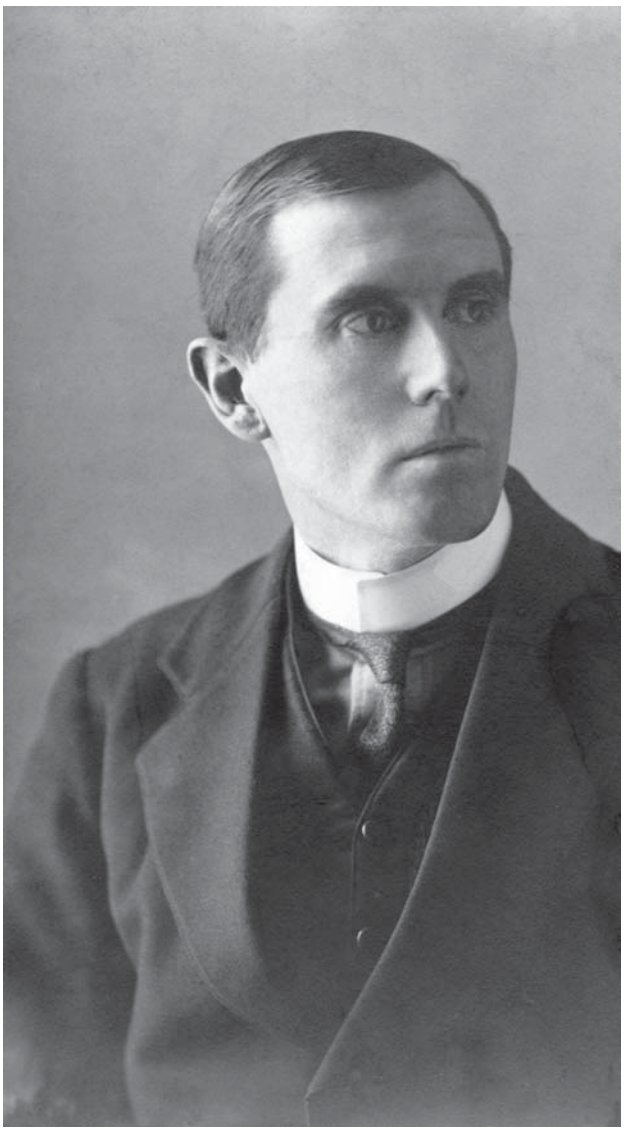


Figure 1 William Dickinson Lang (1878-1966). NHM photograph. Archive reference PH/10/13.

dominate the images. Preliminary cleaning experiments have been undertaken using ultrasonic treatment in water, and with the addition of bleach or Quaternary-O. Dramatic results were obtained in all cases with the skeletal features of the bryozoans becoming clear for the first time.

2. William Dickson Lang (1878-1966)

William Dickson Lang[3] (Figure 1) was born on 29th December 1878 in the Indian Punjab, where his father Edward Tickell Lang was working as a civil engineer, engaged in the construction of the Jumna Canal. His family moved to England when he was one year old. In 1894 he began his education[4] at Christ's Hospital School in Hertford, moving to Harrow School in Harrow in north west London. In 1898 he went up to Pembroke College, Cambridge, where he read Natural Sciences. He was awarded the degree of Bachelor of Arts in Part I in 1901 and Part II in 1902, receiving the degree of Master of Arts in 1903.[5]

While he was still studying, he began working for the Department of Geology of the British Museum (Natural History) on 1st October 1902 as an assistant[6] in charge of the Protozoa, Coelenterates, Sponges and Polyzoa collections. During the First World War he worked in the Department of Entomology curating mosquitos.[7] A year later, he gained his Ph.D. from Cambridge University and returned to work in the Department of Geology where he became Assistant Keeper in 1921, Deputy Keeper in 1927 and Keeper in 1928, a post that he held until his retirement in 1938.

During his life he researched a wide variety of subjects[8] varying from mosquitos, corals and bryozoans to geology, and he published innumerable papers. E.I. White (1966) cited 131 publications by W.D. Lang. His first articles on bryozoans[9] date from 1904 and are on Cretaceous cyclostomes and cheilostomes, concentrating largely on cribrimorph cheilostomes and he went on to propose the orthogenesis theory (Figures 2-5). He described this as:

> The study of development stages focused attention on the modifications in time of single characters, and showed how a character, independently in different lineages, continually appeared to run through a similar course of development, and often to continue this course until it became so exaggerated as to threaten the organism's existence.[10]

Lang was a member of the Council of the Geological Society from 1923 to 1926 and was awarded the Lyell Medal of the Geological Society of London in 1928. In 1929 he was elected Fellow of the Royal Society.

After his retirement at the age of 60, he lived in Charmouth, Dorset, where he continued his studies on natural history. Until his death on 3rd March 1966 at the age of 87, the majority of his time was devoted to the study of the local geology.[11]

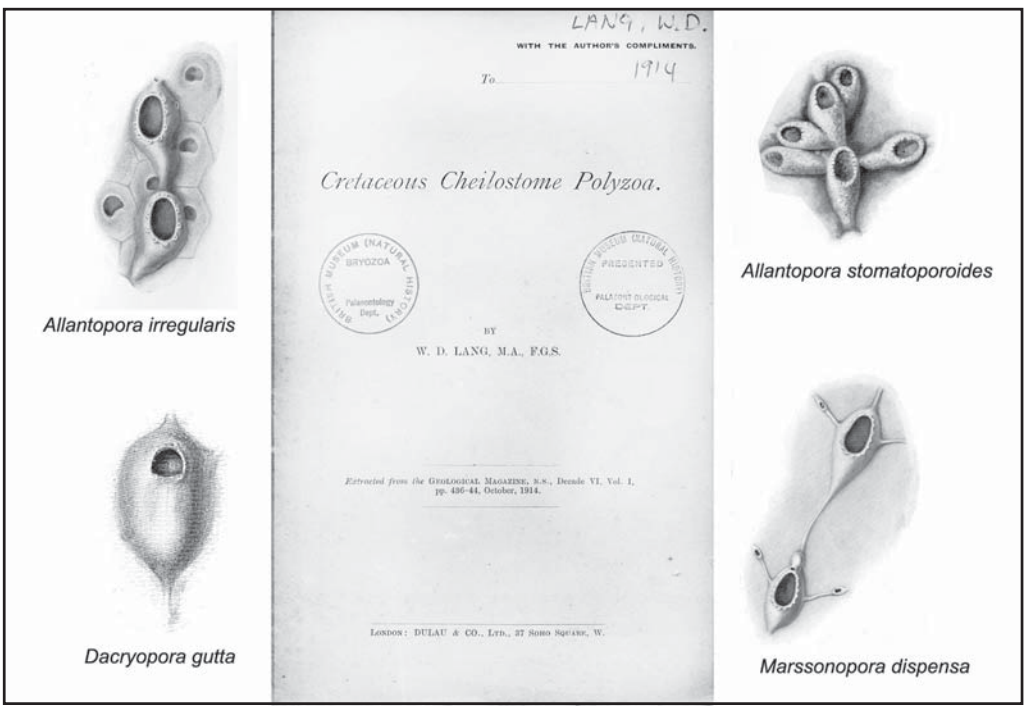


Figure 2. Monograph with Cretaceous cheilostomes described by Lang in 1914.

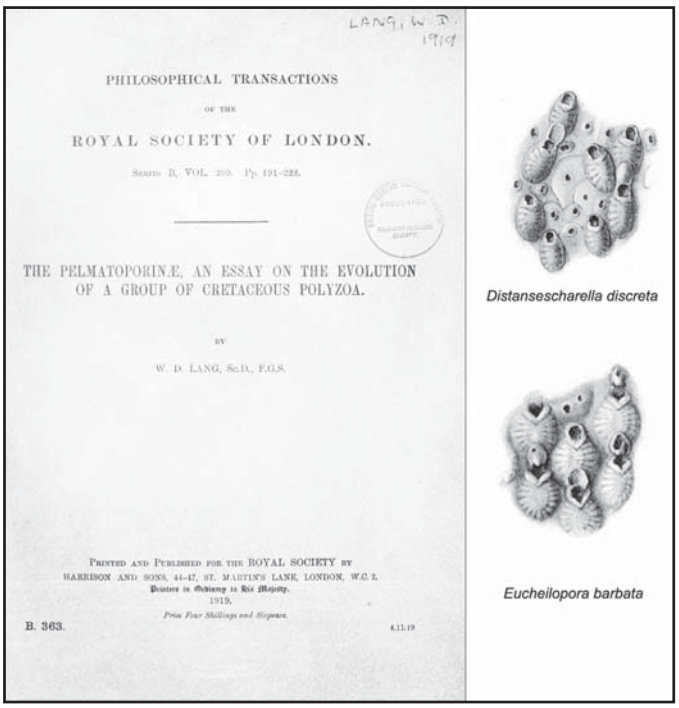
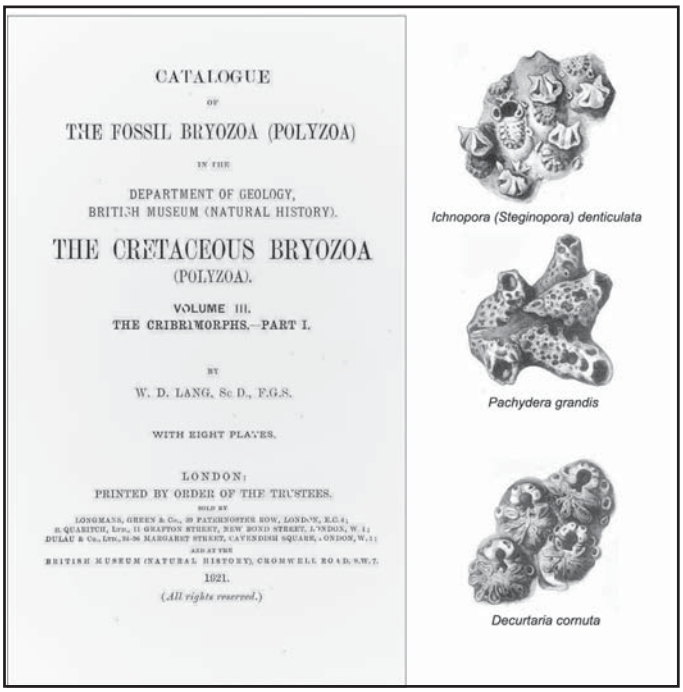


Figure 3. Monograph with Cretaceous cheilostomes described by Lang in 1919.

Figure 4. Monograph with Cretaceous cheilostomes described by Lang in 1921.



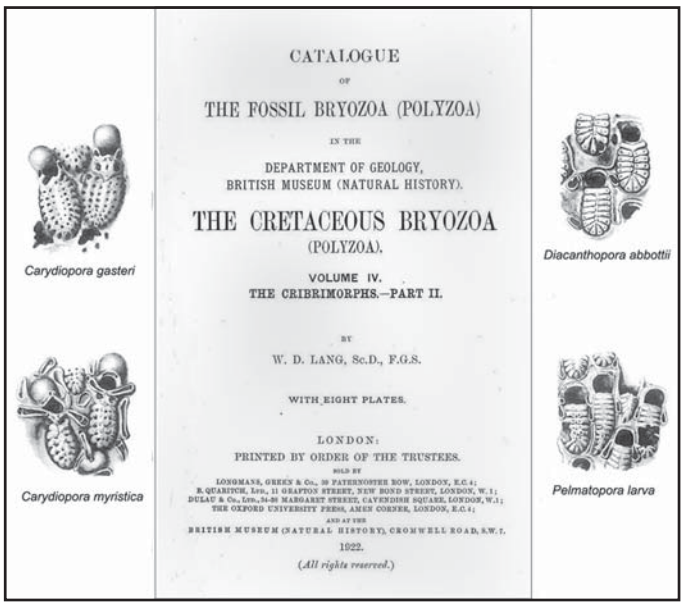
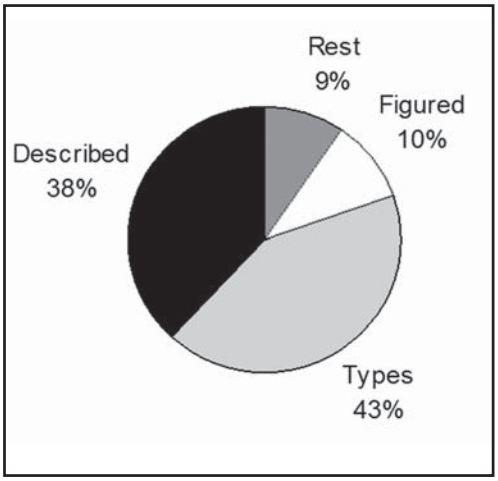


Figure 5. Monograph with Cretaceous cheilostomes described by Lang in 1922.

Figure 6. Trays from the wooden cavity slide cabinets at the NHM, London, where the Lang Collection is kept.

3. Fossil Bryozoan Collection of W.D. Lang

The Lang Collection is housed at the NHM, London, and includes 2866 specimens catalogued, mostly published and preserved in cavity slides (Figure 6). There are 216 different species that belong to 88 genera, being 43% of types, 10% figured specimens and 38% cited (Figure 7). 86% are from England (Sussex 927; Surrey 585; Cambridgeshire 189; Norfolk 141; etc.) (Figure 8), 5% from Germany, 3% from France, 2% from the USA and also Denmark, 1% from Holland and Bohemia as well and a very small proportion from Sweden and Russia (Figure 9).



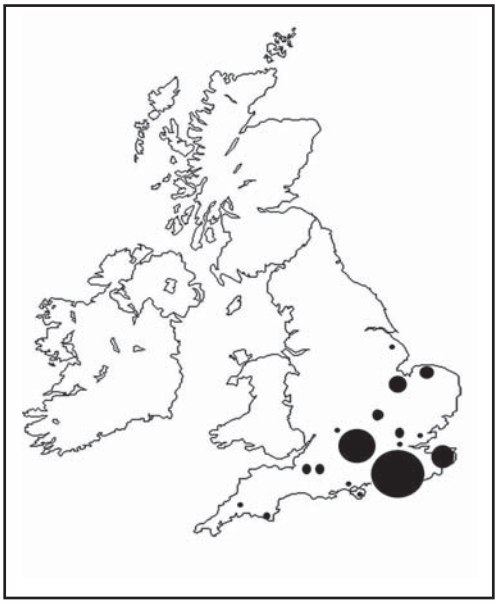


Figure 7 (above). Percentage of types, figured and cited specimens of the Lang Collection.
Figure 8 (right). Geographical distribution in UK after abundance of the Lang Collection.

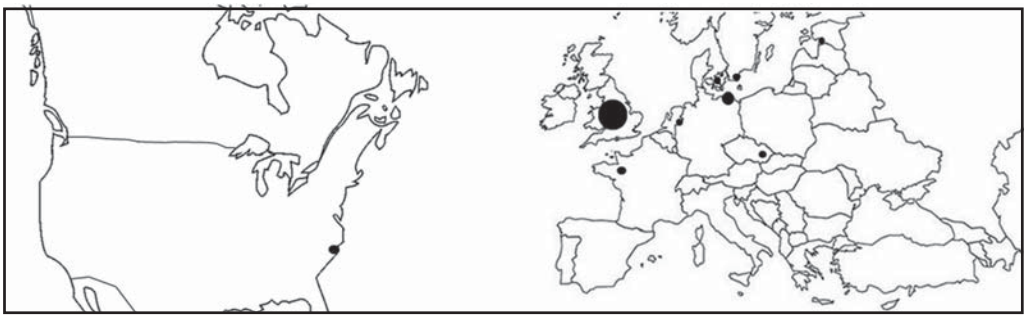


Figure 9. Geographical distribution in the world after abundance of the Lang Collection.

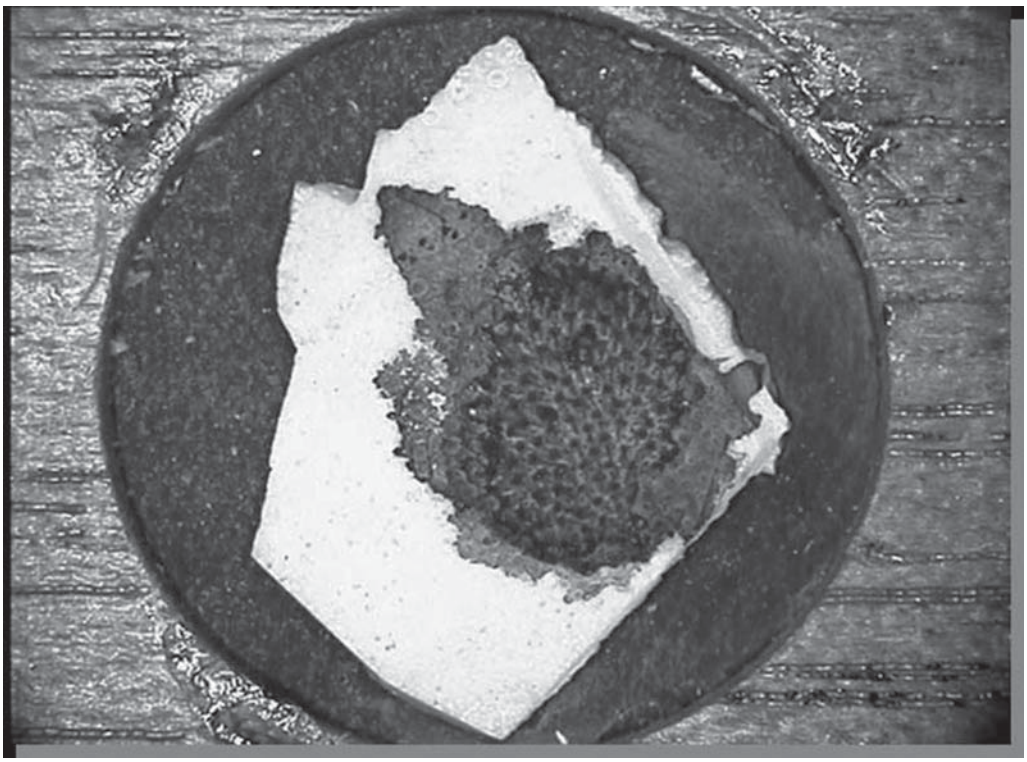


Figure 10. Cavity slide with Dishelopora binoculata *Lang dyed in dark blue, from Santonian of Chatham. Holotype, NHMUK PI D8167.*

Most of the specimens of this collection are dyed with a blue paint (Figure 10), probably methylene blue ink (see below "Cleaning experiment"), which was used to observe more easily some bryozoan structures, such as spines patterns, pores, and other bryozoan features, more easily, under binocular microscope. This technique was broadly used in Entomology[12] and probably Lang learned it when he worked in the Department of Entomology during the First World War as these specimens were published after 1914. This thick coating makes it very hard to identify specimens precisely with the use of current techniques such as SEM (Scanning Electron Microscopy).

Almost 14% (13.71%) of the collection has been redetermined by Dr Gilbert Powell Larwood (1930-1997) in his 1956 Ph.D. thesis[13] and in the *Bulletin of the British Museum (Natural History)* published in 1962.[14]

4. Cleaning experiment

Three cavity slides with a thick layer of blue paint (Figure 11) were chosen for the preliminary cleaning experiment. All of them came from the Cretaceous Chalk of England and are, therefore, resistant to weathering. One was cleaned in the ultrasonic cleaner with normal tap water; another was cleaned in the ultrasonic cleaner with the addition of bleach

Figure 11. Cavity slides chosen for the cleaning experiment. On the left side NHMUK PI D28248, holotype of Monoceratopora lewesiensis *Lang, 1916 from Turonian of Sussex. In the centre NHMUK PI D29895, cited specimen of* Hexacanthopora kintburiensis *Lang, 1916, from Campanian of Worthing. On the right side NHMUK PI D29070, paratype of* Hexacanthopora kintburiensis *Lang, 1916, from Campanian of Winchester. Scale bar 10 mm.*

(about 5%) and the last one in the same way as the first, but with the addition of Quaternary-O in a similar proportion. The duration of the immersion in the ultrasonic tank was precisely five minutes.

The blue paint that covers the fossil bryozoans could be (1) carbon ink, possibly the oldest ink used, that (during the 19th century was artificially darkened with a blue pigment such as e.g. Prussian blue[15,16]) or it could be also (2) Indian ink.[17] Both inks do not penetrate the surface that cover, but they are highly resistant to chemical bleaches[18] because the colour comes from a layer that has the carbon that is in suspension in the ink. In the experiment carried out, one of the specimens was easily completely cleaned with a solution of bleach, making not possible to have any of inks cited previously. Another possibility is that it is Blue Ink, e.g. the Prussian blue, which when first used was not

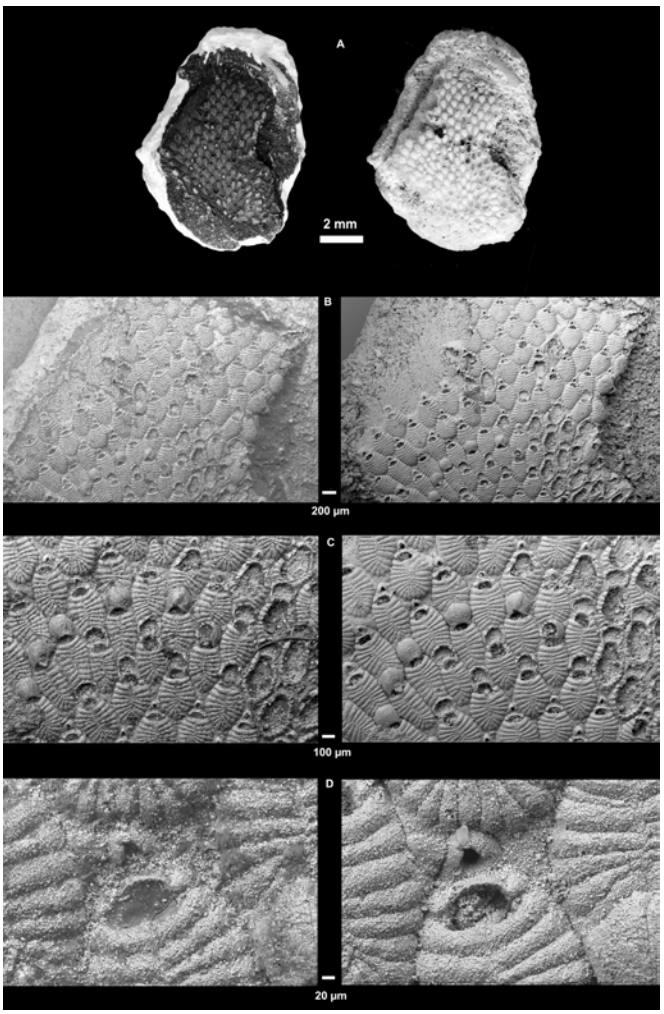


Figure 12. NHMUK PI D28248, holotype of Monoceratopora lewesiensis *Lang, 1916 from Turonian of Sussex. A. General view of the specimen on the left without cleaning and on the right after cleaning in the ultrasonic cleaner plus water. B-D. SEM photographs of the specimen with different magnifications without cleaning on the left side and with cleaning on the right side.*

particularly water-soluble; subsequently a change in composition in 1845 made it less water-resistant. This ink was rarely used at the beginning of the 20th century when Lang dyed the fossil bryozoans of its collection. Finally, the most probable ink used is the methylene blue ink[19, 20] (a thiazine dye), a very important zoological stain[21] that is introduced in the market in 1887 and widely used the first quarter of the 20th century.

NHMUK PI D28248, the holotype of *Monoceratopora lewesiensis* Lang, 1916 was cleaned in the ultrasonic cleaner with normal tap water. This is the most important specimen of the three, and is why it was cleaned only with water. NHMUK PI D29895, a cited specimen of *Hexacanthopora kintburiensis* Lang, 1916 was cleaned in the ultrasonic cleaner with water and 5% of bleach [solution of sodium hypochlorite NaOCl]. NHMUK PI D29070, a paratype of *Hexacanthopora kintburiensis* Lang, 1916 was cleaned in the ultrasonic cleaner with water and 5% of Quaternary-O [a chemical detergent of a high molecular weight mainly used to clean microfossils from clay particles.[22, 23]]

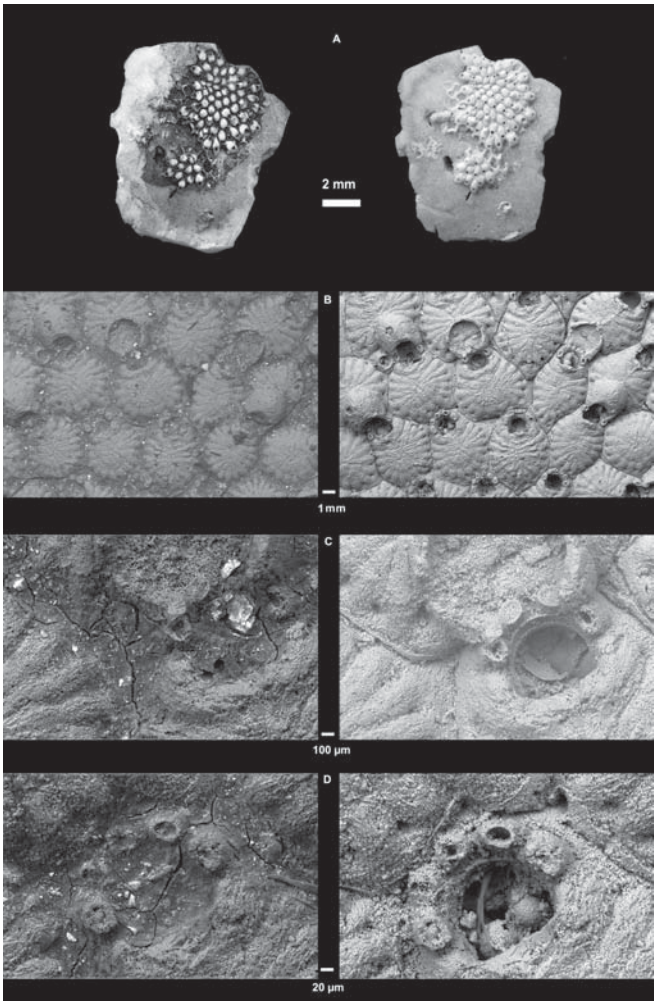


Figure 13. NHMUK PI D29895, cited specimen of Hexacanthopora kintburiensis *Lang, 1916, from Campanian of Worthing. A. General view of the specimen on the left without cleaning and on the right after cleaning in the ultrasonic cleaner plus water and bleach. B-D. SEM photographs of the specimen with different magnifications without cleaning on the left side and with cleaning on the right side.*

5. Result

The results of these experiments were successful for all of three specimens, revealing all the skeletal features preserved in the bryozoans (Figures 12-14). Among the different methods used, it was the combination of water and bleach that obtained the best results, as it completely removed the blue paint. The other two methods, one with Quaternary-O and the other with only water, both left some residual colour.

The reason why bleach was the most successful is that it works breaking the double bonds of chromophores,[24] which are regarded as being responsible for the colored

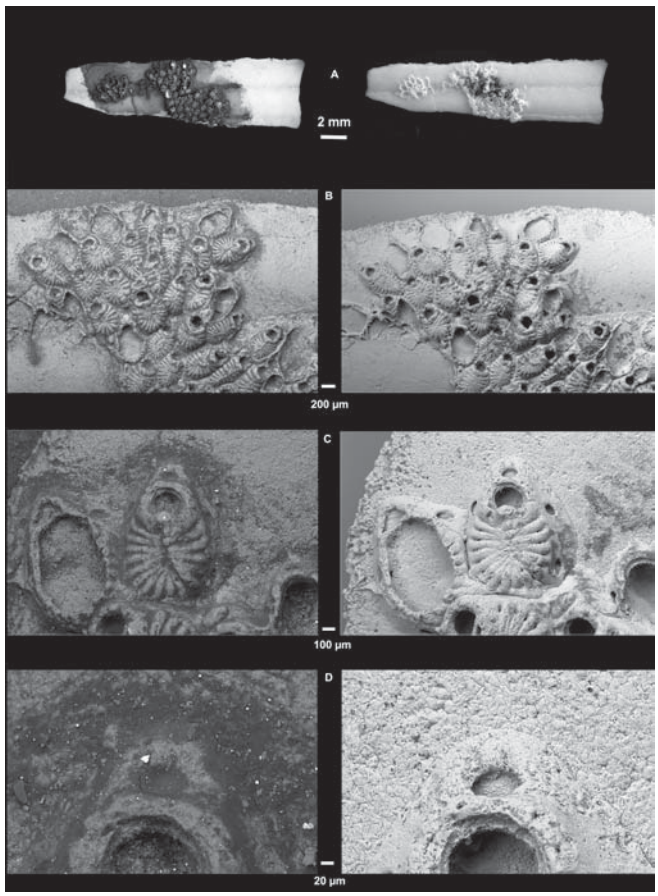


Figure 14. NHMUK PI D29070, paratype of Hexacanthopora kintburiensis *Lang, 1916, from Campanian of Winchester. A. General view of the specimen on the left side without cleaning and on the right after cleaning in the ultrasonic cleaner plus water and Quaternary-O hand side. B-D. SEM photographs of the specimen with different magnifications without cleaning on the left side and with cleaning on the right side.*

properties. The consequence is that this group of atoms loses the colour or reflects it outside the visible spectrum.

6. Conclusions

Good results have been obtained with all three treatments to clean Chalk fossils previously dyed with blue ink -certainly methylene blue ink-, i.e. with normal cold tap water, with water plus 5% solution of bleach and water with 5% Quaternary-O, all of them introduced in ultrasonic cleaner for five minutes. Although all three methods worked, I would endorse the use of a solution of water and 5% bleach because there was no residual blue ink adhering to the specimen after the treatment.

7. Acknowledgements

I am very grateful to Anna Taylor (NHM, London) for databasing the Lang Collection.

Notes

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