Steindorff Microbe Hunter, an iconic microscope that is a sculpture, a work of art. New interesting facts. Its established presence (with an award) not only in design culture but also in museums. Overall optical performance evaluation by means of Diatom Lab microscope test slides.

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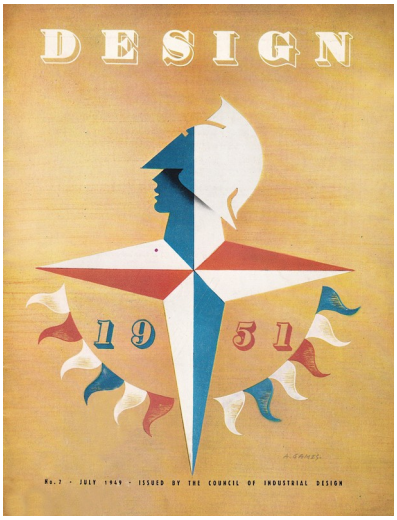
Figure 1. The same Steindorff Microbe Hunter seen by both sides. Serial number 60043. From the Diatom Lab collection.

Since I recently received a rare Steindorff Microbe Hunter (figure 1) as an exciting gift from my wife, I have seen that aesthetically it is truly a work of art and that unfortunately too little has been written about this iconic instrument yet, because the remaining documents are few and often difficult to find. I then began a personal research work, sometimes quite hard, discovering that several important revelations for the history of microscopy (and for our culture in general) have almost been lost nowadays, therefore they deserve to be divulged again, collected and analyzed.

This microscope model, unlike many others, is like a two-faced Janus, on the one hand it shows a strong artistic component, on the other it has various technical peculiarities. This double value and its bifurcated shape gave me the inspiration to make the image in Figure 1 and a video where the instrument itself appears mirrored as it solemnly rotates a full 360 degrees to show its amazing sculptural form (the video can be viewed at the following link: https://youtu.be/rj3ZtbN52RU). In order, I will deal here with the cultural issues and then with the technical ones.

The Steindorff Microbe Hunter is instinctively regarded by many microscopists as one of the most beautiful microscopes ever made in the past, and I have the same opinion too, but very few know that its splendor crossed the borders of the laboratories to also be admired within the design culture and in some museums too. It soon made itself known in the world of design since 1949, when it was admired at the Hannover Technical Export Fair and the Design magazine, issued by the Council of Industrial Design, published the following words: “Steindorff showed a fine binocular instrument

with a stand which swept forward, downward and back again in a bifurcated loop to give uninterrupted access to the sides and back of the compound stage" [Gayner, R.H.,1949] (figure 2).



An unconventional shape has been adopted for the latest microscope made by the seventy-year-old firm of Steindorff, Berlin. Base and sides are in one piece

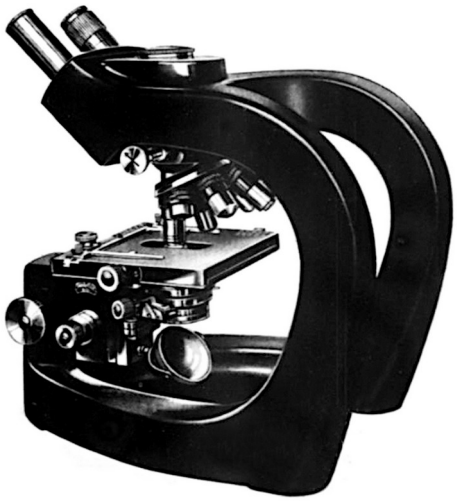


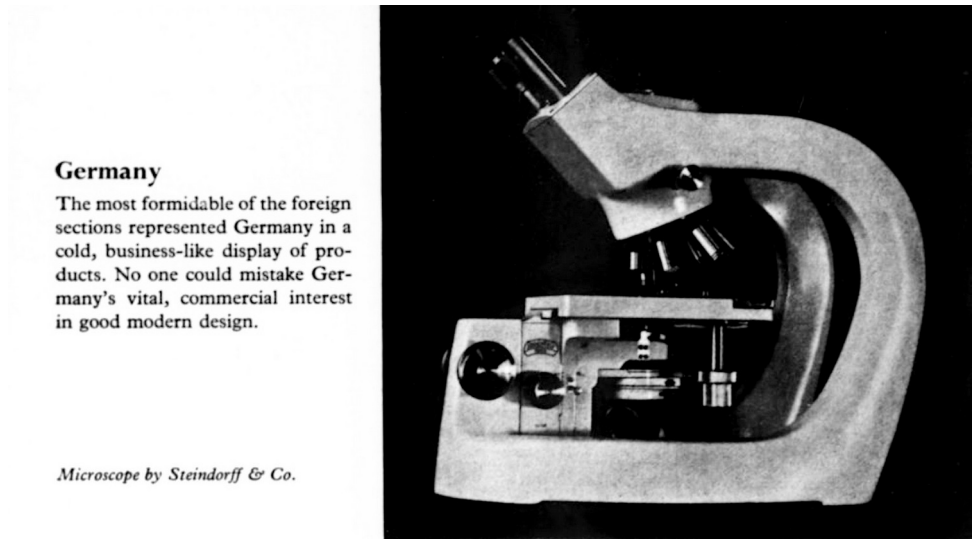
Figure 2. Design cover (July 1949, No. 7). Steindorff Microbe Hunter image and its short description contained within. (The larger printed year can be misleading, the real date is below)

Between August and November 1954 the Decima Triennale di Milano or X Triennale di Milano (Exhibition of Modern Industrial, Architectural and Decorative Arts) was held in Milan, Italy (figure 3) and attracted a large number of visitors from all the world. Not only it marked the birth of modern Italian design, but it also hosted many installations containing works from different Countries (United Kingdom, Canada, Germany, Spain, France, Norway, Finland, Denmark, Sweden, Netherlands, Belgium, Austria, Switzerland and Israel). The German section was set up by the architect Egon Eiermann (1904–1970), who decided to also put a Steindorff Microbe Hunter on display, chosen in its white colored variant (figure 4): needless to say, this instrument was awarded the Honorary Diploma during the exhibition for its exemplary shape based on ergonomic aspects! [Wichmann, H.,1990]. Still Wichmann in the same book argues that the shape of the microscope corresponds to the style of the time, that included sweeping curves, which we find in Isamu Noguchi (1904-1988) too, the American artist and landscape architect, known for his sculpture and public artworks.

Figure 3. Billboard of the Decima Triennale di Milano

Figure 4. Flyer advertising the German section within the Decima Triennale di Milano. The microscope is on display.

Again, the Design magazine devoted a further space to this amazing microscope, on the occasion of an article about the Decima Triennale di Milano [Farr, M. 1954]. The photography of the microscope is identical to the one in the flyer depicted in Figure 3.



Germany

The most formidable of the foreign sections represented Germany in a cold, business-like display of products. No one could mistake Germany's vital, commercial interest in good modern design.

Microscope by Steindorff & Co.

Figure 5. Image and description appeared in Farr, M. (December 1954). *Impressions from the "Triennale".* Design, Council of Industrial Design, No.72: 14-19. That is the Steindorff Microbe Hunter on display in its white colored variant at the Decima Triennale di Milano.

The same photograph appeared again in the Industrial Design magazine (figure 6) on page 36 , inside the article entitled "Letter from the X Triennale" [Dunbar, J. , 1954]. Here is a quote: "The foundation of West Germany's display is concrete, lightened by wood and wicker. All the display stands and tables, even display screens, are made of a rough gray-brown reinforced concrete, an interesting background for the very precise fruits of German industry. (…). Very few home furnishing are shown – heavy industrial equipment is presented as legitimate example of industrial design in Germany today". The photograph description of the instrument is simply "Microscope, Steindorff & Co., Berlin"

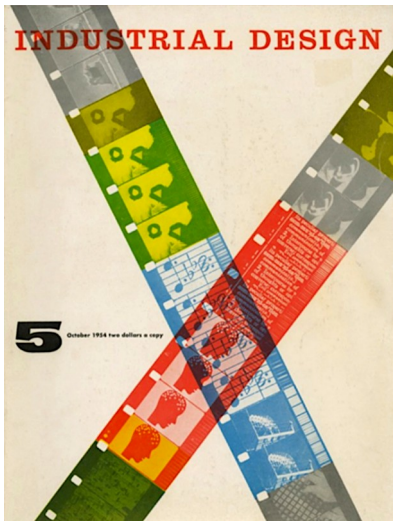


Figure 6. Industrial Design cover. (October 1954, Iss. 5)

THE IMPERIAL SURGICAL CO.,
361 HORNBY ROAD, FORT, BOMBAY

Steindorff Microbe Hunter — The special features of the instrument are: Monocular and binocular observation is obtained through one optical system; photographic equipment is mounted on the monocular tube, a turn of a knob permits binocular observation up to the moment the photograph is taken; curved supports arch away from the observer, permitting rapid, unobstructed handling of slides on a large, freely accessible stage; an extra large, dust-proof nosepiece is provided for six objectives, and built-in lighting is achieved by a special lamp that may be attached directly to the mirror support.

Figure 7. Excerpt from Journal of Scientific & Industrial Research, Vol 12A, No. 11, November 1953, page 51 (India)

At the time several advertising spaces have also been dedicated to this iconic microscope, in specialized magazines but also in newspapers, and even in India and Brasil, further proof that it was

the Steindorff & Co.'s flagship (figures 7, 8, 9).

Figure 8. Excerpt from The University of Toronto Medical Journal, February 1954, Volume XXXI, Number 5

Figure 9. Excerpts from the Correio da Manhã, April 25 1954 (Brasil)

Last but not least, the importance of this microscope does not end here as it has also been validated at a museum level. It is exhibited in at least three museums open to the public: 1) Die Neue Sammlung – The Design Museum (München, Germany). Founded in 1907, it is one of the leading design museums in the world, with the largest collection of industrial and product design. A white colored specimen is kept in this place; 2) the Chau Chak Wing Museum (Camperdown, Australia), a museum of art, science, history and ancient cultures at the University of Sydney. It keeps a black enamel specimen with serial number 61503, stored in its metal box having the shape of a hatbox; 3) the National Museum of Australia (Canberra, Australia). It keeps a black enamel specimen (object number 1986.0063.0015), stored in its wooden rectangular box.
A further specimen (the one in my possession) is also clearly visible not only in this work, but also in the (for today still virtual) museum of antique & vintage microscopes kept at Diatom Lab, where there are dozens of other rare microscopes always visible at the website www.diatomshop.com, with reviews being posted periodically. It came to me (together with its original wooden rectangular box shown in figure 10) in excellent optical, mechanical and aesthetic condition, its serial number is 60043 and some paper transport documents (that I don't show here for privacy) certify that the shipping from Germany to Italy was requested in 1949. Fate wanted it to remain in Italy until today, where I have never found news of another specimen before. But fate is nice because it wants to connect the specimens arrived in Italy to palm gardens! It's better to explain right away: we know that the Steindorff Microbe Hunter appeared in the 1951 West German drama film Dr. Holl (figures from 13 to 18), directed by Rolf Hansen and starring Maria Schell, Dieter Borsche and Carl Wery. At the 1st Berlin International Film Festival it won the Certificate of Honour award. But not everyone knows that many scenes were filmed in Italy (in Sorrento and Rome) and the laboratory created inside the Italian villa where Angelika Alberti (Maria Schell) and Dr. Holl (Dieter Borsche) move has large windows overlooking a wonderful palm and agave garden (figure 11). Curiously Diatom Lab also has a palm and agave garden (figure 12) with dozens of rare specimens thriving in open ground since 2011 and in Italy there are not many large dedicated gardens of this type, especially in the North. Another coincidence is that the version of the microscope kept at Diatom Lab (including the wooden rectangular box) is identical to the one that appears in the film: in fact they both have the mechanical stage with separate (no co-axial) controls, the substage condenser

with iris diaphragm and filter holder (focusable by a rack and pinion mechanism) without the optional oblique illumination device that moves the iris off-axis, separate (no co-axial) coarse and fine adjustment knobs, the dustproof revolving nosepiece with throttled tube, the six objectives that are not color coded. Other versions of the Steindorff Microbe Hunter have one or more opposite characteristics, but in any case, unfortunately, the specimens surveyed and survived to date are just over a dozen.

Figure 10. The Steindorff Microbe Hunter kept at Diatom Lab in its original wooden box. The monocular tube for photomicrographic or projection attachment and the oil immersion canisters are visible at the top of the lid.

Figure 11. A small glimpse of the palm garden in Dr. Holl (1951)

Figure 12. A small glimpse of the palm garden at Diatom Lab

The Steindorff Microbe Hunter appears several times in the movie, but initially (in the seventh minute) another microscope is shown to us, a smaller monocular Zeiss Jena Stand L (figure 13).

They are both splendid black enamel microscopes, belonging to an era that no longer exists and yet we can remember and testify.
These two instruments have a low design: all motion devices are arranged below the plane of the stage, to to ensure ergonomics. From the point of view of photomicrography, the Steindorff Microbe Hunter - besides the fact that it is trinocular - has an edge because it is more massive and heavier, which better eliminates vibrations.

Figure 13. The Zeiss Jena Stand L with Dr. Holl (Dieter Borsche)

Figure 14. The Steindorff Microbe Hunter with Dr. Holl (Dieter Borsche)

Figure 15. A small glimpse of the Italian palm and agave garden that can be admired from the laboratory in Dr. Holl

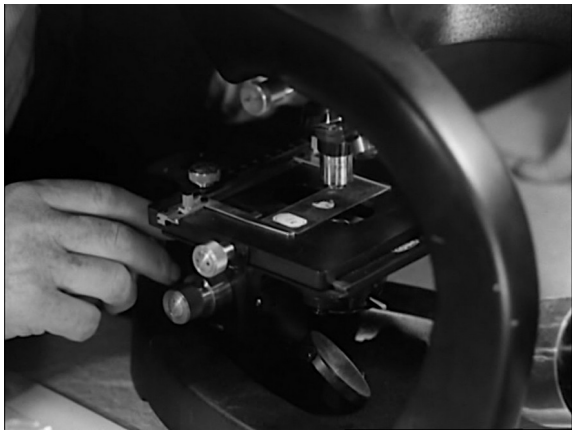


Figure 16. A frame in which different details of the Steindorff Microbe Hunter are captured

Figure 17. The Steindorff Microbe Hunter seen in the distance

Figure 18. The wooden rectangular box supplied with the Steindorff Microbe Hunter

And now a more technical but no less intriguing part will be addressed. The Steindorff Microbe Hunter that arrived in full at Diatom Lab has six Steindorff Achromatic objectives: 4x (unengraved numerical aperture), 10x/0.30, 30x/0.65, 45x/0.85, 60x/0.85 and 100x/1.30 Oil immersion. The instrument is also equipped with two pairs of Huygenian eyepieces (6x and 10x). The 30x and 45x objectives have a numerical aperture vaule 0.20 points higher than the 30x/0.45 and 45x/0.65 lenses mentioned by Mach M., del Cerro M. (2008) with reference to the instrument 540671 produced in 1954 (all the other objectives, on the other hand, respectively have the same numerical apertures). The six-position revolving nosepiece was a surprising, innovative fact for the time, it makes it easy to observe samples at really multiple magnifications. Moreover, few know that this instrument has an infinite fine focus travel (1 div. = 0.002 mm) as had also been anticipated by Otto, L. (1959), which in my opinion is a real finesse, it means that the fine adjustment always proceeds smoothly, never stops when reaching the end, but resumes in reverse, avoiding possible mechanical damages to internal components caused by rugged microscopists. In any case the race is so large that if you stay halfway while observing a microscope slide (setting the instrument while observing the three lines printed on the right side: the central single line that always remains stationary should be more or less halfway between the other two) it is unlikely to reach the end. Another aspect that very few know is that the Steindorff objectives (at least those that were produced from 1949 to 1958) "are corrected for a mechanical tube length of 170 mm measured from the lower end of the nosepiece to the upper edge of the eyepiece tube" (Beeber J., Hallmann G., 1958, page 19): in fact I have personally measured the tube lenght of my Microbe Hunter and it corresponds to what was declared. Ernst Leitz GmbH. (Wetzlar) and VEB Rathenower Optische Werke (Rathenow) produced microscopes having the same uncommon mechanical tube lenght (Otto, L., 1959), but this fact is on the contrary well known to the owners of a Leitz Ortholux I for example, as the Leitz objectives clearly show this engraved data (absent in all the Steindorff objectives that I have viewed).

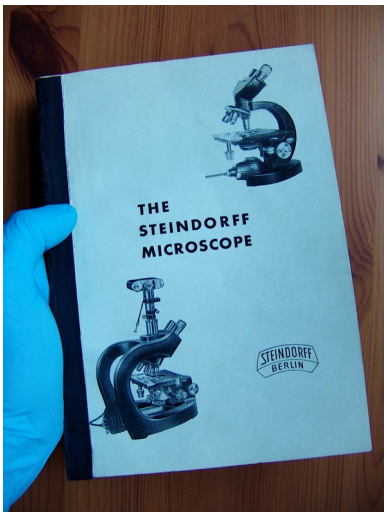


Figure 19. Beeber J., Hallmann G. (1958). *The Proper Use and Care of The Steindorff Microscope*, Berlin, Steindorff. The original manual kept at Diatom Lab.

Bild 2.17 Forschungsmikroskop „Mikrobenjäger"
(Werkphoto: W. Steindorff & Co., Berlin)
Achromate und Huygensokulare, Stativ mit doppeltem Tubusträger, 6fachem Objektivrevolver und angebauter Beleuchtung mit Regeltransformator. Grob- und Feintrieb wirken auf den Tisch, als Feintrieb dient eine „endlose" Mikrometerschraube. Koaxialer Kreuztisch mit tieflegendem Antrieb, Kondensorrevolver mit vollständigem Abbeschen Beleuchtungsapparat. Binokularer Tubus mit Dioptrienein stellung an einem Okularstutzen und gerader monokularer Tubus für Mikrophotographie

Figure 20. The Steindorff Microbe Hunter depicted in: Otto, L. (1959). *Durchlichtmikroskopie. Geräte und Verfahren*, Berlin, Veb Verlag Technik

In a new forthcoming publication I write: "Since the appearance of the microscope, some Diatom species (called Test Diatoms by microscopists) have been and still are used to test optics, because striae and areolae distances in a same species collected in a same area are constant regardless the size of the frustule. In other words Test Diatoms are extremely valid and accurate to quantify resolution of optical microscopes, defined as the smallest distance between two points on a specimen that can still be distinguished by the observer or camera system as two separate entities. It follows that Test Diatoms are also the elite tools to compare microscope models, objectives, eyepieces, condensers, light sources, microscope cameras, optical filters and contrast techniques

with each other". Due to the rarity of the Steindorff Microbe Hunter, I think many would be curious to read an overall optical performance evaluation by means of Test Diatoms, now that we have further known its history and its technical characteristics. I performed the experiments using the following Diatom Lab microscope slides:
1) the *Diatom Test Slide version 2.0* (figure 21);
2) the *Microscope Test Slide in commemoration of Edmund J. Spitta*;
3) the microscope slide of selected, micromanipulated diatom *Craticula cuspidata* (Kützing) DG Mann ex Rotonda et al. (1990).
Regarding the *Diatom Test Slide version 2.0* I chose to photograph the "classic" *Stauroneis phoenicenteron* (Nitzsch) Ehrenberg 1843.
Regarding the *Microscope Test Slide in commemoration of Edmund J. Spitta* I chose to photograph the following species: *Epithemia turgida* (Ehrenberg) Kützing 1844 and *Navicula smithii* Brébisson, 1856.
As is the case with all Diatom Lab innovative microscope slides of selected, micromanipulated Diatoms, specimens are fixed directly to the underside of the custom optical quality cover glass using the proprietary Nano-adhesive and the proprietary Diatom Cubed high refractive index mountant, to ensure maximum optic performances.

Figure 21. The *Diatom Test Slide version 2.0* on the the Steindorff Microbe Hunter mechanical stage.

I took the photomicrographs using a digital full frame camera and I preferred the single shot rather than the focus stacking to test the depth of field. Bearing in mind that the objectives are Achromatic (that is, they have a limited correction for chromatic aberration) from the late Forties, the results are better than I expected. The following observation we find in *The Proper Use and Care of The Steindorff Microscope* (Beeber J., Hallmann G.,1958) reveals an important aspect of those years "students, laboratory and medical microscopes are mostly equipped with achromatic objectives and Huygenian eyepieces". Therefore it is no coincidence that the Steindorff Microbe Hunter was recommended in the healthcare sector, in fact fluorite and apochromatic lenses were solely used in particular laboratories also because of their much higher price (the difference in price still remains

today of course), although “Fluorite (semi-apochromatic) objectives are better corrected than achromatic ones and apochromatic objectives have the best chromatic and sperical correction” (Beeber J., Hallmann G.,1958). In any case it was possible to request the most suitable Steindorff optics for one's needs.
For the purposes of this publication, to show the useful details in bright field for each Diatom, all photomicrographs (having the original dimensions of 5760 x 3840 pixels) have been cropped in the area of interest to the size of 1531 x 1531 pixels. As you can see all Diatoms chosen for the experiment have been resolved with good results (figures from 22 to 37) . All lenses supplied with the instrument showed a good depth of field. Each Diatom has been imaged in two different ways, the first in color while the second setting the camera to monochrome, in this last option we can get closer to the typical black and white results of of that historical period. In the case of *Stauroneis phoenicenteron* (Nitzsch) Ehrenberg 1843 and *Navicula smithii* Brébisson, 1856 I also produced photomicrographs in oblique illumination, inserting a specific opaque stop in the filter holder. The type of lens used is indicated in the description of each photomicrograph.

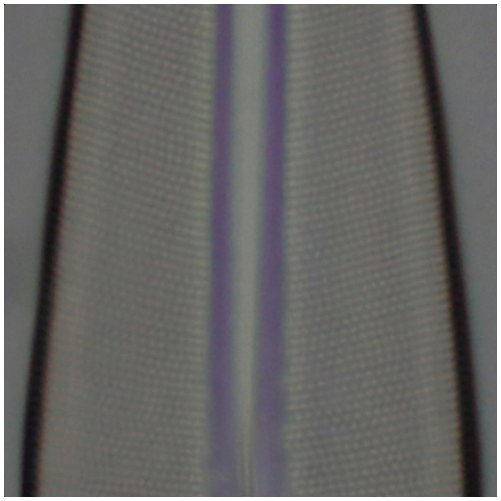


Figure 22. *Stauroneis phoenicenteron* (Nitzsch) Ehrenberg 1843. Bright field. Steindorff Achromatic 45x/0.85 lens.

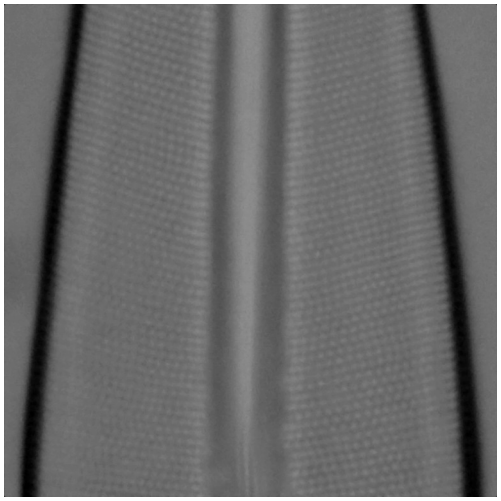


Figure 23. *Stauroneis phoenicenteron* (Nitzsch) Ehrenberg 1843. Bright field. Steindorff Achromatic 45x/0.85 lens. Monochrome.

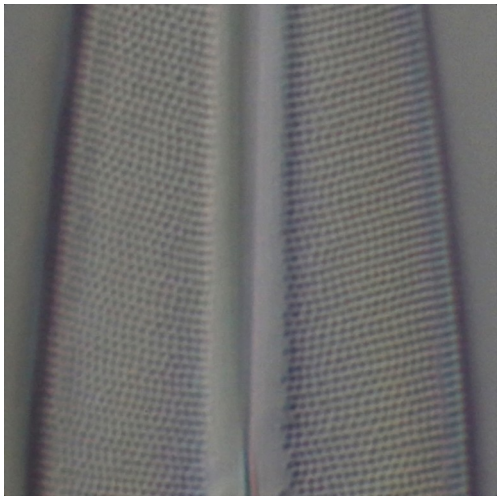


Figure 24. *Stauroneis phoenicenteron* (Nitzsch) Ehrenberg 1843. Oblique illumination. Steindorff Achromatic 45x/0.85.

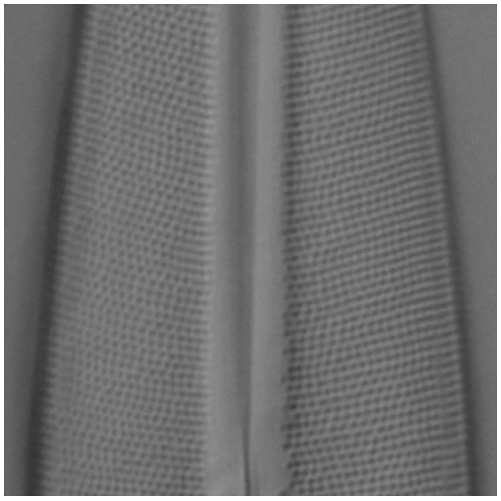


Figure 25. *Stauroneis phoenicenteron* (Nitzsch) Ehrenberg 1843. Oblique illumination. Steindorff Achromatic 45x/0.85. Monochrome.

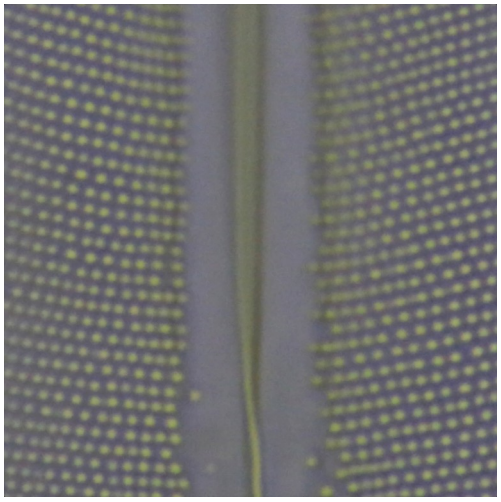


Figure 26. *Stauroneis phoenicenteron* (Nitzsch) Ehrenberg 1843. Bright field. Steindorff Achromatic 100x/1.30 Oil imm.

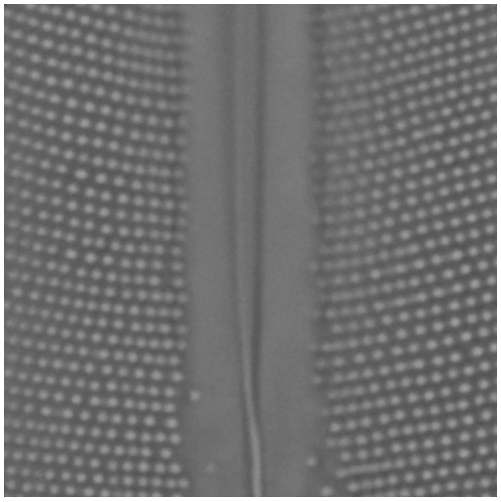


Figure 27. *Stauroneis phoenicenteron* (Nitzsch) Ehrenberg 1843. Bright field. Steindorff Achromatic 100x/1.30 Oil imm. Monochrome.

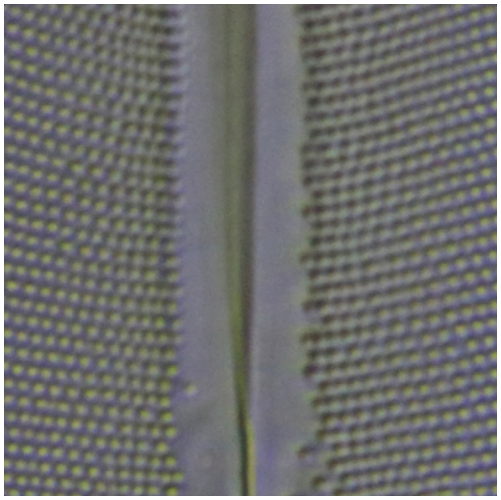


Figure 28. *Stauroneis phoenicenteron* (Nitzsch) Ehrenberg 1843. Oblique illumination. Steindorff Achromatic 100x/1.30 Oil imm.

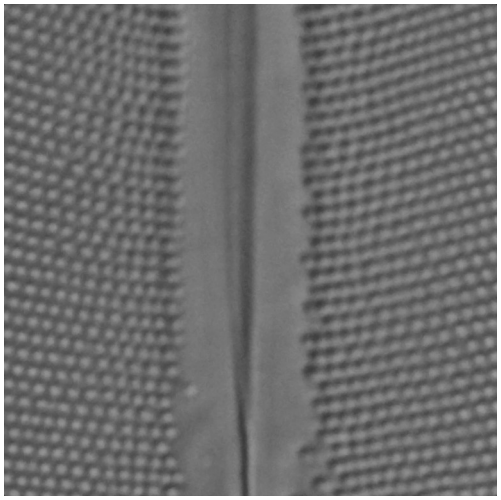


Figure 29. *Stauroneis phoenicenteron* (Nitzsch) Ehrenberg 1843. Oblique illumination. Steindorff Achromatic 100x/1.30 Oil imm. Monochrome.

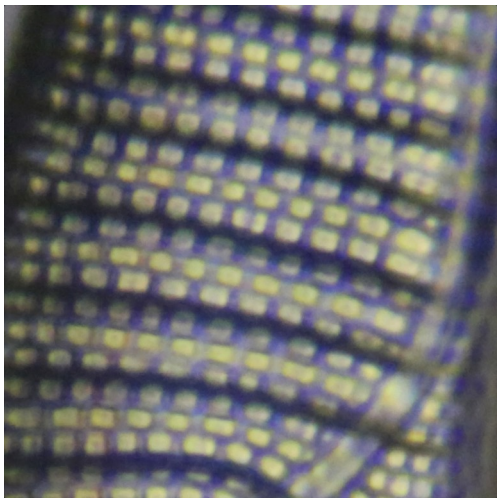


Figure 30. *Epithemia turgida* (Ehrenberg) Kützing 1844. Bright field. Steindorff Achromatic 100x/1.30 Oil imm.

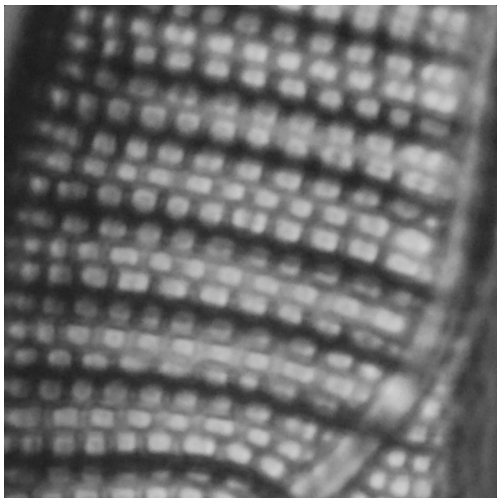


Figure 31. *Epithemia turgida* (Ehrenberg) Kützing 1844. Bright field. Steindorff Achromatic 100x/1.30 Oil imm. Monochrome.

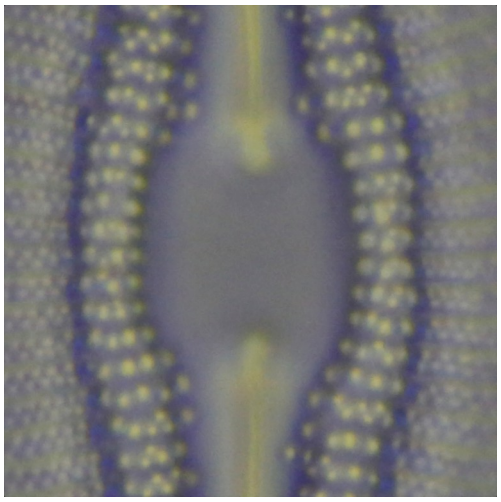


Figure 32. *Navicula smithii* Brébisson, 1856. Bright field. Steindorff Achromatic 100x/1.30 Oil imm.

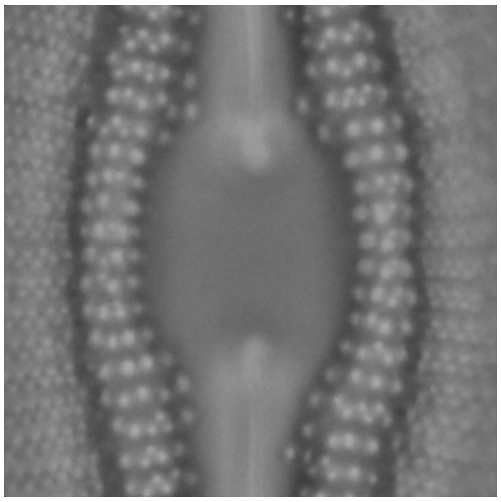


Figure 33. *Navicula smithii* Brébisson, 1856. Bright field. Steindorff Achromatic 100x/1.30 Oil imm. Monochrome.

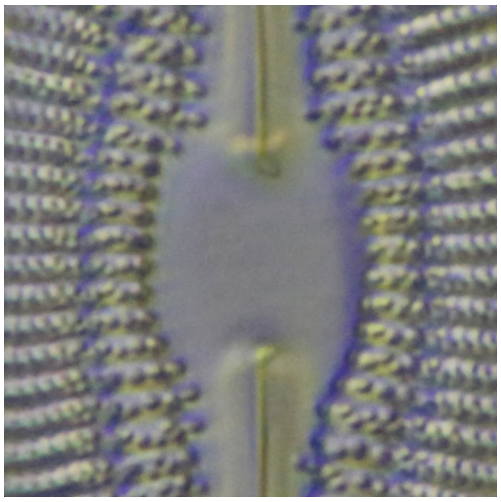


Figure 34. *Navicula smithii* Brébisson, 1856. Oblique illumination. Steindorff Achromatic 100x/1.30 Oil imm.

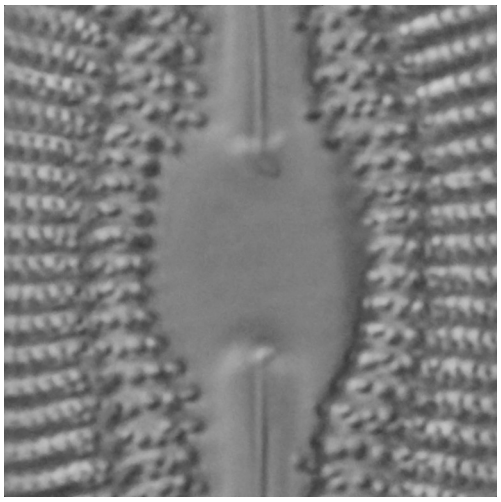


Figure 35. *Navicula smithii* Brébisson, 1856. Oblique illumination. Steindorff Achromatic 100x/1.30 Oil imm. Monochrome.

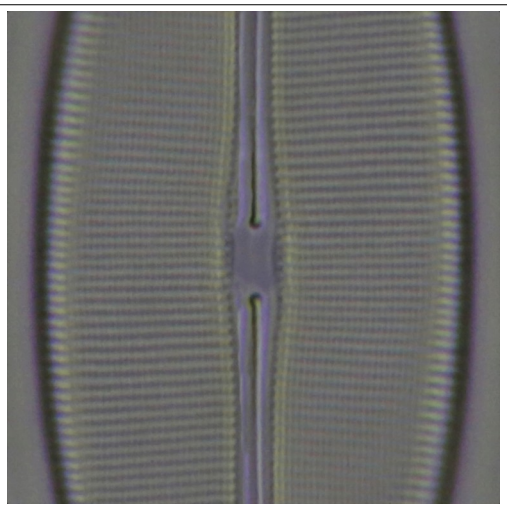


Figure 36. *Craticula cuspidata* (Kützing) DG Mann ex Rotonda et al. (1990). Bright field. Steindorff Achromatic 100x/1.30 Oil imm.

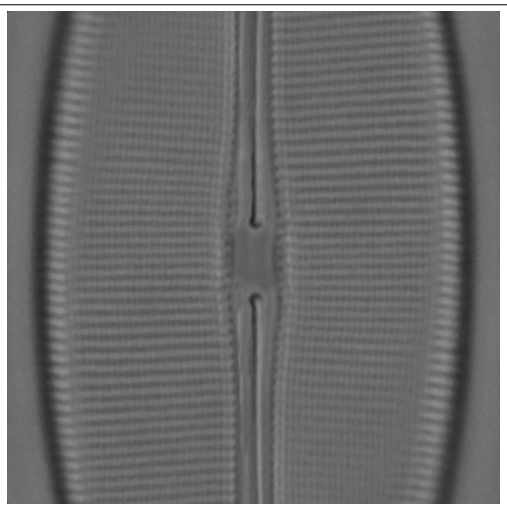


Figure 37. *Craticula cuspidata* (Kützing) DG Mann ex Rotonda et al. (1990). Bright field. Steindorff Achromatic 100x/1.30 Oil imm. Monochrome.

As was foretold, the heavy weight of this iconic instrument is a positive added value that eliminated potential vibrations during the photo sessions.
We understand at this point that, considering Diatoms as "merciless" tests for the microscope, the Steindorff Microbe Hunter equipped with Achromatic microscope objectives was certainly useful to the laboratories of the time that decided to buy it.

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