

Figure 33.1: *The 1m-Reflector of Hamburg Observatory*

33. The 1 m-Reflector of the Hamburg Observatory: an Object of Technical Heritage – a Preservation Concept

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33.1 Introduction

Within the scope of my diploma thesis, supervised by Prof. Dr. Keller-Kempas on behalf of the FHTW/University of Applied Sciences Berlin and Prof. Dr. Gudrun Wolfschmidt on behalf of the University of Hamburg, I have developed a concept of preservation for the 1 m-reflector (see Fig. 33.2A) of the Hamburg Observatory that mainly focuses on the issue of preserving the functionality of this device and its further utilization, as well as requesting the maintenance of the traces of its use.

By conserving and restoring technical heritage it is possible to ensure the transfer of the technology's development phases through their legacy. The awareness for the traces of its production and utilization as well as the perception of a technical object that is fully functional allows for the creation of concepts to maintain the irrecoverable values of the historical and material authenticity of an object. The realization of such concepts is particularly difficult in the field of technical heritage.

Maintaining the functionality, for instance, may conflict with preserving a coating that already bears traces of use.

Since the early last century Georg Dehio's motto, "conserve, don't restore", has been one of the principles of the preservation of historic monuments that should also apply to handling of technical cultural assets.¹

Renovation work has not only been applied in the past to preserve technical cultural assets for the purpose of restoring it to almost brand new condition. The renovation of the Potsdam double reflector dating from 1899, for instance, involved repainting and also fitting state-of-the-art controls in 2005, which is in contrast to different approaches such as the conservation measures performed on the large reflector of the 1887 Kuffner Observatory in Vienna which was completed in 2002, whereas old coatings were exposed and preserved. It was also necessary to modify the mechanics here, but the original components were preserved and are now presentable.²

The main focus of the presentation was the following question: Why is it so important to preserve the traces of use in particular and how can we meet this requirement? I therefore would like to present the instrument

in more detail and sketch out the current status of its condition in order to then proceed to the problems of its preservation that result from the atmospheric environment inside the building and the current condition of the instrument's paint coat. Moreover I will present approaches for handling this situation, which are thought to be open for further discussion.

The device weighs 26 tonnes and extends approx. 5 m into the dome, whereas the main tube bearing the 1 m mirror is approx. 3.6 m long – just to give an idea of the dimensions (see Fig. 33.8A and 33.8B).

Currently we see a historic instrument with traces of use as well as conversions and auxiliary fittings that have been undertaken over the course of time. It is witness to a long period of astronomical research and demonstrates the requirements placed on relevant technology of the time.

The instrument is the first large Zeiss telescope fitted with a counterbalancing device by Franz Meyer. With its optics, mechanics and the 10 m dome construction (see Fig. 33.8B) it forms an ensemble that represents a historic period in the construction of telescopes by the astronomy department of Zeiss, which was founded in 1897.

It is one of the very few large astronomical instruments from the first decade of the last century, whereby its condition still demonstrates a high degree of authenticity. Fortunately the instrument has been neglected over the last three decades. This has changed its overall condition for the worse, of course, but it also means that today we can observe the instrument with all its documents of time as they have not been destroyed by new paint coatings and modernization efforts at the expense of the ancient substance, as it has happened with many other similar devices.

It is the combination of the Hamburg Observatory astronomy park with the complete photo plate archives including the hand-written observation books that partially include the writings of Walter Baade that further add to the great value of the reflector telescope as a monument.

The instrument is fitted into a dome structure, which was completed in 1909. The extension was built in 1926 (see Fig. 33.6A and 33.6B).

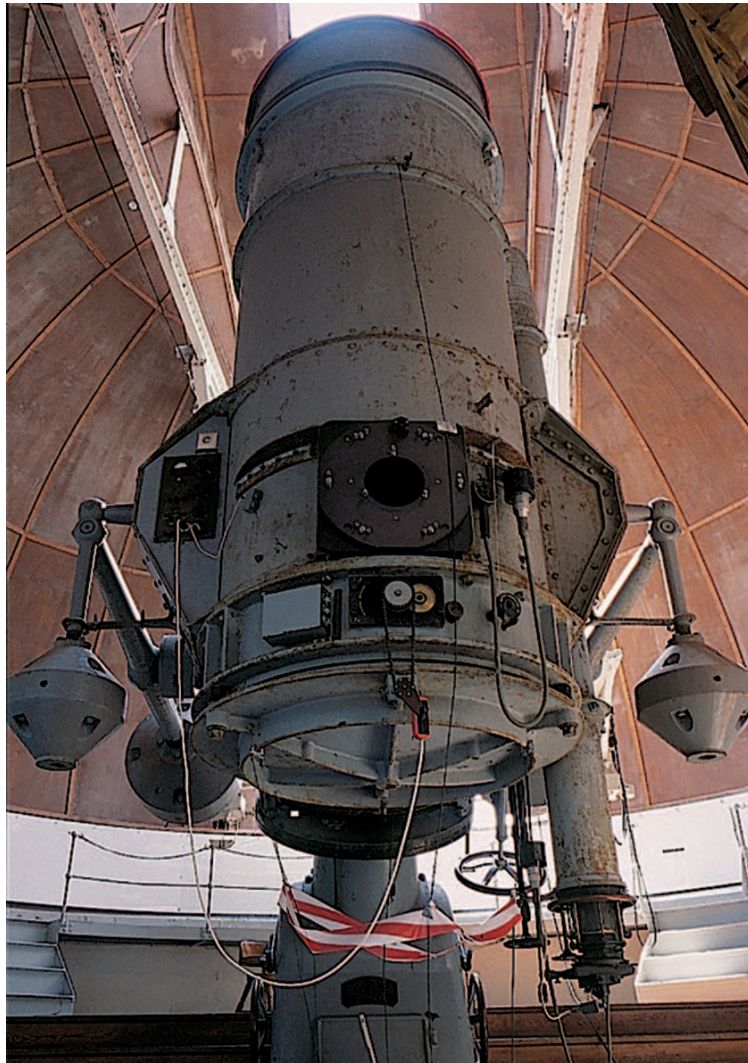


Figure 33.2: Pictures of sections of the 1 m reflector telescope, building and aerial view. Above: The 1 m reflector telescope, view of tube with conversions and extra fittings; Below left: The dome structure of the 1 m reflector telescope. View of the slit opening; Below right: Aerial view of the 1 m reflector telescope building (Above and Below left: Beatrix Alscher; Right: Archives of Hamburg Observatory)

33.2 The Conservation Challenge

33.2.1 The Condition of the Instrument – the Coating

The instrument is currently ready for operation, although there are some restrictions to the fine mechanics:

- The high relative air humidity has a corrosive effect on the materials (see Fig. 33.3).
- Fragile products of corrosion are hazardous to the optics and mechanics.
- Corrosion developing on the surface of the instrument also reduces the bonding of the coating.
- The aged coating and corrosion products dominate the overall impression.

The coating: Different traces of ageing of the coating are visible on the instrument.

- In the lower section of the base: very stable, still adhesive coating with large cracks developing (see Fig. 33.3A).
- In the bracket area: hard, multi-layer paint flakes that are barely bonding with the host material (see Fig. 33.3B).
- In the upper section of the tube: very fragile, flaking final coating that gives view to further corroded layers (see Fig. 33.3C).

The visual, chemical and physical examination of the coating has revealed that the instrument has been repaired with new layers of paint on an irregular basis.

The thickness of the paint in the area of the base and counterweights show thick layers with up to eight decorative sequences. The layers on the tube are far thinner, which means that more importance was given to the removal of the old layers. Therefore, the following characteristics can be proposed for the individual parts (see table 33.1, S. 298).

It can be seen that the initial oil system changes to an alkyd resin system with the application of red lead (see Fig. 33.4). Extreme brittling and cracking of the coating in some parts shows typical ageing symptoms for alkyd resins.³

The damage to the coating also shows that the last large-surface repair measures were conducted some time ago, which can be seen from the largely reduced binder on the coating of the counterweight of the hour axis.

The assumption that the last coat of paint was applied for the IAU Convention in the 1960s is not too far-fetched as traces of already removed technology still can be found on the final paint composition (see also Fig. 33.9).

The oil system detected in the lower layers raises the question whether it could still be the original coating applied by Zeiss.

Of particular interest in this context was the comparison⁴ of the cross-section polish of the instrument in

Hamburg with cross-section polishes of a further Zeiss telescope, the refractor manufactured for the Zurich Observatory in 1906. Beneath newer compositions on the device in Zurich it was also possible to trace the oil-based primer found on the base of the 1 m-reflector telescope. The sequence of layers on the counterweights was also similar.

The paint systems of the base and counterweight of the hour axis should therefore be followed up further and, if necessary, be given particular relevance with regard to issues of conservation.

33.2.2 The Current Climate Situation

The instrument is mainly exposed to uncontrolled climatic conditions.

The climate situation and its effects on the materials can be outlined as follows:

High degrees of fluctuation of the relative air humidity and temperature result in strain on the material and thus lead to cracks in the coating, reduced easy movement of the construction elements, and cracks in the wood.

The mean of the relative air humidity is approx. 70–100% which can and visibly does result in microbial contamination and infestation by insects. The development of condensation water resulting from the temperature falling below the dew point activates corrosion on the metals (see also Fig. 33.3), increasing ageing of the coating and also moisture penetration of the brickwork.

The mechanics and optics are also threatened by products of corrosion. Looking at the main reflector inside the cylinder you can see that the fins slide across each another, thereby trickling corroded metal onto the remaining mechanics and surface of the reflector. When the instrument is moved these particles have an abrasive effect on the reflector (see Fig. 33.5).

33.3 The Preservation Concept

After viewing the overall ambient situation the following general requirements can be specified for the practical realization of the preservation:

Dehumidification of the building.

Stabilisation of the ambient climate, particularly after a period of observation.

Reliable corrosion protection of the instrument from corrosion.

So before thinking about conserving the instrument it should first be ensured that the building can reassume its protective function again.

33.3.1 Dehumidification of the Building

Tempering of the walls was favoured when developing a concept of stable ambient climate. This prevents condensation, convection and climate fluctuation.

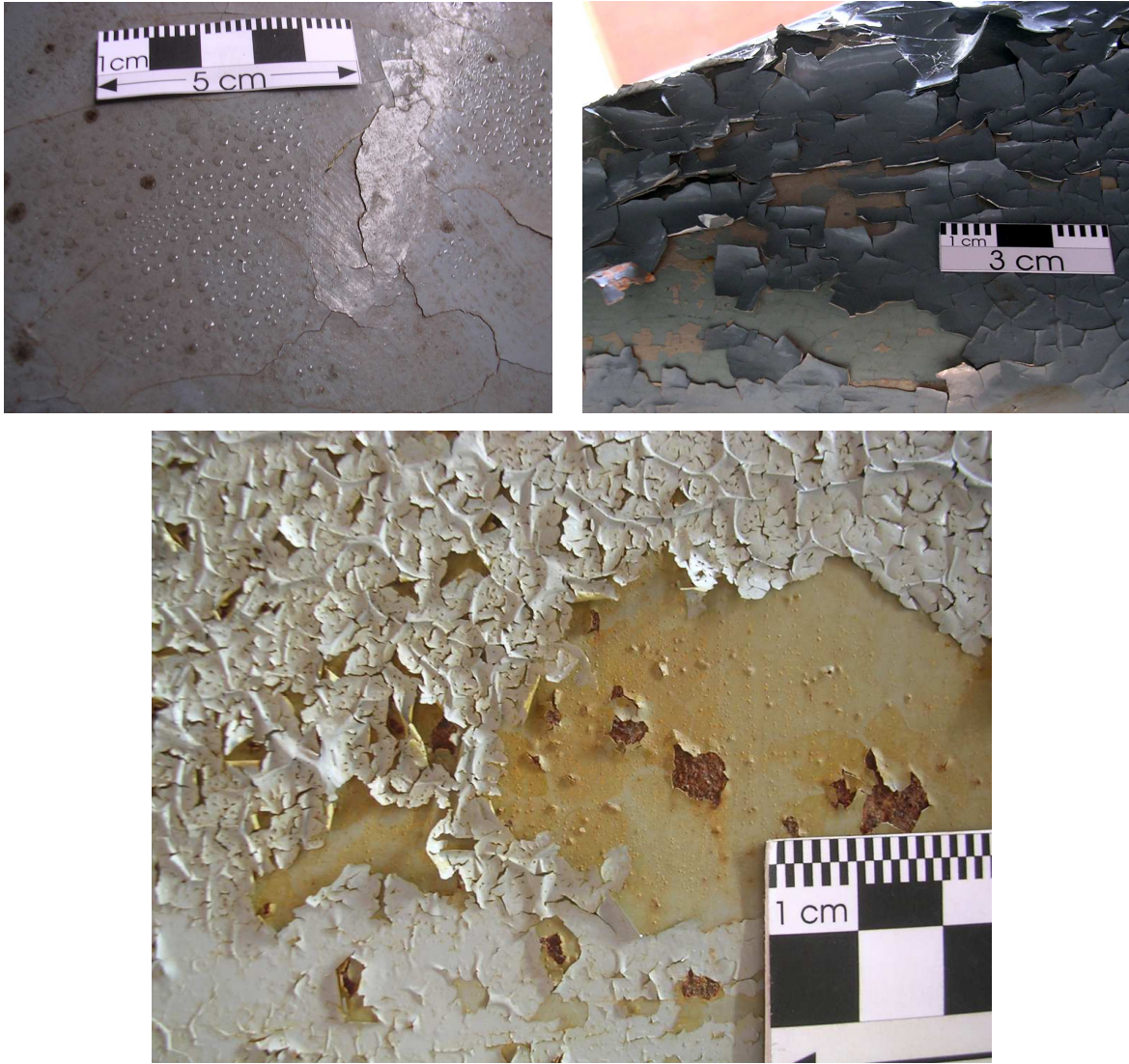


Figure 33.3: *Different traces of ageing of the coating. Above left: Condensation has resulted in surface cracks; Above right: Hard multi-layered flakes of paint with hardly any adhesion; Below: Fragile brittling and corrosive undermined coating areas (Photos: Beatrix Alscher)*

This type of tempering also protects from salt migration, damp rising from the ground and moisture penetrating resulting from rain and snow. The effect of wall tempering is exemplified again in Fig. 33.7, page 300, using the example of the 1 m-reflector telescope. The heating coils in the brickwork provide heat that wards off moisture from the ground and from outside. Climate fluctuations are toned down, convection is prevented.

33.3.2 Traces of Use

About the traces of use on the instrument:
Why? You could now ask why the instrument should not simply be overhauled and painted again using stable, state-of-the-art protection against corrosion. The question is justified and consequently brings us back to the initially commented question concerning the reason why the traces of use should be preserved with the instrument as well as maintaining its functionality and use.

As a document of history the 1 m-reflector of the Hamburg Observatory initially “only” conveys the state of technology and its importance during a particular period. According to the traces of use, however, a unique history is conveyed that, for instance, can provide details on a special purpose of use or particular characteristics of the users themselves. These indications can be found mainly on the surface, such as wear on intensively used areas, indentations that were used as aid marks or from conversions and auxiliary fittings.

The traces of use most relevant to the reflector telescope in order to build a “bridge to the past” are the special conversions and auxiliary fittings in particular that were built for the instrument during the course of its scientific use. While these still existing conversions and fittings are self-explaining, traces of removed telescope elements as well as orientation aids sketched onto the telescope surface with a pencil can also be found and are thus witnesses of these no longer existing technological components (see also Fig. 33.9, page 302).

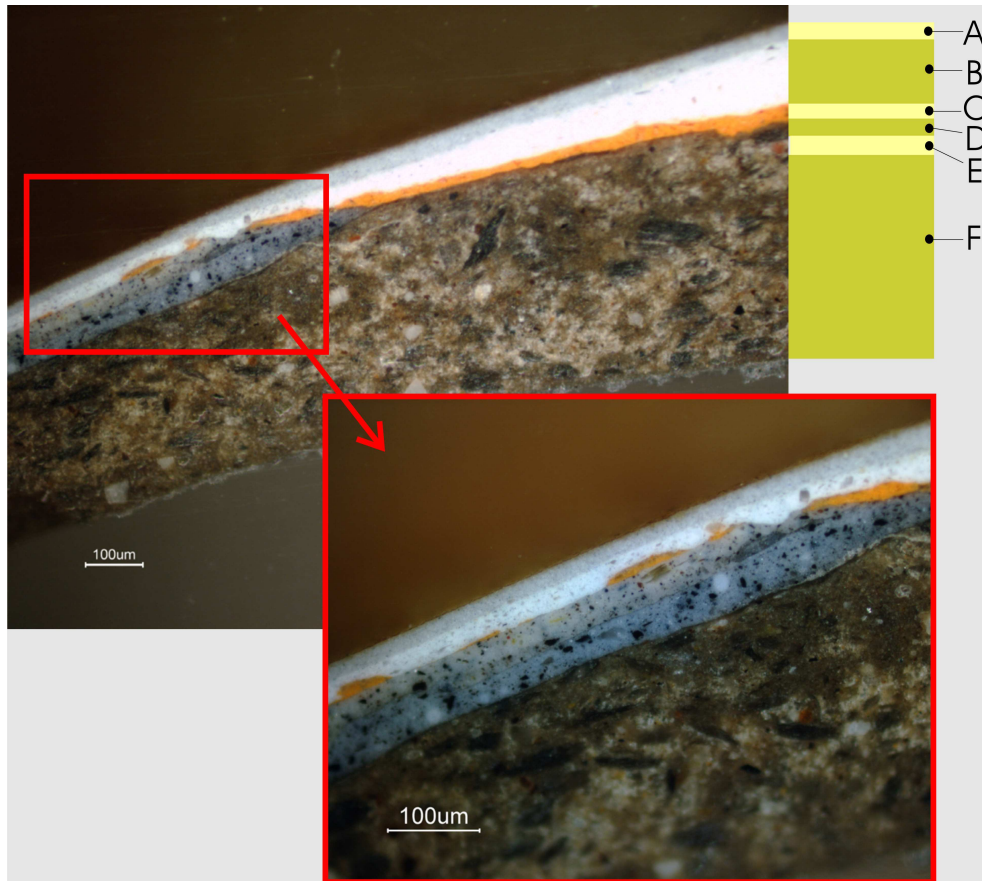


Figure 33.4: *Cross-section polish of probe 5, tube base, inner cladding A: Gray composure, fine filling materials (lithopone). B: White layer that can be interpreted as primer with rough filling materials as can be found on other polished sections of the tube. C: Red lead, on layers F and D. D: Second gray composure with coarse filling materials (lithopone portions). E: 3rd gray composure with coarse filling materials – reacts positively to basic lead carbonate analysis. While layers A, B and C are similar to the other tube composures the layers D, E and F can be found again at the counterweights and base. (Photos: Beatrix Alscher)*

33.3.3 Maintaining its Functionality?

Why preserve it and keep it fully functional? Maintaining its functionality cannot and must not be questioned here. The device is fully operational and no interference with the aged substance is necessary to achieve this status. Taking it out of service due to worn parts would be comparable to covering up a work of art. Only if fully functional will the reflector telescope be capable of conveying its full complexity to the observer and, according to Walter Benjamin,⁵ be capable of unfolding its full aura.

The actual underlying idea of the conservation concept:

Alois Riegel describes “value of age” as the feelings any person may have when looking at a monument, which allowed him to derive his maxim to prevent any “arbitrary intervention by human hand into the developed status of a monument”.⁶ With “historic value” he also credits the monument with the ability to document, thereby describing a particular phase in the development of human achievement.⁷

The 1 m-reflector telescope of the Hamburg Observatory, for instance, is an example of the characteristics of documentation listed by Riegl. By keeping it in working condition it will also be possible to experience it with all one’s senses. Of course, only the slightest possible intervention into the “evolved condition” would form the foundation for a concept of preservation for this technical document of time.

33.3.4 The Concept of Handling the Paint

The current status of the paint, however, gives reason for discussing different approaches to preservation.

The concept of handling the paint: In his main magnum opus “The Seven Lamps of Architecture” art historian John Ruskin (1819–1900) looks into the subject of reconstructive and improving restoration. He sees the actual value of an architectural monument in the traces of its age.⁸ If this idea is transferred to the 1 m-reflector telescope it is possible to critically question whether the traces of age are really conveyed by the surface, i.e. by the condition of the coating. This would entitle the coating to first degree priority of preservation.

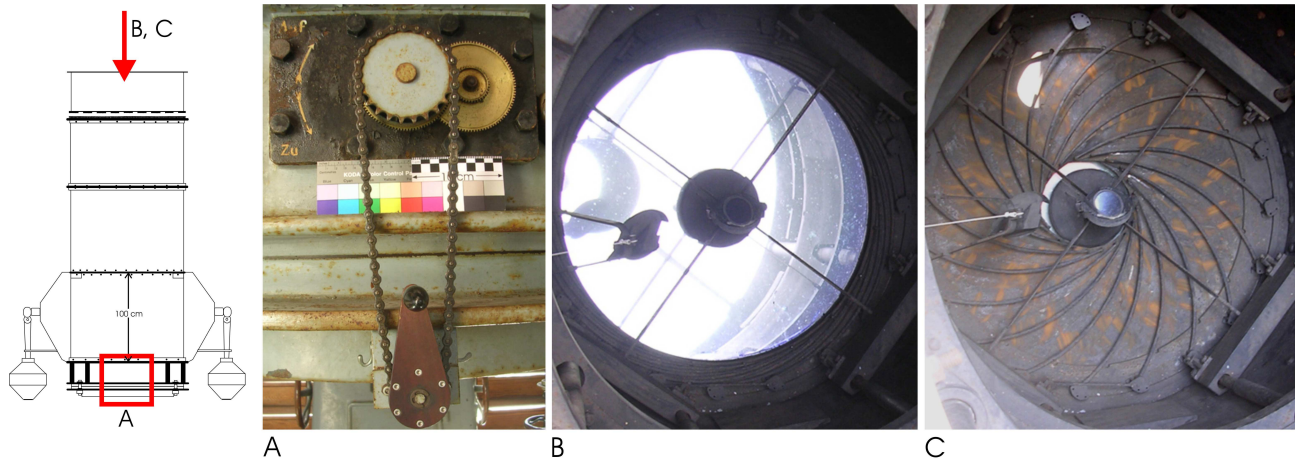


Figure 33.5: *Iris actuator system*
A: Crank handle with chain and gearwheel on outer surface of the tube
B: View of the main reflector with iris open / inside tube
C: View of main reflector with iris open and central covering / inside tube (Photos: Beatrix Alscher)

Table 33.1: *Coating characteristics at various components*

Component/Part	Surface coating characteristics
Tube	Red lead primer with state-of-the-art alkyd resin final coating
Base	System without red lead, oil-based primer, final coating based on alkyd resin, similar to tube
	Large counterweight on tube. Counterweight on hour axis. Filling similar to that of the counterweight on the hour axis.
	Lead-free anti-corrosion paint on red lead passes into alkyd resin system.
	System without red lead, oil-based primer, all coatings react positively to lead-containing filler materials; high decomposition of binder.

Could it not be so, perhaps, that there may be many traces that represent the age of the reflector telescope which, however, are concealed by the dominance of an intensively aged coating? Which historic information can the current condition of the paint still give us today?

The paint reflects the neglect of the instrument over the last decades. The flakes of paint brittling away can only give little detail on its true age, and it is not only the characteristics of ageing of the coating that give the reflector telescope its individual character.

Far more, the telescope is defined by its individual technical components and it becomes clearly visible that the authenticity of the instrument can be derived from the traces of its use. This brings up the question of how to handle the paint coating: What should it include and what is the expressive power of such a form of preservation? Let's have look to the following graphic.

Two approaches can be argued here:

- Preserving the instrument consists of renewing or patching up the paint coat from time to time. If this tradition were to be continued and renewal of the paint coat were to be considered it would be "... the acceptance of change as an essential parameter in the process", according to Jukka Jokile-

hto.⁹ In this case it should be evaluated as to what is an essential element of the object's "readability". If the object is mainly defined by its surface such intervention would hardly be justifiable.

- The uniqueness of the reflector telescope, however, is based on the technologically historic components as well as the conversions and additions. Therefore, a new paint coat would not impair the historical informational value of the instrument and ensure preservation of the instrument by acting as an anti-corrosion agent. This stands in contrast to preserving the wear marks on the coating as well as generally preserving all materials as required by the E.C.C.O.¹⁰ documents.

As the functionality of the telescope is being maintained it requires reliable protection from corrosion. This initial situation also advocates a new coating to preserve the telescope in the context of the tradition of its maintenance.

To sum up: a new coating to protect the instrument while preserving its traces of use could be the ideal compromise for both approaches.

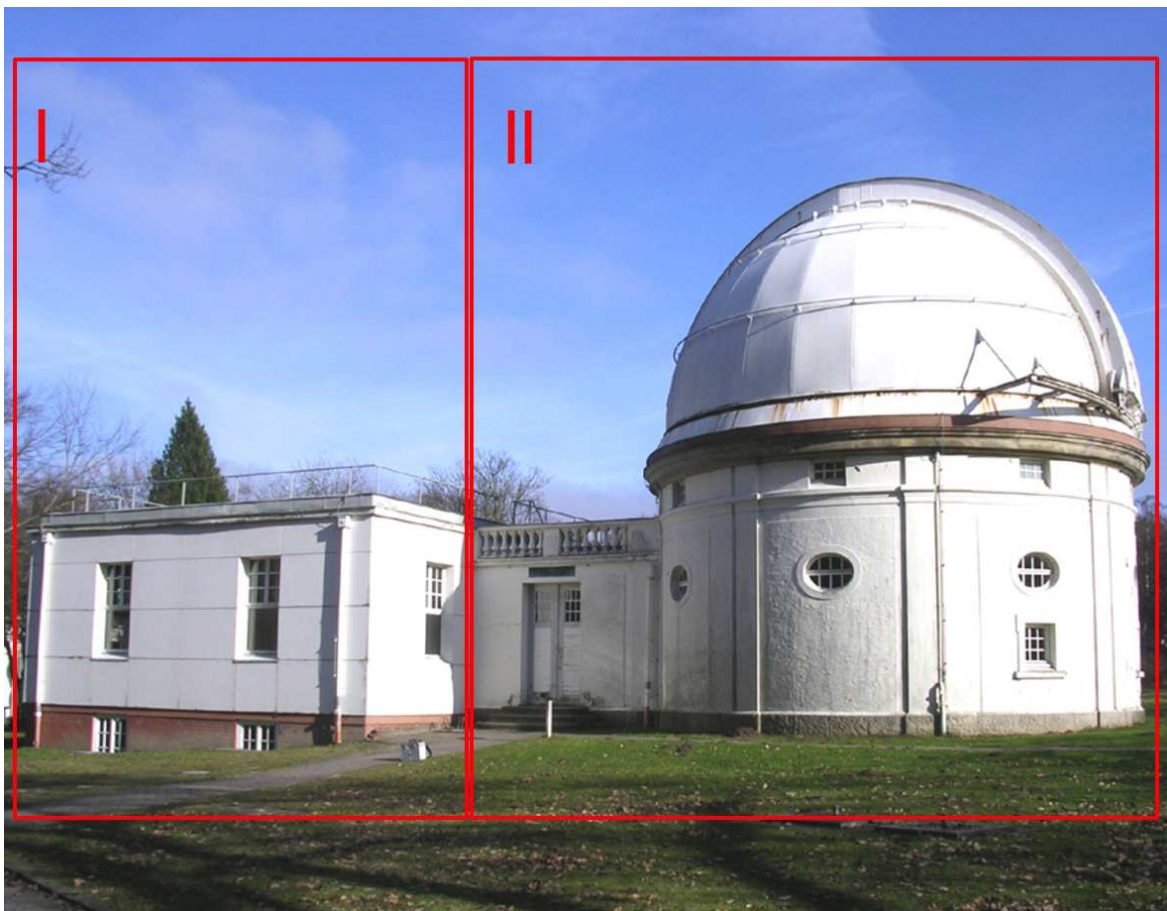
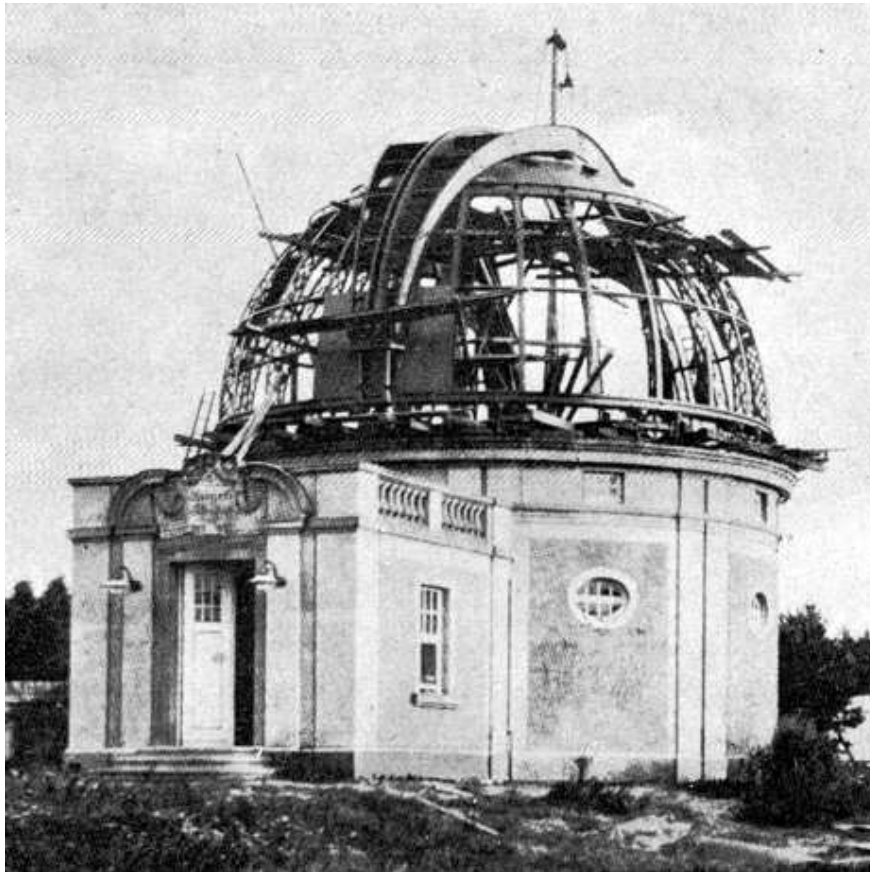


Figure 33.6: Current and historic photos of the 1 m reflector telescope building. Above: Dome with original entrance, 1909; Below: Recent photo of the building; (I: 1926 extension, II: Dome structure of 1909) (Above: Archives of Hamburg Observatory; Below: Beatrix Alscher)

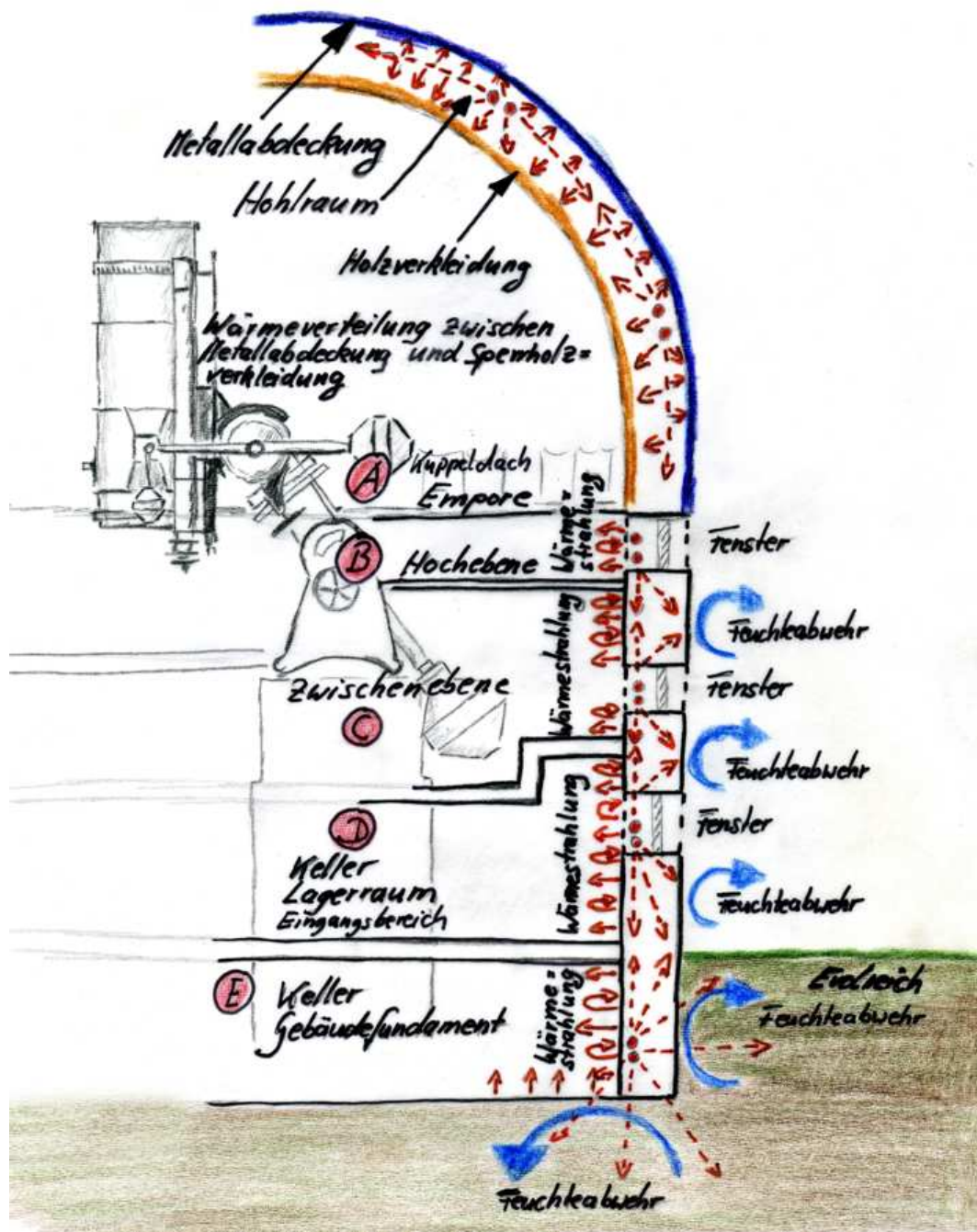


Figure 33.7: Sketch of wall tempering mechanism on the 1m reflector telescope structure (Skizze gefertigt an Anlehnung an Skizze bei Großschmidt 2004, S. 325.)

33.4 Conclusion

Finally, I would like to focus on the history of the instrument once again. Here (see Fig. 33.10 above) are two very early photographs of the device.

These recordings provide interesting background information and show us that the eyepiece was gold-painted at the guide refractors. There also were windows in the dome (see Fig. 33.10A) and the rollers of the dome guide were not lined (see Fig. 33.10B).

These questions, however, should not mislead you into thinking of a restoration that would return the current

instrument to such “brand new” condition. Far more it should make us envision how much history this reflector telescope has gained and how much more it still has to tell us today.

The main reflector of the telescope, manufactured in 1907 by Schott in Jena, in conjunction with the instrument, is capable of reflecting almost 100 years of history with its kinks, curbs and edges in the form of valuable traces of use, conversions and extensions.

The current condition of the 1m-reflector telescope by Zeiss, which was entered into service in 1911, is rare, if not unique. From a perspective of preservation, how-

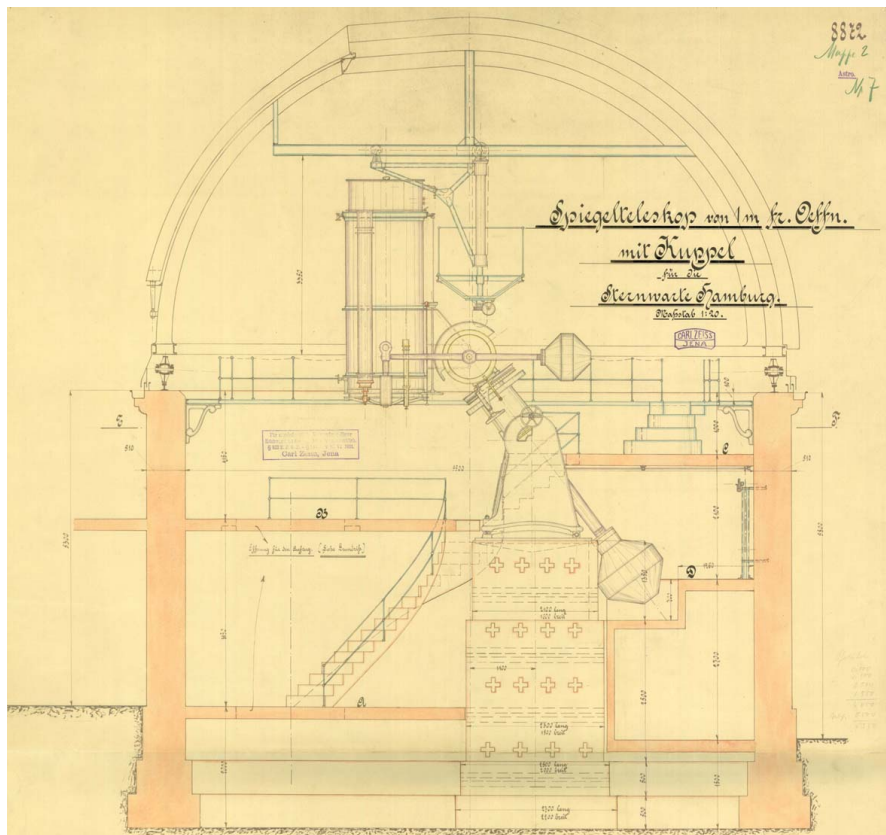


Figure 33.8: A view with one of the large counterweights and of the overall construction with counterweights, tube and large base. Above: View with one of the large counterweights; Below: Entire construction with counterweights, tube and large base (Above: Beatrix Alscher; Below: Archives of Hamburg Observatory)

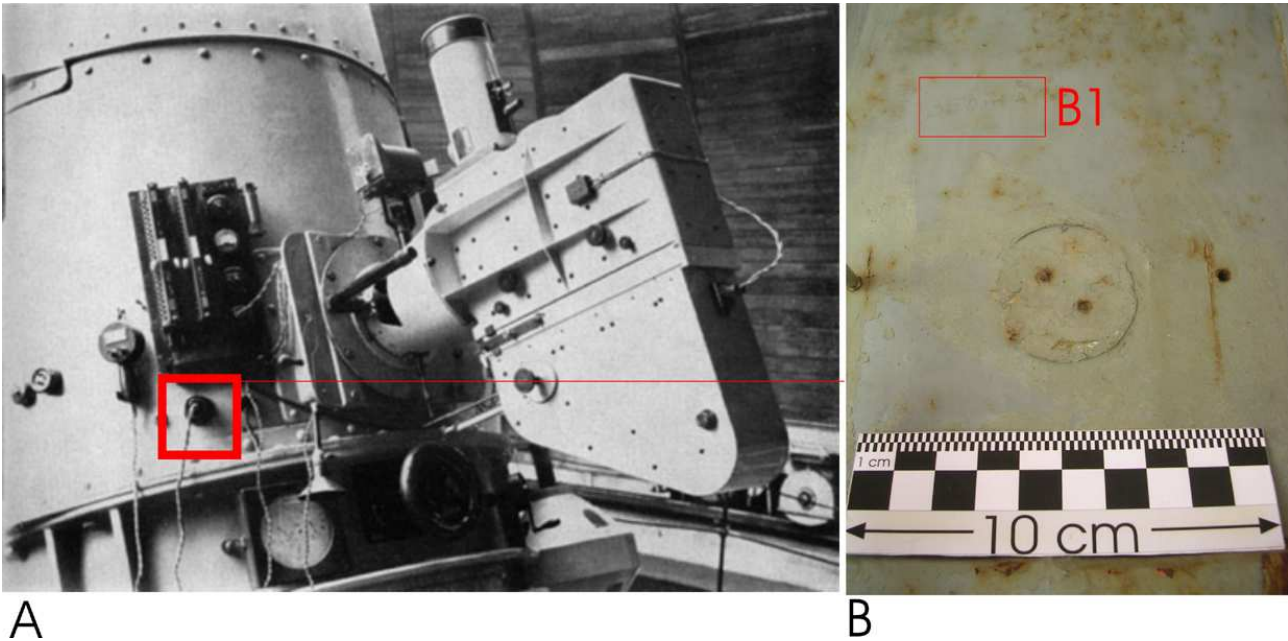


Figure 33.9: *Traces of use on tube surface A: Photograph with spectrograph, around 1953. B: The socket connection shown in picture A can still be found on the surface today. The writing in pencil can be found slightly above (B1): 350 mA (Photos: A: Mitteilungen der Hamburger Sternwarte in Bergedorf, Band 22, Nr. 237. Wellmann, Peter: Die spektrographische Einrichtung des Bergedorfer 1m-Spiegelteleskops. In: Zeitschrift für Astrophysik 33 (1953), Heft 2, S. 117, Abb. 2. B: Beatrix Alscher.)*

ever, this can only be considered an opportunity that should be put to use correctly.

33.5 Important Persons and Companies Explained

- Carl Zeiss (1816–1888): Mechanic and entrepreneur. Founder of company Carl Zeiss Jena, whose astrology department founded in 1987 built the 1 m-reflector telescope including the observation platform and dome construction. Further construction for the Hamburg Observatory in this time:
Lippert astrograph with dome construction
Dome and observation platform / elevator platform for the large refractor
- Otto Schott (1851–1935): Chemist and glass engineer. Founded the “Glastechnisches Laboratorium” together with Carl Zeiss and Ernst Abbe in 1884, later to become “Jenaer Glaswerk Schott & Genossen” – Schott AG.¹¹ Manufacturer of the main reflector and deflection mirrors of the 1 m-reflector telescope.
- Ernst Abbe (1840–1905): Physicist, optician and entrepreneur. Created the basics of modern optics together with Carl Zeiss and Otto Schott.
- Franz Meyer (1868–1933): Engineer at Carl Zeiss and developer of the load relief construction. Also involved in the construction of the Treptow refractor of 1896. First load relief construction at Carl

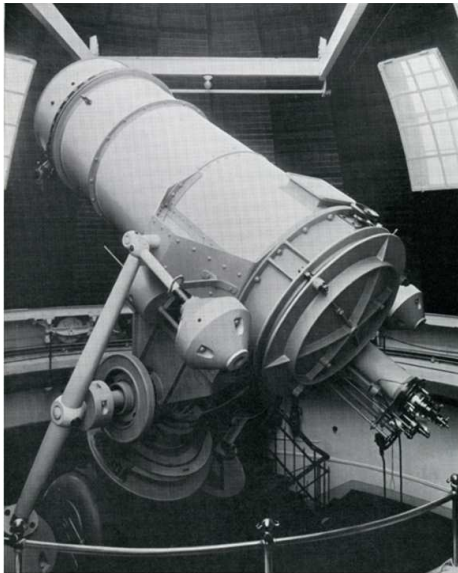
Zeiss was the reflector telescope for the Innsbruck Observatory in 1905.

- Walter Baade (1893–1960): Significant astronomer of the 19th century. Worked on the 1 m-reflector telescope from 1920 to 1930. His observing and scientific activities represented the most prominent research period of the reflector telescope.¹²

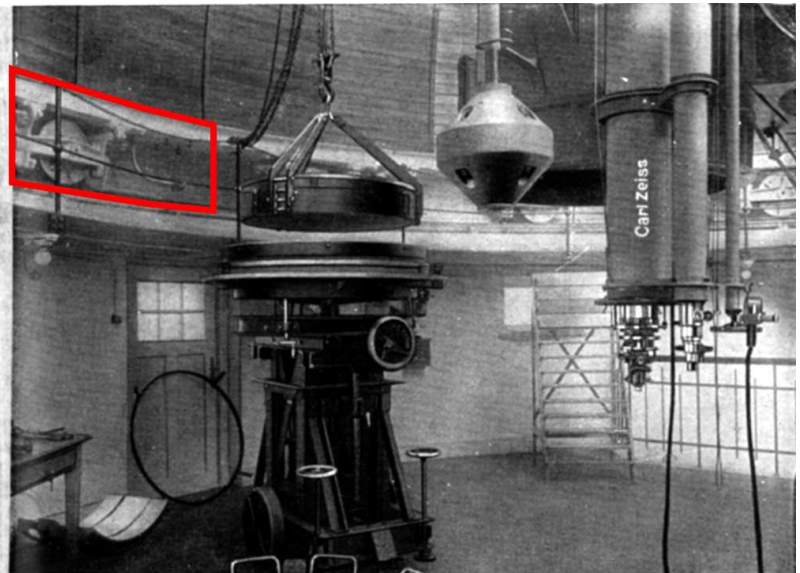
1. Breuninger et al. 2005, p. 2.
2. Cf. Sterne und Weltraum (2001), p. 78–83.
3. Hantschke et al. 1998, p. 182.
4. With friendly support of Prof. Dr. Christian Stadelmann, FHTW-Berlin.
5. Benjamin 1963, 15.
6. Huse 1996, 146.
7. Janis 2005, 22.
8. Janis 2005, 18.
9. Jokilehto 1999, 304.
10. European Confederation of Conservator-Restorers.
11. <http://de.wikipedia.org/wiki/Schott\AG>.
12. Heckmann 1976, p. 204–205.

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A



B

Coating Problem

Continue traditional maintenance:
New paint coat



Keep tradition of maintenance

Intervention for restoration:
Secure paint coat



Maintain testimony by material

Figure 33.10: Above: Historic photograph with dome panelling and dome wheel guide A: Historic photograph from the time when the dome still had lamellar structured wood panelling with integrated windows. The uncovered dome wheels are also visible. B: Historic photograph with uncovered dome wheel guides (highlighted by red box) Below: Coating Problem. (Photos: A: Jahresbericht der Hamurger Sternwarte 1913, S. 7. B: Carl Zeiss Katalog, 1933, p. 15, fig. 20.)

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