Martin Ledergerber

Endoscopy as an Investigative Method

Abstract Endoscopy is a non-destructive, straightforward, optical investigative method that permits one to examine changes inside brass instruments. This article describes the results of repeated endoscopic examinations of sixteen period brass instruments that were played regularly over several months. Moreover, endoscopic assessments were made of the effectiveness of preventive conservation measures that had been developed by researchers of the project and applied by musicians while the instruments were in use.

Introduction Endoscopy is one of three testing methods used in the interdisciplinary research project "Brass instruments of the 19th and early 20th centuries between long-term conservation and use in historically informed performance practice".[1] Historical brass instruments held in public and private collections that explicitly allow the use of their instruments were loaned to musicians to be played daily over a period of fourteen months. Endoscopically accessible parts of sixteen instruments were inspected before the start of the project, after seven months, and at the end of the project, and the findings were documented. These inspections aimed to show the extent of any changes to the internal surfaces or damage that might have occurred in historical brass instruments in regular use.

The aim was also to test the effectiveness of preventive conservation measures suggested in the research project, particularly active drying. To this end, half of the instruments were dealt with in accordance with a preventive conservation protocol, while the remaining served as a control group and were maintained by the musicians in line with common practice.[2]

Method Different types of endoscopic device are used in non-destructive optical examination methods. Those with non-medical applications are called borescopes. The sixteen brass instruments were inspected using a rigid borescope with a viewing angle of 30° and a depth-of-field of 10–15 mm.[3] To document our findings and observations, the borescope was connected to a digital camera, which captured the images in manual mode in order to ensure identical camera settings and image comparability. Endoscopy was

1 See www.hkb-interpretation.ch/projekete/korrosion (last consulted 22 October 2022).

2 See the article by Martin Ledergerber/Emilie Cornet/Erwin Hildbrand in this volume, pp. 48–60.

3 Rigid borescope with cold light projector n° 81482 (Karl Storz GmbH & Co. KG, Tuttlingen, Germany), kindly provided by the Basel Historical Museum.

DOI: 10.26045/kp64-6179-008

one of three different methods used to examine thirty tuning and valve slides from sixteen instruments (5 trumpets, 8 horns, 1 trombone, 1 Wagner tuba, 1 tuba).[4] By means of a rigid borescope, it was possible to conduct a visual inspection of both openings in thirty tuning and valve slides; sixty areas were thus inspected in total. On average, the length of each inspected section was 83 mm, depending on the length of the straight section accessible to the rigid borescope. Starting at the tube opening, an image was taken every 5 mm, with the lens always directed towards the outside wall.

To establish whether any changes occurred in the instruments, and if so, to what extent, all 60 areas were inspected before and after the project and also at the midway stage. This permitted the comparison of identical areas in their initial, intermediate, and final states. At the evaluation stage, some 3,300 borescope images were compared visually. Depending on the changes observed, they were classified into three categories:

– *no change*: no changes were visible in surface texture or appearance;
– *slight change*: slight changes were visible in surface texture and appearance; existing deposits had increased slightly and expanded; random new and localised deposits were visible;
– *significant change*: significant changes were visible in surface texture or appearance; the surface area of existing deposits had increased greatly or significant change was apparent in them; new deposits were present across wide areas. Figures 1–3 show examples of these three categories.

Results The endoscopy confirmed that the initial state inside the tuning slides varies greatly, depending on the history of each instrument. Recently cleaned instruments, for example, showed almost blank inner walls with only a thin and homogeneous layer of copper oxides, whereas other instruments in their initial states presented signs of heavy, irregular corrosion. A large variety of deposits and surface textures was observed inside the different tuning slides, and even in different sections inside the same tuning slide.

During the course of the project, the instruments were played an average of 275 times, for around 6.19 minutes. The average total playing time for each instrument was 28.3 hours. Figure 4 shows changes observed through use, as determined using the method described. In the group of instruments that were actively dried after use, in accordance with the preventive conservation protocol (black), there was only one instance of obvious change in the tuning slides inspected. In the group of instruments that were maintained in accordance with common practice, and which were not actively dried (grey),

4 See the articles by David Mannes/Eberhard Lehmann and Bernhard Elsener et al. in this volume, pp. 83–91 and 61–72.

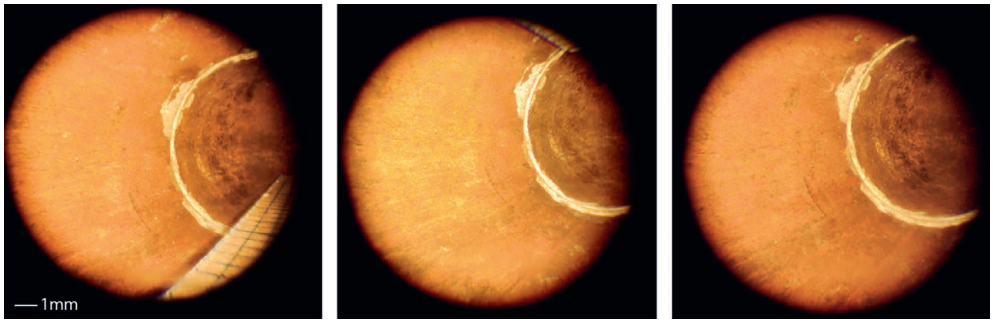

Figure 1 Endoscopic image of a tuning slide (horn B098) showing no change (from left to right: initial state; intermediate state after 991 minutes of being played; final state after 1,978 minutes)

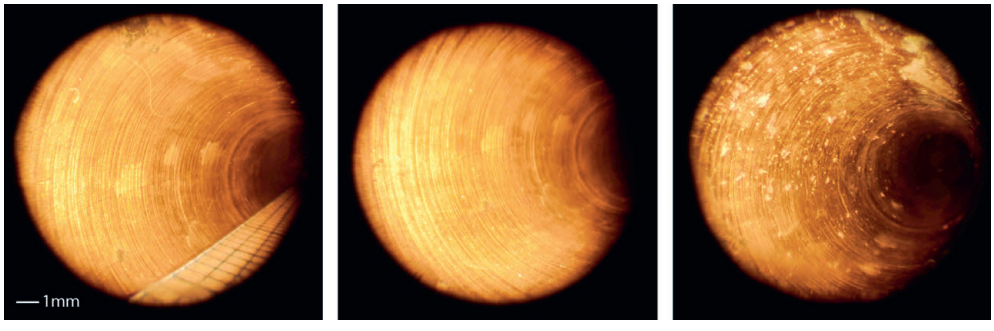

Figure 2 Endoscopic image of a tuning slide (trumpet HKB 5027.1_B) in which slight changes have occurred during use (from left to right: initial state; intermediate state after 961 minutes of being played; final state after 1,893 minutes). Whitish spots have appeared.

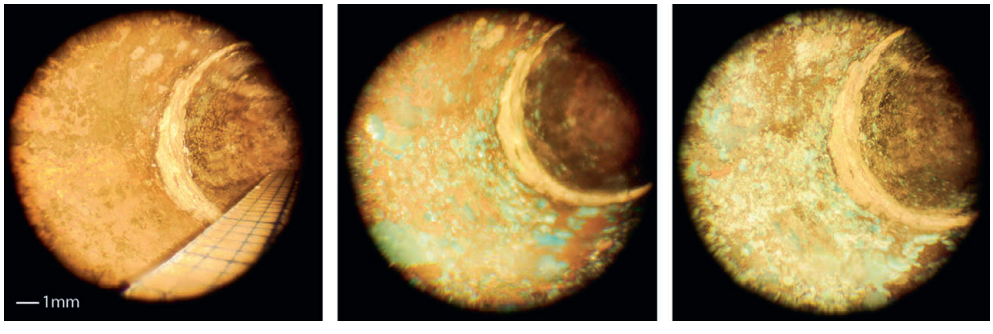

Figure 3 Endoscopic image of a tuning slide (trumpet B088.1_B) with significant changes (from left to right: initial state; intermediate state after 1,054 minutes of being played; final state after 2,014 minutes). In this example, green and white deposits have formed over time across almost the entire surface. The green deposits are a clear sign of copper corrosion. Part of the brass, though a small amount, has thus been converted from metal into corrosion products during the period of use. This conversion has led to a loss of original substance.

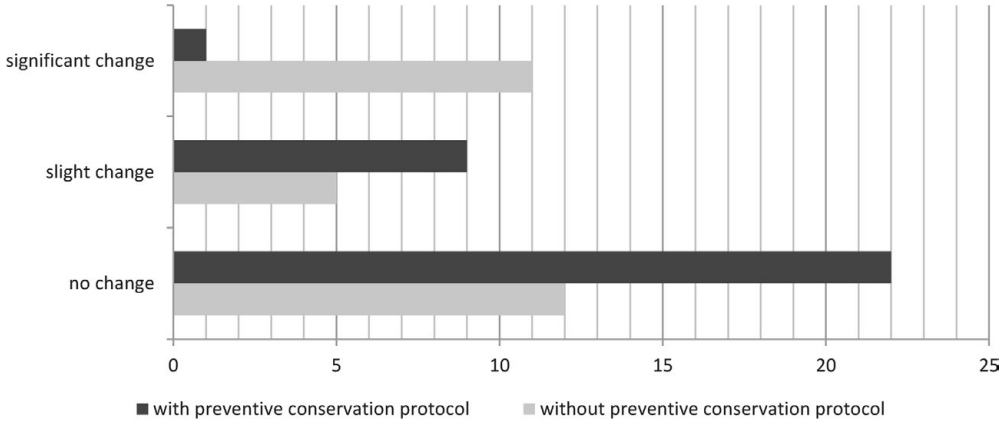

FIGURE 4 Diagram illustrating the frequency and extent of changes inside the tuning slides inspected, as a result of use. The frequency of cases in each category is broken down according to different types of use.

11 instances of obvious change were observed. In the instruments that were actively dried, there were 9 instances of slight change, and 22 instances in which no changes were observed. In contrast, in the instruments that were not actively dried, 5 instances of slight change were observed, and there were 12 instances in which no change was observed.

Conclusions Endoscopy is a method suitable for examining the internal areas of brass instruments. As it is a visual method of inspection, findings are directly observable and accessible. Moreover, an endoscopic examination can be reliably repeated; this means changes happening over time can be documented in photographs.

The use of a rigid borescope is limited to the parts of the instrument with straight access. It is therefore important to point out that the endoscopic examination in this project detected only part of the internal surface of the tuning slides in each instrument. The area under investigation does not necessarily represent the condition of the remaining areas within the instruments which were not accessible to the borescope.

Inside period brass instruments that are played regularly, corrosion can be observed in many cases. Only in a total of three instruments were no changes observed in any of the tuning slides. In all other instruments, we observed areas inside the tuning slides that showed slight or even significant changes.

Whether corrosion develops or not obviously also depends on the initial state of the instrument. It appears that existing corrosion can have a protective function. Overall, the endoscopy shows that there are fewer changes to the tuning slides of the instruments that have been maintained according to the preventive conservation protocol. Our investigation has shown that changes in the interior of regularly played period brass instruments

outside a museum context cannot always be prevented by active drying. However, the frequency and extent of the changes can be reduced significantly by means of the preventive conservation method presented in this project.

Content

To Play or Not to Play

Corrosion of Historic Brass Instruments

Romantic Brass Symposium 4 • Edited by Adrian von Steiger, Daniel Allenbach and Martin Skamletz

Musikforschung der
Hochschule der Künste Bern
Edited by Martin Skamletz
and Thomas Gartmann
Volume 15

Dieses Buch ist in gedruckter Form im Januar 2023 in erster Auflage in der Edition Argus in Schliengen/Markgräflerland erschienen. Gestaltet und gesetzt wurde es im Verlag aus der *Seria* und der *SeriaSans*, die von Martin Majoor im Jahre 2000 gezeichnet wurden. Gedruckt wurde es auf Eos, einem holzfreien, säurefreien, chlorfreien und alterungsbeständigen Werkdruckpapier der Papierfabrik Salzer im niederösterreichischen Sankt Pölten. Das Vorsatzpapier *Caribic cherry* wurde von Igepa in Hamburg geliefert. *Rives Tradition*, ein Recyclingpapier mit leichter Filznarbung, das für den Bezug des Umschlags verwendet wurde, stellt die Papierfabrik Arjo Wiggins in Issy-les-Moulineaux bei Paris her. Das Kapitalband mit rotschwarzer Raupe lieferte die Firma Dr. Günther Kast aus Sonthofen im Oberallgäu, die auf technische Gewebe und Spezialfasererzeugnisse spezialisiert ist. Gedruckt und gebunden wurde das Buch von der Firma Bookstation im bayerischen Anzing. Im Internet finden Sie Informationen über das gesamte Verlagsprogramm unter www.editionargus.de, zum Institut Interpretation der Hochschule der Künste Bern unter www.hkb.bfh.ch/interpretation und www.hkb-interpretation.ch. Die Deutsche Nationalbibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliografie; detaillierte bibliografische Daten sind im Internet über www.dnb.de abrufbar.
DOI 10.26045/kp64-6179 ISSN 2700-8681 ISBN 978-3-931264-95-6