

## Media release

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### **A renaissance for historic brass instruments**

## **Materials science meets the world of music**

**On June 10<sup>th</sup> a rather unusual Science Apéro took place at the Empa Academy. Instead of focusing on cutting edge technology, as is usually the case, it dealt with culture and history. In the course of a CTI project, Empa scientists have analyzed historical brass instruments in order to discover what materials were used in their manufacture and how exactly they were made. Musical works from the 19th century sound different on today's instruments, so exact replicas of the original instruments can help «conserve» the historic tones.**

It doesn't often happen that an event at Empa begins with music from the Romantic era. Markus Wuersch, Professor of Trumpet at the Bern University of the Arts (BUA), and his students offered the audience a musical selection from a three-year CTI project, played on trumpets which replicate historical instruments from the second half of the 19th century and were manufactured by the project industrial partner, Blechblas-Instrumentenbau Egger, Basel.

In order to be able to accurately replicate brass instruments which are over a century old, one needs to know the processes and techniques used by the old masters – a subject for art historians. According to Adrian von Steiger, the Project Leader and a music scientist at the BUA, this information can be gleaned from the few remaining manufacturers' workshops, and from pictures and competition records. But this kind of source research did not satisfy the initiators of the project, since the same manufacturing method can produce different results depending on what materials are used in the construction of an instrument. At this point Empa joins the story.

### **Modern analytical methods serving history**

Coordinated by Empa metallurgist Marianne Senn, researchers from Empa, the Paul Scherrer Institute (PSI) and the Materials Technology Institute (IWT), analyzed over 40 French brass instruments from the romantic period using a technique known as energy dispersive x-ray fluorescence (ED-XRF). This analytical method allows scientists to detect and quantify the presence of elements from magnesium to uranium. Furthermore, because it is a non-destructive process which can be carried out using mobile equipment, ED-XRF is very well

suited to this purpose, as historical instruments are usually to be found in collections and museums which, of course, do not readily hand them out to anybody – not even researchers.

The analyses showed that the alloys from which the old instruments were made contained lead, an element which is no longer used in making modern instruments. On the other hand the zinc content in the old alloys was lower than in today's metals. The work of the analysis team, however, did not stop there. In order to study the historical manufacturing methods in more detail, two horns which were in a poor state of repair were sacrificed for metallographic investigation.

But how can a microscopic view of a metal sample reveal to us much about the techniques used by the old masters? "Every process applied to the metal leaves its mark", says Marianne Senn. The archaeological metallurgist specializes in investigating the composition and treatment of old metal samples. The size, shape and orientation of the grains in the metal, as well as other structures such as sulphur inclusions or grain boundaries, provide clues as to what happened to the metal in the past. With the help of metallographic investigations, hardness measurements and techniques such as electron backscatter diffraction analysis (EBSD), Marianne Senn and her team were able to compare historical samples with replicas manufactured by the Egger Company. This enabled them to determine, for example, at what temperature the materials were annealed and how they were shaped.

### **A wide tonal range**

The emphasis of the project lay in the implementation of the results. The next step after the analytical investigation was therefore the practical application of the experimental findings. An Asian sheet metal manufacturer supplied material with the same composition as the "historical" samples. The suitability of this material was confirmed by innumerable metallographic, chemical and mechanical tests, following which the workshop of the Egger Company was given the go-ahead to begin constructing the replica instruments.

This was not an easy task, since lead-containing brass cracks more easily than modern alloys and has different soldering characteristics too. But the hard work has paid off, says Rainer Egger. "The difference in playing characteristics and tonal quality is greater than we expected." The metallurgical properties of the historic brass used make the tone of the replicas a little louder but richer in harmonic's, which means that they are particularly suitable for playing music from the Romantic era, for which modern trumpets often have too harsh a sound. "In concert the tone is more colourful," according to Egger. This is already been demonstrated by the Symphony Orchestra of Biel, which has used the replica instruments. There has been no lack of interest from musicians either, and in the right circumstances the tonal qualities of the historical brass also make it suitable for use in modern instruments.

### **Potential not yet exhausted**

Now that these tonal differences have been confirmed both by musicians and initial acoustic investigations, the scientists plan to launch another project with the Egger Company in which the tonal differences are to be acoustically studied in detail, with the aim of revealing the link between materials and playing characteristics. "This is not a question of authenticity," says project leader von Steiger, "but rather an understanding of the music and historical playing methods." Egger also believes the project offers great opportunities. "In our business there are no large budgets available for research and development. These kinds of research projects offer a valuable opportunity to deepen our knowledge of the relationship between the original instruments and their replicas."

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### **Literature**

Project website:

<http://www.hkb.bfh.ch/de/forschung/forschungsschwerpunkte/bspinterpretation/historischinformierterblechblas/>

### **Further information**

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Speakers at the Science Apéro: Adrian von Steiger, Rainer Egger, Markus Wuersch und Marianne Senn (l-to-r)



Markus Wuersch and his students playing the replica trumpets made in the course of the project



«Just like the original»: a replica of an early 19th century demi-lune trumpet

The images can be downloaded from [www.empa.ch/bilder/2013-06-27-MM-WA-Blechblasinstrumente](http://www.empa.ch/bilder/2013-06-27-MM-WA-Blechblasinstrumente)