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"Practice-Oriented Research". Fifteen Years of Brass Projects at the Hochschule der Künste Bern

When the Hochschule der Künste Bern HKB initially embarked on research in the middle of the first decade of the twenty-first century, no one could have foreseen that research into historical brass instruments would prove particularly successful in the long term, nor that this would soon develop into a whole series of research projects that would continue to this day. The brief retrospective that we offer here can only provide an interim snapshot, given that activities in this field remain ongoing. We shall trace the development of this project series, explain its results and its accompanying activities, and hope thereby to provide insights into the specific framework on which it is based and that has itself influenced the overall conception of the series.

New organisational forms and their legal foundations Research is a relatively recent phenomenon at universities of art, and especially at universities of music. In Switzerland, the rise of research at these institutions is closely related to a transformation that took place at the turn of the new millennium, when the traditional conservatories were made departments of the newly established universities of applied sciences and arts.[1] The Swiss music conservatories had previously been devoted mostly to instrumental and vocal teaching and had been financed by the cantons, but the *Fachhochschulgesetz* (FHSG, "Law on Universities of Applied Sciences") that came into force in 1996 meant that they were no longer to provide exclusively artistic training, but were instead obliged to fulfil a 'fourfold performance mandate'. This meant that they had to engage in "practice-oriented research and development"[2] in addition to teaching, further training and services. The

1 For the history of the Swiss universities of applied sciences and arts, see Hans-Kaspar von Matt: *Die Schweizerischen Fachhochschulen: eine Biografie. Geschichte und Geschichten über die Bildung eines neuen Hochschultypus*, Bielefeld 2022.

2 The German original runs "anwendungsorientierte Forschungs- und Entwicklungsarbeiten", *Fachhochschulgesetz* FHSG *vom 6. Oktober 1995 (Stand am 1. Januar 2013)*, art. 3, para. 3, www.admin.ch/opc/de/classified-compilation/19950279/201301010000/414.71.pdf (all URLs in this text last accessed 28 July 2022). "Den FH wird somit eine Aufgabe übertragen, die für einige unter ihnen neu ist: die Forschung." ("The universities of applied sciences are thus given a task that is new to some of them: research.") *Aktion* DORE *– Kompetenzförderung in anwendungsorientierter Forschung an den kantonalen Fachhochschulen, Tätigkeitsbericht vom 19. August 1999 bis zum 31. Dezember 2001*, Bern 2002, p. 6. The FHSG was replaced on 1 January 2015 by the "Hochschulförderungs- und -koordinationsgesetz" (HFKG, "Law for the promotion and coordination of the universities") of 30 September 2011, which came into force on

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ment was subjected to public appraisal in November 2018 – in line with the practice established since the beginning of our series of projects – in a concert[44] at the fifth Romantic Brass Symposium.[45] Ian Bousfield played the *Concertino* by Ferdinand David, accompanied by the Sinfonie Orchester Biel Solothurn conducted by Kaspar Zehnder. Since the beginning of the project series, HKB students had also steadily become more involved. The HKB trombone class attended a full, intensive week on research into brass instruments at the time of the symposium, and they joined their professor in the final orchestral chorale of the David *Concertino* (see the music example below).

MUSIC EXAMPLE Ferdinand David: *Concertino for trombone and orchestra* Op. 4, bars 340–343: solo part with the first entrance of the trombone chorale towards the end of the work (reduced scoring, extracted here from the printed parts, Leipzig: Kistner, circa 1838)

What was new about this project was how it investigated aspects of instrumental sound using empirical methods, in collaboration with a research unit of the Swiss Federal Laboratories for Materials Science and Technology Empa under the direction of Armin Zemp (this was also what prompted the name of the project, namely "The Sound of Brass", which otherwise might seem at first somewhat unprepossessing). This meant that even hitherto sacred cows were subjected to analysis, such as the shibboleth that the material of a brass instrument allegedly has a negligeable influence on its acoustic properties.[46]

There is another new thematic area in our research on brass instruments that has thus far been explored in a preparatory project funded by BFH itself, but which has not

44 www.hkb-interpretation.ch/tromboniade.

45 "The Sound of Brass. Fifth International Romantic Brass Symposium" (20–22 November 2018), www.hkb-interpretation.ch/romanticbrass5. Proceedings in preparation.

46 Armin Zemp/Gwenael Hannema/Bart Van Damme/Adrian von Steiger/Martin Skamletz/Rainer Egger: Determination of Vibro-Acoustic Properties of Brass Instruments, in: *Historic Brass Society Journal* 31 (2019), pp. 77–91.

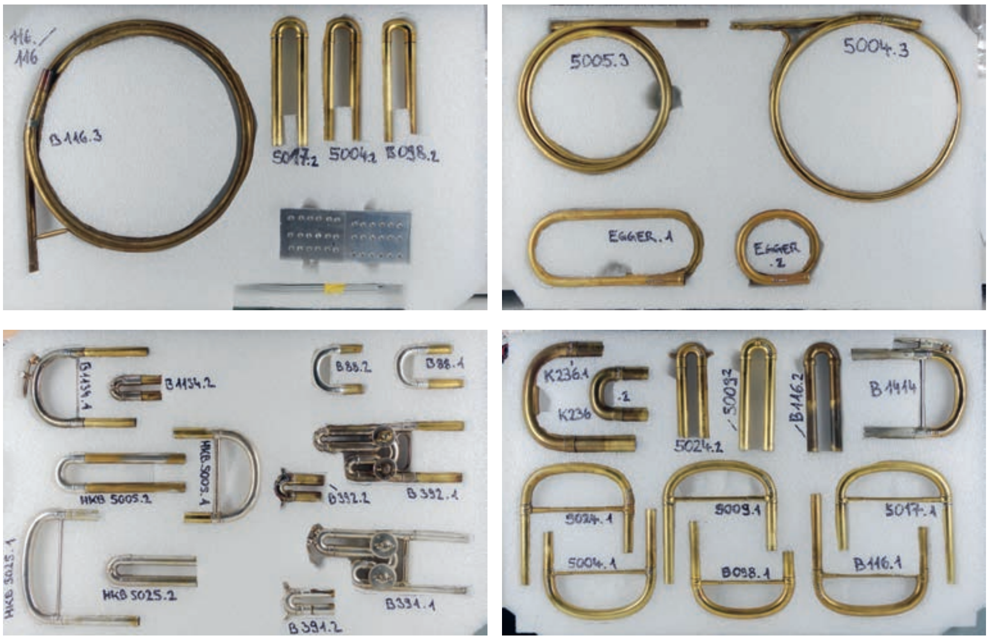


FIGURE 2 The 34 parts of the 16 instruments examined in detail before, at the project's mid-point, and at the end of the long-term study

FIGURES 3 AND 4 The *tuba français à 6 pistons*, made before 1920 by J. Gras in Paris; and its valve slide of the first valve

Figure 1 Test set-up using small brass plates to assess the corrosiveness of different oils and greases

Figure 2 Test arrangement using data loggers for climate testing on a trumpet

In a first phase, we tested the interior climatic changes generated by playing on modern brass instruments. Then, after determining the test parameters, we carried out systematic climate measurements on all 16 instruments involved in the project (5 trumpets, 8 horns, 1 trombone, 1 Wagner tuba, 1 tuba). Relying on a wide scope of instruments ensured that the insights gained were valid for different instrument types featuring varying tube lengths and diameters, and thus diverse forms and volumes.

The test series showed that the climatic effects caused by playing are comparable for all instrument types we examined.[12] Figure 3 shows a typical curve progression during playing. Within the first minutes of playing, the humidity scores within the instruments

and between 0 and 100 % relative humidity, with an accuracy of ±2 % (MSR Electronics GmbH, Mettlenstrasse 6, 8472 Seuzach, Switzerland, www.msr.ch).

12 Emilie Cornet: *Approches pour la conservation préventive des instruments de musique en cuivre de la collection Burri à Berne*, unpublished report, Swiss National Museum, Affoltern am Albis 2013, pp. 6–9.

Corrosion basics In general, copper and brass alloys are quite resistant to atmospheric corrosion due to the formation of protective layers of corrosion products, which greatly reduce the rate of attack.[9] If we wish to monitor the efficiency of a preventive action to reduce corrosion, electrochemical measurements are best suited to determining the corrosion state and the instantaneous corrosion rate of an alloy in a given environment.

Rather like a battery, corrosion reactions are redox reactions composed of oxidation (anode) and a reduction reaction (cathode):

Oxidation: $2\,Zn \rightarrow 2\,Zn^{2+} + 4\,e^-$ (1a)

Reduction: $O_2 + 2\,H_2O + 4\,e^- \rightarrow 4\,OH^-$ (1b)

The electrons released at the anode have to be consumed immediately by the cathodic reaction to maintain electro-neutrality, thus the anodic dissolution current and the cathodic current must be equal (Figure 1) and correspond to the corrosion current.

Of the information contained in Figure 1, only the corrosion potential ϵ_{corr} can be measured experimentally. The corresponding corrosion current density i_{corr} flowing in the system is short-circuited, thus the current measured from external $I = 0$. However, i_{corr} can be indirectly determined by measuring the polarisation resistance Rp, the inverse of the current versus potential curve close to the corrosion potential ϵ_{corr} (insert in Figure 1).

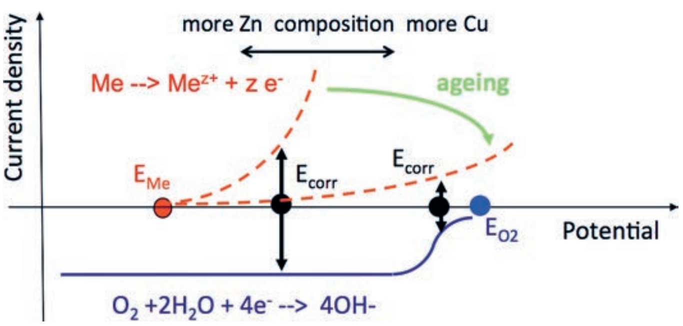


FIGURE 1 Schematic current density – potential curves for brass in neutral solutions. With time of immersion (ageing) the corrosion rate decreases and ϵ_{corr} moves to more positive potentials. ϵ_{corr} establishes at the point of electro-neutrality.

From the measured polarisation resistance Rp, the corrosion current density i_{corr} can be calculated with the Stern-Geary relation[10] that holds for uniform corrosion.

$i_{corr} = B/Rp$ (2)

The constant B in equation (2) depends on the specific system under test; a value of 26 mV for B has been assumed in this work.

9 Mattsson/Holm: Atmospheric Corrosion of Copper and Its Alloys.

10 Revie/Uhlig: *Corrosion and Corrosion Control*, pp. 53–82.

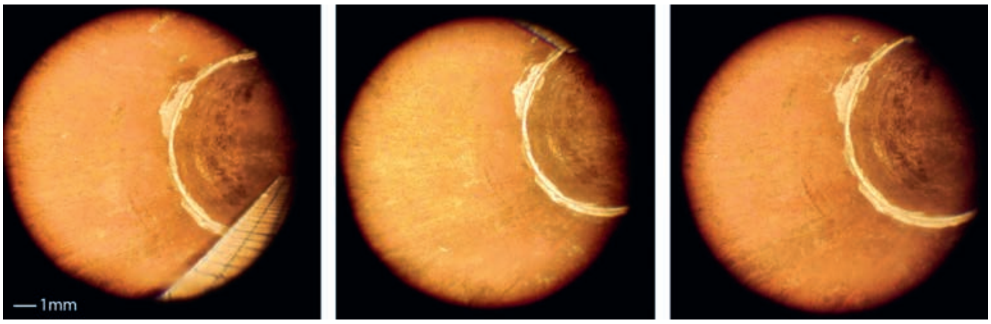


Figure 1 Endoscopic image of a tuning slide (horn B098) showing no change (from left to right: initial state; intermediate state after 991 minutes of being played; final state after 1,978 minutes)

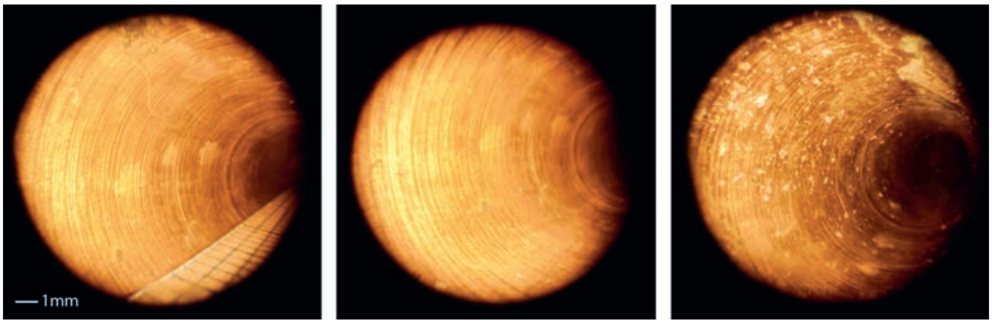


Figure 2 Endoscopic image of a tuning slide (trumpet HKB 5027.1_B) in which slight changes have occurred during use (from left to right: initial state; intermediate state after 961 minutes of being played; final state after 1,893 minutes). Whitish spots have appeared.

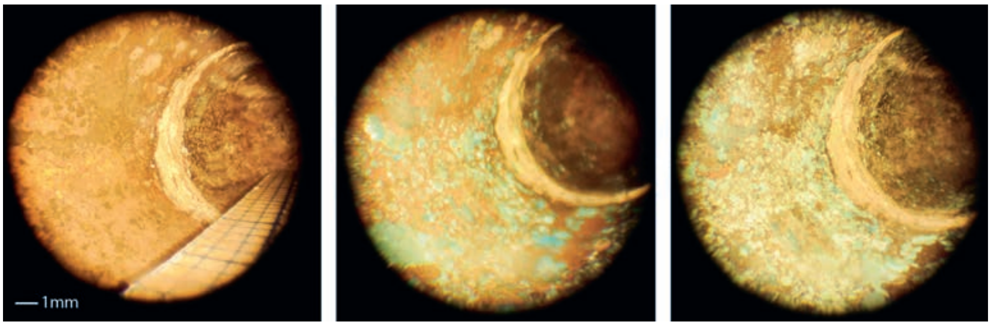


Figure 3 Endoscopic image of a tuning slide (trumpet B088.1_B) with significant changes (from left to right: initial state; intermediate state after 1,054 minutes of being played; final state after 2,014 minutes). In this example, green and white deposits have formed over time across almost the entire 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 1 Les Adolescentes in *Le Sacre du Printemps* (Photo Gerschel, in: *Le Théâtre*, 1 July 1913, p. 20)

LES SYLPHIDES

Rêverie romantique en un acte de M. Michel FOKINE

Musique de CHOPIN

LE SACRE DU PRINTEMPS

Tableaux de la Russie païenne en 2 actes, de Igor STRAWINSKY et Nicolas RŒRICH

Musique de Igor STRAWINSKY

Chorégraphie de NIJINSKY

Décors et Costumes de Nicolas RŒRICH

LE SPECTRE DE LA ROSE

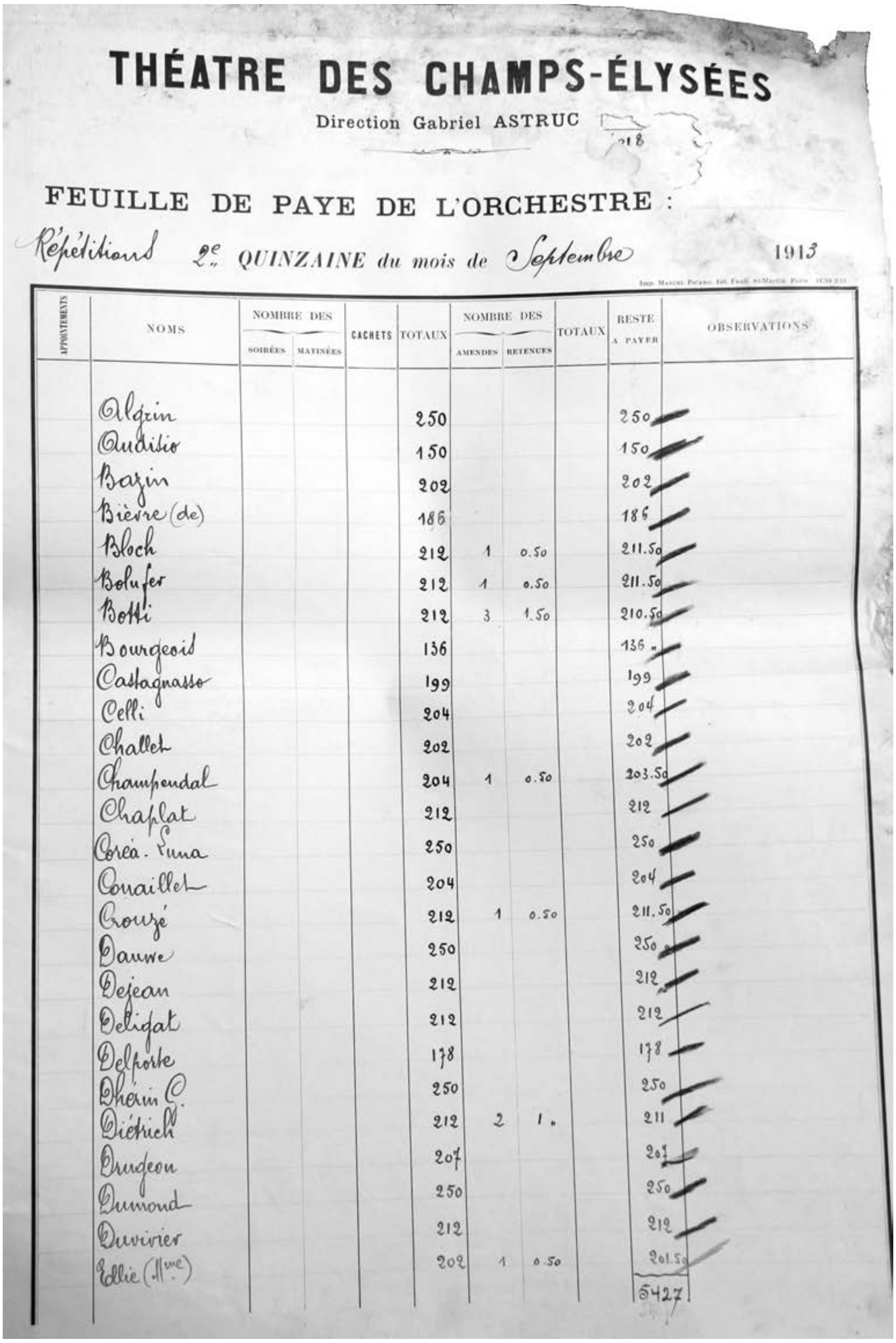
Tableau Chorégraphique, Poème de Th. GAUTIER

Danses Polovtsiennes du "Prince Igor"

Musique de BORODINE

Danses composées et réglées par M. FOKINE

Figure 2 Programme (clippings) of the *Sacre* premiere, 29 May 1913



THÉATRE DES CHAMPS-ÉLYSÉES

Direction Gabriel ASTRUC [illegible]

FEUILLE DE PAYE DE L'ORCHESTRE :

Répétitions 2e QUINZAINE du mois de Septembre 1913

Appointements	Noms	Nombre des soirées	Nombre des matinées	Cachets	Totaux	Nombre des amendes	Nombre des retenues	Totaux	Reste à payer	Observations
	Algrin				250				250	
	Audibio				150				150	
	Bazin				202				202	
	Bièvre (de)				186				186	
	Bloch				212	1	0.50		211.50	
	Bolufer				212	1	0.50		211.50	
	Botti				212	3	1.50		210.50	
	Bourgeois				136				136 »	
	Castagnasso				199				199	
	Celli				204				204	
	Challet				202				202	
	Champendal				204	1	0.50		203.50	
	Chaplat				212				212	
	Coréa. Luna				250				250	
	Couaillet				204				204	
	Crouzé				212	1	0.50		211.50	
	Dauwe				250				250	
	Dejean				212				212	
	Delidat				212				212	
	Delporte				178				178	
	Dhérin G.				250				250	
	Dietrich				212	2	1.		211	
	Drugeon				207				207	
	Dumond				250				250	
	Duvivier				212				212	
	Ellie (Mme)				202	1	0.50		201.50	
									5427	

Figure 4 First page and excerpt from the last page ("supplémentaires") of the payrolls of September 1913 for the Théâtre des Champs-Élysées (Archives Nationales, Fonds Gabriel Astruc, shelfmark 409 AP39)

Figure 4 Ferrule on Kodisch trumpet (below) and a new ferrule made for the copy (top; photo courtesy of Scott Clements)

Figure 5 Engraving of the garland of the Kodisch copy; the supporting plaster of Paris is still in place (photo courtesy of Scott Clements)

Figure 6 The old and the new Kodisch instruments side by side (photo courtesy of Scott Clements)

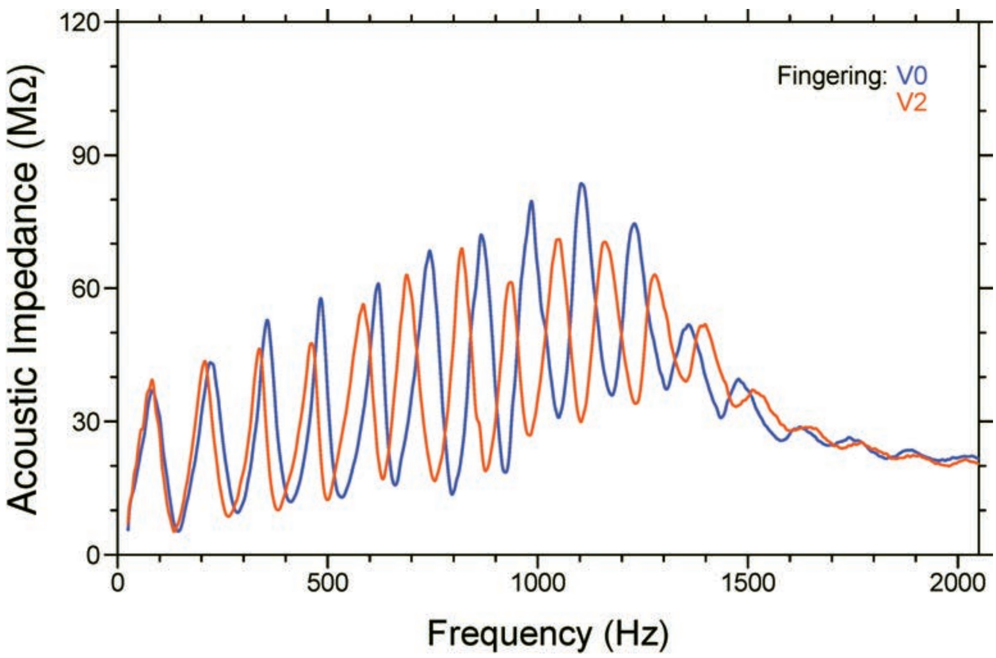


FIGURE 5 Input impedance of the 4½-foot B♭ trumpet (or 'posthorn') by Joseph Lathrop Allen (NMM 7061). The blue curve illustrates the acoustical behaviour of the instrument without valves, while the red curve was measured with the second valve depressed.

FIGURE 6 Trumpet in 4½-foot B♭ by Joseph Lathrop Allen, Norwich, Connecticut, between 1846 and 1849 (NMM 7061)