Historical Scientific Instruments in Contemporary Education

Scientific Instruments and Collections

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Edited by

Elizabeth Cavicchi
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Cover illustration: School group experimenting at the Lorentz Lab of Teylers Museum in Haarlem, The Netherlands, Courtesy of Teylers Museum.

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Foreword

In the last twelve years, nine volumes of the *Scientific Instruments and Collections* series have appeared. They include contributions by over ninety different authors working as university scholars, museum directors, collection managers, curators, restorers, collectors, antiquarians and, with this volume, science and mathematics educators.

Over such a time interval, several changes have occurred. Sadly, a few authors have passed away, and I wish to recall Inge Keil, Inga Elmqvist Söderlund and James Caplan. On the positive side, *Scientific Instruments and Collections* has been transformed from a branch of the *History of Science and Medicine Library* into an independent series. I therefore would like to thank Stefan Einarson and Rosanna Woensdregt of Brill for the trust accorded to the Scientific Instrument Commission (SIC) of the International Union of History and Philosophy of Science and Technology (IUHPST), the volumes editors and authors, the series editorial board and myself. We always try to publish only the most recent research on ancient and historical scientific instruments.

The present volume is, in fact, the first book completely dedicated to the use of historical scientific instruments in educational activities for primary and secondary schools, colleges and universities, museums, exhibitions and cultural festivals. As Elizabeth Cavicchi and Peter Heering specify in the *Introduction*, there is no intention to systematise every aspect of the topic. The volume presents selected papers from annual SIC meetings, and the authors represent nine countries (Belgium, Estonia, France, Germany, Greece, Italy, Switzerland, The Netherlands and the USA) and about twenty institutions. Nevertheless, the educational initiatives expounded upon in the following pages outline a vast array of combinations between historical scientific instruments, educators, students and the general public. The connecting live-wire is the conviction that historical apparatus facilitates the understanding of those scientific principles which usually disappear within the "black boxes" of today's laboratories.

Among the collection of examples to adopt and adapt to any exigencies, the readers might, however, find too much. In some cases, an educational activity presented as regular practice by an author cannot be identically replicated elsewhere. The public use of historical scientific instruments is limited by the law of some countries and the internal protocols of different institutions. Such limits are only partially emphasised in the volume chapters, and require a few words of caution.

Firstly, the law and safety protocols might regulate – limit or forbid – the public use of some objects (especially those with sharp parts), dangerous substances (for example: mercury, asbestos and other chemicals), and physical phenomena (electricity, radioactivity, and so on). Even the best precautions presented by an author might not be enough when moved to another context. Before replicating any activities, it is therefore important to carefully check if they are permitted by local law.

Secondly, the concept of "cultural heritage" is still evolving and strongly country-dependent. The local law and regulations might establish if a scientific instrument is a "cultural heritage item", and if and how it can be touched, activated, used or restored. For example, we learn from the book that MIT students visiting Harvard University were allowed to handle an original Galileo compass. At the Museo Galileo in Florence, access to another original Galileo compass would be granted only to students with specific university-level research projects, and under very strict controls. As another example, we learn that, in France, science students restore historical scientific instruments. But restoration is "cultural heritage"-dependent too. While an "old" scientific instrument in private hands can be restored by anyone, in Italy an "historical" scientific instrument in a public institution can only be restored by a professional restorer and his/her pupils. As a final example, we learn from the book about historical instruments put into operation. Once again, this depends on the law, as repeated public performances favours the deterioration of the item. In this case, the authors of the book offer different perspectives, from the regular use of not-so-important devices, through the exceptional use of important devices, up to the use of museum devices activated by the expert in order to finally film their functioning once and for all.

The invitation to attentively examine local law before trying to emulate anything, does not emphasise a limit, but rather an interesting aspect of the book. The volume takes a picture of the awareness of the relationship between historical scientific instruments and the "cultural heritage" in different countries and institutions. The purpose of the many educational activities presented is, by the way, to increase such an awareness by the interaction between the students and scientific instruments from the past.

To conclude, at the end of twelve years between the first and the ninth volume of this series, another important change will take place. From the next volume, the tenth, *Scientific Instruments and Collections* will pass to the hands of another very capable general editor, who will bring in new ideas and indicate new perspectives. It is my pleasure to wish A.D. Morrison-Low success in the future; and, in addition to hers, acknowledge the steady collaboration that

I received from the present and past series editors: Stephen Johnston, Mara Miniati and Sara Schechner. Many thanks to them and to all the volume editors and authors who contributed to the success of the series.

Giorgio Strano (General Editor)
May 2021

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Notes on Contributors

Dominique Bernard
was a "Maître de Conférences" in physics at the University of Rennes 1, France, where he rescued old scientific instruments. He works on the history of ancient physics instruments, developing an experimental approach to them. In 2018, he published a book on the University collection, which won the 2019 Scientific Information Prize of the Academy of Sciences.

Paolo Brenni
studied experimental physics at the University of Zürich, where he graduated in 1981. He then specialised in the history of scientific instruments and of precision industry in the period from the beginning of the eighteenth century to the mid-twentieth century. He is a researcher in Florence for the Italian National Research Council (CNR) and collaborates with the Museo Galileo. He catalogued and restored several collections of scientific instruments in Italy and abroad, and has written numerous articles about instrument history, their trade and their production. Since 2005, he has been President of the Scientific Instrument Society.

Roland Carchon
holds a PhD from Ghent University in nuclear physics. During his professional life he was a researcher at the Nuclear Research Centre (Mol-Belgium) and the International Atomic Energy Agency (IAEA-Vienna). After retiring, he has been a collaborator at Ghent University Museum for the History of Sciences, with interests in the educational applications of museum collections in a historical context and the popularization of scientific theories.

Elizabeth Cavicchi
completed a doctor of education (EdD) degree at Harvard University; master's degrees at Harvard, Boston University and MIT; undergraduate degrees at MIT. She has written and presented internationally on explorations interweaving history, science phenomena, teaching and learning. At MIT's Edgerton Center, Cavicchi encourages learners to be explorers. Her seminars provide direct experiences with observation, experiment, instruments, history and social justice. Cavicchi's artwork spans watercolours, pastels and sculptural media.

Stéphane Fischer
is assistant curator at the Museum of the History of Science in Geneva, Switzerland, and is in charge of the Museum's collections. He organises and sets up numerous projects – exhibitions, replicas, demonstrations, publications – in connection with the collections and their promotion to the public.

Peter Heering
is professor of physics and its didactics at the Europa-Universität Flensburg, Germany. His research focuses on the history of physics, especially experimental practice, which he investigates using the replication method, the use of historical content in science education, and the historical development of teaching experiments in physics education.

Jan Waling Huisman
holds a BASc in Environmental Sciences and Engineering, and studied as a physics teacher. A staff member of the University Museum Groningen, in the Netherlands, since 1989, he is a collections manager with curatorial tasks. He has cooperated in dozens of exhibitions and projects in different roles, including project management and designing, and engineering interactives. Using old instruments to engage the public in understanding science is one of his key targets.

Françoise Khantine-Langlois
PhD and former professor in the technical department of the University Claude Bernard Lyon 1, is currently an associate researcher at the Sciences and Society, Historicity, Education, Practices (S2HEP) laboratory at Lyon 1 University. She manages the University's collection of physical instruments and is president of the Association de Sauvegarde et d'Étude des Instruments Scientifiques et Techniques de l'Enseignement (ASEISTE).

Alistair Kwan
studied and taught physics, history of science, and education in the United States, Australia and New Zealand universities. He has worked on how historical objects, environments and architecture can constitute primary source evidence in education, research, and heritage interpretation, especially for voices and kinds of knowledge that the textual record does not represent.

Janet Laidla
has a PhD in history. Her research has previously concentrated on early modern historiography in Estonia and Livonia. Her current research interests lie in the history of knowledge of the modern period. She currently works at the University of Tartu as Lecturer of Estonian History and Curator at the University of Tartu Museum.

Pierre Lauginie
is a former lecturer and researcher in physics, who has developed an experimental approach to history of science based on adaptations of historical experiments. His present interests concern the history of instruments and measurement, and the popularization of science.

Panagiotis Lazos
is a physicist with an MSc in History and Philosophy of Science from the Technical University of Athens and the National and Kapodistrian University of Athens. He is a PhD candidate in the latter. He had taught high school physics for more than fifteen years and is currently the Head of the 4th Laboratory Center of Natural Sciences of Athens. His research and publications are on the history of scientific instruments, history of science, didactics of science, and the use of open source platforms in science education.

Pietro Milici
has a PhD in mathematics (University of Palermo, Italy) and in epistemology (Paris-Sorbonne University, France). He is a researcher in the Department of Theoretical and Applied Sciences (DiSTA) of the University of Insubria (Varese, Italy). He is the founder of www.machines4math.com, a Research and Development company for tangible educational materials. He collaborates with the Cabinet of Curiosity of the University of Brest, France; is a component of the EuroPoleni research group (on the eighteenth-century Italian polymath Giovanni Poleni). His main research interests deal with mathematical machines (mainly for tractional motion) from historical, philosophical, and educational perspectives.

Flora Paparou
works currently as a science teacher in secondary education, in Athens, Greece. She is a chemical engineer and holds a PhD in science education. Her research focuses on the material culture of science, as well as on the integration of the history of science in science teaching. From 2003 to 2008 she organised the Science Museum of Chios educational programme. Since 2012, she has been systematically involved in the documentation of the Athens University scientific instrument collections.

Frédérique Plantevin
is lecturer in mathematics at the University of Brest, France, and member of the Laboratorie de Mathematiques de Bretagne Atlantique (LMBA). She is involved in initial and continuing teachers' training, in particular through her implication in the Instituts de Recherche sur l'Enseignement des Mathématiques (IREM) network. She has developed a line of work with primary and secondary teachers on historical instruments in the classes. In 2016, she founded the Cabinet of Curiosity in the Faculty of Science where the collection of outdated scientific instruments is housed.

Julie Priser
is collection assistant and PATSTEC (Patrimonie Scientifique et Technique Contemporaine) project manager for the Brittany region. She works for the protection, conservation, and valorization of old and contemporary scientific instruments at the University of Rennes 1, France.

Alfonso San-Miguel
is physics professor at the University Lyon 1, Director of the Ampère Physics Federation, and president of the Rhône region branch of the French Physical Society. He is also member of the Friends of Ampère Society. He has initiated outreach projects involving university students and the above mentioned learned societies. He has also set up projects for the safeguarding and development of the scientific heritage with physics master's students in collaboration with the Association de Sauvegarde et d'Étude des Instruments Scientifiques et Techniques de l'Enseignement (ASEISTE).

Danny Segers
holds a PhD from Ghent University in materials research by nuclear methods. He has been a professor of physics with teaching duties in the departments of informatics and veterinary medicine. In the period from 2006 till 2016 he was the director of the Ghent University Museum for the History of Science. During that time, he was teaching a course on the history of science.

Constantine Skordoulis
is Professor of Epistemology and Didactical Methodology of Physics at the Department of Primary Education, National and Kapodistrian University of Athens. He is the academic coordinator of the postgraduate program "Secondary Science Teachers Education" at the Hellenic Open University. He studied natural sciences at the University of Kent at Canterbury, UK, and worked as a visiting researcher at the Universities of Oxford and Groningen. His research interests include the history of science and science education from a critical perspective.

Trienke M. van der Spek
is chief curator and head of the science collections at Teylers Museum, Haarlem. She previously worked at Rijksmuseum Boerhaave in Leiden as curator and head of collections. Graduating as a chemist, she also held positions in science education at Nemo Science Museum in Amsterdam and at the University of Amsterdam. Her research interests include the popularisation of science in the nineteenth century and Teylers Museum's institutional and collection history.

Constantina Stefanidou
is a physicist with a PhD in Science Education from University of Athens. After a long period of teaching science in secondary education, she now has a position in the Department of Education at the National and Kapodistrian University of Athens. Her research and publications are on didactics of science, focusing on historical and philosophical perspectives as well as conceptual difficulties and their relation to model-based teaching and learning, and informal science education. She participates in international conferences (ESERA, IHPST, etc.) and science communication actions.