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"Science is better understood through the engagement with its objects"

Performing a canonical experiment with a replica is a complementary means to investigate how science has worked historically. And "Experimental history of science" is the respective research programme, initiated and developed by H. Otto Sibum, who visited UAB in order to give a lecture at the Center for the History of Science (CEHIC-UAB). By building replicas of historic devices and performing the historical experiment, Sibum was able to enlighten hitherto neglected dimensions

of past experimental practice that were not transmitted in the literary sources. To know more about pleasures and pitfalls that aroused from these recreations, from UAB Divulga we have posed him a few questions.

Otto Sibum holds the endowed Hans Rausing Chair in history of science and is director of the Office for History of Science at Uppsala University, where he is engaged in probing new approaches to the history of physical sciences from the eighteenth century to the present. Before Sibum has been director of research at the Max Planck Institute for the History of Science in Berlin and associate researcher in the department of history and philosophy of science at the University of Cambridge. Sibum has received several awards, including the Paul-Bunge-Prize (1994), and is currently a visiting professor at the EHESS, Paris.

What is "Experimental history of science"?

"Experimental history of science (EHS)" is a research programme currently used in the history of science as well as in science education at some universities. With the aim to complement conventional historiographical approaches EHS aims at studying past experimental practices by means of investigating the material culture of science: laboratory equipment, instruments, laboratory space, body techniques... The idea is to use this material culture with the aim to get access to the working knowledge of the past actors. The name of the programme was partly inspired through archeology, in particular the work of "experimental archaeologists" who reconstruct past objects to better understand the past working process.

And the idea also came from experimental archeology?

No, the idea came basically from my interest in using history in physics teaching at the University of Oldenburg, where I did my physics PhD with a partly historical topic. That was rather unusual, since physics considers itself as a-historical, even by definition. Therefore, history of physics is usually not taught in physics education. But in Oldenburg some professors convincingly held the position that history of science is an important part of the discipline. Hence in my thesis I tried to change physics teaching at the university through the use of history of science.

What did you do?

Well, we proposed to change the practical physics courses that were most often boring exercises in repeating text book values of canonical experiments like for example the measurement of the speed of light. Instead of learning to use standardized devices (most often black boxes) We replaced them with replicas of these canonical experiments. Why not building Foucault's device for measuring the speed of light or Coulomb's torsion balance? Why not using James Joule's apparatus to determine the mechanical equivalent of heat? Hence we set up this practical courses purely with replicas of old experiments. This was the beginning of the "Experimental history of science." When I started working at Cambridge University in the department of history and philosophy of science I developed this into a historiographical programme in history of science. Butthe idea emerged out my pedagogical engagement.

How were the replicas build?

We used the physics department workshop, where devices for the ongoing investigation were constructed. Initially, the craftsmen were not very interested, they said "oh, what do you want this old stuff for? We don`t even know any longer how parts of these devices were built ...". But the interesting thing is that after a few months working on the devices, they realized how challenging and exciting the making of these replicas was: they discovered for themselves working techniques that were already lost in their field of artisan expertise. Hence after half a year the project became the most attractive one for them. Every time I went to the workshop with a plan and said, "Can we build this?", my request was more than welcome.

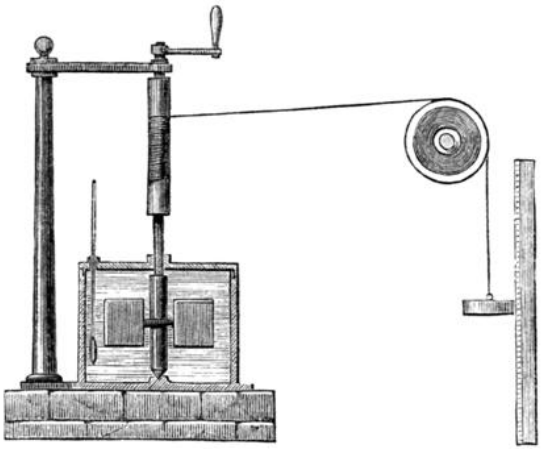

Figure 1: Engraving of Joule's apparatus for measuring the mechanical equivalent of heat.

And what materials did you use?

In most cases our inquiries looked more like detective work. Materials from the eighteenth century you need, would not get in the shops were the physicists buy their equipment. You have to find the right instrument makers shop and interview him where to go. When we built Lichtenbergs elctrophor, for example, we needed a special kind of raisin. In the end only a local violin maker in town could help us to get the exact mixture that was used in late 18th century Göttingen. Usually, students did this complex detective work with great enthusiasm and success.

Then, once you had the equipment, you re-enacted the experiments.

The process of recreating the experimental performance with the replica is another important step in the process. Usually, when you try to perform the experiment it ends in a great mess: most often you face the fact that the experiment does not work. Then you carefully read the historical publication again and you notice that the historical actor must have left out an important hint in his text or the visual representation in the text was not correct, because the replica does not work as it should be. I have to say that the problems I as the historian may encounter may not necessarily will be the ones of the historical actor. Since we neither live in the nineteenth century nor can we walk back into an early Victorian laboratory in Manchester, we cannot tell exactly what problems the historical actor may have faced. But our experiences become a great

heuristic tool to ask question about past practices.

Tell us an example of this.

With the replica of the device used by James Joule's in the experiment to determine the mechanical equivalent of heat, I realized that you should have extraordinary skills in thermometry. You must be very good at measuring the temperature of both the room and the water in the container. The question is, how could Joule learn this skill in his time? Where could he have learned thermometry? Then we have a look at the daily life of the historical actor to find out.

Where did Joule learn?

When you reconstruct his daily life you see that Joule was not a professional scientist, he never went to university, he had a private education, largely because science, at that time, was not as defined as it is today, there were few professional scientists. However, Joule was the son of a rich brewer in Manchester. In his diary, we can read: "I worked 8 hours a day at my father's brewery, and in the morning and in the evening, I made some experiments." I thought that if Joule worked for almost 20 years, 8 hours a day in a brewery, I needed to know what it meant to be a brewer in early Victorian Manchester. So I studied a lot of materials that provide information about the daily routine of a brewer. And I found that during that time the true experts in thermometers and thermometry were brewers! Just at that moment, they were learning how to produce beer on a large scale, which requires a lot of exact knowledge about what temperature is needed for the right mashing heat. In addition, to collect taxes, the government wanted to know exactly how much alcohol was produced. Therefore, daily life of brewers, such as Joule, consisted of taking precise measures of various stages in the production process.

Figure 2: Sibum reconstructing one of his historic experimental devices.

This could be seen in your recreation?

Performing with the replica also showed that the way Joule moved himself in the experiment, his body gestures, was very similar to that of the brewer's working techniques. After I had reported my discovery of this intimate connection between brewing and scientific experimentation, everyone seemed immediately convinced: "Sure, it looks very natural, why had no one mentioned it before?" And I would answer, because nobody had looked at the practical dimension of experiment. The performance with the replica in conjunction with conventional historians methods was the means to reveal and understand hitherto unrecognized practices required in this outstanding experiment. In the literature Joule so far appeared as a genius with extraordinary talent. My findings show that Joule must have appeared as a genius as long as his hidden connections to artisan knowledge communities (brewing, instrument making) were not known. But he remains a singular figure, because no one else could have done it.

But he had collaborators…

Yes, first, he collaborated with an instrument maker, who built a new thermometer much more sensitive and accurate than any other thermometer in Britain. Furthermore, when you perform the experiment, you experience that a single person can not perform it on his own, an assistant is needed to do the manual work. This person must be physically strong because he has to wind up the weights in a rather short time. An untrained person will start sweating and hence create to much body heat that would spoil the experiment. Possibly Joule took some of his workers in the brewery. In his publication this assistant is not mentioned.

Thus, material culture studies are very useful.

Yes, science is better understood through this engagement with the object. Museums hold many objects that represent the past, but too little effort is yet devoted to make these objects speak. Still our historical memory is to a large degree shaped by the literary documents of our culture of science. But as we have seen they are incomplete. I would say that "Experimental History of Science" goes further and complements our attempts in revealing the daily work and life of past science. They sometimes even make us reinterpret the literary sources and rewrite previously written accounts of the past.

Are these devices still build?

Yes and No, unfortunately in the University of Oldenburg, where this all started, only little is done there now. The pedagogical project of including history of science into physics education was very much connected to my old physics professor who is by now retired and with his retirement a new regime of science education was installed that does not any longer regard history of science as central. It will go on at the University of Flensburg. In history of science, "Experimental History of Science" is continuously expanding for example in Uppsala, at the Max Planck Institute for the History of Science in Berlin, at the Cambridge University, where they have the Whipple Museum for the History of Science, and now at Harvard University, where they offer classes on the history of science using the material of the museum. Moreover, I think it is even fair to say that currently

amongst general historian the interest in material culture is growing, too. This is exciting and may lead to interesting exchanges.

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