IL NUOVO CIMENTO **44 C** (2021) 165
DOI 10.1393/ncc/i2021-21165-7

COMMUNICATIONS: SIF Congress 2020

Physics instrument makers in 19th-century Veneto: Two case-studies

FANNY MARCON(*)

Centro per i Musei, Dipartimento di Fisica e Astronomia "Galileo Galilei", Museo di Storia della Fisica, Università di Padova - Padova, Italy

received 26 January 2021

Summary. — Often considered marginal figures in the history of physics, instrument makers, who often worked in the 19th century for institutions such as universities, high schools and observatories, actually contributed significantly to the development of physics and to its diffusion thanks to the instruments they made and sometimes designed. In this article, we examine the case of the instrument makers working in the Veneto region in the first half of the 19th century by presenting two instruments as case studies. These two instruments —a steam engine and a heliostat— won in 1822 and 1829 prestigious awards in the context of the industry prizes promoted by the Venetian and Lombard *Istituto di Scienze, Lettere ed Arti*. Through the study of these instruments, I will also shed light on the often unsuccessful attempts at technological development that characterised Veneto in those years.

Though they often worked for institutions such as universities, high schools, observatories and academies, instrument makers are often regarded as minor figures in the history of physics and astronomy. In this article, based on my current PhD researches, I will focus on the Veneto region and examine the role these mechanics had in the circulation of physics knowledge in the region. I will present in this sense two instruments as case studies, a steam engine and a heliostat. Through these instruments, I will also explore the issues related to the sector prizes promoted by the *Istituto Veneto* and the *Istituto Lombardo di Scienze, Lettere ed Arti*, an attempt to initiate technological development in the region.

Until the 1860s, the Veneto situation perfectly mirrors what historian of science Paolo Brenni describes in *Costruttori italiani di strumenti scientifici del XIX secolo* [1]. A myriad of mechanics worked for the University of Padua, for the high schools founded by Napoleon, such as the Liceo Maffei in Verona and the Liceo Santa Caterina in Venice, and for local academies, such as the *Accademia Galileiana* in Padua or the *Accademia di Agricoltura* in Verona. After the annexation of Veneto to unified Italy, in 1866, an attempt to create a scientific instrument company that would be competitive at the national and international level in 1883 was actually made by a private entrepreneur, Vincenzo Stefano Breda, in collaboration with the University of Padua. The aim was to transform the workshop of the observatory —the *Specola*— of the University of Padua into a large company. The initiative failed in 1898 due to the lack of private capital and government investment [2]. The failure to develop a precision industry in the region, as

(*) E-mail: fanny.marcon@unipd.it

Fig. 1. – Dufour's model of the steam engine.

well as the low salaries paid, led almost all the mechanics working for universities and high schools to devote themselves, with varying degrees of success, to other occupations, such as hiring bicycles —this was the case of Valentino Strapazzon [3], mechanic at the Physics Cabinet of the University of Padua from 1879 to 1925— or building bridges —as Paolo Rocchetti, mechanic at the *Specola* in Padua, did from 1842 to 1877 [4].

Despite the unfavorable context for the development of a flourishing scientific instrument industry, many of the mechanics of the region demonstrated excellent skills, great inventiveness and ability in making fine instruments. They contributed significantly to the development of physics and its diffusion in the region in three ways: i) by collaborating closely with physics professors and manufacturing prototypes of their inventions, ii) by designing, improving and manufacturing instruments for both research and teaching that contributed to the circulation of physics knowledge in the region through the various institutions([1]), iii) by participating in the industry awards promoted by the *Istituto Lombardo* and the *Istituto Veneto di Scienze, Lettere e Arti*, and thus contributing to the attempt at technological development in the region. We will focus on this last point and analyse two prize-winning instruments as case studies: a steam engine to be applied to a tobacco factory, that was presented by Stefano Dufour and awarded a silver medal in 1822, and a heliostat, made by Antonio Tessarolo and awarded a silver medal in 1829. Let us underline that the industrial prizes promoted by the two institutes were organised from 1806 onwards, alternately in Venice and Milan. Their purpose was "to more and more encourage and promote the national industry and to bring to a higher degree of perfection the useful arts and manufactures by the public and solemn distribution of prizes"([2]). Though these prizes, held throughout the century with fluctuating success, never really achieved the purpose for which they were created, scientific instrument makers from both Lombardia and Veneto participated in them in large numbers.

In 1822, Stefano Dufour, a mechanic from Nevers (France) but long established in Milan, presented a model of a steam engine applied to a tobacco factory (fig. 1) to the industrial prizes in Milan. This model introduced in Italy, for the first time, the improvements proposed in France by Charles Albert and Louis Martin. The two French engineers won a prize from the *Société pour l'encouragement de l'industrie nationale* in 1809 with a machine whose strong points were its small size and the possibility of economising a large part of the steam produced. In the wake of their success, they built a steam engine in 1825, which remained in use until 1859, to replace the famous Marly engine [6]. In the letter presenting his model to the *Istituto Lombardo*, Dufour pointed out that his machine was designed to be built and used at the Venice Tobacco Factory, which at the time still used animals work [7]. However, although the model

([1]) We can deduce this information from the study of collections in universities and schools such as the Liceo Maffei in Verona and the Liceo Foscarini in Venice.

([2]) "d'incoraggiare e promuovere ognor più l'industria nazionale e condurre a maggior perfezionamento le utili arti e le manifatture con la pubblica e solenne distribuzione de' premj" [5].

Fig. 2. – Tessarolo's heliostat.

was regarded as excellent by the jury of the industry awards, therefore deserving a silver medal, the steam engine itself was never built in Venice, due to Italy's backwardness in the field of steam engines as well as to the lack of interest of both the Austrian rulers and the local community [8]. If Dufour's model of machine represents a failed attempt to introduce and apply a technical innovation from abroad and is thus a lost opportunity for the technological and industrial development of the Lombardy-Venetia Kingdom, it nevertheless became a vehicle for the dissemination of knowledge as, in 1826, the Emperor of Austria decided to donate the model to the Physics Cabinet of the University of Padua. Dufour's model was thus sent from the seat of the government in Milan to Salvatore Dal Negro (1768–1839), professor of physics at the University and director of the Cabinet [9]. It was then used for teaching, allowing students learn about some of the latest improvements to the steam engine and the possible applications of this machine to an industry. It thus represents an interesting case of a radical change of function of a scientific object, from a technological cutting-edge model to a teaching instrument. It is also an example of a transfer of knowledge from an instrument maker to a university.

As for the heliostat presented by Antonio Tessarolo (1803–1839), it won a silver medal at the industry awards in 1829 (fig. 2). Antonio Tessarolo was the son of the mechanic of Padua University Physics Cabinet, Francesco (?–1842), and his trusted collaborator. In 1828, Dal Negro charged Antonio with the construction of a new model of heliostat, conceived by the Bolognese physics amateur Pietro Prandi, who had described his instrument in an article published in 1824 but never had it built [10]. Heliostats were invented around 1720 by the Dutch physicist Willem Jacob 's Gravesande (1688–1742), with the aim of projecting the Sun's rays into a laboratory by means of a mirror that followed the movement of the Sun. This provided a fixed light source to be used for optical experiments. Tessarolo accepted the challenge and manufactured Prandi's new model of heliostat, developing parts of the instrument by himself, such as the clock and the rack system that transmits the movement of the clock to the polar axis. The 1829 industry awards jury enthusiastically welcomed Tessarolo's work. However, the instrument had no further developments and no other of these heliostats was built, as far as we know. Why? According to the historian of science Allan A. Mills, Prandi-Tessarolo heliostat actually "incorporated all the desiderable improvements which had eluded Malus, Charles and Hachette" ([11], p. 387). Mills himself reports that the heliostat presented by Léon Foucault in 1862 was known for three important improvements, but that "the Malus and Charles instruments incorporated (b) and (c) ([11], p. 387), whilst Prandi had all three, *plus* adjustments for the latitude and altitude, nearly forty years earlier!" ([11], p. 387). Beyond the technical details, it is interesting to add another comment by Mills on the Prandi-Tessarolo heliostat: "It is unfortunate that such a practical design remained unknown outside Italy. This is probably because it was published in Italian in works of very limited circulation ([11], p. 389). Surely the poor circulation of Italian scientific journals abroad was a problem, but another main obstacle to the diffusion of this heliostat surely was the lack of what we might call a "technological context". As we said at the beginning of the article, many instrument makers were active in the territory at the time, but none of them managed to acquire a national, let alone European, dimension. This lack of sufficiently large workshops certainly was a limitation to improve, build, disseminate and apply innovations and obviously limited the scientific and industrial development as well. In this sense, the industry awards, despite their efforts, could not do much to alleviate the situation. The Prandi-Tessarolo heliostat was not the only "victim" of this unfortunate context in the Italian peninsula, as we can recall, for example, the case of the collector ring for electromagnetic generators that Antonio Pacinotti (1841–1912), published in the magazine *Il Nuovo Cimento* in 1863: the article went completely unnoticed, while it became a milestone in the development of industrial electricity, when Zenobe Gramme described and patented an identical device in Paris in 1870. Pacinotti's invention, like Prandi's before him, was sterile for very similar reasons. As for Tessarolo's heliostat, it remained a prototype, only known at this time within a very small circle of scientists.

To conclude, the two cases presented in this paper highlight how instrument makers contributed to the transmission of scientific and technological knowledge in the region: they not only introduced, designed and made cutting-edge scientific and technological instruments, be they local prototypes or foreign inventions, but they also disseminated these innovations, knowledge and scientific practices in high schools, universities and academies. The instruments we examined also shed light on the links that existed between the various cultural institutions in the region and between local physics professors and instrument makers, thus revealing pages of physics in 19th-century Veneto as yet unknown. Finally, the case-studies also underlined how the lack of a technological and industrial context, which the industry prizes failed to encourage, did not allow local mechanics to make their inventions and achievements known outside their restricted regional context.

REFERENCES

[1] Brenni P. and Misti M., *Nuncius*, **1** (1986) 141.
[2] *Archivio della Società veneta per imprese e costruzioni pubbliche*, "Archivi e Imprese", 11–12.
[3] *Archivio storico della Camera di Commercio di Padova*, fascicolo Valentino Strappazzon.
[4] *Archivio storico della Camera di Commercio di Padova*, fascicolo Fonderia Rocchetti.
[5] *Collezione degli Atti delle Solenni distribuzioni de' premj d'industria fatte in Milano ed in Venezia dal 1832 al 1839*, Vol. 6, Milano 1839.
[6] Brandstetter T., *La machine de Marly: un spectacle technologique*, "*Le Bulletin du Centre de recherche du château de Versailles*", online, 2012, mis en ligne le 18 décembre 2013, consulté le 15 janvier 2021.
[7] Stefano Dufour's letter to the *Istituto Lombardo di Scienze, Lettere ed Arti*, 26 August 1822 (Archivio dell'Istituto Lombardo di Scienze, Lettere ed Arti).
[8] *Tecnologia. Annali Universali, 1° di Agricoltura, economia rurale e domestica, 2° Arti e mestieri,* Vol. **VI** (1828), p. 298.
[9] Imperial Regio Governo's letter to Sebastiano Melan, Rettore Magnifico of Padua University, 19th October 1826 (Archivio per la storia dell'Università di Padova, Rettorato 1825, busta 42).
[10] Prandi P., *Descrizione di un nuovo eliostato*, *Nuova collezione d'Opuscoli scientifici*, Bologna 1824, pp. 244–250.
[11] Mills A. A., *Heliostats portables (illuminateurs solaires)*, in *Annals of Science*, Vol. **43** (1986), pp. 369–406.