HISTORIC INSTRUMENTS FOR THE TEACHING OF PHYSICS: a chronology of the situation in Argentina

María Cecilia von Reichenbach*

Abstract

The introduction of scientific disciplines in Latin America was deeply influenced by the acquisition of scientific instruments, especially in the experimental sciences. These tools constituted a key in the workings of the teaching scenario aimed at the preparation of a critical mass of young students required to carry out scientific research in the New World. The aim of this treatment is to describe this process in Argentina, especially with respect to the instruments devoted to the teaching of physics. The background investigation for this chronology was executed in the attempt to discover what instruments were bought and when and for what purposes they were purchased. I present here a brief review based on written historical records concerning the first didactic scientific instruments used in the country and, in particular, the history of the collection belonging to the Physics Museum of the La Plata National University.

Key-words: scientific instruments, demonstration, physics.

Introduction

The aim of the research to be described here was to contribute to the study of the history of scientific instruments in Argentina, restricting that analysis to those apparatuses related to the teaching of physics; with this investigation aimed at providing an element in the

* Museo de Física, Departamento de Física, Facultad de Ciencias Exactas, Universidad Nacional de La Plata. CCT- La Plata, IFLP, CONICET. Calle 49 y 115, C.C. 67 (1900) La Plata, Provincia de Buenos Aires, Argentina. cecilia@fisica.unlp.edu.ar. Doctora en Física, Profesora Adjunta con Dedicación Exclusiva UNLP, Investigadora Adjunta CONICET, Directora del Museo de Física UNLP.

construction of a picture of the scientific cultural heritage of Argentina. This work would ideally be useful as a source of information for other studies on the history of science as well as for the ongoing research carried out in science museums related to the rescue, conservation, and diffusion of Argentina's material heritage. This combined information can assist science-history investigators working with this legacy to share data, resources, and advice with respect to studying, maintaining, and exhibiting the collections.

The interest in scientific instruments has undergone a lengthy journey throughout the history of science, but recent changes have occurred in the character and scope of those technical tools. A fruitful exchange between historians and museum-trained specialists has enabled a wider vision in the study of scientific instruments. The specialized meaning of an instrument as an experimental device in terms of its function or use was expanded to consider the broader context of material culture. I explore here the relationships between the instruments as artifacts; the natural phenomena they were designed to study; and the social, political, and scientific context in order to expand the science historians' approaches to both research and teaching practices related to artifact-centered studies. The aim is therefore to find an intersection between the studies of material culture and historiographical topics: biographies, circulation and global history, science and practice, and embodied knowledge (ANDERSON, 2013, p. 35). Such collaboration might elevate the specialized significance of an instrument as merely an experimental device into the realm of material culture.

The study of didactic objects, in particular, allows an insight into and crosslinking among several aspects of the history of science, education, museums, and commercial scientific materials. The flourishing trade of scientific objects and the growth of scholarly practices and professions in the 19th century left a material testimony not only through the existing collections of instruments, but also in a variety of associated documents: ancient inventories, catalogs, and user manuals delivered by providers along with text books, programs, class agendas and institutional memoirs. The analysis of such historical objects allows a study of the traffic between the educational and scientific sectors as well as the forms of chronicling acquired in the dissemination of scientific knowledge (GARCIA, 2013).

The pioneering work of Guillermo Ranea was the first publication emphasizing the significance of the international trade of scientific apparatuses with respect to the development of physical sciences in South America. This article took into account the way in which the acquisition of a collection of scientific instruments manufactured in Germany had brought about the introduction of experimentalism in physics at the turn of 20th century in Argentina (RANEA, 1994 p. 119). Ranea's work promoted, among other facts, the reevaluation of that collection, which revaluation thereafter gave rise to the Physics Museum of the La Plata National University.

This present report could be regarded as an initial contribution to the creation of a catalogue of the first didactic physics instruments, their history, and their impact on society throughout all of Argentina. Such a catalogue would hopefully also serve to determine the present status of the ancient-instrument collections. This project has notable predecessors in, for example, Spain (SANCHEZ TALLÓN, 2011) and Brazil (GRANATO, 2013 a, b). Since several historians and museum directors have been contacted in order to provide information on the origins of these collections, we hope that this report will engender others, so that an overview can be gained.

The first instruments in Argentina

An exploration of the history of scientific instruments is tantamount to a search into the establishment of experimental science. Thus, the source material for this investigation was nothing less than the available literature on the development of physics in Argentina. The key references basically consist of three pioneer publications: the first, written by the polemic Ramón Loyarte, comprises the period 1827 – 1922 (LOYARTE, 1924); the second, authored by Federico Westerkamp, covers the years 1923 – 1972 (WESTERKAMP, 1975); while the final one is a recent compilation by Diego Hurtado de Mendoza (HURTADO, 2012) in collaboration with authors from the older Argentine physics centers. Several articles needed to be consulted in order to complete the historical treatment up to the year 1930—namely, one related to the general history of science in the country (ASÚA, 2010 and WEINBERG, 1996); another dealing with a history of the universities (BUCHBINDER, 2005); and the papers written by Eduardo Ortiz, those being related to military institutions and the situation surrounding the development of physics before 1930 in the country (ORTIZ, 2009, 2010) along with others. Finally, in addition, I consulted selected papers on the national primary and secondary schools and teacher-training institutes (SPALDING, 1972).

As asserted by Asúa, the history of physics in Argentina began in the 18th century (ASUA, 2012, p. 14) with the introduction of Newtonian ideas in several handbooks, and later progressed through publications by certain priors belonging to the Order of Jesus. Although far from the major scientific discoveries occurring in Europe, and even poorer than those scientific developments in other Latin-American countries; those first concrete manifestations of this educational movement in Argentina must be considered when the history of this science is studied.

Thus, according with Asúa (p. 17), the first native-Argentine scientist was the Jesuit Buenaventura Suárez (1679 – 1750). He introduced Newtonian ideas in the then enormous historical zone referred to as the Rio de la Plata before 1750, and another Jesuit, the Spaniard Ramón María de Termeyer, (1737 – 1814) was the first to perform electricity experiments (p. 19). Nevertheless, the instruments used in their investigations were aimed at research and not at teaching. The same generalization could be said for the "awesome instrument collection" for experiment and demonstration brought from Europe by Martín de Altoaguirre (1708 – 1797). The purpose of these apparatuses seems to be to perform electricity demonstrations in Buenos Aires's "tertulias"[1] for the purpose of astonishing cultured citizens. When Martín Altoaguirre died; his son, Martín José, decided to sell the collection to the Monserrat Preparatory School of Córdoba University, a prestigious Catholic school; but several bureaucratic problems prevented the transaction until some years later. The reasons for that delay were based on a lack of money and the suspicion that these instruments would not be useful to the University. The authorities of the Cabildo[2] claimed that "neither are studies in experimental physics conducted in this university, nor do we have machinery in the other schools for the destiny those instruments deserve" (ASUA, 2012 p.25). In addition, the argument was raised that speculative physics was enough to teach within the theological curriculum of the University. This position was refuted by the then governor, Nicolás Pérez del Viso, asserting that the essence of the study of natural philosophy was experimentation. The negotiations to acquire the collection resulted in an argument over speculative versus experimental physics; but in in essence the issue involved a confrontation between the secular clergy and the Franciscan order that were in charge of the University after the expulsion of the Jesuits. In 1815 the collection was finally acquired in order to teach experimental physics, although no trained personnel were available to oversee those instruments. Apparently this collection is the oldest in the country, and is part of the permanent collection of the Monserrat National College Museum. In the original collection were disc-electrostatic glass-ball machines and Leyden-bottle batteries, an aeolipile

[2] Get-togethers for presentations or discussions among the elite of different interests within the arts and sciences.
[2] The city's governing body.

(steam turbine), conducting rods, thermometers, scales, hygrometers, densimeters, a vacuum machine, hydraulic-demonstration apparatuses, and optical instruments (*e. g.*, a camera obscure, a magic lantern, microscopes).

El deán Gregorio Funes en la ancianidad, por Fidencio Alabez. Museo Histórico Nacional de Buenos Aires.

As stated by Ramón Loyarte (p. 20), one of the first Argentine physicists, the earliest experimental physics course was created by Dean Funes, when he was in charge of the Monserrat College in 1807. No data on these courses are available. The physics book of the theologist Diego Estanislao Zavaleta during those years was written without formulae and with few diagrams, thus reflecting lectures developed in the absence of any experiments.

The Mathematics Academy was founded in 1810 to satisfy the technical needs in time of war. The European professors Felipe Sentenach and Felipe de Senillosa were hired to develop mechanics courses.

The first lectures in which experiments were introduced were given by Avelino Díaz, in 1822, although with a poor set of instruments (LOYARTE, p. 28). Loyarte considers this series of classes as the beginnings of the physics' teaching in Argentina. During that same year the Physical and Mathematical Sciences Society was founded in Buenos Aires.

During the Martín Rodríguez government, in 1823, through an initiative of the President Bernardino Rivadavia, Argentina benefitted from "the acquisition, in Europe, of physics and chemistry laboratories so that in the teaching of these disciplines the experimental aspect has the site and the foreground it deserves". Those facilities were installed in the Santo Domingo convent, but by 1834 only an inventory of the collections remained, that list indicating the great incompleteness of those laboratories. Meanwhile, Rivadavia had hired the Italian physician Carta Molina to develop an experimental-physics course in April 1826, but Rivadavia soon dismissed Molina from his post and designated Octavio Fabricio Mossoti in that position, although the latter had been previously hired to direct the Astronomical Observatory in Buenos Aires. Mossoti taught this course from 1828 to 1834, but then returned to Italy. "He was the first in developing a real experimental course, through his knowledge and the laboratory material available", and for the first time in the Río de La Plata "lessons and experiments on electricity were developed"

(LOYARTE, p. 38). The destiny of the instruments changed when, in May 1835, the "Restaurador" Juan Manuel de Rosas decided to discontinue mathematical- and experimental-physics courses. Rosas donated the instruments to the Jesuit Francisco Majetsé, for him to use teaching in a federal republican secondary school, but "there were a few [instruments], and [those] in bad condition" (LOYARTE, p. 45).

Once Justo José Urquiza replaced Rosas as President, scientific-cultural links become slowly reconstructed. In the Preparatory-Studies curriculum of the Buenos Aires National University an experimental course was established in 1854, and the French colonel Camile Duteil was appointed as departmental head. He directed the reconstruction of the few instruments preserved by Majesté and decided to acquire new ones. Although Duteil might have written some of the texts on the manuscripts of his lessons, only three years later in 1857 one of the most famous manuals in physics, written by Adolphe Ganot, was presented as the official text. This handbook was famous, among other notable characteristics, for the frequent inclusion of instrument illustrations and for the use of those apparatuses to introduce each topic.

The next experimental courses were held in Buenos Aires and developed there by Nicanor Albarellos, the engineer Mariano Moreno, Pompeyo Moneta, and Amadeo Jacques; where the last of these had taught experimental physics in Montevideo, as related in *Juvenilia*, a novel written by Miguel Cané. No records of these courses exist, though the curriculum continued until 1865.

In that same year of 1865, The Exact Sciences Department of the National University of Buenos Aires was created for the purpose of training professors and engineers, but in 1875 the department was transformed into the School of Physical Mathematical Sciences, with the idea of hiring European specialists in the different fields. This changeover coincides with a national teaching plan for secondary schools that included the natural and exact sciences in order "to open new careers for the youth" (LOYARTE, p.49). Among the first students were some individuals who would later become brilliant professionals, such as Valentín Balbin, Luis Huergo, and Guillermo Withe. Professor Bernardino Speluzzi was remembered by his students, but those classes included no practical demonstrations since Speluzzi had a theoretical background. Nevertheless, a considerable instrument collection was acquired for the classes, as indicated in a list drafted up by certain professors of the University of Buenos Aires using funds supplied by the provincial authorities. Those apparatuses, as the ones acquired for chemical experiments, were bought in Europe by several of the importation agencies in Buenos Aires (LOYARTE, p. 52).

Likewise, in the Province of Córdoba during the same years a congressional law allowed the hiring of foreign professors for the university and the secondary schools. Germán Burmeister, Director of the National Museum, contracted seven professors and secondary-school teachers between 1870 and 1873 and among them Carlos Schultz Sellack to teach physics. With those scientists the Argentine National Science Academy was founded, although its development was hindered by several problems, thus resulting in dismissals and resignations.

When, in 1876, the School of Physical Mathematical Sciences of the National University of Córdoba was reorganized, the course of study leading to a teaching degree in physics was created, among others. The study programs included experimental physics and practical exercises along with the use of scientific instruments. These programs were reformed in 1883, with the same aim of preparing secondary-school teachers.

In 1872 the Naval Military School was founded; in the beginning oriented to mathematics and navigation, but later on to the sciences as well. Although the first dean was a mathematician, the next were astronomers, thus explaining that the first instruments to be purchased were an electric chronograph, two astronomical pendulums, and a Gautier theodolite repeater. In addition to certain meteorological and photographic apparatuses, complete physics and chemistry cabinets[3] were purchased, especially under Eugenio Bachmann's deanship. He consolidated the scientific faculty, hiring three foreign professors and commissioning one of them, Ulric Courtois, to purchase books and instruments in France. Under the deanship of Manuel José García Mansilla the School was relocated to Río Santiago, not far from the National University of La Plata, which proximity allowed a facile interchange between both institutions. García Mansilla renovated the laboratories, created a museum, and incorporated as teachers two of the first doctors in physics graduating from the country: José Collo and Teófilo Isnardi. In the physics cabinet stands a complete set of wireless telegraphy; Gram dynamos; precision electrometers; and a large projection apparatus with three electric bulbs, accessories, and a complete set of lenses (PUGLISI, p. 32). A group of professors recently published a digital catalog of the remaining instruments (MERODO, 2005), where the photographs show 236 groups of complete and well conserved pieces, covering the main topics of basic physics, including modern apparatuses such as a Wilson camera and photoelectric cells. The main collection was manufactured by Max Kohl (Chemnitz) and covers three catalogs—those from 1904, 1911, and 1925—but also containing instruments from E.

[4] Collection of didactic instruments sometimes along with the appropriate furniture—*e. g.*, tables, blackboards, screens, and other accoutrements—for use in the classroom.

Ducretet (Paris); along with five catalogs from 1900 and 1911 plus some, after 1955, from Leybold (Köln, Germany) [4].

New perspectives in education: the experimental sciences favored

At the turn of 20th century arose general efforts to change the theoretical character of the teaching of physics (SPALDING, 1972). This new perspective included experimental methods, stimulating the installation of instrumental cabinets. In some instances the apparatuses were acquired for only demonstrations by the teachers; but in others for student use, either individually or in groups. In both circumstances, the collections of instruments were purchased in Europe or the United States, and the destiny of those acquisitions depended on the skillful use and care of the collection in question.

The massive immigration into Argentina that occurred during these years created new challenges, dividing an oligarchical governing class and giving rise to a political shift that considered education as the key to homogenizing the nation and a means of giving those new citizens the opportunity of improve their future. To implement this program the training of teachers and professors was begun, it was entrusted to a group of intellectuals who had charge in the government. The creation of Normal Schools for training primary teachers was followed by the creation of secondary-school-teaching degrees. To that end, Joaquín V. González founded the National Secondary-Teachers' Institute (INPS) in 1904, hiring some European teachers—among those Willhelm Keiper, a German physics teacher, who played a key role in the connection between the European scientific community and the national authorities. Keiper recommended the hiring of respected German physicists to teach and do research in new educational institutions, such as those in the universities at La Plata and Tucumán (MENDEZ, 2008).

One of the German professors of the INPS, Georg Berndt, refers to the use of some simple instruments in 1911: the vernier compass, speedometer, micrometer screw, spherometer, analytical balance, pycnometer, thermometer, hydrometer, Jolly balance and stopwatch. The same set of objects is cited eight years later by another professor, the German physicist Jacob Laub (FERRARI, 2014).

Georg Berndt, in the "Report on the progress of INPS, 1910", complained about the lack of adequate demonstration instruments for experimental lectures. The existing collection, being “not appropriate enough for the instruction of future teachers”, suffered from an

[4] Future plans included research on the history of apparatuses and professors; along with selected physics demonstrations for groups of students from other institutions.

absolute lack of those measuring devices and other precision instruments necessary for laboratory work. For this reason teaching the physics course in 1909 was impossible because of the vital role Berndt gave to experiments. He also complained about the lack of tools and a mechanic for working in the shop.

In 1910 the budget of 6,500 Argentine pesos were given by the Ministry of Education to buy instruments, but Berndt considered that a further 10,000 pesos would be needed to acquire an adequate supply of instruments. In his opinion, an excellent and typical collection could be bought for 30,000 pesos that would insure a good scientific instruction. He believed that “this amount cannot be considered too high, compared for example to the 75,000 pesos initially given to La Plata Physics Institute, and then more than 30,000 pesos last year, for the acquisition of laboratory equipment."

The new instruments were bought in Europe and included analytical scales, spectrometers, Gaede vacuum pumps, refractometers, galvanometers, devices for aeroelectric measurements, a direct-current motor, mono- and triphasic–current generators, a turner, and tools. Some of the providing firms were Fuess, Siemens & Halske, Zeiss, Hartmann, Guenther & Tegmeyer, Lippich (a polarization device), and Wimshurst (an electrostatics machine).

During that same year, the national educational authorities decided to move the physics-cabinet collection of instruments belonging to the permanently closed Normal Superior School into the INPS. This excellent acquisition including demonstration instruments allowed the INPS, in Berndt's words, to complete the set of apparatuses and precision devices existed, thus enabling the collection to be more widely appropriated in general for practical laboratory work. The new acquisitions included large Ruhmkorff coils and an electromagnet with accessories, several instruments for meteorological measurements, and a microscope with polarization accessories.

Nevertheless, the set of scientific instruments described by Laub in 1915 was not for teaching but for research on X rays—*i. e.*, Lindemann X-ray tubes with platinum cathode targets, rapid Miller anticathode tubes with platinum, a Siemens tantalium anticathode tube, photographic plates for recording X-rays, among others. In fact, Laub—as well as Berndt and Walter Sorkau—aside from their teaching activities developed scientific research (FERRARI, 1997). The apparatuses cited in their papers and institutional reports indicate a preference for precision research instruments over those used for demonstrations. These investigators prioritized laboratory work; and rather than having their students perform conventional exercises, they assigned them experiments involving original investigation. We have no record of students participating in those undertakings;

or if they did, in what way: the research papers contained only the signatures of the various professors (FERRARI, 2014).

Physics beyond Buenos Aires

In Rosario, Santa Fe province, one of the largest cities in the country, the School of Mathematical, Physical Chemistry, and Natural Sciences was created in 1920 in the Littoral National University, it having been founded in 1912. The aim of the first physics courses was to teach basic elements for engineering students. The first professor was the engineer Lorenzo Baralis, in charge of Elements of General Physics, who developed an encyclopedic course. We have no record of didactic instruments being used at those times. The first study plan for the degree in physics dates from only 1960 (GALLES, pp. 157-163).

In the city of Santa Fe, the capital of the province, different purposes led to the arrival of physics: the subject, as it was taught, was directly linked to engineering. The provincial university there was created in 1890, and physics was included in the first plans. Nevertheless, in the process of nationalization the emphasis on chemistry replaced that on physics as the support discipline. In October 1912, the School of Pharmacy was moved; and "chemistry, physics, and toxicology cabinets and laboratories" were installed (VALLEJOS - ARCE, p. 127). The documents from that period indicate that "practical teaching supply is almost good, but lacks of some experimentation devices". The scarce information available indicates elementary materials, "because only the use of instruments related to practical pharmacy was taught". The emergence of physics as an academic discipline began in 1920, when the School of Industrial Chemistry was created. The scope was scientific investigation, but not necessarily related to basic science, rather to chemical engineering. Only in the year 2006 did training for a doctorate in physics begin. That the physics laboratory was provided with didactic instruments at that time—such as electrostatic machines and galvanometers—can be inferred from the papers published by the then professors of physics and chemical physics. Nevertheless, complaints from the professors arose to the effect that the laboratory was not well equipped.

In the northwestern province of Tucumán the first didactic instruments were exceptional ones: the apparatuses were, in fact, handmade by a Catholic priest, Jean Marie Cazes, who had arrived from France in 1905. He began teaching all varieties of classes at the Sacred Heart Preparatory School, but specializing in physics courses in 1920. Cazes constructed all the instruments he needed himself in order to perform experimental demonstrations, those performed by him as well as the ones used by pupils (either individually or in groups). He also made instruments for the National College professors. His courses were very popular, and part of their appeal and prestige was attributed to their homemade apparatuses.

The National University of Tucumán was created in 1914, after previous efforts to raise the awareness of public opinion made fundamentally by Juan B. Terán, a member of the circle of Joaquín González. The spirit of the new university followed the proposal of the La-Plata branch: namely, an emphasis on teaching in science. The University was designed as an institution devoted to acquire knowledge (especially in applied areas) more than to confer professional titles, as were the circumstances at the universities in Buenos Aires and Córdoba. The German physicist Richard Gans, director of the La Plata Physics Institute, had been previously called to participate in conferences organized to gain an auspicious climate. Around 1920 Gans was commissioned to recruit European scientists for Tucumán's Physics Institute. As a result of this policy, the German physicist José Würshmidt arrived at Tucumán in 1925, opening to the north provinces the possibility of gaining knowledge on the most current developments in physics, along with the ability to receive degrees and do research in that discipline. As stated by R. Tagashira (p. 94), "he installed the replica of a German classroom with elements imported from this country". At present, we are searching for information about the origin, quantity, and present conditions of these objects.

Since in San Luis, Mar del Plata, Bariloche, and other cities the first activities in the teaching of physics at the university level began later than 1930, that aspect of the history of these instruments lies beyond of the scope of this report.

Secondary-school physics cabinets

The objective of educating immigrants in a unified program was achieved by the President Domingo F. Sarmiento, who took the American example where Horace Mann had designed institutions created to equalize the opportunities of citizens. The laws established by Sarmiento mandated the creation of institutions to form teachers. At that time, other similar institutions existed, but were ineffectual. For the unification of opportunities, the new ideas consisted in free public lay schools, especially in the provinces, in order to produce educated citizens, thus promoting the appropriate development of a working democracy. Consistent with the American conception and practice, physical, chemical, and biological cabinets were included and trained staff hired to begin the nationwide project. The first Normal School was created in Paraná in 1870, in charge of producing competent teachers for public primary schools, followed by further schools for that same purpose in Corrientes, San Luis, Jujuy, and Santiago del Estero. Sarmiento's successors, Nicolás Avellaneda and Julio Argentino Roca, continued this program, which policy had as one of the main purposes the installation of nationalistic ideas in the immigrant populations and a contribution to the country's modernization process (SPALDING, 1972). In addition, the provinces favored this initiative, passing some provincial schools into the national project. That circumstance pertained, for example, to the Normal School of Concepción del Uruguay (founded by Justo José Urquiza). Major acquisitions of the relevant instruments, from both the USA and Europe, were made to provide cabinets. Apart from those of the public training schools, major collections of physics instruments were acquired in the Catholic institutions; such as, for instance, the Jesuit Preparatory School of Santa Fe.

Scientific didactic instruments in the National University of La Plata

The first devices for physics demonstrations at the National University of La Plata (UNLP) belonged to the Secondary School, where a set of instruments—having been originally purchased around 1885—were inherited from the early Provincial Secondary School. Nevertheless, a few years later the disrepair became evident in those devices, until their refurbishing by trained personnel. Certain arguments arose around the use of those apparatuses because the ongoing institutional curriculum reserved teaching a comprehension of theoretical principles, and thus the use of those instruments, as an aspect of preparation for the university, but not for primary degrees in professions or training in the trades. Thus, the discussions on methods, objectives, and contents of the various curricula determined which type of instruments would be considered for which circumstance. The physics teachers' team being composed of scientists, decided on the purchase of instruments for mass use, to allow students the direct access to them for experimental training. As this point of view had been encouraged by authorities, the acquisition was soon made of instruments from the firm Knott in the United States (MAGLIANO, 1935, p. 4). Moreover, those professors were the authors of physics textbooks that were profusely illustrated with pictures of the same instruments[5].

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[5]Recently, authorities transformed the physics cabinet into a museum, where instruments were restored by technicians, teachers and students, and apparatuses reconstructed into working condition.

Together with the foundation of the UNLP, that being the third national university, the Institute of Physics (later called the High School and Department) was created in 1905. Joaquin V. González, founder and first president of the new university in La Plata, gave to the Institute of Physics a remarkable degree of priority, within the so-called by Eduardo Ortiz "positivist experiment" (ORTIZ 2010, p. 3).

The Institute begun working under the administration of the La Plata Observatory; and the Uruguayan engineer Tebaldo Ricaldoni, a local experimentalist, was invited to direct the institute from 1906 to 1909. The "princely sum" of 99,000 pesos was given to cover the purchase of modern equipment and installation expenses, according to the experimental nature that González expressly wished to give to the Institute and the whole university (LOYARTE, p. 67). González, however, considered that Ricaldoni could not begin to "further the study of physical sciences and to create a competent corps of people who can utilize the primary materials and all the natural energies of the country". Therefore Ricaldoni was dismissed and the Institute removed from the Observatory and transferred into a new School of Physical, Mathematical and Astronomical Sciences (PYENSON, p. 153). The

prestigious German physicist Emil Bose was hired, along with his wife, the chemist Margrete Heiberg, to put the Institute into working condition. Ricaldoni's legacy was the acquisition in Germany of 2,761 instruments for the demonstration of physical phenomena. This collection—a key in the formation of the first doctors in physics in the country—was purchased in the prestigious firm Max Kohl in the German city of Chemnitz and was later completed with the acquisition of instruments that were more sophisticated, to be used for both teaching and research. These devices (or, at least, those remaining) form the patrimony from which the Museum of Physics was created in 1984 and opened in 1998.

No documents survive explaining either the choice or the description of the instruments purchased, but two valuable testimonies can be consulted: the Max Kohl catalogue, with manuscript indications about the items selected, and the article written by Margrete Heiberg Bose in 1911 (HEIBERG, 1911). In this paper she describes the institution, the laboratories, and the cabinets, as a sort of advertisement to convince certain German scientists to replace her deceased husband, Emil Bose, in his earlier post as head of the Institute. Referring to the instruments, she criticized Ricaldoni's selection, because "it could be purchased more and better if acquired in specialized firms" (HEIBERG, 1911). Heiberg's paper also mentioned those instruments bought under Bose's recommendation from the following German firms: Zeiss, Edelmann, Hartmann & Braun, Ruhstrat, Siemens & Halske, Fuess, among others. As stated by Ranea, both the catalog[6] and Heibergs's paper are extremely interesting documents in terms of the history of the scientific instruments, and especially for the cataloguing of the collection (RANEA, p.120).

Some of the instruments are still used to perform demonstrations for the public (mainly primary and high-school groups), but in a restricted manner: only one group a day and only those instruments whose conservation is not endangered by handling. In other instances, reproductions are used that take into account the idea behind the original apparatus but are constructed in such way that interested people could reproduce a replica.

The survival of the heritage is guaranteed by preventive conservation and restoration of the instruments and also by creating a digital inventory, constructed in a normalized database provided by SEDICI—Servicio de Difusión de la Creación Intelectual, (Service for the Diffusion of Intellectual Creation)—of the UNLP. Although nowadays specialized conservation techniques and museum specialists are hired, a key institution that gave advice on the first attempts to construct a museum starting from a collection was the group of local university -museum representatives (Red de Museos [Museum Network], UNLP), who played a fundamental role in helping to avoid mistakes.

Final considerations

This brief review has documented the historical relationships between scientific instruments and political, educational, and social intentions and has presented an analysis of the context that led to the purchase of collections of didactic instruments. These historical facts and the conclusions drawn from them, however, required an in-depth study of each circumstance involving the extraction of information from the documents related to the problems, intensions, purposes, and decisions as well as from the objects themselves. Perhaps, in the future, the best results could be obtained through an interdisciplinary effort made by historians and instrumental specialists alike. In addition, a review of the present

7 Now digitalized and available in Museum's website http://museo.fisica.unlp.edu.ar/catalogo.

status of those instruments bought in that period would be an interesting undertaking—it providing information concerning the true cultural heritage related to the teaching of physics that still remains.

The survey of these collections depended on bureaucratic procedures, the various directors' attitudes, and the circumstance that in many instances the devices were not intensively used but cautiously stored. The high quality of the instruments and their solid construction and careful design also helped to extend their lifetime. Behind each well conserved collection usually was someone in love with the pieces, who looked after those objects, but sometimes in hermetic and hidden places. A review of the present status of the instruments would be a meaningful task, but also a major effort, if we consider the Brazilian-project experience. Hopefully, the present report will constitute a starting point for an updated catalogue of this material heritage.

The Argentine physics labs in universities, schools, preparatory schools, and military training institutes were usually equipped through local importation agencies—*e. g.*, Otto Hess, Lutz &Schulz—with collections bought from well reputed firms from Europe and the USA, the most common being Max Kohl (Chemnitz), E. Leybolds Nachfolger A.G., Carl Zeiss, Ernst Leitz, and Phywe from Germany; Ducretet, Maison J. Salleron, Jules Duboscq, Charles Chevalier and sons, and Deyrolle from France; and E. Edelman from the USA. A similar practice also seems to be true in other countries of Latin America; as, for example, is asserted in the Max Kohl catalogue (MAX KOHL, p XI) and found in the description of Granato's work on the scientific heritage of Brazil (GRANATO 2103, P. 697).

A few interesting experiences indicating positive attitudes towards these collections can be cited. Sometimes coming from the authorities of schools, sometimes from science teachers, the news of a recovery of some colleges' cabinets is a promising recent development. When isolated efforts (those, for the most part, discouraging) were abandoned and collaborative work was begun, that new approach was occasionally supported by government institutions and assisted by advice from museums—such being the situation with "School Footprints" (Huellas de la Escuela), an official program working with schools to recover their material legacy. Moreover, the work of the UNLP Museum Net in the public schools of La Plata and environs, for example, is also making a difference. When students are involved in the process of recovering a cabinet's instruments, a feeling of belonging often results, creating a new sense of relationship with the institution. Indeed, once young students understand the value of their actions, their enthusiastic engagement becomes the signal of a promising future.

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