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"Something new!". The Presentation of Didactic Objects for Teaching Natural Sciences at School During the World Exhibitions of the 19th century

"¡Algo nuevo!". La presentación de objetos didácticos para la enseñanza de las ciencias naturales en la escuela durante las Exposiciones universales del siglo XIX

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Keywords

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ABSTRACT: The gradual introduction of universal science education in Europe and the rest of the world during the 19th century was a sign of unprecedented educational reform and represented a lucrative new market for a large number of companies. They then developed educational objects and presented them at the World Exhibitions held from the middle of the 19th century onwards. The purpose of this article is to study the modalities and significance of the successive exhibitions of three types of educational objects dedicated more specifically to the teaching of natural sciences: wall charts, clastic models and school museums.

Palabras clave

Educación
Ciencias naturales
Objetos didácticos
Exposiciones mundiales Pedagogía

RESUMEN: La introducción gradual de la educación científica universal en Europa y el resto del mundo durante el siglo XIX fue un signo de una reforma educativa sin precedentes y representó un nuevo y lucrativo mercado para numerosas empresas. Estas desarrollaron objetos educativos y los presentaron en las Exposiciones Universales celebradas desde mediados del siglo XIX. El propósito de este artículo es estudiar las modalidades y la importancia de las sucesivas exposiciones de tres tipos de objetos didácticos dedicados específicamente a la enseñanza de las ciencias naturales: gráficos murales, maquetas clásicas y museos escolares.

INTRODUCTION

Spectacular, world exhibitions have left their mark on the collective memory and remain precious witnesses of their times: they undoubtedly constitute one of the rare means capable of restoring to us, as a whole, the society of the second half of the 19th century. Through the objects they exhibit, they showcase the

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full range of human activities and familiarize an international public with the latest progress made in all sectors of production, including education and instruction. Thus, they allow visitors —members of the jury, specialists and the general public— to evaluate and compare the progress of a national school system. For historians of education, world exhibitions are therefore a source of information on the evolution of public education in the world, both organizing and exhibiting countries. We are interested here in the progress made in elementary scientific education, by highlighting the innovative school objects dedicated to the teaching of natural sciences that were presented at the various successive universal exhibitions up to the turn of the 20th century. The focus on this teaching is related to a political idea of many progressive governments that the mission of primary education is not only to teach reading, writing and counting, but also and mainly to develop the intellectual faculties (observation) and morality of the student, giving him at the same time the greatest possible quantity of useful knowledge (agriculture, hygiene, etc.). Three main questions are posed here: What does it mean to exhibit a school object? Which objects in the teaching of natural sciences are most often exhibited? How does the display of these objects comply with the recommendations of school curricula? The sources consulted to provide elements of response to these questions come from the extensive literature on world exhibitions: reports, guides, specialized publications, articles, illustrated albums, commercial catalogue (Pizzigoni, 2024, pp. 14-16), etc. On the methodological level, these different sources have been cross-referenced diachronically and synchronically.

1. DISPLAY SCHOOL OBJECTS TO THE WORLD

1.1. Bringing together the extraordinary from all continents

World Exhibitions have emerged in Europe in the mid-19th century and have closely accompanied the development of industrial capitalism and modern mass societies. Because they promote comparisons between the past and the future of humanity, between the civilizations of the world, between the diversity of human productions, these exhibitions promote a universalism of technology (Demeulenaere-Douyère & Hilaire-Pérez, 2014, p. 7-25). Lasting an average of six months and organized in national pavilions since the Paris Exhibition of 1867, they represent the showcase of the know-how of the organizing country and the participating nations. Thus, the Universal Exhibitions are an opportunity for each people to realize, by comparing themselves with others and by looking back on themselves, the progress they have made and what remains to be pursued. In addition, they are exceptional places of discovery, meeting and sociability, thus facilitating future commercial exchanges, as evidenced by the values of the number of exhibitors per exhibition —with the respective share of national exhibitors— and the number of visitors which is in the millions, the record being held by the Universal Exhibition in Paris in 1900 with more than 50 million visitors (Aimone & Olmo, 1993, p. 303).

The exhibitions are also all immediate or commemorative celebrations for the organizing countries. They are almost always anchored in symbolic dates: 1855 was for France the bellicose celebration of the Crimean campaign, as was 1867, which consecrated the military victories of Emperor Napoleon III; 1878 celebrates national reconciliation after the fall of the Second Empire, the bloody clashes of the Paris Commune and the advent of the Third Republic; 1889, that of the centenary of the Revolution; and 1900, a round date of emphatic virtue, an opportunity to take stock of the past century. This dimension inspired all other countries: the United States, which, in 1876, saw in the Philadelphia exhibition the opportunity to celebrate the unity of the reconquered nation a hundred years after the Declaration of Independence; the Habsburgs celebrated in Vienna, in 1873, both the twenty-five years of reign of Emperor Franz Joseph and the integrity of the Empire despite the military defeats and the split of Hungary.

Every article produced or obtained by human industry, whether of raw materials, machinery, manufactures, or fine arts, divided into different classes and sections, are admitted to the exhibition. Not all of these categories of items were presented at the first exhibition, it happened gradually. Thus, at the first London Exhibition in 1851, machines and manufactured goods were the only novelties that attracted the curiosity of visitors. With the Paris Exhibition of 1855, the fine arts made their entrance on the scene, followed in 1862 by the school objects presented at the second London Exhibition. It is not without reason that the Royal Commission wished to give an increasingly important place to the things of teaching and to everything that concerns education, since this industry, if we may so speak, is the starting point and in some way the foundation of all the others:

> "C'est par une éducation bien réglée, sage et féconde, appropriée aux diverses aptitudes et ne laissant en friche aucune des portions du fonds national, qu'un peuple agrandit de jour en jour la sphère de son activité et de sa puissance." (Hanriot, 1878, p. 47)

The function of the exhibitions is therefore not only to bring together the most recent innovations, to make an educational effort to inform visitors, to promote the know-how of many companies related to the field of education, but also to evaluate and compare the progress of a national school system (Matasci, 2015, p. 98).

1.2. The staging of school systems

It was therefore from the third Universal Exhibition, that of London in 1862, that achievements relating to popular education were exhibited for the first time: a class was then specially created, class XXIX, under the name "Educational works and appliances". The classification adopted for this exhibition was as follows: books, maps and models; furniture and equipment used in teaching; toys and games; and models for science education.

The 1867 Exhibition in Paris confirmed the innovation of the London Exhibition of 1862 in the field of public education and developed it by creating Group X which brought together the objects especially exhibited in order to ameliorate the physical and moral condition of the population (Geslot, 2012, p. 347-359). It is in this group of "social causes", and more particularly in class 89 devoted to "Materials for and methods of teaching children" that we find the objects of interest devoted to the scientific instruction of children, the next class being dedicated to the instruction of adults. The Imperial Commission therefore created Group X to receive objects specially exhibited with a view to providing the working population of the countryside and cities with the means of improving their condition, in order to bring them out of the ignorance, misery and demoralization in which they still found themselves more or less immersed in the second half of the nineteenth century. We can thus find in the school exhibition of group X a large number of objects that could have been placed in other classes of the first nine groups. For example, when a member of the agricultural and penal colony of Mettray in Indre-et-Loire (France) for young delinquents exhibits a pair of clogs, it is not the more or less imperfect making of this crude shoe that attracts the attention of the judges, it is the result of a system of education whose aim is to remove a child from all the consequences of a first fault that is honored. Comparing the first two "universal" school exhibitions, that of London 1862 and that of Paris 1867, we see an increase in the number of nations that took part in these events, but also in that of the exhibitors of these various nations. The same was true for all the universal exhibitions that followed one another until the end of the nineteenth century (see figure 1), when some states of the German Empire (Second Reich), founded in 1871, were not present, for political reasons, at certain school exhibitions held on European territory.

Figure 1. Education experts studying the New Jersey educational exhibit at the Columbian Exposition in Chicago in 1893

Source: Dittrich, 2010, p. 3.

In admitting for the first time an educational section to the London Exhibition of 1862, the Royal Commission had not only brought together in a single classroom all the objects which were to be included in it, but it had also assigned to it a separate room where the products of all nations, brought together, made it possible to make an easy comparison. From the Paris Exhibition of 1867, with the increase in the number of exhibiting nations, the creation of national pavilions, and the multiplication of classes and objects on display, visitors lost the ability to be able to take in an entire school section at a glance, without travel and without fatigue. Where the Imperial Commission has not been able to devote a separate room or compartment to a single category of objects of elementary education, “it has assigned them a special place, either on the walls of the various rooms [made available to the two classes of group X], or in a series of cabinets or showcases isolated or united.” (Pompée, 1868, p. 38). The disoriented public then had to rely on official catalogues and other visitor guides to be able to look for what they had an interest in seeing and studying.

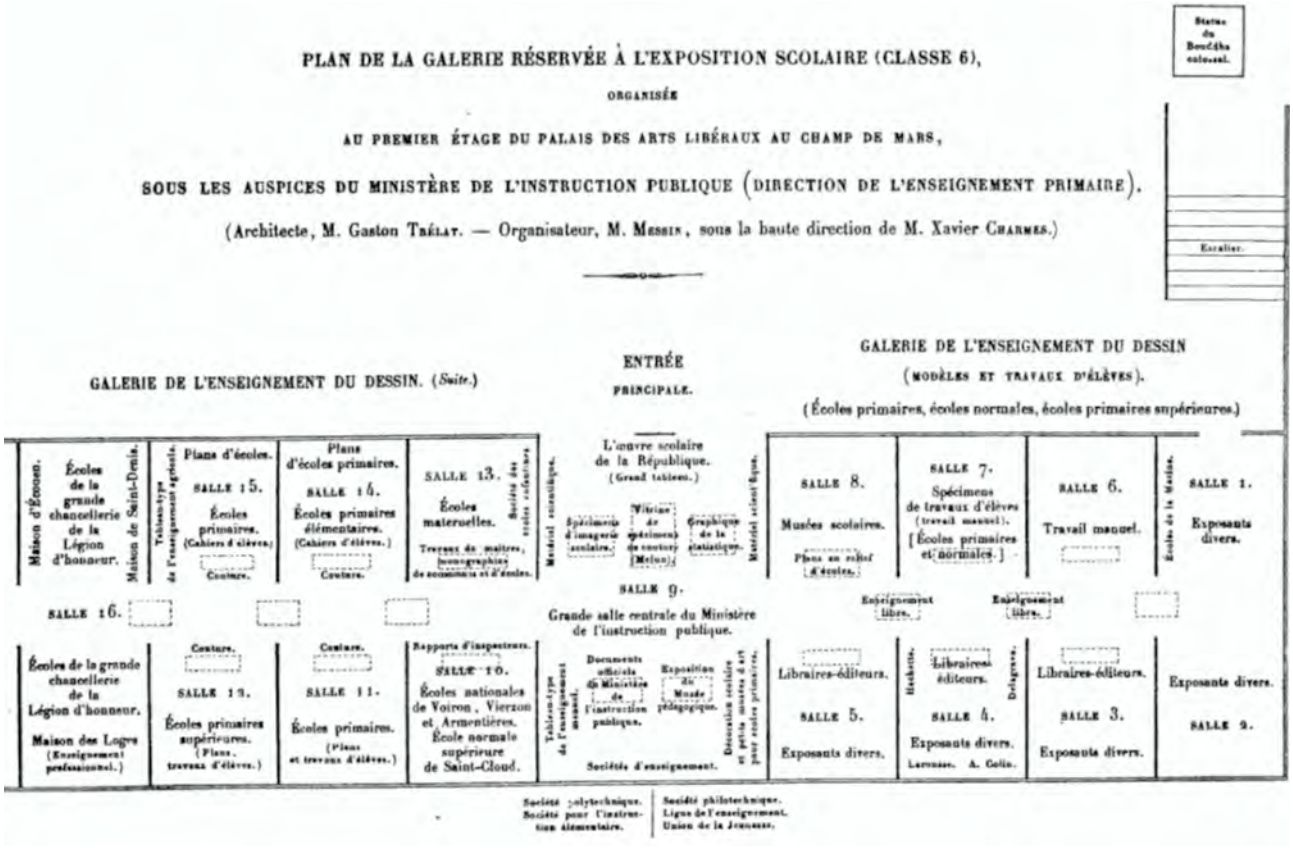
1.3. What should be included in a school exhibition

It is interesting to compare the official titles of the sections of the exhibitions reserved for educational matters, i.e. what each school section should contain, with the observable reality described by specialist

visitors and the general public, with a plan to support it (see figure 2), in search of possible discrepancies. On what the school part of a universal exhibition must necessarily and in the first place, the opinion of Charles Hanriot, inspector of the academy, is enlightening:

> "Plan de maisons d'école, matériel d'enseignement, devoirs de tout genre faits par les écoliers, travaux à l'aiguille, etc. Mais ce ne serait pas suffisant ; il faut qu'on voie le for intérieur de notre enseignement, c'est-à-dire nos méthodes." (Hanriot, 1878, p. 47-48)

Figure 2. Plan of the school section at the 1889 Paris Universal Exhibition (class 6), located on the first floor of the Palais des arts libéraux located on the Champ-de-Mars



Source: Picard, 1891, p. 26.

To read it implicitly, the producers of school objects that are exhibited are mainly ministerial and academic authorities, users (teachers and students) and publishers of school materials. Over the course of the exhibitions, other objects will be presented: monographs, models and photographs representing a type of primary school (nursery, elementary, upper primary, normal, primary, upper normal). At the Paris Exhibition of 1889,

> "une école modèle avait été installée [à l'initiative du ministère français de l'instruction publique] à l'Esplanade des Invalides [...]. L'intérieur de l'école modèle, le logement de l'instituteur, le préau, etc., tout avait été mis à la disposition du Syndicat du mobilier scolaire à qui incombaient les frais de la construction ; et sous l'encombrement des

> cartes, tableaux, images, appareils en tout genre apportés par chaque éditeur, les qualités propres à l’œuvre de l’architecte disparaissaient complètement.” (Leblanc, 1900, p. 19)

Other nations have presented such constructions within their respective pavilions. For the Paris Exhibition of 1900, only a model class, by its presentation and its tools, had been presented by the French ministry. The type chosen was the one most frequently found in France: the classroom of the one-teacher school, with its most common school furniture.

On the specific level of the elementary teaching of the natural sciences and its subjects, the first reports indicate that this usual and useful knowledge

> “doivent être mises à la portée des enfants par des lectures convenablement choisies et dont on exigera périodiquement des résumés, par des explications familières, des entretiens qui, sans être des leçons techniques, n’en vont pas moins au but pratique, simple et indiqué par le bon sens, qu’il faut atteindre.” (Hanriot, 1878, p. 61)

In the early days of popular scientific instruction in France, the book of current readings was therefore the object most commonly used in the classroom, as well as at home (Egginger, 2010, pp. 65-79). But in other European countries, new objects were recommended by pedagogues such as William Tuckwell, an English Anglican clergyman. He was headmaster of New College School, a private preparatory school for boys aged 4 to 13 in Oxford, then of Taunton College School, a modern public school. Because he was an advocate of teaching elementary science in these schools, Tuckwell contributed to the development of science education for all:

> “It would be nearer the fact to say that the especial importance of science-teaching in schools, is in its serving beyond any other known means to open children’s minds, to stimulate their reasoning powers; not to teach dull formulas, learnt by a memoria technica, but to start boys and girls on a course of realising and comprehending life and nature. This statement (as is right with a statement concerning physical science) is one to be tested by direct experiment.” (Inconnu, 1870, p. 49)

Tuckwell was a pioneer of school science, and it was he who really first introduced a regular course of instruction amounting to no less than three hours per week per boy (Inconnu, 1936, p. 914). In these schools under the leadership of Tuckwell, science is not made optional. It is taught simply, and with inexpensive apparatus (every boy is also required to collect his own specimens, to perform his own experiments, and to show at every step that he knows what he is doing). For schools which have large purses or liberal friends, Tuckwell recommends from 1869 the purchase of clastic models from Dr. Auzoux which he admired in the London Exhibition of 1862 and Paris Exhibition of 1867:

> “Dr. Auzoux’s models of plants and plant organs, ranging in price from 20 to 100 francs, and ten times the size of life, form a luxuriant assistance to beginners, which only those can appreciate who have worn out their eyesight and their temper over a composite floret or glume of a small grass. The same excellent modelist, whose catalogue is on the table, provides every organ necessary for the study of comparative and human physiology; and his prices ought not be beyond the reach of any prosperous school. In any case, a skeleton will be necessary, and will cost about £ 5; and if the Committee of Council were to authorise the reproduction of such typical physiological cases as, from the skilful hands of Mr. Charles Robertson of the Oxford Museum, drew so many admirers in the Exhibition of 1862, theses would find immediate purchasers in many of our schools.” (Tuckwell, 1869, p. 19)

Thus, innovative objects for the improvement of the elementary instruction of science, presented in the school sections of the first universal exhibitions, were spotted by certain pedagogues who advertised them around them. The culmination of this was the New Orleans World's Fair 1884-1885. The participation of the French Department of Public Instruction in this American exhibition was facilitated by the fact that France had a ready-made school exhibition, which had just been shown at the *International Health Exhibition* of London a few months earlier and which was therefore to be "recycled" (Acland, 1884, pp. 164-165). The largest exhibition ever held abroad, it covered almost all branches of education, but mainly those that have received the most considerable increases since the consolidation of the Third Republic, in particular elementary scientific education for all. Two rooms, out of the nine assigned to the French school section, contributed to it: room III, which presented the teaching materials of primary education and the work of pupils in elementary primary schools; and room V, dedicated to equipment and work relating to the primary normal schools (Buisson, 1886, p. 5). And this innovative school equipment will be the focus of the second part of this study.

2. EMBLEMATIC OBJECTS OF THE ELEMENTARY TEACHING OF NATURAL SCIENCES

2.1. Wall Paintings

Jean-Jacques Rapet, Inspector General of Primary Education and French rapporteur for the first of the Universal Exhibitions, which proposed a school section, that of London 1862, pointed out the existence of books with images that

> "servent de base à ces leçons sur les choses usuelles, dont l'usage, déjà général en Allemagne, s'est beaucoup répandu depuis quelques années en Angleterre [...] et usitées seulement dans nos salles d'asiles sous le nom de *leçon de choses.*" (Rapet, 1862, p. 49)

He indicates that it would therefore be of great interest to introduce these object lessons, by modifying their character, in primary schools in France. To illustrated books intended for science teaching, however, he recommended adding representations of things, in the form of large images (wall boards) or smaller ones (good points), so that students could grasp scientific concepts by sight, considered as "the best way to make people understand the facts." He also regrets that these objects are not currently in the classrooms and that French producers, apart from the Dezobry compagny cited in its report for its collections of images intended for asylum rooms (future nursery schools), do not seem ready to fill this gap. But he must have been wrong because a few years later, the French school industry would be aware of its glory as far as wall boards otherwise known as wall paintings (charts) were concerned.

In fact, the school section of the 1884 New Orleans Exhibition in the United States has deserved to be marked in the history of education as the archetype of school exhibitions on the subject of the objects of the elementary teaching of the natural sciences. Benjamin Buisson informs us that many private and public American schools, even at the primary level, have begun to acquire for several years, either paintings such as the *Charts of the Human Body for elementary instruction in physiology and hygiene* of Milton Bradley & Co., of Springfield, (Massachusetts), let the nine physiological plates of Cutter (Lippincott & Co., of Philadelphia) or, as is the case for nearly two thousand schools in the state of Indiana, the twelve anatomical tables of Professor Eckardt of Vienna (Austria), on which an American publisher (D. D. Van Vie,

of Indianapolis) had explanatory captions applied in English. But this is “nothing” compared to the French section of education:

> “The American teacher visiting the crowed gallery containing this exhibit will be struck […] by the many evidences that instruction is carried outside the text-book, as far as possible, to objects and their relations, teaching theories by things and not by sentences learned by rote. The tendency is strongly in this direction in our own country, but the French carry it farther than we do, seeking in many ways to make the pupil familiar with the main facts in natural science, and with the practical sides of life.” (Inconnu, 1885, p. 198)

Many wall paintings published by French companies are shown there. The best known of all is the Parisian compagny Deyrolle (Faure, 2023, p. 221-222). She presented three different collections in New Orleans (Buisson, 1886, p. 50):

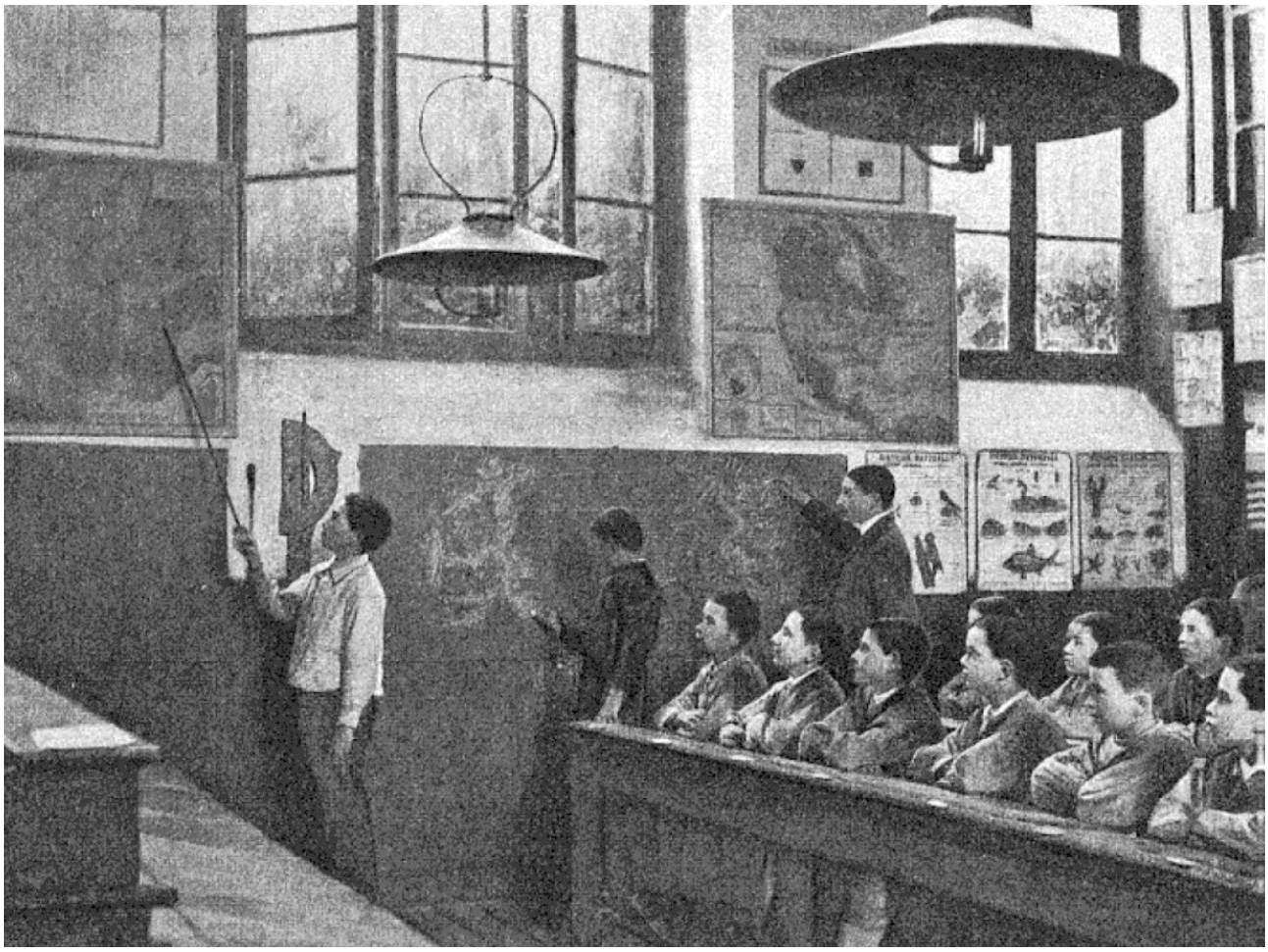
— *Musée scolaire, Émile Deyrolle* (Elementary School). It’s a series of wall pictures for teaching natural science. This series is divided into three parts. The first illustrates the elements of natural science, and is intended for small schools (the figure 3 shows two of these tables illustrating the animal kingdom, particularly vertebrates: one devoted to birds, and one showing reptiles and fishes). The second part illustrates metallurgical processes, coal-mining, glass-making, animals useful and injurious to agriculture, mushrooms and fungi, the most common poisonous plants. The third part, intended for girls’ schools, illustrates the history of textile plants, such as flax, hemp and cotton; the ceramic processes, faience or earthenware, porcelain or China, stoneware, pottery; the cereals and the oleaginous and aromatic plants; the structure of a hen and changes of the egg during the process of incubation.

— *Musée Deyrolle* (Higher Primary School). This collection has been prepared in order to meet the requirements of the higher primary schools. It consists of a wall picture (75 inches by 35 inches), representing the human skeleton; of another picture representing the skeleton of a bat.

— Deyrolle Émile, 23 Rue de la Monnaie, Paris. This collection purpose natural history diagrams.

In his report on the London Exhibition of 1862, Rapet also advocated the use of collections of “the most common” objects in the classroom, which some call *school museums.*

Figure 3. Three teaching wall paintings by the Parisian compagny Deyrolle (Vertebrates, birds; Vertebrates, reptiles and poisons; Invertebrates) hanging on the wall of the Beaufort municipal school (photograph presented at the 1900 Paris exhibition)



Source: Ministère du commerce, de l'industrie, des postes et des télégraphes, 1902, p. 50.

2.2. School Museum

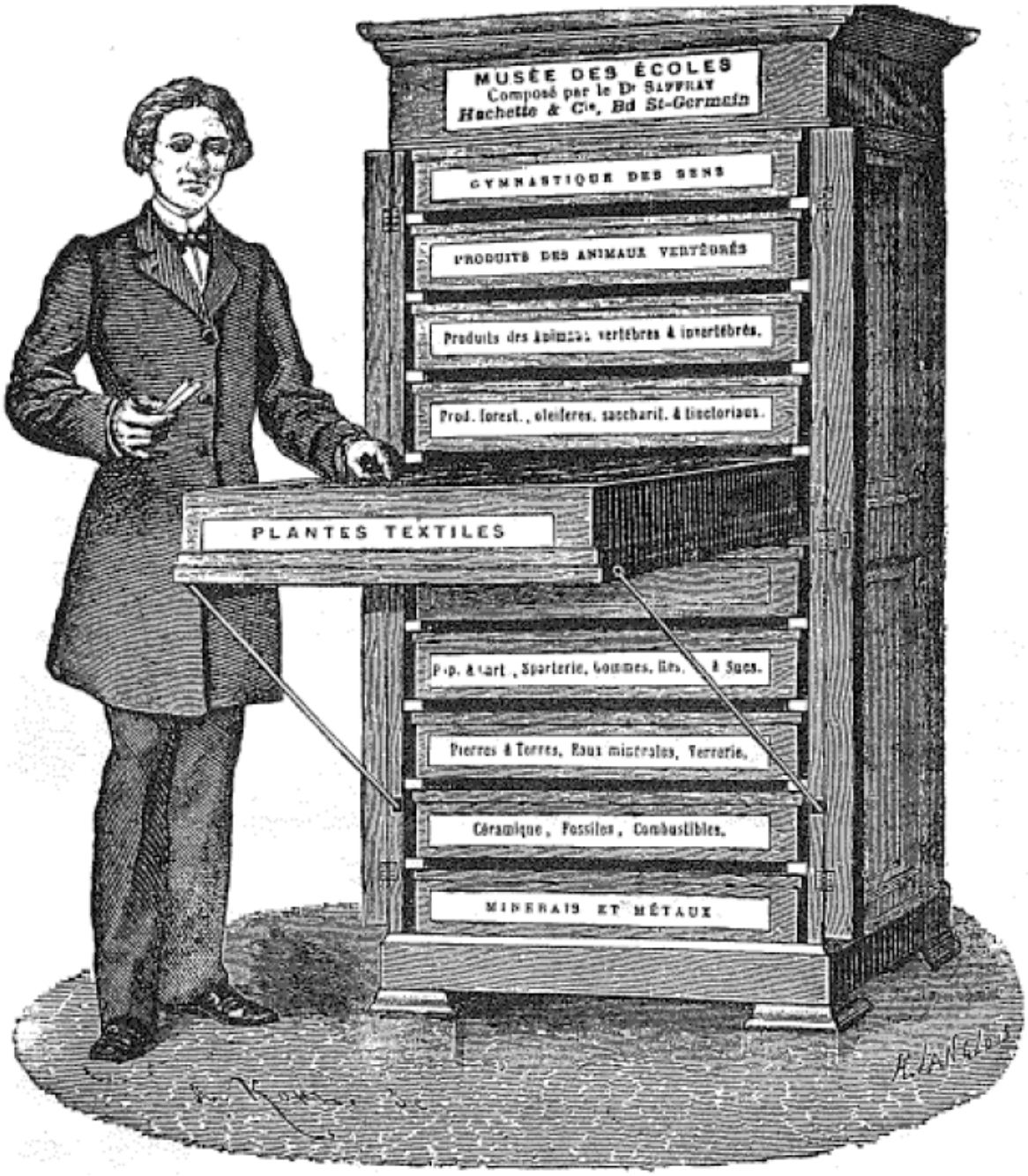
It was during the Paris 1878 Exhibition that a very large number of school museums were exhibited, due to the initiative of teachers with the help of their pupils, and to private industries. These collections are intended to give children clear, accurate ideas about everything around them. During this exhibition, the first room of the French compartment for class 6 (Education of young children and primary instruction) could have been called the *publishers' room,* because of the considerable displays made by the compagnies of Belin, Hachette, Colin, Delagrave, etc. The entire room, however, was not exclusively devoted to books: there were also innovative materials for the elementary teaching of science. In his visit report, Hector de Backer recommended to teachers a school museum published by the Delagrave company under the commercial name of *Petit nécessaire pour leçons de choses* and which attracted his attention:

> "C'est une boîte divisée en trois compartiments principaux, subdivisés chacun en un grand nombre de cases, renfermant, dans un ordre méthodique, divers échantillons,

> à l’état brut et à l’état travaillé, des principales matières que l’homme emploie pour la satisfaction de ses premiers besoins : alimentation, vêtement, habitation.” (Backer, 1879, p. 79)

He pointed out that this “small library of things” cost only 25 francs, that it was certainly not as good as the school museums produced by the teachers themselves and also presented at the exhibition, but that it could nevertheless be of very useful service to them.

Figure 4. *Musée des écoles* by Doctor Saffray published by Hachette & C[ie]



Source: Picard, 1891, p. 316.

At the next Universal School Exhibition, that of New Orleans 1884-1885, other Parisian publishers in turn presented their own school museum, The Deyrolle company thus highlighted its *Musée Deyrolle* (Higher Primary School). This collection has been prepared in order to meet the requirements of the higher primary schools. It consists of a collection of 100 useful and noxious insects, all indigenous to France; representatives of the myriapoda, arachnida, crustacea, annelida, vermes (amongst which there is to be found the trichina), mollusca, echinodermata, polypes, sponges. Geology is illustrated by a collection of rocks, one of fossils, and one of minerals. Botany is illustrated by two herbaria, one of 100 plants, the other of 50 cereals. There are also instruments for collecting and preserving specimens, and a guidebook for carrying on these operations. The Hachette company exhibits its *Musée des écoles* of Doctor Saffray (see figure 4). These are several collections of specimens and samples of raw or worked materials intended for the practical teaching of object lessons and the teaching of natural sciences. Each collection is contained in a wooden box with compartments: box n° 1, stones and metals; box n° 2, boxwood, ceramic, glass; box n° 3, heating and lighting; boxes n° 4 and 5, calving; boxes n° 6 and 7, food. Each box of about 115 samples costs 28 francs. An explanatory catalogue in which the teacher will find the essential elements of the object lessons accompanies each box. Finally, the Delagrave company presents another object, on the border between wall paintings and school museums, entitled *Musée industriel scolaire Dorangeon.* This is an interesting collection illustrating the processes of 75 trades and containing more than 1,200 samples and specimens. This collection was designed by Charles Dorangeon, a professor of industrial technology in Amiens.

2.3. Clastic models

Among the innovative objects presented in the school sections of the World Expos, there are also substitutes for nature that teachers and their students can observe and handle at leisure: models that can be dismantled, in parts, known as clastic models (Egginger, 2025, p. 24-25). Whatever the universal exhibition envisaged, from London 1851 to Paris 1889, the clastic anatomy of the French doctor Louis Auzoux did not suffer too much from competition, both from his French colleagues and from foreign exhibitors:

> “M. Auzoux s’est distingué plus que tout autre dans ce genre. Ses travaux, déjà si remarqués aux dernières Expositions françaises, auraient mérité plus qu’ils n’ont obtenu à l’Exposition de Londres. Il y a une puissance d’invention, et presque du génie, dans la manière dont il parvient, avec une matière susceptible de moulage, et pouvant donner un nombre illimité d’exemplaires à reproduire, quant à leurs attributs physiques, toutes les parties de l’organisation de l’homme et de certains animaux, depuis les plus grands jusqu’aux plus petits, depuis le cheval jusqu’à l’abeille.” (Roux, 1855, p. 5)

To read these words, from the first presentation at the first of the Universal Exhibitions, the craze was total, even though, due to English modesty, only the model of the equine flayed was certainly broken down and recomposed in front of visitors, but in a remote corner of the first floor of the Crystal Palace. Then, for successive exhibitions, a large number of human, animal and plant models were presented to everyone, specialists and the general public, just like what happened at the Paris Exhibition of 1867:

> “La grande chambre d’anatomie clastique de M. Auzoux est, j’ose le dire, l’une des plus intéressantes expositions du Champ-de-Mars. Partout on met sous les yeux d’un public plus ou moins facile à séduire des œuvres d’art, des engins, des curiosités dont je ne saurais nier l’utilité et le mérite. M. Auzoux *étale* devant une foule sans cesse compacte l’engin le plus merveilleux de la création, le corps des animaux. L’*anatomie*

> *clastique* permet de montrer pièces par pièces, morceaux par morceaux, tous les organes, tous les détails du corps d’un animal, comme dans une véritable dissection. C’est de l’anatomie imitative.” (Garrigou, 1867, p. 491)

The clastic models of Dr. Auzoux were not presented, in the early days of the Universal Exhibitions, in the classes reserved for the elementary teaching of science, since they did not exist until the London Exhibition in 1862. In 1851, during the *London Great Exhibition,* “the temple of the world’s industry”, the Auzoux models are classified in the VIth division, the one reserved for instruments of science and the arts (Laya, 1851, p. 6; Roux, 1855, p. 4-6). For the first Parisian exhibition in 1855, Auzoux products “composed of solid parts that can be dismantled one by one” (Commission impériale, 1855, pp. 89-90) are classified in the 6th section of the 12th class of the group IV, the one which brings together the objects of industries specially related to the learned professions and related to hygiene, pharmacy, medicine and surgery. From the first school exhibition proposed by the London Exhibition of 1862, the Auzoux models were brought together in the 29th class reserved for the methods and materials of elementary education, even though some nations had sent objects that could be used at the three levels of education: primary, secondary and higher education. Among the new productions exhibited that enrich the Auzoux collection extended to the plant kingdom —the catalogue for the year 1855 consisted of only fifty-three numbers, that of 1862 has eighty— the report of the international jury mentions, among other things, the *Gland du chêne débarrassé de ses enveloppes* (see figure 5) (Cloquet, 1862, p. 114).

Figure 5. Photograph of the Auzoux clastic model of the *Gland germé* [Fruit of the Oak *Quercus robur*] *débarrassé de ses enveloppes* (Egginger, 2018, p. 31)

Source: Musée National de l’Éducation, inventaire 2009.00512.

Of the Vienna Exhibition in 1873, the jury report of group XXVI cites the collection of clastic anatomy of flowers, made by the German Robert Brendel of Breslau (now Wroclaw in Poland), but without forgetting to indicate in a rather chauvinistic way "that M. Auzoux, who had not exhibited Vienna, is the creator of clastic anatomy." (Levasseur, 1875, p. 382).

After the death of Dr. Auzoux in 1880, his widow continued for some time the work of her husband, helped by her own brother Amédée Montaudon. At the New Orleans Exhibition 1884-1885, several iconic models from the collection were presented like Clastic Man, Egg of Hen, Heart of Adult, Complete Eye, Ear, Larynx, Foot of Horse, Stalk of Stock *(Cherianfhus cheiri),* Grain of Wheat *(Triticum aestivum),* Spikclet of Wheat *(Triticum aestivum),* Kipe of Cherry, and Piece of dicotyledonous woody stem *(Quercus communis).* These clastic models complement those presented by the widow of Dr. François Germain Lemercier, who was long assistant of Dr. Auzoux. La collection Lemercier exposées comportait : Structural Anatomy of Man, Stomach expanded (two parts), Structure of the Stomach, Gastric Peptic Gland, The Same withered, A Cystose Gland, Gastric Mucous Gland, Glands of Brunner, Structure of the Small Intestines, Glands of Lieberkiihn, Villus of the Small Intestines, L'Écorché de Houdon (an anatomical human model), Maxilla, with its Support, the famous Big Molar-Tooth, Typical Foot of the Horse, A Bean, A Germ, A Small Nut, and Two Grains of Pollen (Buisson, 1886, p. 50).

3. ALSO TO SHOW WHAT IS NOT VISIBLE: THE ART OF TEACHING

3.1. Teaching by aspect

> "Ce n'est pas l'objet en lui-même qui doit être jugé, c'est son utilité pour l'éducation de l'homme, c'est l'examen du but qu'il doit atteindre, c'est la discussion et la constatation des résultats obtenus." (Pompée, 1868, p. 33)

To judge in what way, by what method the elementary teaching of the natural sciences is given in the schools of the exhibiting countries is a rather difficult thing. In the early days of school exhibitions, student work represented the largest part of the objects presented. Selected with great care by those who exhibit them, they show the results of teaching at its best. In going through them, many successive juries note that the natural sciences are taught in a more scientific way than the programs, which are also often exhibited, seem to require: they contain "a host of scientific details that are often not within the reach of children from 7 to 13 years old, which the assiduous student will no doubt easily learn by heart, but that he will not understand." (Gobat & Hunziker, 1890, p. 33). Elementary education is clearly not reduced to simple explanations of the most indispensable, usual and useful notions of the natural sciences. If it is permissible to judge the teaching of these sciences by the exhibition, it must be recognized, on the other hand, that the means of teaching play a preponderant role. Among the first of these to be exposed are intuitive means. The report of Charles Barbier, a municipal teacher in Paris and member of the jury of the class of 89 at the Paris Exhibition of 1867, praised the presence of "paintings for teaching by appearance" (Barbier, 1868, p. 117) hanging on the walls of the model classroom of the largest school building installed in the exhibition grounds, that of the Prussian School. The same was true at the Vienna Exhibition of 1873, during which a very large number of objects relating to teaching by aspect were exhibited in the Austro-Hungarian section (Levasseur, 1875, p. 389-399). The use of wall boards intended to be placed before the eyes of pupils in the classroom began to develop throughout Europe. Many schools were then equipped with these new objects intended to illustrate the lessons of the teachers and to complete their demonstration based on observation, comparison and then generalization. By seeing them, students observe, judge, remember,

imagine and reason no longer on words or ideas but on what they observe, in class or elsewhere. They learn to see, to examine, to know, and even to listen attentively to the teacher commenting on the illustrations on the plates. It is to educate the senses first, and then to exercise judgment through inductive reasoning. The wall boards are therefore at the service of teaching through appearance and observed knowledge, the cardinal virtue of the scientific spirit. They are also teaching materials suitable for collective use. They do not take the place of gigantic pages of textbooks but are more “wall paintings representing the objects that the teacher maintains with all the pupils” (Berger, 1888, p. 2854) and which he does not have at hand or which could not, in real size, be placed before them. Wall boards are exact representations of “natural” or unnatural objects, represented in the form of good, life-size, coloured drawings that are so attractive as to excite the curiosity of those who look at them. Quite often, a few explanations appear next to the illustrations.

3.2. Object-based teaching

Teaching by appearance is reinforced when the thing represented in two dimensions on a wall board is placed in front of the pupil and in his hand, but rather the thing in three dimensions. This is what the school museum allows, this collection of all kinds formed by the teacher or bought ready-made with a view to his teaching. This term must be understood in a more restricted sense to designate the usual objects used by the teacher in the teaching process called object lessons. The school museum is founded on the simple idea that it is enough to see to understand and is therefore “a valuable auxiliary to the object lesson” (Fatalot, 1888, p. 1991), a lesson on the thing and by the thing symbol of a science education for all.

Very quickly, criticism was levelled at school museums published by many education industries. The most serious were sent by the zoologist and academician Eugène-Louis Bouvier. He thinks that they contribute to completely disinterested the teacher and the students in the constitution of the museum. He also points out that ready-made museums, containing the most vulgar objects alongside relatively rare samples, are necessarily expensive, which makes their acquisition difficult. If they are cheap, like the *Dorangeon Museum,* the very numerous samples must be reduced in size, and they thus lose a large part of their value for teaching (Bouvier, 1886, p. 233). It is finally Dr. Saffray who indicates the way to follow in the notice placed at the beginning of his *Catalogue raisonné du Musée des écoles:*

> “Le musée de l’école, dit-il, tel que le comprennent nos éducateurs, doit être composé de deux parties bien distinctes. La première, ou *Musée-type,* comprend les objets nécessaires pour l’enseignement par l’aspect, pour la démonstration tangible qui doit accompagner toute leçon de choses, toute causerie d’histoire naturelle. La seconde, ou *Musée annexe,* comprend des objets destinés à donner des notions un peu détaillées sur les productions et les industries de la région : on y joint des spécimens de tous genres que les dons, les échanges et les recherches des élèves permettent de réunir.” (Saffray, 1885, p. 5)

Saffray thus proposes a “hybrid” school museum, which would be composed of a limited part of the sound samples of his *Musée d’école* manufactured, and objects brought by the master and his pupils. Reduced to these proportions, the museum sold by publishers would be more easily accessible to all budgets, and exotic products would be better represented. Some objects intended for lessons on the things of nature are not only observed and touched, they can also be broken down and then recomposed.

3.3. Teaching by action

Towards the end of the nineteenth century, the reform that sought to transform the elementary teaching of the natural sciences continued by developing still further the faculties of observation, comparison and generalization, according to the intuitive and inductive method. To this end, many school curricula in Europe introduce practical exercises such as animal and plant dissections. As this requires equipment that is still not very present in many primary schools, it is often the teacher alone who “operates” on his desk with the help of clastic models. Manipulable and dismountable, they make it possible to study living beings from several aspects. Often magnified more than ten times to better represent the organization, their large format facilitates the demonstration of the master at a distance. They are therefore pedagogical, because they serve the art of teaching natural sciences, and didactic, because they explain to students the biology of animals and plants. They also serve to set up a teaching of comparative anatomy which will be continued, for the most deserving students, towards the higher grades of the primary order. However, the rather high cost of clastic models is a definite obstacle to the individual practice of dissection and does not allow the student to be given a very active role. Some publishers then sought to adapt to this problem and developed their commercial offer by offering new inexpensive clastic models made of resin and soon of plastic material.

4. CONCLUSION

For his elementary teaching of natural sciences, the teacher brings to class samples taken from the nearby nature that the students are invited to observe attentively, or even to dissect. But he can also rely on samples from the classroom’s manufactured school museum, comment on the teaching boards hung on the classroom walls and manipulate the school’s clastic models. The place of objects from the school industry is therefore not negligible within educational spaces and the World Expos have played a significant role in their promotion and dissemination in Europe and the rest of the world, cheapness being an essential condition for success (Rapet, 1862, p. 50). The school sections of the Universal Exhibitions, designed and organized in a pedagogical and didactic spirit, were aimed not only at the initiated, but also at the general public whom they wanted to seduce and attract. They offered him the means of forming an idea of the methods of teaching, of comparing the principal methods, of noting the results, of appreciating the effects, here of indifference, there of general devotion to the public school; so that each visitor, if he knew how to observe and judge, could easily conclude from this examination whether he had reason to be proud or humbled of the rank of his country in the scale of education and progress. In order that each exhibition may remain a lasting monument, testifying to the great place that education has held in it, each organizing state has a detailed catalogue drawn up of the entire school section, and asks an international jury for education to report on all the objects exhibited. It is these types of documents, among many others, that constitute valuable sources for the historian of education. In fact, precursors or witnesses of the pedagogical reforms of primary science education that followed one another during the second half of the nineteenth century, are to be identified, inventoried, restored for some and enhanced, within the framework of heritage campaigns that we must all carry out at our level.

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