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The Military Academy for Mathematics of Barcelona (1720) and its role in the history of engineering in Spain

(1) Introduction

In the eighteenth century, a Spanish way of the Scientific Revolution reached its height.[1] Some authors affirmed that there was a militarization of science.[2] In the field of engineering, a military academy was established in Brussels in 1677 that was the model for the creation in Barcelona in 1699 of a new centre. The goal was to organize an Engineering Corps of the State, training its members in a school. This Academy began in 1720, after the War of Spanish Succession. H. Capel considers that the military engineers constituted the most important technological Corps of the Spanish monarchy.[3] Nevertheless, a more in depth study of the contents of the training is needed to understand the role of the Barcelona Academy in the history of engineering in Spain. The training of military engineers was conceived in the framework of "mixed" mathematics, a strong current in the Spanish scientific world. The courses in the Academy followed the textbooks produced by contemporary Spanish authors, such as Tosca.[4] The syllabus included modern scientific development, as is shown in classroom notes or in the catalogue of the library of the Academy.

This is a presentation of a project of research, just in its preliminary stage. The Military Academy of Mathematics of Barcelona has merit a series of interesting studies that provides us with a very important number of data and interpretations. The most complete study was made by Horacio Capel and his collaborators some years ago. After them, some historians of science, historians of art, and military historians have made outstanding contributions. The celebration of the third century of the creation of the Academy in 2003 was an occasion to make some new contributions.[5]

We would like to study some aspects not sufficiently developed by these authors. First of all, the training in the School can be studied going in depth in its contents. We plan to analyse the syllabus, mainly in Mathematics. It should be remembered that Mathematics included a broader field, where "mixed" Mathematics played an important role. Second, giving that in the 19th century Catalonia became the leading Spanish region in relation with engineering, mainly in its agricultural and industrial applications, we would like to analyse what was the impact of a centre of engineering working in Barcelona in the 18th century.

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[1] J.L. Peset; A. Lafuente, "El conocimiento y el dominio de la naturaleza: la ciencia y la técnica", in *Historia de España Menéndez Pidal*, (1988), vol. XXX–1, pp. 349–394; M. Sellés; J. L. Peset; A. Lafuente (comp.), *Carlos III y la ciencia de la Ilustración* (1988).

[2] J.L. Peset, "Ciencia, nobleza y Ejército en el Seminario de Nobles de Madrid 1770–1788", in: *Mayáns y la Ilustración* (1982), pp. 519–535; A. Lafuente, J.L. Peset, "Militarización de las actividades científicas en la España Ilustrada (1726–1754)", in: J.L. Peset (ed.), *La ciencia moderna y el Nuevo Mundo* (1985), pp. 127–147; A. Lafuente, J. L. Peset, "Las academias militares y la inversión en ciencia en la España Ilustrada (1750–1760)", *Dynamis*, 2, (1982), pp. 193–209; M. D. Herrero Fernández-Quesada, *La enseñanza militar ilustrada. El Real Colegio de Artillería de Segovia* (1990).

[3] H. Capel. *et al.*, *De Palas a Minerva* (1988); see also H. Capel, *Geografía y Matemáticas en la España del siglo XVIII* (1982).

[4] V. Navarro-Brotons, *Tradició i canvi científic al País Valencià modern* (1985).

[5] J.M. Muñoz-Corbalán (coord.), *L'Acàdemia de Matemàtiques de Barcelona* (2004).

(2) The Military and Modernization

After the War of Spanish Succession (1701–1714), a centralised state was established in Spain. There were many attempts to prevent the decline of the Empire. The new dynasty, the Bourbons, decided to reinforce the Military forces. The war continued in Europe, and in America. The Crown was convinced to strength the Navy for the protection of the transport of silver and other goods.

In the late seventeenth century, the Spanish Army planned its modernization applying science and technology into the warfare. The organization of academies for the training of officers as military engineers was proposed. Nevertheless, as Salavert has pointed out recently, the existence of the so-called "proyectistas" (project promoters) revealed the tensions between professionals and non-professionals in the world of Engineering.[6] One of the borders between these two fields was scientific training.

Peset and Lafuente considered that the Spanish Crown promoted a militarization of scientific activity in the 18th century.[7] They mentioned the set up of the Academy of Mathematics of Barcelona (1720), the Academy of *Guardamarinas* (Navy officers) of Cadiz (1717), the colleges of surgeons of Cadiz (1748), Barcelona (1764), and Madrid (1780). The College of Nobles of Madrid was also directed by military officers after the expulsion of Jesuits (1767). Peset and Lafuente interpreted that the Bourbons put the scientific policy of the State in the hands of the Army. In addition, the projects to set up an Academy of Sciences in Madrid, which would be a good opportunity for a civilian science, failed.

It is clear that in Spain the military played an important role in the scientific and technological activity in the 18th century. They intervened in a number of institutions and projects of construction. Nevertheless, the State also contracted foreign engineers and scientists, such as the French chemist Louis Proust. We think that the option for the military was not strategic, but a way to manage immediate needs, with no long term purpose to incorporate the Army to the Engineering or research. For example, in 1799, a civil corps of Engineering was set up. This was the origin of the profession as separate from the Army. The main responsibility of the members of the corps was the design and construction of the system of roads, construction of harbours, canals, etc.[8]

(3) The creation of the Academy of Mathematics (1720)

The Academy of Mathematics of Barcelona was a centre for training military engineers. The centre opened some years after the creation in 1711 of the Corps of Military Engineers. This was a pioneering initiative in Spain and Europe, with only similar precedent in France.[9]

The location of the Academy in Barcelona can be explained for several reasons. First, the projects to install an academy in Madrid in the last years of the 17th century failed; second, the Spanish Military Academy of Brussels was closed after the Utrecht treaties (1713–1715); third, Catalonia was the main centre of the Spanish Army in that time, because of the border with France, and the proximity to Italy, but also because the Army occupied Catalonia after the war of Spanish Succession, during which the Catalans opposed the Bourbons; finally, the Academy was a personal initiative of the Engineer in Chief Jorge Próspero Verboom, who was trained in the Academy of Brussels.

In 1720, the first director of the Academy of Barcelona was the artillery officer Mateo Calabro. Calabro stressed the general scientific orientation of the training, including cosmography and navigation. He had several differences with the Engineer in chief, Verboom, who considered that the Academy should give not only scientific training, but also applied knowledge. The differences also included the management of the Academy. Verboom thought that Calabro gave too many opportunities to non military and non aristocrat students.

[6] V.L. Salavert Fabiani, "Técnica y proyectismo en la España del Conde de Aranda", in: J.A. Ferrer Benimeli (ed.), *El Conde de Aranda y su tiempo* (2000), pp. 61–107.

[7] A. Lafuente, J. L. Peset, "Militarización ..." (1985).

[8] A. Rumeu de Armas, *Ciencia y tecnología en la España Ilustrada. La Escuela de Caminos y Canales* (1980).

[9] H. Capel *et al.*, *De palas ...* (1988); J. Riera, "L'Acadèmia de Matemàtiques a la Barcelona Il·lustrada (1715–1800)", in: *2° Congrés Internacional de Història de la Medicina Catalana* (1975), pp. 73–128; J.M. Muñoz-Corbalán (coord.), *L'Acadèmia...* (2004); M. R. Massa Esteve, "L'Acadèmia de Matemàtiques de Barcelona (1720–1803) i els enginyers militars espanyols", *Quaderns d'Història de l'Enginyeria*, VII (2006), pp. 299–307.

(4) Pedro Lucuce and his course

In 1738 Pedro Lucuce was named as new director. All the authors agree that Lucuce conducted the most brilliant period of the Academy. Pedro Lucuce was born in Avilés (Asturias) in 1692. He entered the Army in 1711 and participated in the War of Spanish Succession. After the war, he was in the Royal Guard in Madrid, where he studied Mathematics. In 1730 he was admitted as member of the Corps of Military Engineers. In 1736 he was named teacher of the Academy of Mathematics in Barcelona, after several positions in the Army. He was the director in the period 1738–1779. In 1756, he was named director of the Military Society of Mathematics in Madrid, an attempt to promote research in Mathematics in the Spanish Army. Two years later the centre was closed down. In 1768 he was in charge of a report on the unification of units of measure in the Army. The report was published in 1773.

It must been pointed out that in 1739 the ordinance of the Academy obliged the director to select the most useful textbooks in order to form a syllabus that must be dictated to the students. Each 15 days, the students should present to their teacher the written version of what was dictated. In the archives of the Army in Barcelona, there exists a handwritten version of the Course of Mathematics dictated by Lucuce, corresponding to the treatises 3 and 7. The notes were taken by two different students.[10] There is not a date of the manuscript, but a mention to Benet Bails suggests that the notes can been dated at the years 1770.

A preliminary study of the two treatises of the Course of Lucuce leads us to several conclusions. Analysing the treatise 3, it seems inspired by the volume 3, treatise 7 of the *Compendio Mathematico* of Tosca (1710) and also by the *Dictionaire Mathématique* of Ozanam (1691).[11] The influence of the books of Belidor has been stated by several authors, but this is not confirmed by our preliminary study. For instance, Trigonometry in the course of Belidor is defined as a part of Geometry; in contrast, Tosca and Lucuce defined Trigonometry as a science which showed us to solve triangles.[12] In relation to the other definitions, we find more similarities between the three authors, but there is a closer coincidence in the problems proposed by Tosca and Lucuce.

Treatise 7 contains Static and Optics. Comparing with the corresponding parts of the *Compendio Mathematico* of Tosca (vol. 3, treatise 9 on Machinery; vol. 4, treatise 12 on hidrotechcnology; vol. 6, treatise 18 on Optics; vol. 6, treatise 19 on Perspective), we found several similarities.

(5) Influence of the Academy

As Capel and his collaborators pointed out, only an eight per cent of the graduates of the Academy of Mathematics obtained a post in the Corps of Military Engineers. The Academy, therefore, was conceived as a way to perform the training of the officers, not as the way to enter in the Corps. Giving the fact that the Academy admitted non military students (officially, 10 per cent each year), Ernest Lluch wondered which the destiny of the graduates of the Academy was.[13] Most of them would be officers of the Army with no technical responsibility.

The Academy of Sciences and Arts of Barcelona was founded in 1764 by 16 gentlemen.[14] One of them, Ramon de Marimon, was member of the Army, probably a graduate of the Military Academy of Mathematics. We have no information about his further participation. Josep Subiràs, graduate of the Academy, was a very active member of the Academy. The Academy also named Joan d'Escofet Palau in 1790. He had been teacher of the Academy of Mathematics and was an distinctive officer of the

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[10] Military Archives, Anònimo (without date, Barcelona).

[11] See T.V. Tosca, *Compendio Mathematico en que se contienen todas las materias más principales de las Ciencias, que tratan de la Cantidad* (1757) and M. Ozanam, *Dictionaire Mathématique. Idée générale des Mathématiques. Dans lequel sont contenus les termes de cette science, outre plusieurs termes des Arts & des autres Sciences, avec des raisonnements qui conduisent peu à peu l'esprit à une connoissance universelle des Mathématiques* (1691).

[12] See Belidor, *Nouveau Cours de Mathématique a l'usage de l'Artillerie et du Génie où l'on applique les parties les plus utiles de cette Science à la Théorie & à la Pratique des differents sujets qui peuvent avoir rapport à la Guerre* (1725).

[13] E. Lluch, *Las Españas vencidas del siglo XVIII: claroscuros de la Ilustración* (1999).

[14] A. Nieto-Galan, A. Roca Rosell, *La Reial Acadèmia de Ciències i Arts de Barcelona en els segles XVIII i XIX* (2000).

Corps of Military Engineers. He directed the works of the Royal Road between Barcelona and Madrid. These examples indicate that the military engineers played a role in the Academy of Sciences and Arts of Barcelona. Nevertheless, this role should be better studied.

The Spanish Corps of Military Engineers had a small impact in civil society during the 18th century. Its intervention in civil engineering was covered in 1799 by the set up of a new Corps, in this case not depending of the Army.[15]

In Catalonia, in the very beginning of the 19th century, a series of technical schools were founded.[16] They were promoted by the Board of Commerce, an independent entity funded by the State where the most relevant trade makers and industry entrepreneurs were represented. These schools were the basis of the engineering school created in 1851. In the first half of the 19th century, they developed a culture of engineering.

The creation of the schools of the Board of Commerce began when the Academy of Mathematics was in decline and, finally, was closed in 1803. Was the existence of the Academy a contribution to the culture of engineering in Catalonia? What was the activity of the graduates outside the Corps of Military Engineers? Who were the civilian trained in the Academy? How can we evaluate the contents of the training in the Academy in its different periods? For the moment, we are not able to answer these questions. Our research will be focused in these subjects.

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[15] A. Rumeu de Armas, *Ciencia y tecnología...* (1980).

[16] Á. Ruiz y Pablo, *Comercio y navegación de Barcelona. Historia de la Real Junta Particular de Comercio de Barcelona (1758–1847)* (1919); F. X. Barca-Salom, "L'Escola de Matemàtiques de la Junta de Comerç", *Quaderns d'Història de l'Enginyeria*, vol. 1 (1996), pp. 83–126; A. Escolano Benito, *Educación y economía en la España ilustrada* (1988); A. Roca Rosell, "Técnica, ciencia e industria en tiempo de revoluciones. La química y la mecánica en Barcelona en el cambio del siglo XVIII al XIX", in: M. Silva Suárez (ed.), *El siglo de las luces. De la industria al ámbito forestal. Técnica e ingeniería en España* (2005), vol. III, pp. 183–235; C. Puig-Pla, *Física, Tècnica i Il·lustració a Catalunya. La cultura de la utilitat: assimilar, divulgar, aprofitar* (2006); A. Nieto-Galan, A. Roca Rosell, "Scientific Education and the Crisis of the University in 18th Century Barcelona", in: M. Feingold, V. Navarro-Brotons (ed.), *Universities and Science in Early Modern Period* (2006), pp. 273–288.