Exhibition "Leonardo Torres Quevedo: The Universal Engineer"

Through August 2020 more than 21,000 people have visited the exhibition **"Leonardo Torres Quevedo: The Universal Engineer"** at the King's Castle of San Vicente de la Barquera, Spain (see Figure 1), organized by the Academy of Sciences, Engineering and Humanities of Lanzarote and the association of Friends of Scientific Culture, in the context of the commemoration of the centenary of the *Electromechanical arithmometer* (1920–2020), the last great contribution to the History of Computing from the Spanish genius, characterized in 1930 by Maurice d'Ocagne as "the most prodigious inventor of our times" (*Le Figaro,* May 25, 1930, p. 6).

Given the size of the castle, it has been possible for the first time to conceive a complete tour of Torres Quevedo's work articulated in four sections which, from February 2020 and until lockdown as a result of the pandemic, could only be visited separately and simultaneously in two different venues: the Palace of the Audience in Soria (exhibition "Leonardo Torres Quevedo: From Cable Cars to Automatics"), and Spanish National Research Council's Institute of Physical and Information Technologies ("Leonardo Torres Quevedo: The Conquest of the Air").

The tour thorough the work of the Spanish genius begins with the section dedicated to the *transbordador*, the system conceived by Torres Quevedo in 1883–1884 and developed over the next few years to conquer the air by means of an aerial funicular of multiple supporting cables working at constant tension independent of the transported load and which *auto-balance* in the event of the breakage of any of them. (For more information, see ojs.ehu.eus/index.php/Fabrikart/article/view/12495/11403)

In 1890, Torres Quevedo changed his interest toward the development of his *auto-rigid airships*, the *telekine*, and *algebraic machines* (which solved algebraic equations).

The second section of the exhibition (see Figure 2) is devoted to the solution of the problem of air navigation by means of his airships, characterized by their internal funicular beam made of nonmetallic elements that self-rigidify by only the pressure of the internal gas, an invention patented between 1902 and 1907 in France, Spain, and the United Kingdom, tested over the next few years and manufactured for various countries during the World War I and post war era, including those by the French Zodiac Company which influenced the design of most later dirigibles. (For more information, see tandfonline.com/doi/abs/10.1179/175812111X13033852943237.)

The third exhibition section, describes the history of the *telekine* (see Figure 3), for which on December 10, 1902, Torres Quevedo had filed in France the patent application for a "Système dit télékine pour commander à distance un movement mécanique," perhaps the world's first complete remote control system, conceived to command airships without risking human lives. In essence, an automaton capable of memorizing, interpreting, and executing by itself a series of codified orders received from an emitter of hertzian waves. (For more information, see ethw.org/Milestones:Early_Developments_in_Remote-Control,_1901.)

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Figure 1. King's Castle in distance and entrance to exhibition at the Castle.

Throughout 1905, Torres Quevedo carried out tests remotely controlling an electric car with electric batteries and motor and also electric boats, one in the Casa de Campo pond in Madrid and a second and bigger one in Bilbao's estuary. Having demonstrated the possibilities of radio control with cars and boats, he did not consider it necessary to test his invention with his airships.

The fourth exhibition section (see Figure 4) deals with Torres Quevedo's work in computing and automatics. This was his most important work and the most relevant to this journal.

Once the tests of the *telekine* were completed, the Spanish government created the Laboratory of Applied Mechanics in 1907 to allow Torres Quevedo to carry on the construction of his *algebraic machines* designed at the end of the 19th century, and develop the potential implicit in the *telekine*—arguably the first electromechanical automaton in history and the starting point for his automatics.

In 1910, he presented "some general considerations on the procedures of mechanical automation that allow the intelligent activity of the worker to be replaced by the purely mechanical work of the machine," together with the designs of the first electromechanical digital computer in history . . . and the first approach to "a new body of doctrine," his automatics, that would give theoretical support to the new machines he had in mind.

Thus, between 1913 and 1914, Torres Quevedo presented in Madrid and Paris his first automatic chess player, an electromechanical automaton that unfailingly defeats the human opponent in a final game of rook and king (handled by the machine) against king (defended by the person), demonstrating in a practical way the possibilities of artificial intelligence.

Figure 2. This room has many posters of Torres Quevedo's airship work; half of them are shown in the figure.

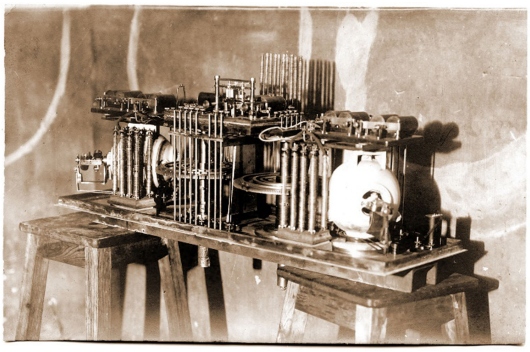

Figure 3. 1905 postcard of the *telekine*.

Figure 5. Picture of the 1920 *electromechanical arithmometer*.

In 1914, he published his *Essays on Automatics*, defining this new science to be about "automatons endowed with discernment," which Torres Quevedo exemplifies in this monograph with the designs of an electromechanical *analytical machine* and extends the application to his chess player.

Finally, in 1920, he completed his *electromechanical arithmometer* (see Figure 5) which, endowed with a keyboard, a computing unit, artificial memory and printer, might be considered the first modern computer, whose centenary is being commemorated throughout 2020. (For more information, see http://gaceta.rsme.es/abrir.php?id=469)

(Brian Randell in his 1975 book on *The Origin of Digital Computers: Selected papers*, provided the first English version of both, the *Essays on Automatics*, originally written in Spanish and translated into French in 1915, and the monograph on the *electromechanical arithmometer*, available since 1920 only in French.)

All four sections of the exhibition are accompanied by articles, books, blueprints, and letters.

Various sections of this exhibition have been previously exhibited at Spain's National Science and Technology Museum in La Coruña, Cosmocaixa Alcobendas, Eureka! Science Museum in San Sebastian, Bilbao's Bizkaia Aretoa, Madrid's Science Fair, the Universities of Lleida, Zaragoza and Madrid, etc. In the coming months, while we approach the date for the opening of the permanent Exhibition Space dedicated to Torres Quevedo in his native home town at the Valle de Iguña, this temporary exhibition is planned to be shown in Madrid, the Diocesan Museum of Santillana del Mar, the City Library of Aguilar de Campoo, etc. The exhibitors believe it is necessary to

Figure 4. Portion of the computing and automatics part of the exhibits; the bust in the picture is one of two busts in the exhibition.

keep showing Leonardo Torres Quevedo's work until he receives the recognition he deserves as "the most prodigious inventor of his time."

Further information on Torres Quevedo's contribution, the articles and books we have written, etc., can be found at: www.torresquevedo.org. Updates about exhibitions, lectures, articles, etc., will be posted at facebook.com/groups/leonardo.torres.quevedo

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Resources and Opportunities of the IEEE History Center and ETHW

The ieee history center opened in 1980, just as computers were becoming personal for people beyond the early adopters and the Computer Society signed its 44 000th member. Since then both organizations have expanded the ambit of their activities. The Center offers considerable resources for historians of computing: in free, online primary, and secondary sources, and funded opportunities and awards.

The History Center administers the Engineering and Technology History Wiki (ETHW, ethw.org). Currently enjoying two million visitors per year, this site acts as a repository for professional technical organizations, technologists, and researchers who want to upload and contribute relevant archival or primary documentation or articles. Over 50 first hand histories relating to "Computers and Information Processing" and submitted by individuals include memoirs by Allan Alcorn, IBM veterans, and Eleanor Ireland. Subjects range from working at Intel and NEC to creating early digital art and the MELVYL catalog. The site also hosts the IEEE Milestone Program, which includes recognition of numerous computer-related achievements around the world. Practitioners or historians seeking a stable archive at which they might place memories and historical materials they may have collected should consider using the ETHW.

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In the opportunities domain, through its administration of the IEEE Life Members Fellowship (ieee.org/about/history-center/fellowship.html), the History Center has supported historians in computing. The US$25 000 grant, which helps underwrite a year of scholarship, has assisted 15 junior scholars since 1995 with their projects. Their names and research titles will be familiar to *Annals* readers, including Jacob Gaboury ("Image Objects: An Archaeology of Computer Graphics"); Joy Lisi Rankin ("A People's History of Computing in the United States"); Corinna Schlombs ("Productivity Machines: German Appropriations of American Technology from Mass Production to Computer Automation"); and Andrew Russell ("Open Standards and the Digital Age: History, Ideology, and Networks").

The Elizabeth & Emerson Pugh Young Scholar in Residence (ieee.org/about/history-center/internship.html) underwrites two months of research experience for promising scholars in the history of technology and engineering. The recipient helps with the Center's projects connected to their own area of interest.

The Bernard S. Finn IEEE History Prize (ieee.org/about/history-center/prize-paper.html), formerly the IEEE Life Members' Prize in Electrical History, honors the best paper in the history of electrotechnology published in a scholarly journal during the preceding year. Recent winners include Thomas Haigh and Mark Priestley, Gerardo Con Diaz, and Bernard Geoghegan. The recently instituted IEEE William and Joyce Middleton Electrical Engineering History Award