Portable Steam Engines and Traction Engines and their Use in Rural Areas. The Case of Lezíria Ribatejana, Portugal

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In the second half of the 19th century, the area known as Lezíria, in Portugal, started to use portable steam and traction engines in agricultural production. From more than a hundred examples, all of them manufactured in England, a few more than a dozen survive nowadays with different levels of preservation. This paper is a first attempt at their study, marking their use and importance in different agricultural activities in the production of goods (such as olive oil) through an archaeological perspective.

Introduction

The purpose of this paper is to investigate the use of portable steam and traction engines in a very specific rural area in Portugal known as Lezíria, and to demonstrate the significance of these machines to industrial archaeology studies in Portugal.

More than a geographical zone, the Lezíria is a cultural region located in the floodplain of the River Tagus. This extension of land is located from Salvaterra de Magos, passing through the fields of Vila Franca de Xira, extending north to Alpiarça and Golegã[1]. These areas developed a type of agriculture that is in direct relation with the River Tagus' flood cycles and natural behaviour, producing, among other minor crops, wine, olive oil and cereals. The region is integrated in an extensive geographical and cultural area known as Ribatejo. These lands developed along the Tagus River naturally over the centuries due to its silting or artificial drying of the fields. Geographically, it corresponds to roughly 900 km^2 on both sides of the Tagus River (Fig. 1). While the characterisation of a geographical area is easy, the challenge is to determine the level of correspondence between the geography and specific social and cultural zones within it.

The study of portable and traction steam engines in Portugal is fairly recent. Indeed, the methods used to analyse these machines originated from the study of larger stationary steam engines, the first to arouse attention among archaeologists,

especially since these were located inside the industrial buildings the researchers intended to study[2]. Nowadays, the study of industrial equipment is practically an exclusivity for archaeologists, with student dissertations also being a focal point for the subject[3].

The initial prominent study of portable steam engines in Portugal was a research project developed by a team of archaeologists entitled "The use of steam in Portugal (1820-1974)"[4], one of the main objectives of which has been to map all the surviving steam engines in the country, and to study their use, context and economic importance[5].

The study of portable steam engines fits into the concept of 'archaeology of the machine', as Neil Cossons defines it, denoting that these studies have not been given the attention they deserve in view of their capacity to study the socio-politics and economic importance of the materiality of industrialization[6]. They are direct testimonies of how industrialized technology was used in agricultural production.

The type of steam engines used in agricultural production in the Lezíria correspond to three different major categories: portable steam engines, traction engines and stationary steam engines.

Despite not being the purpose of this paper, stationary steam engines were also key in the generating of energy in the agricultural activities of Lezíria, even though they were largely outnumbered by portable steam engines. The oldest stationary engine (rated at 2 hp) in this area is documented through written evidence from 1842 in Quinta da Cardiga to power an olive oil mill[7]. These same documents also allude to another stationary steam engine in Quinta da Alorna (18 hp) a few years later (1851), though we believe that this one was a boiler manufactured in Portugal which operated a vertical engine made in France, thus two different engines[8]. Such stationary engines existed in other properties as well, such as Rio Frio, Quinta do Casal Branco in Almeirim, or the farm of the Casa Cadaval in Muge. If portable steam engines could be moved to work with different accessories, the stationary ones, due to their size, would be located inside a building and operate fixed engines, supplying energy to more demanding equipment.

Stationary steam engines are therefore quite frequent in Portugal and a direct testimony of the country's recent industrial past, however only two have been given

legal protection and neither example is in Lezíria. These engines are in the Estação Elevatória dos Barbadinhos[9], which supplied water to Lisbon; and in the Vale de Milhaços gunpowder factory.[10] Others survive due to the effort of private owners. Most examples which existed in Portugal were scrapped after being decommissioned. The concern about the future of these machines has been an object of discussion in a study about the recovery of one of these steam engines produced by Buckley & Taylor (Oldham, Greater Manchester), belonging to a textile factory from Soure, today displayed in a shopping mall[11].

As for portable steam engines and traction engines, the numbers are greater and it is possible to find several extant examples in Lezíria (Table 1), a number which increases enormously upon the consultation of archival evidence. In this paper, only five portable steam engines will be the focus of the discussion. They were specifically chosen on the basis that they operated in key points of Lezíria and it is still possible to visit most of them, therefore allowing for an evaluation of their original context. Surviving textual information also tell us that these were functionally differentiated, demonstrating their varied uses in late 19th and early 20th centuries. When comparing numbers, portable steam engines significantly outnumber traction engines, something that appears to have been a convention in numerous countries besides Portugal. As Gregory Trevor remarked: "The first portable engine appeared before the first traction engine. But the last portable engine appeared after the last traction engine"[12]. Portability won over traction since the latter could not compete with portable diesel engines appearing in early 20th century.

Moreover, the Lezíria region has geomorphological characteristics making it more amenable to the use of portable steam engines. The uneven terrain would create problems for the work of ploughing engines or traction engines pulling ploughs, only possible in not marshy plains.

Portable steam engines

Generally speaking, a portable steam engine is a source of energy built on very simple technology. It has a firebox and a boiler barrel, inside of which several tubes would be heated while transporting hot air into a smoke box, connected to a chimney. The steam produced by the boiler is injected into an engine, usually located in the upper

part of the boiler. This engine, which could be simple or compound (two twin cylinders or a high pressure and a low-pressure cylinder), triggers one piston connected to a crankshaft, moving two flywheels coupled with the help of a belt, usually made of leather. This belt could also trigger other machines that had no independent energy source, such as threshing machines, balers, sawmills, water pumps and stone crushers, among others.

The first portable steam powered machine is considered to have been built by the British engineer and inventor Richard Trevithick in 1812, although the only evidence is a letter from him to the financial and agricultural writer Sir John Sinclair[13]. However, this is likely given that the patent for the use of steam given to Boulton & Watt had expired the year before. It is in the subsequent years that several companies and consortiums appear, developing machinery such as John Fowler, Ransomes, Richard Garret, Foster, Clayton & Shuttleworth, and Brown & May, just to name a few.

In the book *Portable Engines*, Trevor Gregory mentions that portable steam engines developed due to the need to provide energy to threshing machines, their more faithful 'customer'[14]. The use of these two pieces of equipment was clearly one of longest relations in the primary sector. In Portugal, these associations are constantly mentioned in the archives since portable steam engines' owners were required to submit their equipment to different security tests[15].

These machines appear in Lezíria in the 1860s, some decades after the first stationary steam engines[16]. However, their presence was not widespread. This new technology, for different reasons, was not available in every farm, thus, agricultural production continued to be for the most part non-mechanised until late 19th century, with animal force being among the most regular source of energy for ploughing or even water pumping. In the catalogue of the *Exposição de Alfaia Agrícola na Real Tapada da Ajuda*, an exhibition made in Lisbon in 1898, most farming devices presented in this volume were still operated by men or animals, demonstrating that despite their presence, steam engines were not the most frequent form of producing energy[17].

The highest production period of these machines in England occurred between 1895 and 1915, and its end was dictated by the development and spread of the diesel engine[18]. However, some of these machines, although the real number is impossible to determine, most of them acquired in early 20th century, during the highest production

moment, were used in farming activities until at least the 1960s. This information was obtained from oral testimonies of people who still worked with them. Nevertheless, official information from government records traces their use around the same date range[19]. It was a government duty to inspect these machines, following a law passed in 1884[20], due to the dangers they could represent for workers[21]. Although rare, some boiler explosions have been documented[22]. The testing of the machines led to the creation of a process in which all the documents were made available for future inspections. All the machines received a small plate with the process number testifying their approval (Fig. 2). Nowadays, all the documentation of these procedures are kept at the former Direcção Regional de Economia de Lisboa e Vale do Tejo archive (ex-DRELVT), although not publicly available for consultation anymore[23].

One of the best preserved portable steam engines from Lezíria is kept at the Benavente Museum. Not much is known about it except that it was built by the Davey Paxman & Co. Ltd., in Colchester, England, with the construction number 15209 (Fig. 3). The surviving testing plate, dating to 28 January 1950, refers to Process 246, although the folder detailing the procedure involved was never found at the former DRELVT archive.

Portable steam engines were slowly and carefully introduced in the life of rural populations beginning in the late 19th century. Land owners were conscious of the obstacles in adaptating to these new engines in terms of production and labour. Furthermore, in considering yield capacities of respective locales, the type of production and the available number of workers also had to be taken into account[24]. This period marks an age of changes in traditional agricultural methods that were not always well received by people. Several writers wrote in their novels of the way people felt about steam engines. For example, the novel *Gaibéus* by Alves Redol, published in 1939, is one of the best cases where the author mentions several times the loud sound of the machine with its *tan tan tan tan tan tan…*, that would destroy the traditional silence[25].

While hundreds of these machines may have worked in Lezíria, changing a traditional rural landscape, physical and documentary evidence do not testify to more than two dozen objects. As noted above, five examples will be discussed in this paper, which best articulate the story behind their use.

Quinta da Alorna, Almeirim

In this large property, where wine and olive oil, among other products, were extensively produced, there is a portable steam engine built by Ransomes, Sims & Head, in Orwell Works, Ipswich, England (Fig. 4). It was built between 1869 and 1880 during the 11 years in which that company held those three names, one for each partner[26]. Its construction number is 4302 and it has two inspection processes, one for the boiler (809) and another for the engine (620) with a force of 12 hp. The oldest document referring to the engine is dated 8 July 1896 and the most recent 1973, when it was decomissioned and said to have been sent to a junkyard, a destiny that had been traced since 1954 when the equipment is stated, in another document, as not working anymore[27]. This machine had several uses in the farm during its active life. It was clearly used in association with a cereal mill which still survives at the property[28]; a grape grinder (from the French producer E. Mabille Fréres)[29]; and an olive oil mill. However, this last use was not the chief one dictating its acquisition, since the Quinta da Alorna was one of the first farms to have a stationary steam engine (1851) in this area of the country for exclusively powering an olive oil mill, a *Veraci* system. Although not surviving, there are documents and even some photographs of a boiler and a stationary vertical engine that would be working in a factory building where an olive oil mill used to be in early 20th century. Some workers of this farm told us that when that stationary engine was decomissioned, the portable steam engine was placed outdoors and powered the mill (Fig. 5).

Quinta do Casal Branco, Almeirim

In the Casal Branco farm two similar portable steam engines have survived. While one continues to reside at the farm, the other was leased by the Braancamp Sobral Lobo de Vasconcelos family to the Almeirim Museum, now residing in the lobby (Fig. 6). This large equipment was built by the Clayton & Shuttleworth company in Lincoln, England, generating 35 hp. It has the construction number 87316 and the plates detailing equipment's testing (process 4038) reveal that it worked between 1934 and 1962, though probably acquired in early 20th century when the farm started to register means for production enhancement. It is a curious example since it reveals some

changes made after its arrival in Portugal, which may indicate some security issues, such as the protection of some gears with a metal plate, preventing potential injuries to workers. Two processes exist in the ex-DRELVT archive mentioning that the Casal Branco had two other portable steam engines, both also built by Clayton & Shuttleworth (processes 3147 and 3598). Any of these may have been used in association with a threshing machine which still exists at the property. The estate still preserves today a large stationary steam engine. The boiler is a Babcock & Willcox, built in 1920, while the horizontal engine, bearing the year 1930, has no builder imprint[30]. The owner of all these machines appears in the former DRELVT archive as being Manuel de Braamcamp Sobral, son of the former Earl of Sobral.

The study of the Casal Branco engines may in fact shed light into the history of the farm, since one can consider that owning four portable steam engines and one stationary engine denotes a substantial level of production.

Chamusca

Many portable steam engines machines, due to their technological obsolescence and lack of monetary value, where simply discarded by their owners. Sometimes, the respective municipalities recovered them and displayed them in public places, transforming them into monuments. This seems to be the case of one of the engines located in Chamusca, in public exhibition since 2000 (Fig. 7). It belonged to the Vasconcellos Melo family, who owned several properties in the area. It was built in Lincoln, England, by Ruston, Proctor & Co. Ltd., with the construction number 36341 and an output of 10 hp. Although we have no idea about the production activities it was involved in, it seems to be the machine appearing in several photographs made in the 1950s representing the rural country[31], so it is safe to say it was clearly involved in agricultural work.

Quinta de Santo André, Coruche

A portable steam engine made by Marshall, Sons & Co Ltd, Gainsborough, England, construction number 47090, is owned by the Veiga Teixeira family in a farm in Coruche (Fig. 8). This machine operated an olive oil press mill, a *Veraci* system, that the farm's owner decided to preserve, so it is still associated to its primary use context. For many

years, its wheels were removed and it became temporarily stationary. Despite its uncertain construction date, it is clear from consulting the inspection plates that it was fully functional in the 1930s and 1940s. It is a curious example of how workers interacted with the machine since one of those men, the late Mr. Antero, a resident in Benfica do Ribatejo, and who worked at the olive oil mill in the 1950s, just a boy at the time, mentioned once to the authors how good October quinces tasted when roasted inside the engine's firebox, one of his most beloved memories.

Earl of Sobral olive oil mill

The Earl of Sobral was the owner of several properties in the Almeirim area, including the Casal Branco and the aforementioned stationary and portable steam engines from that estate. However, there is documentary evidence of other machines which might have worked on his other properties. Process 811 from the former DRELVT archive refers to one of those machines which was on his property (not mentioning which) in 1896 and used for "agricultural activities". This same machine may have been in use in 1905 and is revealed in the book *Dois lagares de azeite: officinas, material, technica e notas economicas,* discussing the organization of two olive oil mills in the Almerim area, one of them, again a *Veraci* system, as the property of the Earl of Sobral. The mill's equipment was operated by a portable steam engine, made by the Robey & Cº Ltd (Fig. 9). The same book mentions that this engine was used in the winter to activate the olive oil mill and in the summer to pack straw[32]. Although physically not surviving, there is clear evidence of its use in the olive oil mill, fundamental in understanding the use of such machinery.

Traction engines

The number of traction engines, known as *caminheiras*, working in agricultural fields is rather reduced when compared with portable steam engines. The reasons behind this paucity are clearly related with the character of the terrain of these properties, which were not level enough, and with the costs associated with the acquisition of such engines. Only very rich land owners, with vast property and available capital, could in fact buy them.

A traction engine uses the same technology as a portable steam engine, however the energy produced by the boiler is used to provide traction energy to its wheels, making it move. Since it must be manually operated, it has a compartment for two people: the driver and the fireman, the latter being responsible for feeding wood or coal to the boiler. The traction engines' ability to move does not mean that they were not used to provide energy to other equipment, but they were generally used as traction engines for ploughing, or even as steamrollers to make roads[33].

The first traction engines were built in England in 1859[34], excluding the machine designed by Nicolas-Joseph Cugnot in France in 1771, on display at the Musée des Arts et Metiers in Paris as a prototype. The concept was developed by Thomas Aveling and Richard Garret, who considered it counterintuitive for a machine which produced energy to be pulled by horses[35]. The most well-known producers for these machines were the companies John Fowler from Leeds, Charles Burrell from Thetford and Aveling & Porter from Rochester, among many other smaller ones[36].

In 1879, the *Companhia das Lezírias*, a large Consortium of rich farmers and investors, including the Portuguese crown (which owned over 48,000 hectares of land)[37], is mentioned in the publication *Gazeta dos Lavradores*[38] as the first company dedicated to agriculture to ordering of farming equipment from England in the form of a ploughing engine and its accessories (at the cost of 5.000. *reis*), built by Howard[39] that would work the company's land as well as anyone's who would rent it.

For the Lezíria region, one of the most reliable sources of information are photographs of agricultural work. Some of the known photographs are kept at the Vila Franca and Coruche Museum. In one of those photos (Fig. 10), there is a traction engine being used in agricultural activities. There are six people in this specific photo whose clothes are indicative that this was photographed somewhere in Ribatejo[40]. One of the most curious peculiarities of this machine is the upper protection of the chimney, shielding against any sparks that could ignite the straw. This solution was not observed in other engines, such as the fifteen examples that were employed for road construction by the National Roads authority. In another example from Coruche (Fig. 11) we can observe as the traction engine is *alqueivando*, or fallow the land after the crop, which was made by human hands using sickles.

Despite the technological impact that these machines may have had in the agricultural production, they did not entirely usurp human labour. Two men would be required just to operate the machine – the driver and the fireman – while several others would help in its work. Ploughs and other accessories would need people to carry them into the field, bearing in mind that neither of the two men operating the traction engine would be doing such tasks.

The use of steam in the Lezíria agricultural production

The first steam engine to operate in the Lezíria area is said to have been used to power an olive oil mill in Quinta da Cardiga in 1842. Almost a decade later (1851) another stationary steam engine was also generating energy to produce olive oil in Quinta da Alorna. The use of fixed machines seems to have been rapidly replaced by portable steam engines, and by late 19th century the number of portable equipment surpassed that of stationary engines. The reason is easy to understand. While a land owner would need a large building to accommodate a stationary engine and its boiler, a portable steam engine was not only smaller, but it could be used in many different activities throughout the year around the farm.

While portable steam engines were largely used in olive oil production, they also powered threshing machines, saw benches, balers, grape crushers, cereal mills, and the like. Many of the examples discussed in this paper were multi-functional. Their success was clearly related to their portability, activating olive oil mills, grape crushers, threshers, or balers[41]. Their impact on agricultural work in the Lezíria seems to have been extensive, and despite the lack of specific numbers of engines for respective properties, it seems that, in the context of olive oil production certainly, the use of traditional animal force completely disappeared by early 20th century, confirming the proficiency of steam engines in this production area. Olive oil, flour, and wine were the three main products whose production, initially using human and animal force, gained immensely from steam power.

The impact of the machines in the landscape was also remarkable. These new 'iron monsters' were producing new sounds and new visual impressions in their increasing influence on labour. They were also responsible for marking and dividing time more precisely. While before mechanized agriculture, the sunset typically dictated the end of

working day, the introduction of the steam engine and its whistle became the new signal for the end of a working day[42].

It is important to state that, despite their portability (with some engines being constantly moved around a property), those that performed a single activity, as was the case for the Santo André machine, had their wheels removed for extended periods.

The study of these machines has provided interesting information about the farms where they worked from an economic but also social perspective. Not all land owners were able, or needed, to acquire such energy generators and, as far as Lezíria is concerned, they were exclusively associated with large farms owned by noble families and with important titles, which had direct relations with the Crown. Large land owners in Portugal were almost exclusively nobles, therefore such equipment was necessarily connected to their properties, and usually more than one example.

Traction engines are only known indirectly through photos and documents. At least one of them was used in agricultural activities and owned by *Companhia das Lezírias*, a company of several land owners which possessed substantial tracts of fields which needed to be ploughed. Traction engines or steam tractors were more expensive and their existence in smaller numbers has led to their lesser survival to the present day.

Even though portable steam engines and traction engines were made in different countries in Europe and in the United States, all of the surviving engines in the Lezíria were produced in England. Future directions in this study may focus on English archives in order to understand whether Portuguese farm owners directly requested these machines from companies, or if the engines were sent to Portugal and then sold on to be used in large properties.

Conclusion

The study of steam engines and the impact of mechanization in agriculture in the Lezíria area is at its inception. Only seventeen portable steam engines survive from a likely number of some hundred in the first half of the 20th century, with some surviving until the 1950s, when they were replaced by universally more affordable diesel engines.

Their use, whether inside a building or in an open field, was to power several types of agriculture equipment which would press olives and grapes or grind cereal. The production of such foodstuffs was consequently enhanced by the introduction of this new technology.

While this paper has focused on a very specific territory, the use of portable steam engines in agricultural production is known to have taken place all over Portugal, though holistic studies have not yet been undertaken.

None of the engines mentioned in this paper has any legal protection. Despite their importance in the study of the agricultural production in Lezíria for almost 100 years, their preservation or destruction is entirely at the discretion of their owners and the sensitivity they demonstrate towards such machinery. Most of the machines remain derelict or are sent junkyards, evinced by several examples. Contrary to England, for example, none of the engines in Portugal remain functional. What is still part of living memory from some Europeans has been relegated to the more distant past for others, and few can still recall the smell of burned oil and the *tan tan tan tan tan tan* of these machines, disrupting the silence of the countryside.

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Captions

Fig. 1 – Map of the Lezíria region with the places mentioned in the text.

Fig. 2 – Inspection plates.

Fig. 3 – A portable steam engine from the Benavente Museum.

Fig. 4 – A portable steam engine from Quinta da Alorna.

Fig. 5 – The Quinta da A[43]lorna building where the olive oil mill and the portable steam engine were located.

Fig. 6 – A portable steam engine at the Almeirim Museum.

Fig. 7 – A portable steam engine from Chamusca.

Fig. 8 – A portable steam engine from Quinta de Santo André, Coruche.

Fig. 9 – The Earl of Sobral olive oil mill (after Freitas *et al.*, 1905).

Fig. 10 – A traction engine working in Lezíria (Museu de Vila Franca de Xira).

Fig. 11 – A traction engine working in Coruche (Coruche Municipality).

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