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This paper addresses some fundamental aspects of the circulation of knowledge connected with the spread of the cork laboratory management and organization in the early 1940s. By looking at the communication of research ideas between USA and Portugal, this paper first analyses the actors involved in this process, especially their agendas and means. Inspired by the widespread belief in the powers of science to improve cork products cork researchers gathered in institutions—among whom the “Junta Nacional da Cortiça (1936-1972)” proved most influential. We will see the way in which the Corporate Organization for Portuguese Cork - the institutional framework established by the Salazar dictatorship in the 1930s - dealt with the threats and needed cork development.

Cork research attracted reformers, foresters as well as civil engineers to whom it appeared to be a technology with performing powers. Second, the paper looks at the processes of hybridization and transformation of the cork knowledge that was communicated between USA and Portugal: the Almeida Garrett 1942 travel of learning and the origins of the Portuguese research in a small laboratory in Lisbon.

Finally, reports about the implementation of the cork research programs in Portugal an impact on Portuguese cork industry.

**Keywords:** cork research; laboratory; USA; Portugal; knowledge flows/transfer

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**A framework to explain cork knowledge flows.** This paper, addresses some aspects of the circulation of cork science and technology knowledge in the early 1940s. By looking at the transference of technology between the USA cork laboratories and Portugal, this paper analyses, first, the actors or mediators of knowledge involved in this process and, second, the dimensions and transformations of the knowledge mediated. I am thus trying to contribute to the discourse on the globalisation of technology knowledge and institutions from a historical perspective.

Some of the questions are drawn from debates on one of the major theoretical frameworks for comparative science research, the neoinstitutionalist school of sociology at Stanford University. One of the core issues of the neoinstitutionalist approach is a global convergence of institutions – a term used in a very broad sense, meaning organisational structures as well as cultural normative standards and “myths”. Technology History research within the

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1. The paper presents part of my work in the research group “Laboratorio de História e Política Florestal” at the Euronatura Center, funded by two Portuguese municipalities: Seixal and Coruche. A preliminary version of this paper has been fruitfully discussed with the participants of the 2011 APHES Coimbra Congress; “As instituições como agentes de inovação”, November 2011. I also want to thank ... for their helpful comments.


neoinstitutionalist frame includes large-scale empirical studies on – just to mention a few examples – international curriculum developments, the global circulation of certain reforms, or new trends in education. On the other hand, institutionalism seeks explanations for the major “diffusion” processes that took place (mainly) during the last 200 years, such as the spread of the nationstate, of human rights, or of institutions such as universities and educational ministries. In this paper, I employ some neoinstitutional assumptions regarding the conditions of model transfer to account for the appeal of the cork products research. However, I also want to confront aspects of the diffusionist model and the re-examination of the complex interconnections, links and relations between central and peripheral territories.

One question concerns the centre–periphery nexus and the directionality of knowledge flows in the historical context of the development of the Portuguese cork industry. Thus, in contrast to notions of one-way knowledge transfer, I want to show that one cannot assume a simple export of American institutions and rational scientific knowledge to the “undeveloped” territories. Of course, the economic relations of power did not stimulate symmetrical contacts – the knowledge flows differed.

I will present the notion that the creation of the Junta Nacional da Cortiça (Cork Portuguese Board, 1936-1972) was a turning point in Portuguese Cork research and development strategy. From the first years, the new Board made efforts to accommodate cork research to the last international research standards. The Board directors determined to link Portuguese cork with progress and modernity, commissioned a young engineer to visit and copy the best cork USA laboratories.

At the heart of this study is the relationship between politics, science and cork during this period. Portuguese fascism appealed to Portuguese researchers and scientists to defend their identity and their materials. This paper seeks to retrace the history of the first cork products Portuguese laboratory, thus providing a context for understanding the development of cork research. We will examine the institutionalisation of this cork research in public laboratories, the process of professionalization of first cork researchers, and the editorial politics of the scholarly journals. This should allow us to measure the significance of cork knowledge for public research and to situate cork research and its practitioners within the national and international sphere. It will be through the circulation of engineers and scientific artefacts that we follow the weaving of ties between cork countries.

The JNC (and the Instituto dos Produtos Florestais (IPF), 1973-1988) played a vital role in the management of the Portuguese cork research for half a century. Still, there is not academic literature about the JNC. Those are some of the reasons that have pushed for the release of this study: a) to bring the JNC to light and b) to recognize the important value of this institution within the cork industry and within Portuguese contemporary history. In addition, this study campaigns for the reappearance of some form of public associative group within the cork business, able to defend the interests of the sector. Knowing about the past of the sector helps to understand the present of it. Especially, it is relevant to enlighten the work of the JNC today because, due to the recent international economic crisis, several local governments in Portugal are aiming to implement some of the old duties the JNC performed at its time.

**ESTRUCTURE OF THE SUMMARY**

4 In a tribute to the history of the Portuguese Cork National Board (JNC), a book, released in 2010, entitled “Junta Nacional da Cortiça (1936-1972)” captures stories and accomplishments that haven’t yet been told about this Institution.
The article is divided in four parts that aim to cover the trajectory and the historic context of the JNC research lines in a comprehensive way. Thus, the first part deals with the circumstances in which the cork sector was, prior to 1936. The second, intends to explain how the JNC was a product of the political context of Portugal at that time: the “Estado Novo” which, on its turn, was characterized by favouring corporativism in the economy. The third, covers the Almeida Garrett “travel of learning” in the USA. Finally, the fourth chapter looks some aspects of JNC transference of technology, and its influence in other cork countries as Italy and Spain.

FIRST PART: PORTUGUESE CORK SECTOR PRIOR TO 1937

The Portuguese cork sector is not only important for being the biggest producer and manufacturer of cork in the world. In addition, Portuguese cork production enables the preservation of a precious ecosystem (rich in biodiversity): the “montado” (Cork oak forest). However, the cork industry in Portugal is going through challenging times. Today, the greatest part of the demand for cork comes from the wine and spirits trade, where cork is used as bottle’s stopper. But, since the beginning of the 80’s, spirits producers have started choosing alternative materials to bottle, such as plastic and aluminium stoppers. Within this critical context for the cork sector appears this study.

To begin with, it is worth noting that Portuguese cork started to have market value as a woodland product at the end of the XIX century. A succession of negative and positive events for the cork sector took place after 1880. During this first third of the 20th century, the foundations for the creation of the JNC were laid, the state started using specialized departments to institutionalize the “forestry services”, as well as to regulate technology, like it did with other sectors as the “fisheries.”

During the time frame from 1920 to 1936, the cork sector in Portugal was going through difficult times. For instance, the 1929 economic crisis that started in the USA, had an important impact on cork exports. The USA, that used to import 60% of the total Portuguese cork exports, drastically reduced its cork demand. However, even if the cork production often stagnated during the 1920s, cork extraction kept high. In fact, cork demand was so large that people started to indiscriminately harvest cork at the point of extracting “male cork” from the trees. Eventually, the appearance of these bad practices led to two attempts – along this period of time- made by interested parts, of putting into action administrative measures for the protection of cork oaks.

Therefore, it can be observed that efforts were made - even if timidly - to ameliorate the situation of the sector. Those efforts were coordinated actions amongst cork stakeholders. That fact would support one of our thesis, which is that the future of the Portuguese cork sector depends on the joining together of the actors interested in the “commercial survival” of this material.

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6 The first removal is therefore undertaken, and the male cork is removed which, being hard, inelastic, irregular and dense is unusable in the production of stoppers. It is only at the third removal, when the tree is over 40 years old, that cork of a high quality will be obtained.
Aplicações da cortiça (revestimento), n.º 840, EAFN colection.
SECOND PART: A NEW STATE WITH A CORK POLICY

In 1933, an authoritarian regime was installed in Portugal with the name of New State – “Estado Novo” in Portuguese - and with Antonio de Oliveira Salazar as his leader. The creation of the JNC took place within a centralist and corporatism ideological trend that prevailed in the “Estado Novo”. Scientists and engineers were important players in a political regime that replaced any form of liberal representation by ideological nationalism, the one-party state, systematic repression, and a social corporatism formed by organic social unities. The state should assume for the time being the responsibility of building a new social structure based on the harmony of the different organs. In 1936, Salazar took the opportunity provided by the Spanish civil war, to strengthen the country’s social structure with organizations of a fascist character.

New organisms of economic coordination were created to guarantee the discipline of different economic sectors. Be it rice, wine or cork, every major product of raw material deserved a new rationalizing para-State corporatist institution controlling exports, prices or quality.

The Salazar government created the JNC due in part to the consequences of the world economic crisis of 1929 on the sector. Furthermore, the following question is posed an open to enquiry: to what extent the cork was part of a promotion programme and a project to assert the state authority?

To begin with, it is worth pointing out that Salazar’s “Estado Novo” contributed to the institutionalization of the cork sector by creating the JNC. The new political regime started economic reforms addressed to the industrial sectors that were going through difficulties as cork sector was. As mentioned above, the economic policy of the Estado Novo was centred on a corporatism ideology. In addition, the regime’s economic agenda was marked by interventionist actions. One of the products of this interventionism was the “industrial conditioning” (CI). To give an example of what the “industrial conditioning” was about, it can be said that it subordinated the establishment of new companies or industrial equipment, to a previous governmental authorization.

According to the Portuguese “Organization for Economic Coordination”, the economic reforms ordered by the New State the cork sector performance. In addition, collective actions by the cork sector took place. For instance, the “Associação Industrial Portuguesa” (AIP) launched a campaign for the promotion of the cork. The overarching collective action by the cork stakeholders took the name of “Portugal Corticeiro” and it contributed to the development of the industrial cork stakeholders society of the 1930s.

Reacting to the pressures of cork business associations and traders organized in mixed-capital firms, and bearing in mind the views of naturalists, the authorities set up the JNC in 1936. Nevertheless, the basis of the way the cork industry was organized date far back to the creation of the JNC as well as the problems associated to the sector—such as the surplus of production and the cork’s lack of quality.

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THIRD PART: THE ALMEIDA GARRETT USA TRAVEL OF LEARNING

The institutionalisation of “cork research”. In the early years of the 20th century, a number of new companies began producing “new cork products”, like cork paper or linoleum. In the 1930’s years, the USA was the biggest cork industrial country in the world. That means the presence of the biggest enterprises, and the best private and public cork laboratories in the cork world. Some of the Portuguese firms had direct links with American ones, like Produtos Corticeiros Portugueses (cork discs production), a factory open in 1935 in Amora, associated to Crown Cork and Seal Corporation.\(^8\)

\(^8\) PEREDA, I., C., 2011, Mujeres Corcheras, Euronatura, Lisboa, p. 63. The modern metal bottle cap was developed by the prolific Maryland inventor William Painter, who patented his first stopper in 1885. By 1891, his definitive design, a cork-lined metal cap with a corrugated edge that is crimped around the bottle lip, appeared. Painter called his invention the "crown cap," founded the Crown Cork and Seal Company to market it, and became very wealthy from it. The crown cap was the industry standard for nearly 80 years. In 1955, the crown cap's cork liner was replaced by plastic.
The contact with this American sector permitted a real technological change in the Portuguese cork sector. For American diplomacy, cork was even “a strategic commodity in time of war (...) the Soviet Bloc is dependent upon imports to meet its corks requirements, since long term efforts to produce an appreciable amount of cork in the USSR thus far have been unsuccessful”.9

The Portuguese technological thought could evolve faster, especially the collective mental frames to which actors of production, such as managers, engineers or workers, are referring to when they think and act.

The transformation of the Portuguese engineers’ mental references influenced the process that led Portugal from the end of the “forest age” into the cork industrial era. The first formally constituted cork products laboratory, created in 1942 for Francisco Almeida Garrett (1909-1984), was one of the first in Europe.

**Origins of the JNC Cork Laboratory.** In 1942 the Portuguese Government finally bowed to pressure from scientists and sympathetic elements of the public to organize and fund cork industry science centrally and established the JNC Cork Laboratory (JNCCL). Since just before 1930 state funding for cork science had steadily increased: the Portuguese Cork Oak Alcobaça Station was established in 1930. The establishment of the JNCCL marked an end to piecemeal support and it was therefore a watershed when the state finally accepted its responsibility to fund cork science properly and to develop a coherent science policy.

But the centrally planned and funded national policy for cork science began before 1930 and this new body reflected priorities established even before the outbreak of the Dictatorship times. As historians we no longer follow the special pleading of the contemporary science lobby in arguing that the Salazar Government state was deaf to the needs of modern science.

If we look more closely at the context of the establishment of the JNCCL, a debate within the cork historians about the reality of the international cork sector in the 1930s can be discerned. This debate helped to shape the final form of the JNCCL, which reflected a particular conception of the state/science relationship.

In order to analyse the genesis of the JNCCL more deeply, I use and extend Frank Turner’s concept of “public science.”10 Turner first proposed the use of this concept as a historical tool, to open up the importance of what scientists and engineers said in public, in a pioneering article in Isis in 1980. Turner showed that throughout the nineteenth and early twentieth centuries many notable scientists were publicly voicing, in speeches, reports and essays, arguments for a social function for science. Scientists produced a “body of rhetoric, argument and polemic” to “justify their activities to the political powers and other social institutions upon whose good will, patronage, and cooperation they depend.” Turner argued for the recognition of this species of scientific rhetoric for what it was: a changing, partisan account of the social and cultural importance of science and scientists. Turner further noted that the goals and language of public science arguments changed over time in response to the changing ideological contexts and the public goals of science. The concept of science presented by its public rhetoric was continually reinvented to appear to serve changing social ideologies. Furthermore, public science was the public rhetoric of professionalism. As such, the professional goals it embodied became progressively more ambitious as science evolved into a recognized profession with increasing social and cultural authority (aided by the arguments of public science).

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Turner also characterized three distinct periods of public science in the nineteenth and early twentieth centuries. During the third of these, beginning in about 1875, the themes of public science shifted dramatically “towards the values of collectivism, nationalism, military preparedness, patriotism, political elitism and social imperialism.” Scientists had changed the political orientation of their rhetoric and its political objectives, partly because they themselves were influenced by the new dominant ideologies of the period, and partly to capitalize on this ideological shift in national values. Hence “science came to be portrayed as a means to create and educate better citizens for state service and stable politics, and to ensure the military security and economic efficiency of the nation”.

Cork publicity signed by Vieira Natividade, several numbers of Boletim Cortiça first years.

Crucially, the social objectives of this rhetoric had now altered too. Part of the goal was to obtain better state funding for science, since only the state could provide the magnitude of resources now necessary for large-scale scientific projects. The hope was to create public pressure on the executive to fund scientific activity. Turner suggested that such public science arguments have been used uncritically by historians as an objective historical resource containing accurate descriptions of the backward state of British science. Turner argued that funding was not now the public scientists’ sole objective. They were also seeking what he called greater ‘power or influence in the civic arena’ for scientists.

I will use Turner’s suggestion as a starting point for a more detailed analysis of the content and importance of some of the Portuguese public science arguments of the 1930s and 1940s. Part of the argument of public scientists was indeed that science was, increasingly, an important constituent of national power and that, as such, the state had a prime responsibility to fund and
centrally organize science. In this sense the establishment of the JNCCL retains an iconic importance as the moment when the state was convinced by scientists that a comprehensive cork national science policy was crucial to Portuguese cork sector development. However, the institutional form and the nature and scope of national policy for science has never been problematized.

I will propose that influential sections of the scientific community produced a long-running critique of the condition of Portuguese science not only to obtain state funds and a centralized structure, but also as an overt attempt to win technocratic power in a rationalized state apparatus.

Detailed analysis of the course of public science arguments during the early years of the Salazar Government reveals a deeper, and so far untapped, level of debate within the scientific community about the best mechanisms for scientific influence over policy. The JNCCL was the institutional result of the triumph of a model of scientific advice and influence put forward by the dominant group in Portuguese corporativism: the engineers. It ensured continuing largescale state funding for science, but it also enshrined an informal system of scientific control of policy for science. While the new department might be under the administrative control of a non-scientific chief, engineers were present in the Advisory Council of the JNC, which in turn controlled the research purse strings.

**Continuity. Alcobaça and the JNCCL.** The key individual in framing a new technocratic forest science from 1930 was the forest engineer Joaquim Vieira Natividade (1899-1968). Natividade was leader-writer of the new monthly journal *Boletim Cortiça* established in 1937 by the JNC. His contributions were increasingly about the role of forest science in the quality of Portuguese cork, and in 1941, in an article entitled «Dez Anos de Estudo do Sobreiro,» he outlined his vision of a scientific executive body within the government machine with responsibility for a wide-ranging policy for forest science. In directing the Alcobaça Station, Natividade took with him some of the best young foresters graduated in Lisbon, including Jorge Brito dos Santos (1914-1981) and Manuel Gomes Guerreiro (1919-2000).

![The five foresters-researchers of the Alcobaça Station, assistants of Natividade, in 1948: Silva Carvalho, Manuel Teixeira, Natividade, J. V., 1941, «Dez Anos de Estudo do Sobreiro», Cortiça, 36.](image)
By 1937 the two centres of technocratic cork science, the Alcobaça Station and the editorship of Cortiça, had been effectively taken over by Natividade. The wars (1936-1939 Spanish civil war or the World War II) were to be the moment to change the International Cork Map. It would require not only the adequate supply of cork for war materials, but would also demand the scientific organization of all aspects of cork production.

To produce all the cork Spain could not provide to the USA buyers, Portugal had to outdo her in centrally organized and directed civil and military science, and had to base all political decisions on scientific considerations, shorthand for considerations of national power. After the outbreak of the war scientists like Natividade felt that their argument for control of a broadly conceived forest policy, which included elements of general economic and social policy, now possessed a new and pressing relevance. In an article in 1940 he noted that the war had caused “big dangers” to the Portuguese Cork Oak forests, and the Government had to be more present in his defence. Natividade thus argued that Portugal should have a comprehensive, centrally controlled and broadly defined cork policy.

Cork science and the establishment of the JNCCL. By early 1940, with the disturbing revelation of a cork war crisis, Natividade began a concerted campaign to secure meaningful input into policy decisions. From 1936, the new JNC would be established with a formal body of specialists and scientists to advise on organization decisions. Natividade would be the forest representation member, and would urge the importance of immediately setting up a new Cork Laboratory in Lisbon. It would form a link between products research and industry, and should also serve as a scientific advisory body to the JNC.

On 1938 a civil engineer, Francisco de Almeida Garrett (1909-1984), would start working for the JNC as a “consultant engineer”. From the first moment he would publish in the Boletim Cortiça, in different directions associated with cork industries problems. The new cork researcher was to advise on the best disbursement of funds for conducting research into industrial problems.

FORTH PART: JNCCL TRANSFERENCE OF TECHNOLOGY

Cork Transference of technology. The idea of a single model of technology transfer must be rejected in the studies conducted in the cork sector, with variation being seen as the natural consequence of adaptation. In order to ensure win a leadership in the field of cork technology, the JNC bought important machines for founding one of the first cork products research laboratories in Europe. Research in the JNC was modernised by the application of new laboratory technologies to cork products.

In 1931 Natividade, most likely relying on his own means, decided to go London in order to better prepare some arboriculture research projects that he was undertaking in Alcobaça, 100 km. north of Lisbon. Natividade had a very clear idea about his desired destination: the John

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12 NATIVIDADE, J. V., 1940, “ A poda dos sobreiros”, Boletim Cortiça, n. 15, p.9: “O arvoredo esta em perigo logo que o preço do carvão sobe. Apenas no inicio desta estranha guerra, ja a presente época de podas se apresenta cheia de tentações, e tentações tanto mais perigosas quanto e certo termos excedido ha muito, pela intensiva exploração, tudo o que era razoável e legítimo pedir a arvore.”

13 From 1933, Garrett had worked in the direction of the “Serviço de Construção de Casas Económicas”. This movement towards “products for construction”, and not to “wine stoppers” was certainly related with the scientific activity of Garrett.


Innes Institute (JIT). In the same year, the JIT received fellows from Michigan, Alberta, Egypt and Hungary. Created in 1910, the JIT was already the premier English research centre dealing in plant breeding and genetics, and was perhaps the foremost center for genetics research, not merely in Europe, but in the world. During his time spent in London, Natividade had the opportunity to work with Cyril Dean Darlington (1903-1981). At that time, Darlington was preparing his masterpiece: Recent Advances in Cytology, which Natividade would later use.16 With a 15 person team, Darlington had created the premier plant breeding school in Europe.

The other technology centre, and most important for the industrial sector, to be visited by the Portuguese cork technology community would be the USA. In 1942, Almeida Garrett would spend two months in USA to study the «manufacture of cork products and his comparative use with substitutes, in the thermal, phonic and anti-vibration insulations.»17 The goal was to know the last cork industrial applications and to observe in loco the biggest laboratories. Garrett would study specially the insulation manufactures.

The list of visited sites by Garrett can give an idea of the influences that would suffer the JNCCL in his origins: the Cork Institute of America, United States Bureau of Standards laboratories, Pittsburgh Testing Laboratory, Engineering Experiment Station of the Pennsylvania State College, Engineering Experiment Station of the Institute of Technology (University of Minnesota) and the sites of the manufactures Armstrong, Cork Isolation Company, Mitchell & Smith, Mundet Cork Corporation and United Cork Company.18 In the USA Garrett bought for the new Lisbon laboratory “complete technical equipments, that will permit new experiences related to the new cork industry applications (...) A lot of cork would be needed in the reconstruction of so many destroyed cities.”19


17 Boletim Cortiça, 39, pp. 17-18.

18 The American cork industry underwent its most dynamic period since William Painter patented the crown cork invention in 1891. The rate at which innovations were occurring, in tandem with increased levels of competitiveness, had brought about a dramatic transformation in the cork world industry map, taking the cork world leadership to the English. In the USA in the 1930s there were the largest cork suppliers in the world. Armstrong Cork Co, in Pittsburg, was the first cork stoppers world maker, being Crown Cork & Seal Co, from Baltimore, the first in the sub-sector of "crown corks". In 1909, Armstrong linoleum was first offered to the trade.

19 Boletim Cortiça, n. 42, p. 9
What occurred after these travels? How effective were the travels efforts? To what extent did they result in transfer of technology?

Natividade acquired a wide knowledge of forestry science and experimentation. He always had the support of the corporate organ of the New State, the JNC, which was trying to spread his influence into the Portuguese cork oak forests. He took advantage of the publications of the JNC to disseminate original theoretical ideas about forest management.

The experiments that were been carried in the Alcobaca forest research site (Mata Nacional do Vimeiro), when scaled up, could be responsible for dramatic changes in the landscape. It’s possible to use the notion of “labscape” to suggest the extent to which laboratory work is involved in producing and maintaining these landscapes. Robert Kohler or Tiago Saraiva have used the concept of labscape to explore the laboratory-field border in the natural sciences.

Natividade expertise was certainly unrivalled in Portugal and Spain, and was perhaps only approached by some of the leading Mediterranean forestry experts who began to meet after the Second World War, as Aldo Pavari (1888-1960), Philibert Guinier (1876-1962) or Paul Boudy (1874-1957). Natividade understood the nature of the changes which had taken place in modern forestry, and worked with several forestry engineers who carried on the momentum of innovation after his death. Through his contacts with forest owners such as Lopes Fernandes, in Alentejo, Natividade proved himself not simply a savant and a theorist, but a man capable of practical success. The Alcobaça forestry station would remain in operation more than 40 years after his retirement, and 20 years after his death.

The transatlantic transfer of industrial technology and the comparative performance of American and Portuguese industry during the second third oh the 20th century must be of interest to cork economic historians. Nowhere was the meeting of experience, energy and greed more fruitful than in the United States. They had increased investment on old and new technology in established workings.

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20 Jorge Brito dos Santos, one of the first Natividade assistants, was hired in 1946 to direct the Technical Assistance Department of the JNC. He would be the last JNC President between 1967 and 1972.

21 KOHLER, R. H., 2002, Landscapes and Labscapes: exploring the lab-field border in Biology, University of Chicago Press; SARAIVA, T., Fascist Labscapes...
After his travel, Almeida Garrett was the first director of the JNCCCL from its creation in 1942 until 1947. During his stay in USA, Garrett improved important techniques useful for his cork work. He would rule the scientific arm of the JNC. It was his USA experience that directly inspired the design of the new Lisbon laboratory. Of enormous importance also were the Garrett contacts with authorities (Duarte Pacheco minister, among many others), politicians, professionals, and high-ranking officials in the Portuguese government.\textsuperscript{22} That was the beginning of the quality control for the cork products, most of them to be exported. And after a few studies made in the Porto Engineering School, that was the beginning of the cork products studies in Portugal.\textsuperscript{23} Garrett received and installed the machines bought in the USA, from machine constructors like “Allen B. Du Mont”, “Sherman W. Frazer”, “Henry L. Scoot”, “Atlas Electric Devices”, “Vibration Specialty”; appropriate machines following the American standards.

\begin{tabular}{|c|c|c|}
  \hline
  Henry Scott machine & Atlas Electric machine & Vibration machine (evibrógrafo) \\
  (determinação de resistência à tracção) & (tempómetro, ensaio produtos betuminosos) & \\
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Physics (vibration, etc.) would be not alone responsible for the innovative character of the JNCCCL. To be sure, a chemistry department was a novelty in clear contrast with the Porto Engineering school cork studies, the only predecessor of Garrett laboratory. In 1965, there would be two engineers in the JNCCCL: Alfredo Baptista de Andrade (electro-techniques), and Basilio Mesquita (chemistry: “glue and cork chemical disintegration”).

\textsuperscript{22} Garrett had been the assistant of Duarte Pacheco between 1932 and 1933. Pacheco would decide to use cork in a lot of public buildings like the Teatro de São Carlos, IST, Instituto Nacional de Estadística or the Emissora Nacional.

\textsuperscript{23} GARRETT, F. A., 1943, “Laboratório de Ensário e de Estudo de Cortiça”, \textit{Boletim Cortiça}, n. 51, p. 103.
Garrett always mixed his works for the State with works for the private sector. Between the eve of the Second World War and the end of the 1950s, Portugal’s cork industry grew quickly, at a pace that was unmatched by most OECD countries. In 1946 Garrett started the building of a new cork manufacture, Socorquex – Sociedad de Cortiças de Exportación, in Moita, where he was the responsible for the making of black cork agglomerate, termal, phonic and anti-vibration insulating products, from 1950 to 1980. Like other authors have wrote, since the mid-twentieth century, most of the raw material from Portugal, previously exported to Great Britain or the United States, began to be transformed by the Portuguese industry, in factories like the Moita one.

Socorquex, from 1953, would be part of one of the biggest tries of the Government to place some “coordination and discipline” between the cork companies. The JNC powerful corporatist agency was trying to rule over the entire cork circuit. Some companies, forming the 95% of the Portuguese cork insulation production, got together to form “Isola, Sociedade Comercial de Isolamentos de Cortiça,” with important firms like Socorquex, Mundet or Robinson. The first President of the Isola Corporation, Daniel Barbosa, had been Economy Minister, and had always tried to attain some kind of industrial concentration in some Portuguese industrial sectors.

Both science and technology sites, Alcobaça Station and JNCL, passed from being an importation technology site to an exportation one. Nativityde forestry masterpiece, Subericultura (1950), was translated into French, Italian and Spanish. New Cork Oak Stations were created following the model of the Alcobaça one, like Tempio Pausania, in Sardegna, Italy, in ... Nativityde was respected by the best Cork Oak scientists in the world. The best of them, may be the only one to achieve Nativityde’s level, Paul Boudy (1874-1957), the founder of the

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24 In 1892, John Smith from New York discovered and patented black agglomerate. In 1909 Charles McManus discovered composite agglomerates.


26 After the World War II, the Robinson English family sold his cork bussiness to a Portuguese group, that started to produce the black cork agglomerate.
Rabat Forest Station in 1945 (the only one in the north of Africa),27 was admirer of the “very important” Genetics Natividade researchs. Boudy would recognise the success of the cork oak “vegetal propagation” works, that gave birth a new “propagation methodologies, thanks to what we will be obtain genetically homogen forests.”

Lisbon JNCL would receive the visit of the leaders of some new laboratories in Europe. In 1967 it is created in Madrid the Laboratorio de Ensayos Físico-Mecánicos del Corcho y sus Manufacturas, and the first director, Luis Velasco, passed some weeks in Lisbon studying in the JNCL.28 He would be a big promoter in Spain of the use in Spanish construction of the black cork agglomerate.29

The JNCL survived the political changes of 1972 and 1974: end of the JNC (and creation of the IPF); the fall of the autarky of the Salazar regime. He closed his doors in 1988, with the end of the IPF in one of the Cavaco Silva governments. Far from denying the importance of institutional factors in the expansion and modernisation of the Portuguese cork sector, these constant upheavals serve merely to reaffirm it.

CONCLUSIONS

What spread around between the USA and Portugal was not local practical technological knowledge, but a specific modern form of model knowledge, in institutionalist terms, a “theorised account”. Comparing subsequent editions of foresters writings (as Antonio Mendes de Almeida or Vieira Natividade), one can trace this increasing “theorisation”. Whereas Mendes de Almeida’s initials articles described the project of the first Forest Research Stations in very simple ways; in the following publications, both Natividade and Almeida Garrett increasingly standardised their methods and disconnected and abstracted them from the original settings.

They incorporated the first Working Plans into a wider system of national research that was underpinned by a general theory of research as an instrument of individual and social improvement. Alcobaça Station and the JNCL evolved into a standard model that was easily accessible and whose claim could be described as follows: more cork oaks, better cork quality. Natividade and Garrett thus developed manuals that were easily accessible and appeared to contain everything a cork grower needed to know, from plant psychology to laboratory furniture and science materials.

According to Meyer and Strang, “theorised accounts” not only formulate patterned relationships such as chains of cause and effect, they also include explanations about the characteristics and advantages in terms of generally recognised values such as efficiency, or progress. Again, this is true for Portuguese cork laboratories, who specified the properties of their methods in a way that increasingly reflected utilitarian notions and particularly elaborated on aspects like rationality, economy and effectiveness.30

However, there are certain limitations to the institutionalist approach. Historical processes of model building and spread must be placed in the context of international geography. Portuguese knowledge was produced in contact with non-urban societies, while the authoritative model was designed in and promoted from American big cities. Thus, it is not random, where processes of model “diffusion” start, but a question of global dominance.

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29 VELASCO, L., 1972, “El aglomerado expandido puro, de corcho, con destino a la construccion civil,”, Revista AITM, n. 54.
structures. Moreover, institutional theory does not explain what happens to the universal models when they get implemented in local settings – below the macro-level of trans- and international communication.

There were a lot of obstacles obstructing the full or “true” implementation of the model. Portuguese engineers had to refine their aims in negotiation with the government. Laboratories could loose their funds when they did not follow Salazar dictatorship rules.

Another transformation occurred on the micro-level, when the model was actually implemented. The JNCCL could be a field of conflict, where Portuguese researchers did not obey the rules of their JNC, or their Ministry superintendents.

Another question to be addressed is not the fact of the introduction of new machines and scientific methods but the sources from which the technology was drawn. Was it imported – as it was during the 1940s – or was it home-produced, as could become in the 1950s and the 1960s? The JNCCL contribution to innovation is not clear. In Portugal, cork products progress remained relatively slow overall. The large-scale producers made good progress and placed themselves in the forefront of technological change, but many producers (in Setubal district) fell far behind.

Now, to come to the last point, what kind of knowledge was it that travelled from Portugal to Spain? The JNC experiments received prominent attention in Spain. Velasco strongly argued in favour of a cork products laboratory at home and supported it as a member of the Spanish foresters collective.

How can these knowledge flows be interpreted? The exchange of knowledge seems to have been complex. Reports of successful activities were intrinsically tied to the legitimisation of the organisations operating. Beside encouraging and motivating engineers, the existence of organisations such as the JNC rested on the support of a sympathetic cork society. The JNC needed to show its cork industrial partners that their money was not spent in vain, like may be they felt in the 1980s.

Looking at the story of the creation of the JNCCL, one can see how developments in Europe and in the USA had already become interconnected at the beginning of the 1940s. There was a real as well as a symbolic space for networks of researchers concerned with cork.

Inspired by the widespread belief in the powers of science to improve cork quality, engineers gathered in a number of governmental organisations – among whom the JNC proved most influential. The emergence of an organisational network of cork researchers as well as the development and circulation of techniques, took place in the context of the making of an Portuguese cork industry that brought about new actors and framed their actions and ideas at home as well as in the USA.

While the expanding state developed a perceived need for science during the 1930s (and while this intensified during the wartime), this emerges as separate from the specific institutional forms by which scientists were incorporated into the machinery of government. The analysis of the play of arguments from scientists and civil servants strongly suggests that the institutional form of the JNCCL emerged as the product of negotiations between the scientific and political elements of the ruling elite.

Two further, more general, points have emerged. The first is that engineers are social actors, and that their professionalization culminates in a claim for executive political authority. What is perhaps surprising is that such claim can be demonstrated to have been voiced so blatantly at

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31 Technological Dependency in American Nonferrous Mining, 322
particular historical moments, and that their role in the formation of distinctive institutional mechanisms for scientific advice has been so underestimated.

State engineers like Natividade or Garrett were not only technical experts; they were also, primarily, members of the intelligentsia. We must bear in mind that in Portugal, 1930 engineers belonged to the highly-educated middle classes. Obviously, this intellectual bourgeoisie was already very influential and played a major role in the Salazar years. Before 1930, the cork intelligentsia lacked a strong institutional and political basis. These foundations were built after 1930 and 1942 with the establishment of new research centres or the rise of the cork press.

The nature, scope and institutional form of JNCC began to take shape under the special conditions of the wartime emergency when the state needed organization of its scientific resources. The Natividade presence provided a mean for the Portuguese state to obtain scientific expertise in a narrowly defined area of policy while keeping the expert at arm's length from the formation of general economic and social policy, an area reserved for the political expert.

This article has addressed this topic: one of the strategies used by Portuguese Government to establish himself on the cork world stage. It sought to explore how Portuguese national institutions and government regulation influenced this process. With the backing of the government, JNC created a laboratory to modernise and operate the Portuguese cork sector in new markets. This was the first step in JNC conquest of the world market and in its conversion into an industrial cork power. Industrial strategy, government institutions and technological innovation played a crucial role in Portugal implantation on a cork worldwide scale.

Portuguese cork need for modernisation presented an opportunity to some engineers like Vieira Natividade or Almeida Garrett. On the State side, the new government of the Salazar dictatorship was in search of an efficient cork industry regulation. With responsibility for regulating the cork sector, the Portuguese government actually took control of the important technological options, that define today the Cork World Map.

Regarding the issue of knowledge transfer, cork research was received as a theorised account in Portugal, and implemented after in Spain – as far as models can be implemented in local situations of negotiation. As far as one can reduce these complex communication flows into a short formula, it might be said that Portugal provided ample information as well as legitimisation of actors and practices, while guidelines and expertise came from the USA.
Finally, we can suggest to conceive this JNCCCL as a “centre of circulation." Alcobaça and the laboratory created by Almeida Garrett produced forms of life and new cork products able to travel among different scales, from the laboratory to the forest and to the cork factory, in the first case producing “labscapes.” They became a centre of circulation within a larger network.

If we look back at the origins of the Portugal cork industry's success, the years following World War II were crucial. Firstly, Portugal strengthened its leadership of the cork world economy to the detriment of countries as Spain and Algeria. Portugal took advantage of the temporary loss of Catalan and Algerian pre-eminence during the war years to increase its capacity and strengthen its position. Countries like Spain and France, unable to keep pace with technological developments, failed to establish or protect its own national cork industry.

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32 "Circulation" seems to have replaced "travel" as a favoured concept in history and social studies of science and to have taken on new significance. Circulation now often highlights exchange: exchange of people, materials, instruments, and practices between laboratories in a network.

33 In Alger, pendant the Liberation war years (1954-1962), the cork oak forests were not exploited. The war and the fires were nefast for the Cork Algerian Patrimony. ASSAD, A, 2011, Quelle politique pour une gestion durable des forêts de chêne-liège en Algérie, Thèse de Doctorat, Agro Paris Tech, p. 142.
General perspective of the "oficina de escolha mecânica" of cork stoppers, Mundet factory, Seixal, 1954. Inventário: EMS.2005.00244.00000