

## The ‘Portuguese Forestry Community’ and Research Fellows abroad between 1915 and 1945

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One of the areas of greatest interest to a researcher in the field of the history of technology are studies done on the process of appropriating new scientific theories and technologies in countries that can be classified as peripheral in terms of their scientific output. Peripheral countries have been usually classified as those whose academic community is distanced from advanced centers in terms of the research they produce and that have participated to a lesser extent in the process of technical development [SAIZ 2003, 223-245].

This article will attempt to reflect on the process of international technology transfer in the 20th Century, specifically between 1915 and 1946. During this period, the achievement and spread of technological innovations were vital to the development of Portuguese forestry. In less developed European countries such as Portugal, the transfer of foreign technical knowledge was more important than that generated within the nation itself. External technological transfer became an essential factor, without which there would have been no push toward the professionalization of this new profession.

Portugal was a country in the periphery of European science and technology. This situation has translated into an external technological dependence in several economic sectors. Reports on travels of learning have become one of the main sources for research in Science and Technology History. The new works of these young engineers will be taken as a valid, albeit only partial, indicator of the direction and structure of the processes of innovation in the Portuguese forestry. Among other things, the degree of Portuguese dependence upon external technology, as well as which countries

played an essential role in the transfer of technology; and which scientific specialties depended most on foreign technology can be ascertained.

One of the most serious problems confronting any researcher interested in forestry innovation is the evaluation of travels' importance as a technological indicator of investment tendencies in new technologies. The various means of innovation in an economy are well-known: advances in productive processes can be invented and incorporated, just as they can be imported directly from another country using foreign technicians in their construction. Only innovations that are applied, put into practice and remain productive can be considered as such.

From our point of view, new technologies brought by forestry students from abroad are not only a partial technical indicator, but are also, depending on whether or not they are put in practice, an important indicator of those tendencies in new technologies. In general, the decision to send Portuguese students to international technological centers is based on expected profits from the new techniques to be imported, and how complex the new technology is.

Taking into account the advantage that travels of learning provide as a source of study (as a consequence of the existence of some kind of travel reports), it is surprising that they have not been used more often as raw material for forest history research. Here, as already mentioned, we can draw valid conclusions and extrapolate them to the process of forestry renewal in Portugal. This permits an understanding of the nature and direction of technological changes, the structure of the transfer and the importance of outside technology.

This study is based on a sample of articles found in various agronomy and forestry reviews. Bulletins has served, from its inception, as the agronomy and forestry students' official bulletin (*Boletim Agros*), in which travel reports were customarily published. With time we will look for all the foresters information in the *Arquivo Histórico do Instituto Camões*. We will study the cases of the following fellows: Mário Azevedo Gomes (USA, 1915), Joaquim Vieira Natividade (UK, 1931), Francisco Santos Hall (USA and Germany, 1931),

Francisco Caldeira Cabral (Germany, 1936), Francisco Mimoso Flores (USA, 1936) and Carlos Manuel Baeta Neves (Spain, 1946).

Until embarking on these travels of learning, new subjects such as forest research stations, forest ecology or forest genetics seem not to have interested Portuguese foresters. However, from the 1920s onwards, thanks to the young researchers who had recently completed periods of training in more scientifically advanced countries, the Portuguese forestry community became more interested in these lines of work. This interest became evident at various seminars and led to their inclusion in university course programs.

Before continuing, certain general considerations must be mentioned regarding the beginnings of Portuguese forestry studies. Much as in the case of France or Spain, the new science came from German forestry schools, principally that of Tharandt, in Saxony [PEREDA 2011, 22]. If the first Spanish forest engineer, Agustín Pascual, studied in Tharandt between 1843 and 1845, then the first Portuguese to do so, Bernardino de Barros Gomes, followed between 1861 and 1862.

### Mário de Azevedo Gomes



Mário Azevedo Gomes

The first of our forestry travellers to be studied is Mário de Azevedo Gomes (1885-1965). While not a forestry engineer by vocation, he was the agronomy engineer to occupy the forestry chair at the *Instituto Superior de Agronomia* (ISA) in Lisbon from 1915 to 1955. Gomes, together with another ISA lecturer, Ruy Mayer, went to the United States of America in April 1915. One of the things Gomes would remember from this trip was the contact with research stations; something he felt was the best way to transfer agronomy technology to small-scale agricultural enterprises: [GOMES 1918, 237 e 1958, 14].

## ARQUIVO DELFIM SANTOS

One of Azevedo Gomes' assistants, the forest engineer Francisco Santos Hall (1898-1954), would follow the steps of his master in the 1930's. Santos Hall would spend some months in Duke University, funded by both the Ministry of Education and of Agriculture. In 1936, Francisco Mimoso Flores would also spend some months in the USA.



**Francisco Santos Hall**

**Azevedo Gomes, António Mendes de Almeida and Santos Hall, with the 1937 ISA forestry students  
(from Baeta Neves Family Collection).**



## Joaquim Vieira Natividade



In 1931, another forest and agronomy engineer, Joaquim Vieira Natividade (1899-1968), most likely relying on his own means, decided to go to London in order to better prepare some arboriculture research projects he was undertaking in Alcobaça, 100 km North of Lisbon [JIT 1932]. Natividade had a very clear idea about his desired destination: the John Innes Horticultural Institution (JIHI). In the same year, the JIHI received fellows from Michigan, Alberta, Egypt and Hungary. Created in 1910, the JIHI was already the premier English research center 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 [NATIVIDADE 1937]. With a 15-person team, Darlington had created the premier plant breeding school in Europe. Natividade would come back to the JIHI in 1937, the same year he would visit the *Instituut voor de Veredeling van Tuinbouwgewassen* (IVT), in Wageningen [PEREDA 2008, 41].

## The Portuguese students in Germany and Spain

Following the USA and England, the third technology center these Portuguese engineers would visit in the 1930s would be Germany. Even though only visited by the forestry engineer Santos Hall, the travels of an agronomy student, Francisco Caldeira Cabral (1908-1992), [v. AAVV] would have importance for the forestry paradigm changes current at that time [CABRAL 1932 e 1940].

The last technology center to be visited by the Portuguese forestry community was Spain. In 1946, Carlos Manuel Baeta Neves (1916-1992), married to Azevedo Gomes' daughter, would spend two months in Madrid to study with Gonzalo Ceballos (1895-1967), a teacher in the Madrid forestry school. Ceballos had already developed a thriving research program dealing with forest entomology, and for Baeta Neves, this was «*an emotional opportunity to exchange views concerning specialty problems with a real forest entomologist for the first time*»:

Lembro-me perfeitamente da emoção com que me apresentei ao Professor Gonzalo Ceballos; era este o primeiro entomologista florestal com que eu podia trocar impressões diretas a propósito dos problemas da especialidade (...) Todos compreenderão o entusiasmo que tinha sentido durante o curto espaço de dois meses que fui bolseiro do *Instituto Español de Entomología* [NEVES 1955, 43].

Baeta Neves would write at least four papers for the Spanish forestry review (*Revista de Montes*), in which he would criticize the new 300,000-hectare pine forest plantations in Portugal, for having been undertaken without first having made any phytogeographical study:

Portugal va transformándose, desde 1920 hasta 1939 la superficie de pinares aumentó en 300.000 hectáreas... ya no se tiene la paciencia a esperar que crezca el roble... los ataques a la sensibilidad y ecología del pino se manifiestan en las plagas, revelando el error padecido.... Nuevas repoblaciones artificiales, instaladas en cualquier sitio, sin tener en cuenta si las condiciones ecológicas respectivas son muy apropiadas. Hoy en día no puede repoblar sin hacer un estudio fitogeográfico; la repoblación artificial se debe enfocar como un problema de sucesión; y asimismo la lucha contra las plagas como un problema de bioecología [NEVES 1946, 96].

This view mirrored that of both Rothmaler and Caldeira Cabral.

## The action of the Portuguese bursaries

What occurred after these travels? How effective were the travels efforts? To what extent did they result in transfer of technology? Most of the travellers would agree that the opportunities for technology transfer had been greatly increased. The skills the Portuguese endeavored to attain were, of course, the ones in which other countries had a lead.

As Azevedo Gomes advocated, conferences should not be the only method used to transfer forest and agronomy service research technology: new research stations should be created, independent from the ISA Lisbon center, and using new transfer methodologies: assessment summaries, books, brochures and booklets (including tree guides), case studies, customer service, decision support systems, management tools, manuals, galleries, posters, presentations, promotional items, scientific reports, research summaries, trade publication articles, training, workshops and conferences, etc.

Three months after Azevedo Gomes was named Minister of Agriculture in 1923, a new Forestry Research Station would be created in Marinha Grande. In 1924, as a dedication to the *Pinus pinaster* research, the first director would be none other than Santos Hall, who would remain the principal fellow for six years. Influenced by Azevedo Gomes, and following the American model, Santos Hall would study the resin extraction method «*establishing the principal experimental basis*» [GOMES 1954, 75]. The importance of travels to survey the progress of forestry abroad was very much the concept of Azevedo Gomes, who had sent the first agronomy engineer woman to Belgium on 1923.

The second *American model* forestry station to be created would be the *Cork Oak Alcobaça station*, managed from its inception by Vieira Natividade. Even if Natividade's travels were more focused on apple tree breeding problems, he would use his new genetics knowledge to establish the first forestry genetics research team in the Iberian Peninsula. For twenty years, from 1930 to 1950, he would work for the forest service, seeking a higher cork quality for the Portuguese cork industry.

Natividade's London travels would later prove very useful for other Portuguese agronomy researchers. Fellows such as António Câmara and Branquinho d'Oliveira would be assisted by Natividades' English scientific contacts [OLIVEIRA 1969].

Câmara and Oliveira would be two of the basic components for the creation of the new Sacavém Agronomy station, in which plant breeding and genetics had formerly occupied the leading role. Câmara had studied genetics in Edinburgh (1932-33), Cambridge (1933) and Berlin at the *Kaiser Wilhelm Institute für Biologie* of Berlin-Dahlem (1938). Botelho da Costa studied in London Science Faculty, where he obtained the *Diploma* as Doctor of Agricultural Chemistry.

Natividade acquired a wide knowledge of forestry science and experimentation. His 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 [PEREDA 2008, 98].

He understood the nature of the changes that had taken place in modern forestry, and worked with several forestry engineers (such as Manuel Gomes Guerreiro) who carried on the momentum of innovation after his death. Through his contacts with timber magnates such as Lopes Fernandes, in Alentejo, Natividade proved himself not simply a savant and a theorist, but a man capable of practical achievements. The Alcobaça forestry station would remain in operation more than 40 years after his retirement, and 20 years after his death. His forestry masterpiece, *Subericultura* (1950), was translated into French, Italian and Spanish.

If the Santos Halls' American travels had put the engineer in contact with «a forest economy served strongly by statistical information linked to dendrometry» [GOMES 1954, 76], Mimoso Flores' American travels would provoke a strong push for the introduction of the forest ecology and nature conservation concepts in Portugal [cf. FLORES 1939, 80]. Flores came back knowing Charles Elton's book *Animal Ecology* (1927) and the works of Arthur Tansley.



With Professor Francis Schumacher, Santos Hall would publish at least one paper: [SCHUMACHER 1933]. In 1944, after the coming back of Santos Hall to the ISA, a new chair of Dendrometry was created. Then, after some years of debate, in 1947 the first non-governmental Portuguese environmental organization was created: the *Liga para a Proteção da Natureza* (LPN), where Flores and other engineers such as Caldeira Cabral and Baeta Neves would advocate for the creation of the first Portuguese National Parks [CABRAL 1971, 20-23].

After the creation of the LPN, its leaders launched a campaign to attract the attention of the Portuguese society. In 1971, after 24 years of hard work, a first natural reserve was created in Arrábida [VAZ 2000, 46].

### Francisco Caldeira Cabral

Caldeira Cabral's German travels would bring about the definition of landscape architecture (*Arquitetura da Paisagem*). Because of the war, Cabral had to leave Germany in 1939 and stop getting his internship money from Instituto para a Alta Cultura [AHIC 1264/9 and NINHOS 2011]. In 1941 he inaugurated the 'Curso Livre de Arquitetura Paisagista'.

Among other new ideas, he made some of the first criticisms of Portuguese forestry policy related to the planting of exotics trees [GRONING 2010, 206]. Landscape architects saw analogies between associations of plants and human society. For a *true* German in those days culture could only be national culture. By resorting to *national* gardens and landscapes as opposed to *international* ones another barrier becomes erected which seemingly allows to refute invasive intentions of plants.

He would recall the «*natural biological equilibrium*» necessary for forest management and conservation. Cabral commented on the fragility of the exotic forest formations and their incapacity to resist various insect attacks. In Germany he had seen how the national government had forbidden «*particular exotic tree experimentation*» after problems associated with the *Pinus cembrata*

planted in the 19<sup>th</sup> Century. He felt that forest management should use new sciences such as *plant sociology*, which proved useful in ascertaining that *pure formations* are not to be found in nature, while *plant associations* gain stability by following natural laws.

Josias Braun-Blanquet (1884-1980) was an influential phytosociologist and botanist born in Chur, Switzerland and died in Montpellier, France. With the *Study of Plant Communities* (1928) Braun-Blanquet popularized this doctrine and defined its subject as follows: every natural aggregation of plants is the product of definite conditions, present and past, and can exist only when these conditions are given. The whole structure of plant sociology rests upon this idea of sociological determination

In the Alcoaça station, Vieira Natividade would be one of the first Portuguese fellows to admit the importance of these new sciences and work methodologies. Plant Sociology would «*put a barrier around that desire for mechanization that causes us to view the forest as a simple factory of wood material*» [NATIVIDADE 1943, 21].

The first thing that stands out upon studying Portuguese forestry travels is the strong presence of foreign technology within the system. The role of the UK and the USA is fundamental to the transfer of technological forestry information to Portugal. The other nation of note here is Germany, in regards to the travels of Caldeira Cabral and Santos Hall. This agrees with existing knowledge of the participation of companies in key forest sectors such as cork. English and American companies' participation in the construction of many of the largest cork factories between 1840 and 1930 is already part of Portuguese economic history.

In addition to Portuguese travels of learning, the study of foreign qualified scientific immigration in Portuguese forest studies helps us to complete our vision of the process of foreign technology transfer onto Portuguese soil. The presence, beginning in 1936, of a German botanist in Portugal was necessary for the technical development of new habitat-type classification methods, such as Phytosociology. Werner Rothmaler (1908-1962) was the first botanist in Portugal to make systematic studies of Phytosociology:

O alemão Rothmaler (1943) foi o primeiro a apresentar um trabalho onde aparecem inventários e associações, usando a metodologia de Braun-Blanquet, sobre a vegetação da Península de Sagres e Sudoeste de Portugal. Em 1945 apareceram os primeiros trabalhos escritos em português, de Fontes sobre os salgados de Sacavém e de Barbosa versando o estudo dos carrascais dos arredores de Lisboa. Outro investigador que desenvolveu um trabalho importante na antiga África portuguesa, particularmente em Moçambique, foi Gomes Pedro que em 1942 apresentou o primeiro estudo geobotânico da Serra da Arrábida. Não podemos esquecer a existência de um forte laço entre investigadores portugueses e espanhóis no campo da Botânica, assim não é de estranhar que em 1948 tivesse ocorrido a primeira Reunião Peninsular de Botânica na Serra do Gerês e cujas atas foram publicadas em 1950 [COSTA 2004, 63].

Having arrived from Barcelona (where he met Braun-Blanquet in 1934, and where the civil war had begun in 1936) Rothmaler collaborated with the botanists of Lisbon and Coimbra, and stayed in Portugal until at least the outset of the Second World War:

Cuando estuve la primera vez en Portugal en el año 1936 para estudiar su vegetación fue particularmente L. Wittnich Carrisso quien me ayudó en mi labor invitándome a trabajar en el Instituto Botánico de Coimbra. Todo el tiempo que permanecí allí, él fue quien siempre me facilitó mis trabajos. (...) Cuando llegó la hora de preparar su tesis doctoral se vino a España y se instaló en Ponferrada; donde centralizó sus estudios de la flora del NO de la Península ibérica. A poco de llegar, cuando Hitler tomo su decisión de *cañones o mantequilla*, las pensiones de estudio que recibía fueron anuladas. El Instituto Botánico de Barcelona y otras instituciones se subscribieron a sus exsiccatos hispanos, y así se pudo sostener, no sin dificultades económicas. (...) En 1934 vivía en Barcelona, como recolector de plantas de la Facultad de Farmacia, y estuvo en el viaje de Braun-Blanquet a Cataluña en esa primavera. [ROTHMALER 1938].

En 1936 mandé a Rothmaler a Portugal, para incrementar las existencia de plantas ibéricas atlánticas en el Instituto Botánico de Barcelona. Y allí le pilló nuestra guerra, y ya no volvimos a vernos hasta 1939 [QUER 1962, 373].

Rothmaler studied various plant communities and associations (in the Sagres Peninsula and Southwest of Portugal), and was one of the first botanists to seriously criticize the eucalyptus plantations [ROTHMALER 1941, 140; 1943, 128]. The German ancestry of Rothmaler (even if his principal botanical education was undergone in Spain) confirms the important role this country had in the transfer, diffusion and implementation of technical innovations in Portugal. No doubt this sort of visitor was an essential cornerstone in the founding of communication networks, the organization of scientific expeditions, the training of qualified technicians and directing equipment and laboratories. Such a presence in the Portuguese agronomy is simply another sign of their importance.

### Forest engineers and the circulation of knowledge

The transformations of engineering cannot be understood without taking into consideration transnational aspects: above all, the networks of knowledge circulation. The circulation of knowledge and scientific and technical practices, as well as the question of models of institutional organization, are among the most widely debated topics among historians of science and technology, and among the researchers specializing in the configuration of modern professions.

This article has attempted to use information gleaned from the analysis of the Portuguese forestry communities' travels of learning to research the transfer of foreign technology to Portugal. Mobility represents a fundamental factor in the transmission of knowledge. Between 1915 and 1946, Portuguese forestry engineers aimed to acquire knowledge and experience through observation, formal studies and contact with other countries. These travels were in some cases financed by the engineer himself (as in the case of Vieira

Natividade) or by the state. The scholarship-holders generally set off with a series of indications concerning the goals of their mission, but were guaranteed certain space for their own initiative. These travels are case studies of the transfer of technology, in which the theme of genetics and ecological methods also have a place. Along with the employment of foreign experts (Rothmaler), local experts carried out the greater part of the transmission and appropriation of the knowledge produced abroad. These engineers also played a key role as teachers, and were active in the selection, translation, compilation and adaptation of scientific works of foreign origin.

All of the above can be seen from two perspectives. The negative, which emphasizes scientific and technical underdevelopment and a strong dependency, characteristics of modern Portuguese economic growth; and the positive, which assumes that without the foreign mobility of forestry technology, the already slow development of Portuguese forestry would not only have been delayed, but would perhaps have stopped altogether.

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