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Revising the institutionalization of science policies: Historical contexts and competing models

ABSTRACT

It is relatively frequent within the social sciences, particularly the history of science, to recognize, with more or less focus, the role of institutionalization and professionalization processes in the development of science and technology. Differences between various scientific institutions are not yet sufficiently understood, including their profiles and the different historical contexts in which they have been created, reformed and/or recreated, which makes up different models and historical implications as regards the assumptions of national science policies. By studying comparative work in the history of the Portuguese science policy process the main purpose of this article is to understand, compare and differentiate the relevant national experiences related to different national science policies agencies, mainly across Europa and North America, during the twentieth century, but with particular focus on the inter-war period and afterwards.

KEYWORDS

organization of science
scientific institutions
science policy
agencies of science
comparative history
Science, Technology
and Innovation (STI)

1. As Salomon mentioned, 'l'oublier, c'est tomber dans le domaine de la mythologie' (1972: 13).
2. Stevan Dedijer (1911–2004) – Yugoslavian academic, with a Physics degree from Princeton University, United States (1934). He served in the American army during the Second World War. He was head of the Nuclear Institute of Belgrade (1949–54). He took a Ph.D. at the University of Lund (Sweden), where he was also founder of the Research Policy Institute. His role in the area of Business and Competitive Intelligence is widely recognized. Dedijer was a consultant in programmes of technical assistance to Portugal in the 1970s.
3. Text dated 1962.

INTRODUCTION

The narrative of the history of science has often acknowledged that the relations between the techniques and pure science were historically built as a result of stimuli from several processes. Whereas in the past the techniques, which were consolidated empirically, did not necessarily depend on theoretical knowledge of scientific basis, the historical trend has moved towards technical progress stemming increasingly from theoretical knowledge acquired through scientific research (Salomon 1972: 11; Dupree 1957: 3; Landes 1998). This evolution, however, has had its institutional and/or organizational reflexes:

[...] d'autre part, un nouveau type d'organisation a présidé aux activités de recherche, le laboratoire conçu sur le modèle de l'artisanat cédant la place aux institutions modernes de recherche fondées sur des équipements importants, des équipes nombreuses, des structures complexes, des liens multipliés entre différentes disciplines. C'est dire, en somme, que l'ère de l'organisation a fait entrer la science dans l'ère de la production; ou encore, que la science n'est pas indifférente au contexte institutionnel dans lequel elle se développe.

(Salomon 1972: 12)

In fact, understanding the meaning and historical significance of institutional contexts is relevant not only for the history of knowledge, which is in line with the respectable internalist tradition, but also for political, economic and social history, combining the legacy of several eminences of a historiography of externalist science. We should bear in mind, as Salomon noted, that 'social objectivity' is embedded in political decisions, and thus a society also results from the 'inevitable space of State intervention and guidelines'.¹

Stevan Dedijer,² an observer and technocrat used to the international circuits, even considered that, at any given moment, a true 'political revolution' had taken place in relation to the 'history of the development of science':

Today, in the middle of the twentieth century, after the intellectual and the economic, we have entered the political stage of the scientific revolution: science has finally become a paramount concern of society and is strongly influencing every one of its traits. [...] In this, the political phase of the scientific revolution, new social inventions are being brought forth to increase the productivity of work in science and the productivity of the social effect of science. The most important social invention at this stage is the planned development of science on a national scale by means of the set of decision called 'research policy'. [...] The 'research policy' stage of the scientific revolution is now in process in most countries. And during all this time, since the seventeenth century, there was a corresponding accumulation of know how in dealing with science which was transmitted through unwritten tradition from generation to generation of leaders of science, administration and political decision makers [...].

(Dedijer 1975³: 490)

After the scientific (cognitive) revolution and the industrial (economic) revolution – since the second half of the nineteenth century, and especially during the twentieth century –, a true *political* (institutional) *revolution* of contemporary science has occurred. Whereas at the time of Dedijer's writing, one could

witness a remarkable development of planning, paving the way for the introduction and assertion of scientific policies believed to be of a 'modern' nature (1950s and above all, 1960s), one must in fact bear in mind the accumulation of past experiences, as Dedijer himself did not forget to point out.⁴

Inevitably, and always bearing the context in mind, the process of institutionalization of modern science refers to the history of scientific institutions. These institutions are diversified; they accompany the sociopolitical process and, if we consider comparative history, we notice that they follow an almost 'standard chronological pattern' – i.e., different settings for different eras, although with some overlapping and hesitations, typical of the choices between different models designed as a result of the balance of wills and interests within the network of actors, of the possibilities, as well as of the economic structure, the cultural and scientific texture of each national space; these models even enable us to draw a typology – although this should always be regarded with limitations, gaps between the historical–geographical complexes, and in light of the need to frame a dialog of action–reaction, consistent with the historical, political and social conditions of each given national space. Several scientific institutions accompanied the creation and the life of nations (bearing the twentieth century particularly, but not forgetting the nineteenth century, and other continuities). This is the true and not-static nature of a historical process.

Thus, throughout the twentieth century, the history of science tells a consistent and dynamic story of a process of science policy institutionalization that took place with more or less rationality, but nevertheless a highly visible one, i.e., a phenomenon of institutionalization following the endeavours of modern science (Ben-David 1971; Gingras 1991), a decisive step of a process with roots in the eighteenth and nineteenth century (academies, societies, associations), and in particular the assertion of what could be referred to as an 'external system of science' (Kaplan 1975: 352), which is made up of a number of scientific institutions that, by mediating the role of the State, came to lead a policy of support, promotion and even 'coordination' of scientific research, especially at the national level, but also with international expression. Although historically there have been private institutions of this kind, we refer to a process that has clearly benefited from the historically contextualized role of the State, which, particularly in Europe, spearheaded this phenomenon of political–institutional nature.

A noticeable feature was the existence of different models of science policy institutions, which one can describe from different concepts such as the theoretical perspective of Jean-Jacques Salomon (1977),⁵ from which we can distinguish an institutional model pointed towards a 'policy for science' and, in some national cases, particularly affected by the imperatives of War, explicitly designed for the formulation of a 'policy through science'. From the second post-war, one could witness a renewed and widespread persistence in creating or reforming science policy, henceforth clearly centred in advancing a 'policy through science', from both strategic and geopolitical points of view, as well as an interest in providing scientific outputs to economic development within an explicit logic of innovation.⁶

This last perspective has roots in the 'narrative' of the *OECD*, successively followed by many authors, many of them being close collaborators of this international organization. In these accounts one often finds the notion of a period preceding the establishment of the bodies of scientific and technological coordination as a period of pre-science policy⁷ (Henriques and Larédo

4. Apart from institutional monographies and histories of science (and technology), there are just a few works comparing and contextualizing the history of science policy institutionalization. An example of a comparative work on the institutionalization experiences of subvention councils for Science, for the period after the Second World War, is to be found in Godin (2000).
5. We must bear in mind a modern concept of science policy, where two dimensions – as we have already pointed out – must be present, according to Jean-Jacques Salomon (author of one of the most comprehensive definitions of science policy), which actually correspond to two policies: a 'policy for science', whose goal and requirement is to provide the ideal environment to activities; and a 'policy through science', whose goal is to explore the theoretical–scientific discoveries. It is in the 'policy for science' dimension, which aims to create an environment for the activities of research, and the 'policy through science', which aims to exploit the discoveries and innovations in various sectors where the government is involved. In fact, the simultaneous existence of these two dimensions evidences the degree of commitment to a science policy. Thus, we can identify two major objectives in a science policy, without prejudice to the methods that were followed: first, allowing scientists to increase their knowledge – putting into practice a 'policy for science';

and second, allowing the public and private authorities to use the scientific knowledge, or to conduct the investigations in accordance with ideological, economic or political criteria – thus implementing a ‘policy through science’. This conviviality with military objectives came to provide an important impetus to this dimension of science policy (Salomon 1977: 45).

6. This perception of Jean-Jacques Salomon is in fact one of the few views enough inclusive and interdisciplinary over the subject of science policies, allowing space for historical accounts to add some perspective to the Science, Technology and Society (STS) field of studies.
7. This aspect is actually much disseminated amidst the specialized literature. For example, we could consider the historical periodization used in the works of reference for the history of science policy in Portugal (Ruivo 1998; Heitor and Horta 2011). But it is also present in other peripheral contexts, as Latin American accounts regarding the institutionalization of science policies (e.g. Amadeo 1978; Dias 2012). In those contexts, it is common to find statements that attribute the beginning of science policy to Vannever Bush and its well-known report, *Science, the Endless Frontier* (1945), in the aftermath of the Second World War. However, as historiographical accounts already revealed, even in cases like Brazil or Argentina, science policy concepts and debates, as well as institutional platforms,

2013; Godin 2009). We must not lose sight of the fact that the Keynesian approach to economy has fostered direct government intervention in the affairs of science and technology, at least from the 1930s, deepening a previous experience – e.g. that of the Great War – whose desiderata came to be assumed in a more explicit sense in the wake of the Second World War. During this twentieth-century second worldwide conflict, in particular, programmes of military research left a vast legacy of experience in the emerging field of science governance and administration, afterwards implicitly paired with the Keynesian approach to macroeconomic growth policies in the ‘golden years’, but most of all based on the logics of security, competition and prestige that shaped the Cold War years. In fact, new institutional developments (relevant to the history of science policy in various nations) emerged back then, thus creating or recreating science agencies slightly different from the institutions for science funding that already existed on the eve of the second world conflagration.

We shall seek to approach this kind of scientific institutions, rather typical of the abovementioned ‘external system of science’, from an historical perspective dating back to the transition to the twentieth century, to the impacts of the Great War and the inter-war decades of upheaval, crossing alignments in order to historically identify several moments of State intervention, particularly with regard to the creation of institutions of science, with different missions, which for fact preceded the aforementioned model of organization of science of the second post-war, normally hegemonic in the imaginaries of contemporary experts regarding science policy narratives. We, therefore, set out to draw the history of a political project sometimes less explicitly assumed than others, surviving various junctures, boosted by different institutional settings and rooted sometimes on genetically distinct ideological formulations; in short, from a perception of politics in science, which is fundamental to the repertoire of different policies, whether successive or overlapping – with different rhetorics and agendas, in a state of coexistence or clash between interests, already in place since the earlier decades of the twentieth century – our account seek to reveal, in a tone of synthesis, the different and competing institutional models of one of the main elements of western civilization – science.

HISTORICAL EXPERIENCES IN THE CENTRAL ORGANIZATION OF SCIENCE

The successive visibility of the technical and material results of scientific research came as an argument in favour of an increased financial support from powers to scientific endeavours – in fact, it was not the cultural value of science what the public and private powers were mainly after (Taton 1964: v). In particular, this was due to the perception regarding the role of applied sciences and techniques contributing directly to the material strength of nations. Thus, the political power decided to promote it by means of funding and by institutionally and organizationally rearranging the development of scientific research. Henceforth, the evolution of science was deeply connected to the way it was organized, and the development of science during the twentieth century was deeply associated with government intervention.

The impact of several wars was indeed essential to the evolution and history of the organization of science in the West. For Spain, the Hispano-American war (1898) meant the definitive end to its colonial empire, favouring the adoption by the elites and the political power of a discourse that

paired the regeneration of the nation with the advancement of science and technology (López Sánchez 2006; Otero Carvajal 2000); also in France, since the Franco-Prussian war (1870–71), the discourse around the urgent need to ensure the scientific and technical superiority of the French nation, bearing in mind the experience of humiliation imposed by German technique, triggered initiatives aimed at organizing a scientific establishment. In other countries, the impact of the Great War would be the main catalyst, as it generated the political conditions, economic and cultural backgrounds to the institutional reorganization of modern science.

Going back to eighteenth-century Europe, cultural and scientific prestige was mostly a French-speaking thing. However, while France was the scientific centre of the civilized world, German science began to be forged also in this period. In fact, German science was not an autonomous process; it was the result of ‘a focused science policy, and taking advantage of favorable circumstances’ (Meyenn 1988: 63). However, at the time of transition to the nineteenth century, the main institutional model of science was still the French; scientific disciplines, technical schools and the prestige of the *École Polytechnique* (Shinn 1988) were intellectually influential at the political level (Meyenn 1988: 65). However, it was precisely during the nineteenth century that other competing models emerged. First, the university of science, which was inspired by the ideas of Wilhelm Von Humboldt. In parallel, the associations for the advancement of sciences raised awareness of the growing social importance of science in the western world, providing a typology of a scientific association movement that was growing progressively more ambitious, announcing a more explicit communication with power, anticipating and even accompanying (e.g. Spain, 1907) the institutional milestones of the history of the nations’ science policies (Ausejo 1993; Gispert 2002).

By the late nineteenth century, the creation of institutions separated from university life, such as institutes and/or laboratories, had become visible, preceding the creation of agencies clearly with a mission of organizing science and design science policy at the national level (Meyenn 1988: 65).

In Germany, the impact of the Napoleonic wars was felt. In this context, the reforms of the Prussian educational system began to take place, promoted by Humboldt’s ideas (Ruegg 2004: 5). Above all, a new orientation arose that would preside over the foundation of the University of Berlin in 1810, an orientation that established a unity between teaching, learning and research. These were the foundations for the ‘German scientific renaissance’. One must not forget, while considering the growing role of higher education, the role of several German companies providing important, multiple and dynamic stimuli (Meyenn 1988: 70).

The Franco-Prussian war was a period of scientific nationalism, which witnessed the rise of the myth surrounding the superiority of German science and technique (Meyenn 1988: 74; Heim et al. 2009). It was a time when science was a symbol of civilization and progress, an arena in which all the powers competed for supremacy.

Meanwhile, however, the growing political centrality of scientific research was gradually eroding the Humboldtian model for the organization of science.⁸ The height of the prestige of that model of university coincided with the first initiatives that, in the long term, would question its efficacy. In January 1911, the Kaiser-Wilhelm Society was founded under the recommendation to order ‘the supplementation of universities by means of ‘auxiliary institutes’, in which, contrary to what has been occurring in universities, it is possible to

were already in place during the 1930s (e.g. Motoyama 2004; Feld 2015).

8. As a matter of fact, though a better knowledge of the history of universities remains necessary, it has been found that the extraordinary growth of the university and the number of universities coincides also with the creation of several other institutions, even competing with the activity spheres of the university itself; a debate on the *model* soon followed, but the university was never really replaced (Ruegg 2004: 3).

9. For a comprehensive description of the German institutions of science policy see Walker (2003).
10. During the Portuguese 1st Republic (1910–26), the Academy had no easy job, with its typography abolished (Decree published on 11 March 1910) and its material transferred to the national press, on the pretext of the need to ensure a 'useful employment of State funds, therefore terminating budgetary funds squandered by the former regime' (Agudo 1992:37).

conduct research without teaching' (Meyenn 1988: 79). As Charle noted, the creation of the Kaiser-Wilhelm Society opened an 'era of large-scale research' and meant, in the long term, the 'gradual separation of research from teaching' (2004: 33, 57, 74). However, the myth of the Humboldtian University would remain (Charle 2004: 48–49).

The success and growth of the Kaiser-Wilhelm-Gesellschaft was such that, in 1930, it had 26 institutes, laboratories and observatories (Meyenn 1988: 79). The strength of German science resulted from continued concerns and policy initiatives regarding the organization of science, with notable individualities such as Hermann von Helmholtz, Max Planck, Walter Ernst and Albert Einstein.

This belief in the predominant role of science, combining the evolution of historical conjuncture due to what it represented in terms of stimulus to scientific development promoted by the war effort, would lead to deeper mechanisms of scientific organization. In October 1920, a new impetus in the institutionalization of science policy took place with the establishment of the *Notgemeinschaft der deutschen Wissenschaft*, a central body for all German scientific research. Despite the political and social difficulties of inter-war Germany, the boycott to German science and the Versailles humiliation, the science policy of the young Republic of Weimar managed to conduct a real 'scientific miracle' in keeping the scientific prestige of Germany – despite the visible growth problems of research structures, in particular as regards the creation of career opportunities, which required heavy State investments; meanwhile, the German scientific potential was actually undergoing a noticeable decrease, as the United States was starting to offer attractive research positions.⁹

The United States, as a young nation early on, was a country that resorted to science as an institutional asset, especially in terms of education, its official discourses and the organization of the State pursuing the creation of knowledge by means of research (Dupree 1957: 2). However, it was not until the Great War that such state of affairs evolved into a central scientific organization, in order to tackle the problem of the lack of appropriate mechanisms to mobilize the scientific resources for the war effort. The impact of the war would, therefore, have an immediate repercussion on the liberal mentality of the federal government and the relative autonomy of the civil and military offices and departments, as well as their scientific and technical services (Dupree 1957: 305).

The American National Academy of Sciences, in theory, should have been the institutional platform for a more extensive organization of science (Dupree 1957: 308; Cochrane 1978); the same could also be argued regarding the European academies. In fact, the idea that the decadent academies were unable to take the necessary steps towards a central organization of national scientific investigations became widespread.

For example, the very creation of the Portuguese Academy of Sciences of Lisbon on 24 December 1779 and its track history certainly had great significance. The action of the Academy had undisputed importance in the development of science in Portugal, garnering notoriety through the institution's public action (e.g. in the campaign of vaccination), through the patriotic intentions of renewal through the scientific or academic solidarity of its members, thus becoming a true scientific corporation. Nevertheless, the evolution of the Academy of Sciences of Lisbon led to a gradual loss of prominence,¹⁰ in part due to the emergence of other institutional actors such as the university – in

theory reformed according to the Humboldtian model – and the establishment of research councils, laboratories and State-sponsored scientific institutes, and even private foundations. Thus began the crisis of the Academy of Sciences of Lisbon, which would imply long-lasting uncertainties as to the nature of its mission.¹¹

Considering the United States and the impact of the economic situation of the Great War, it was then that the proposal of the National Research Council (1916) emerged, an entity within the American Academy of Sciences, with a view to foster cooperation between governmental, educational, industrial and research entities in order to strengthen the ‘national defense’. The new body included governmental entities, universities (e.g. Massachusetts Institute of Technology [MIT] and Throop College of Technology; later Caltech – California Institute of Technology), foundations and industries, which provided a significant basis for representation. The NRC was mostly funded by private foundations (e.g. Carnegie Corporation and the Rockefeller Foundation). It sought to overcome the tensions between pure science and applied science, as well as to put together engineers and scientists. However, its relations with the military were particularly evident, which would be confirmed after 1917, when the NRC acted almost as a research department for the Council of National Defense. With time, however, it seems that the NRC eventually failed to reap the full benefits of its assumptions, unlike the Office of Scientific Research and Development (OSRD) during the Second World War.

The effects of this organizational experience of war were essential, evidencing the level of *imbuement* of research in the economy, making the benefits of a dynamic of industrial research visible to the industry. However, this eagerness of the federal government after the war was followed by disinvestment, as a *laissez-faire* mentality prevailed in terms of the central organization of science, which resulted, during the post-war period, in an ‘emotional rejection’¹² of the assumptions that had guided the action of the NRC. Thus, despite the NRC’s experience as a central agency for scientific organization, coordination and rationalization of scientific and technical resources (which was wider than the assumptions postulated by scientific academies, as it centralized information and brought together experts for a common purpose), during the post-war period it proved unable to take up the administration of science as a full-time mission (Dupree 1957: 323). However, the point of departure would be henceforth different, favouring a path that would lead to major agencies of policy, coordination and funding.

In the post-war era, after the utilitarian pressures brought about by the conjuncture of war, there was also an ‘emotional reaction’ that sought to emphasize, in spite of the inevitability of science industrialization or its connection to military interests, that the organization of science should be contemplated by some measure of support to basic research, conducted by the government and even by the private (Dupree 1957: 341). Following this idea of gathering funds for basic science, the National Research Fund (NRF) was indeed created with contributions from the industry. The NRF was thus a step forward in terms of the mechanisms available to fund American scientific research, seeking the involvement of the industry with the funding of basic research, including at the universities. It was, above all, a model of promotion and organization of science that avoided formulas of governmental control. However, the results were rather scarce, the sums donated were insignificant and the economic depression eventually determined its failure. In addition, the NRF failed to develop any mechanism to distribute the amounts that it

11. On the Academy in France, see Crosland (2002) and Hahn (1971).
12. The civilian scientists returned to their campuses, abandoning the functions they had played in the committees created by the federal government during the war.

raised, through either grants or other type of subsidies, and as a result, nothing actually reached the hands of researchers (Dupree 1957: 342). The NRF was a pioneering initiative, though simultaneously it attracted the interest of private entrepreneurs and especially industrials, and tried to solve the imbalance between basic science and applied science.

The 1920s witnessed a return to normal life, as far as scientific governance was concerned, with regard to the balance between the wartime utilitarianism and the prevailing scientific ethos, which culturally tended to refuse such contractual relationship with domestic production and/or frameworks of collective research, for the sake of research freedom – and due to a view of research that particularly emphasized ‘individual creativity as an essential element’ (Dupree 1957: 362). However, the existence of this area of confluence between the ‘Republic of Science’ and economic realities (finance and industry) had become inevitable. Like the NRC, the NRF consummated such awareness of a growing interrelationship between the government, universities, foundations and industries. The main evidence of this fact is that, in 1929, when the crisis erupted, the Great Depression affected the entire structure of research in America. The impact was of such magnitude that only in 1937 the United States resumed the levels of expenditure that had existed in 1931.

However, the New Deal brought along further attempts to (re)organize science, seeking to overcome its financial constraints. The process occurred in two stages. At first glance, one could say that the doubts about the benefits of science prevailed – and, in this sense, unlike the war, the Great Depression generated, above all, hesitations with regard to the support and funding to scientific research. Research programmes were regarded as negligible compared to other social issues (e.g. unemployment). The New Deal science policy should be viewed in light of the crisis that provided its backdrop. The priority was to fight unemployment and to revitalize the economy, and as a result, scientific institutions faced severe difficulties, along with the long-term research programmes (Dupree 1957: 347). However, like during the war period, the *laissez-faire* attitude was rejected, and in this respect, the science policy leaned towards a certain proactivity.

Such was the atmosphere that surrounded the creation of a temporary Science Advisory Board (SAB) (31 July 1933). The board showed potential to become an important milestone in the US central organization of science history – resembling a kind of minimal configuration designing the basic parameters for a central organization of science, including missions of advice, funding and creation of incentives to innovation, combining purposes within the scientific and technological domains. The SAB represented, in this perspective, a new coordination effort for the organization of science. The SAB was placed under the jurisdiction of the Academy of Sciences and the NRC, and also benefited from a decisive contribution from the Rockefeller Foundation. The SAB’s action overlapped the mission of the academies, while taking stands and clearly assuming quite specific recommendations with regard to the problems of the American scientific establishment – in particular, as regards duplication of efforts, and the urgency of some sort of coordination for the scientific work (Dupree 1957: 351). Like with all the science policy initiatives adopted during the early stages of the New Deal, the general opinion was that all that proactivity was motivated by a desire to cut down on the scientific budget due to the economic situation.

After the emergency state was overcome, by 1935, there was a greater interest of the government in encouraging a commitment of science towards

solving social and economic problems brought about by the crisis, even calling upon the social sciences community to design and plan missions, which was a step forward from the near-sighted perspective of the science policy measures of the first stage of the New Deal.

While preparing the second New Deal, and within the pursuance of 'social goals of science', the SAB participated in the development of the 'Recovery Program of Science Progress' (September 1933), which was presented as a New Deal for science. The programme offered \$16 million for a period of six years, to be distributed to investigations that, namely, had direct relation with public works, to the preservation of resources, to the establishment of new industries and, above all, to ameliorate the acute problem of unemployment amidst the scientifically and technically qualified youth. It was proposed that the NRC should be the managing entity, and that it should be present especially at the universities.

Even during this period, tensions and divisions led to the gradual weakening of the SAB (e.g. prevalence of private institutions, absence of social scientists, hegemony of the natural sciences, etc.). Additionally, the SAB suffered the competition from a newly emerged field of governance: planning. In fact, in 1933 the National Planning Board, later turned into a National Resources Board (1934) and then National Resources Committee (1935), took over many relevant tasks. It was, in fact, entrusted with planning as an objective implicit to the coordination of research. In this way prevailed the idea that research was one among other resources that required a central organization towards the pursuance of social and/or national interests; although the strategic concept of scientific knowledge was not prioritized, nor was the social role of scientists sufficiently acknowledged. Thus, also as a result of the environment itself, the SAB failed to perpetuate itself as a permanent agency. This way, due to the constant quarrels with other entities, the SAB was always a mere attempt to create a central body of scientific organization, both at the governance level and the national scale (Dupree 1957: 358).

Nevertheless, the Great Depression and the response of the American government, particularly through the New Deal and several qualitative innovations, led to an expansion of governmental responsibilities, including those concerning the scientific establishment issues, either within the departments of State, public or private institutions. Whereas the bases of the New Deal were extraneous to research and its results, the qualitative changes that it introduced in science policy were impossible to ignore. The tendency was set towards a scientific coordination by the federal establishment, as well as scientific planning at the national scale (Dupree 1957: 366) – besides the support to civil service, science was present also at the universities, in foundations and in the industries. The well-being and prosperity of the 'scientific system' became more or less present within the concerns of governance, at least because research was one among other national resources. The alliance and the competition with the planning movement also marked the period.

The limitations were still evident (frailties in terms of institutional position, little representation even among scientists), and thus none of these New Deal agencies lasted until after the Second World War. One of the problems lied in the turbulence originated by political shifts, which evidenced the frail position of science, as well as the insufficient theoretical elaboration as to its place in governance and economy, and even as regards its social role. The political whirlpool of that time made it impossible to provide the conditions for the creation of a permanent scheme to the central organization of contemporary

13. The idea behind the OSRD was to shorten the distance from the design of projects to its implementation by the military. However, the NRDC proceeded as a branch of the OSRD. The OSRD was intended to regard American science as whole. The action of the OSRD can be summarized as follows: 'serve as a center for mobilization of scientific personnel and resources of the Nation in order to assure maximum utilization of such personnel and resources in developing and applying the results of scientific research to defense purposes'. One must bear in mind that the Second World War was regarded by the Americans since its earliest stages as a total war that should mobilize all sectors of the nation's life; therefore, the OSRD should become the central organization that 'coordinated' all the scientific entities, covering the departments of war and navy, as well as other departments and agencies of the federal government. It is noteworthy that with the OSRD, the form of committee was abandoned, as the idea of an agency as favoured (Dupree 1957: 371).

14. Diachronically, one may distinguish a first stage in which science emerges as a civil power of data recollection and as an element of governmental regulation; in a second stage, starting with the Great War, science became part of the military *establishment*; in the interwar period, science was regarded as a 'national resource'; with the Second World War, science confirmed the status that it had

science, from a systemic perspective. On the other hand, whereas the emphasis on a tighter connection to economic and social issues was present, the second stage of the New Deal brought about a new cycle of prevalence for fundamental science, in opposition to the tendency, which was several decades' old, towards a rationale underlying science policy that privileged and mostly pursued the applied sciences. A line of thought emerged that valued a systemic logic and the relation between basic science and applied science. Above all, the belief that the State had an obligation towards science regardless of its practical application endured (Dupree 1957: 377).

It was clear, however, that a relevant tendency within the institutional history of science consisted of an insistence upon greater coordination between research efforts, progressively transcending the departments, centres, experimental labs and other units that, as part of their nature, led directly to scientific research (Dupree 1957: 364). The scientific bodies of a political nature thus began to rise as a result of historical conditions marked by the war and by the economic and social crisis, leaving as legacy a number of entities that would cyclically inspire a generation of political leaders (e.g. Vannevar Bush, James B. Conant and Karl T. Compton) to introduce and oversee the science policy of the State.

In the history of the organization of science in America, this path resulted in organizational developments such as the establishment of the National Defense Research Council (NDRC) in 1940, the OSRD¹³ in 1941, during the Second World War,¹⁴ and the creation of the National Research Foundation (NSF) in 1950, which would emerge as the main permanent structure dedicated to the organization of science issues at the end of a long series of experiments regarding organizational models¹⁵ and of science policies implementation and operationalization. With the Second World War, the issues of security and national defence became present within science policies, and the organization of American science during the conflict became permanent.¹⁶

This American path is of the utmost relevance, with successive attempts, as a result of cyclical stimuli, in order to create a comprehensive organization of science as an institution within the State, though connected to a number of public and private entities. This path was followed by European nations reactive to progressive discovery and/or absorption of coordinates for their own organizational solutions, oscillating between two main attitudes: (2) the enhancement and promotion of the cultural dimension of science, i.e., the concern with the advancement of knowledge in a selfless and idealistic perspective, and therefore, support to the scientific establishment, regardless of its practical applications; and (2) the enhancement of the centuries-old evidence of the growing relation of dependency between scientific research, technological development and production, with repercussions visible in society and industry. In the end, the tension of science as an ideal of knowledge and pillar of civilization doubled (Dupree 1957: 377, 379).

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Back in the Old World, the emotional complex of what one might call the 'infused stimulus' for the promotion of a science policy relied much in this will to recover the prestige and reposition the old kingdoms or empires in the game of nations, like this reacting to national 'decadence' through a genuinely European ideal – that of knowledge, historically responsive to the transforming potential of science, at least in cultural terms.

In Spain, it was on the wake of the 1898 crisis, and the end of its colonial empire and within the spirit of a generation, that the Junta para Ampliación

de Estudios e Investigaciones Científicas (JAE) (Sánchez Ron 1988a and 1988b; Sánchez Ron and Lafuente 2007; Otero Carvajal and López Sánchez 2012) was created, in line with the regeneracionist discourse and the action of the *Institución Libre de Enseñanza* (1876)¹⁷ in 1907 (11 January) – which was dissolved in 19 May 1938, following the Civil War, and later transformed into the Consejo Superior de Investigaciones Científicas in November 1939, which still survives today as the main science agency in Spain.

At the end of the nineteenth century, Spanish scientist Jose Rodriguez Carracido¹⁸ realized that the ‘problem of scientific education’ in Spain had become urgent after the disappearance of the last vestiges of Spanish colonial power:

El problema de la educación científica en España se ha planteado como necesidad apremiante inmediatamente después de la pérdida de los últimos restos de nuestro poderío colonial. Replegada en sus lares solariegos el alma nacional hizo examen de conciencia y vió con toda claridad que había ido a la lucha, y en ella había sido vencida por su ignorancia de aquellos conocimientos que infunden vigor mental positivo en los organismos sociales. Refiriéndose a los títulos de las asignaturas de la segunda enseñanza, alguien dijo donosamente que nuestra derrota era inevitable, por ser los Estados Unidos el pueblo de la Física y la Química, y España el de la Retórica y Poética.¹⁹

In this mental context, JAE, also known as Junta de Pensiones, was created in order to break the cultural and scientific isolation of Spain. Its statutory decree stated,

El más importante grupo de mejoras que pueden llevarse a la instrucción pública es aquel que tiende por todos los medio posibles a formar el personal docente futuro y dar al actual medios y facilidades para seguir de cerca el movimiento científico y pedagógico de las naciones más cultas, tomando parte en él con positivo aprovechamiento.

(Sánchez Ron 1988a, 1988b: 6)

Furthermore,

El pueblo que se aísla [...] se estaciona y descompone. Por esto todos los países civilizados toman parte en ese movimiento de relación científica internacional, incluyendo en el número de los que en ella han entrado, no sólo los pequeños estados europeos, sino las naciones que parecen apartadas de la vida moderna, como China, y aún la misma Turquía, cuya colonia de estudiantes en Alemania es cuatro veces mayor que la española, antepenúltima entre todas las europeas, ya que son sólo inferiores a ella en número Portugal y Montenegro.

(Sánchez Ron 1988a, 1988b: 6)

Headed by Santiago Ramon y Cajal,²⁰ JAE had a remarkable impact, by means of assignment of pensions, creation of research institutions and establishment of relations with foreign institutions and scientists from abroad, so that on the eve of the civil war the Spanish science was in a good enough position to become noticed in the international scientific landscape (Otero Carvajal 2000). For some members of an entire medical ‘generation’ (Garnel 2002;

been acquiring within the State organization (Dupree 1957: 380).

15. In fact, the OSRD was never designed as a permanent structure. When the agency was terminated, it was believed that research should remain as an important element of the post-war reorganization of the United States. Thus, there was a centralizing effort, through the separation of the civil and military dynamics, by creating the Office of Naval Research (1946) and the Department of Defense (1947), entrusted with the mission of coordinating military research within their respective fields of expertise. The nuclear energy programme justified the creation of the Atomic Energy Commission (1946), with the tradition of civilian control prevailing. The concerns with basic science, which had been evident in certain sectors since the second stage of the New Deal, justified the creation of the NSF, as the result of the famous Bush report, *Science, The Endless Frontier* [...] (Dupree 1957: 373–74).

16. As it is frequently noted, the logics of defence and, more specifically, the research contracts with the arms industries deeply influenced the university research of the time. The bias towards applied science, neglecting basic science, was also a legacy that lasted until much after the post-war period in the way in which the assumptions of science policy were regarded in several nation-spaces.

17. The *Institución Libre de Enseñanza* was founded in 1876 by a

group of professors (among them, Francisco Giner de los Rios) that had been expelled from the university for defending academic freedom and for refusing to adjust their teaching to the official dogmas of religion and politics (<http://www.fundacionginer.org/>. Accessed 16 August 2012. See also Viu 1988).

18. Jose Rodriguez Carracido (1856–1928) – Spanish chemist and pharmacologist. He graduated in 1874 and joined the army as a pharmacist. In 1881, he assumed the chair of organic chemistry at the Faculty of Pharmacy of Madrid. He was an enthusiastic supporter of the Junta para Ampliación de Estudios (1907–present), and also had a decisive effect on the creation of the Asociación Española para el Progreso de las Ciencias (1908–present). He was a distinguished member of Sociedad Española de Física y Química and headmaster of Universidade Central. In addition to his academic and scientific work, he was a man of culture and a notorious public figure.

19. Quote from Carracido in Sánchez Ron (1988: 2). Also see some texts in Carracido (1917).

20. Santiago Ramon y Cajal (1852–1934) – Prestigious Spanish histologist, graduated in Medicine from the University of Zaragoza in 1873. He was in Cuba in 1874–75, during the colonial war in this province of the Spanish empire. In 1875 he assumed the post of assistant professor at the Faculty of Medicine of the University of Zaragoza, thus pursuing his scientific calling. He obtained his Ph.D. in

Costa 2000), for whom Ramon y Cajal was an example of scientific calling, the Spanish experience was clearly present.

The ‘institutionalization process’ of Spanish science took a further step in 1908, with the creation of the Asociación Española para el Progreso de las Ciencias (AEPC), modelled after the Association Française pour l’Avancement des Sciences (1872), also created in the aftermath of a military defeat (Ausejo 1993: ix). Whereas JAE was entrusted with ‘conducting thinking and action’ in the field of science, AEPC’s mission was to ‘disseminate’ and even ‘advise’. Under the Spanish model, JAE was a primary body and AEPC a secondary one: JAE was the main entity for the promotion of science, an embryo in the modern sense of science policy design and implementation, and was particularly responsible for a ‘modernizing’ effort to place Spanish ‘homeland’ in line with international standards; AEPC was aimed at an ‘agglutination of the collective’ made up by the scientific community, and coordination of various ‘sensitivities’ (Ausejo 1993: x) – it provided a dimension of advice in the design of science policy. The idea was that AEPPC fulfilled a complementary role to that of JAE (i.e., representation of the scientific community) (Ausejo 1993: 77).

One must bear in mind that, whereas the Spanish JAE has enabled the establishment of an institutional structure to support science, it also opened a debate between other models that could be adopted with the same purpose (Trillas 1988: viii). Indeed, as we know, in the context of this discussion, a genuine debate on the institutional support to science, including its purposes, the university has assumed a position, as at that time it became alarmed with the emergence of a model that suggested the autonomy of science in relation to university teaching.²¹ In this respect, the Spanish model of organization of science, later still present with the CSIC model, featured ‘the separation of research and teaching’ (Blasco and Blanco 1979: 144). In another case, in France, however, whereas the famous CNRS marked the culmination of a process of slow evolution and reaction to the Napoleonic educational and scientific system (Gilpin 1968: 133), the model turned out to feature the prevalence of the university within the French scientific system²² (Paul 1985: 353).

The experience of institutionalization and organization of science under the Troisième République (1875–1940) is rather rich, as it was marked by successive attempts at rethinking the educational and scientific system – leaving a heritage of scientific institutions that preceded the notorious CNRS (Paul 1985: 129), such as the Caisse des Recherches Scientifiques (1901–21/1922–present),²³ the Caisse Nationale des Sciences (1930), the Conseil Supérieur de la Recherche (1933), the Caisse nationale de la recherche scientifique (1935)²⁴ and the Centre Nationale de la Recherche Scientifique Appliquée (CNRSA, 1938–41). (Paul 1985: 289, 340).

The French scientific system, like the Portuguese, was strongly affected by the restrictions that the Napoleonic university model placed on the development of science. This was a model that aimed especially at strengthening the construction of the modern State, the bureaucratization and secularization of public servants. The objectives of the French university model were ‘political and social stability’, education with a view to ‘social harmony’ and the supply of liberal professionals, and even, finally, a certain limitation of the freedom of thought, which is considered dangerous for the State (Charle 2004:45). Whereas in the South of Europe the humboldtian myth had its impact, the basic groundwork of universities remained, in many aspects, Napoleonic in nature.

During the nineteenth century, France witnessed a period of clear expansion of its scientific life (Shinn 1988: 151). However, it is also evident that higher education in France neglected scientific research, in the sense that neither the Grandes Écoles nor the universities had the training of scientists or the development of scientific research as their mission. Shinn sustains that research was not fully 'institutionalized' in the French educational system, as it was subject to a fragile status (Shinn 1988: 127, 129, 146, 148). Any social commitment towards science thus depended on the proactivity of governmental policies.

During the transition to the twentieth century, as well as during and in the wake of the Great War, and well into the 1930s, the French authorities eventually realized the role of science in the life of the nation, finally understanding that French research needed mechanisms of governmental support (Shinn 1988: 153). This multiplication of financial agencies, tendentially outside the orbit of the universities, eventually multiplied the sources of funding for French research. A tension thus emerged in France, as in Spain and Portugal, sometimes taking the form of an open dispute, between two scientific groups: those interested in promoting research as an autonomous career, and the university 'mandarins' who wished to maintain the monopoly of science as an accessory feature of the university system (Shinn 1988; Paul 1972).

The creation of the CNRS in 1939 – during the period of the Popular Front, under the impulse of Jean Perrin,²⁵ who was closely associated to Leon Blum, and with Irene Joliot-Curie in government as secretary of research – came to mark the predominance of a specific group and of a certain model of science policy institutionalization (Paul 1985: 343; Gilpin 1968: 133). The CNRS of the second post-war resembled the Kaiser-Wilhelm-Gesellschaft (later, Max-Planck-Gesellschaft), with a vast network of research institutes and centres (Gilpin 1968: 134). The CNRS had labs outside the orbit of the university – not unlike what happened in Portugal; the CNRS contributed to the professionalization of researchers, ensuring the existence of a stable flux of scientists, and also played a role in the formation of other researchers; in this regard, it went farther than the Portuguese experience, as we shall see ahead.

The paradigm of the equation was already that of a modern science policy, with a progressive abandonment of the previous notions of *laissez-faire* applied to the conduction of scientific affairs; the attraction towards the experiences of planning guided even some prominent individuals involved in the process of CNRS creation. From this moment on, the science policy would have to be geared to productive axis from the national point of view. The CNRS now had as its explicit mission 'the development, guidance and coordination of all French science' (Gilpin 1968: 134). The CNRS introduced various aspects of the organization of contemporary science, in addition to enabling the survival of French scientific life during the decades that followed the conflict (Gilpin 1968: 135).

However, the CNRS still failed to achieve some aspirations, in particular the gap that still separated scientific knowledge and technological innovation. This was due, above all, and in addition to various idiosyncrasies, to the fact that it remained subordinated to the Ministry of Education and, also, due to its excessively heavy internal structure (Gilpin 1968: 136). Absorbing all the rich experience of institutionalization and organization of science of the Troisième République (1875–1940), in which the educational and scientific system was successively redefined, the CNRS, in its conception, was mainly the result of this latent conflict between those who above all wanted to professionalize

1877, in Madrid. In 1906 he received the Nobel Prize in Physiology and Medicine for his work in the domain of neuroscience, shared with the Italian researcher Camillo Golgi. He is the author of the famous text *Reglas y Consejos sobre Investigación Científica* (1897). He was president of the Junta para Ampliación de Estudios since its creation in 1907 until his death.

21. Sánchez Ron even mentions, as laid down in the JAE Regulation, published on 22 June 1907, something that resembled a unit of researchers within the university, under Rodríguez San Pedro as Minister of Education – some aspects changed, notably with the elimination of these 'certificates of sufficiency', a set of posts (of 'auxiliary' nature) established in the list of staff of universities, institutes and special schools dependent on the Ministry of Public Instrucción (Sánchez Ron 1988: 8).
22. About the French case, see Shinn (1988, 1994); Fox and Weisz (2009); Weisz (1983); Gillispie (1980, 1983, 2004); and Ben-David 1970.
23. The Caisse des Recherches Scientifiques was created in 1901 as a scientific institution to finance individual research through scholarships. In spite of difficulties, in particular its limited funds, the Caisse was not an insignificant component and created relevant precedents in terms of state funding, preparing the scientific funding structures of the 1930s (Paul 1985: 13, 293; Gilpin 1968: 130).

24. First, in 1393, a Conseil Supérieur de la Recherche was established, made up by notable individuals of science and letters, which provided advice to the government via the Ministry of Education (the chairman of this body was the minister); after much insistence with the government, the Caisse nationale de la recherche scientifique was created in 1935, which unified the management of funds of the Caisse des Recherches Scientifiques (1901–present, already a part of the Office des Inventions, since 1922) and the newly created Caisse Nationale des Sciences (1930) (Paul 1985: 289, 340; Gilpin 1968: 131, 133).

25. Jean Perrin (1870–1942) – French physicist, chemist and politician. He won the Nobel Prize in Physics in 1926. Perrin belonged to a group known for its socialist leaning, which also included Emile Borel, Pierre and Marie Curie and Paul Langevin, who were all activists of Ligue des droits de l'homme. He served as an officer in the French army during the Great War. In 1923, he was elected as member of the French Academy of Sciences. In 1930, he created the Institut de biologie physico-chimique. In 1936, he was appointed Undersecretary of State for Research in the first government of Leon Blum. In 1937, he helped create the Palais de la découverte in the universal exhibition, *Exposition Internationale 'Arts et Techniques dans la Vie moderne'*. In 1938, he was appointed again, during the second government of Leon Blum, Under-Secretary of State for Research. In 1938, he advanced

and institutionalize scientific research, with a similar and parallel dignity to the career of university teaching. However, as mentioned above, in France, in addition to the polarization of the debate around 'militant scientists' and 'university mandarins', another striking aspect was the relative inefficiency of the forces of 'industrial demand' and the weak consistency and coherence of government support – even when compared to the case of Germany and, of course, with the United States (Shinn 1988: 154–55).

The prevalence of the scientists' narrative and the lack of expression or interest from other players resulted in the CNRS model, as envisaged by Jean Perrin and its founders, like in the Portuguese science agency case, which was also based on the idea of recruiting and funding men of science, and not necessarily on the idea of promoting innovation, i.e., scientific and technological outputs with a potential impact on economic development. In fact, innovation as a discourse panacea in science policies still was far from being a central issue in the discourse of the elites who participated in the design of national science policies until the 1940s. This would be a decisive boost that would definitely enter the actors' discourses after the second post-war period.

THE GREAT WAR AND THE EMERGENCE OF AN ALTERNATIVE MODEL

The bodies created in the context of the Great War, whose stimulus was important to change public authorities attitudes during the conflict, had been an exception until then. Scientists and military personnel developed close relationships during the conflict (Paul 1985: 13, 320). It was in this context that scientific institutions, clearly geared towards connecting the research and technical innovation in production, were established. The two world wars would, in fact, accelerate the emergence of scientific research promotion subsidiary role, attributed mainly to the State. Under the pressure of the needs of wartime period, economies of command were tested, for the satisfaction of requirements brought about by the situation of total war. Several mechanisms of mobilization and organization were put together by means of new weapon experiments, laboratory units responsible for developing synthetic materials and improve manufacturing processes were created, for the sake of defense, survival, independence and national interest (McDougall 1985: 5).

During the Great War, decisive innovations occurred in terms of organization of science, particularly in Britain, with the creation of the Department of Scientific and Industrial Research (DSIR, July 1915/1916) (Varcoe 1970; Gummett 1980). In that moment of conflagration, Great Britain consecrated the largest percentage of the national budget to research, and had real differentiated and effective coordination bodies (Taton 1964: 901). Moreover, in France during the war period, upon realizing the superiority of the German technique, a few bodies were established that survived the conflict. The Direction des Inventions intéressant la Défense Nationale (1915) emerged under the pretext of mobilizing science for national victory; it was without a doubt the largest funding agency until the CNRS appeared in 1939.²⁶

The novelty, in addition to the scale of state funding and a reasoning oriented towards national interests (Gilpin 1968: 130), was the explicit association between science and technology, especially through the promotion of cooperation between scientists and engineers, as well as military departments and the industry itself. In short, the war deepened the significance of the debate on the models of science institutionalization and their funding institutions and its respective science policies (Paul 1985: 13).

Thus, although the world conflagration had ceased, by 1922 the Direction des Inventions became the Office National des Recherches Scientifiques et des Industrielles et des Inventions, a body designed for times of peace, as an autonomous entity responsible for the organization of applied research (Paul 1985: 13, 322). This institution would lay down a significant part of the ideology of coordination of scientific research, especially applicable to the productive sector (Paul 1985: 13, 326, 338; Gilpin 1968: 130). However, the Office lacked powers and means of coordination to overcome the conservative industrial and bureaucratic obstacles; thus, it brought forward the project of a *troika* of 'science & technology', industry and defence (Paul 1985: 326). The Office was regarded as a prototype of the CNRS and the Commissariat à l'énergie atomique (CEA, 1948), prefiguring the style of military-industrial complex of the second post-war (Paul 1985: 13, 339).²⁷ The Office was replaced by the Centre National de la Recherche Scientifique Appliquée (CNRSA, 1938–41) (Paul 1985: 289, 340), which by then had been absorbed into the CNRS, which, while appearing as the culmination of a process of slow evolution and reaction to the Napoleonic educational and scientific system (Gilpin 1968: 133), was a model that consecrated the prevalence of the university in the French scientific system (Paul 1985: 353).

The CNRS model, even though its promoters followed with great interest, for example, the Soviet science policies – which adopted a logic of coordination and planning (the Academy of Sciences of the USSR was actually the Joliot-Curie model) (Gilpin 1968: 134) – was clearly anchored in a paradigm of *laissez-faire* and in the belief predominant amidst the pure sciences that this was the best style of science policy (Gilpin 1968: 857). This was also the case, to some extent, of the Portuguese Institute of High Culture (IAC), which promoted a training policy, rejecting an 'ordered factory-like system',²⁸ and neglected applied research.

In Spain, later in 1931, this alternative model of scientific institution, inspired by the British DSIR (or rather also in the French Office des Inventions, in a generic way), was tried with the Fundación nacional para investigaciones científicas y Ensayos de reformas (July 1931). The then secretary of JAE, Jose Castillejo, was appointed to coordinate this body.²⁹ The FNICER tried to raise awareness in the industry in relation to scientific progress, coordinating the private resources with public entities, municipalities, provinces and regions (Sánchez Ron 1988a, 1988b: 18). In comparison to JAE, the FNICER tried to propose a more decentralized and less pedagogical model, 'more applied' and closer to the 'needs' of the socio-economic nation (Sánchez Ron 1988a, 1988b: 19).

In the inter-war period, Portugal did not experiment any entity like the French Office des Inventions, the British DSIR or the Spanish FNICER – there would be no development in the country as far as that issue was concerned until the 1950s or 1960s. In fact, although the promoters of the JEN (the first institution in Portugal with the explicit intention of carrying out the mission of organizing science) described the profile of the Fundación Nacional para Investigaciones Científicas y ensayos de reformas and identified the purpose of the FNICER as *leading industries and private interests to cooperate with research laboratories* and, in addition to *promoting both pure scientific research and applied research, improving the national economy and public hygiene*³⁰, a long time elapsed until such goals were imported into Portugal.

One should point out, among other reasons, the genuine lack of interest of Portuguese public and private capitals in such an endeavour aimed

into the merger of the Caisse nationale de la recherche scientifique and the Office national des recherches scientifiques et des inventions, which then led to the creation, on 19 October 1939, of the Centre national de la recherche scientifique (CNRS). Before the German advance in 1940, Perrin left his university tenure in Paris to flee to exile in New York.

26. In the Academy of Sciences of Portugal (1907), during the Great War, with the support of the Portuguese State, a 'Committee for War Inventions' was even created (Ver Cabreira 1918: 10; Miranda 1916).
27. About the American military-industrial complex, see Reynolds (2000: 495) and Leslie (1992: 199). For greater detail, see in particular Hughes (1990) and Galison and Hevly (1992).
28. Instituto Camões Archive (1965), 'Livro de actas do Conselho Superior do Instituto de Alta Cultura de 1965 a 1967', Minutes of the 1st Meeting of the Superior Council of IAC, 18 January.
29. José Castillejo (1877–1945) – Spanish pedagogue, lawyer and republican. He obtained his Ph.D. under the guidance of Francisco Giner de los Rios (1902), becoming professor of Law at the University of Madrid. Committed to the Institución Libre de Enseñanza, he contributed decisively to the action of the JAE (1907), as its secretary until 1932. In September 1932, he was appointed administrative director of the FNICER. He was later expelled from these

institutions, including the university, due to Franco's prosecution (1939), and was eventually sent into exile in London.

30. Junta de Educação Nacional, *As principais instituições...* (1935: 42).

31. This was in line with a propaedeutical intention of regenerating the Portuguese nation, which was typical of the educational thought of some segments of the national elites of the last third of the nineteenth century.

at connecting research and technological development. It should be noted, moreover, that economic modernization, and especially the industrialization, ranked rather low in terms of national priorities; moreover, the effects of political instability and weakness of public finances had a negative effect on an equally fragile private sector, unavailable to contribute with capital to the industrial promotion of the country. In short, the interest of the economic elite was small – agriculture absorbing more than 60 per cent of the active population, along with trade, attracted their preferences much more, while their capitals were increasingly invested speculatively abroad (some estimates suggest values between 30 and 40 million pounds before the First World War) (Rollo 2009). Although the initiative was left solely to be borne by the State, successive proposals revealed a recurring desire for the creation of entities to support scientific investigation, by some elites with connections to the academic environment.

In Portugal, at the turn of the nineteenth to twentieth century, there was no *movement* similar to that of Spain that was responsible for the appearance of the JAE (Fitas 2012: 19). However, the Spanish example joined the two Iberian nations in a logic of *humiliation*, which regarded the scientific spirit as a formula of national regeneration – although Portugal had not yet lost its overseas possessions then, by the end of the nineteenth century it lived a context of generalized crisis, which would eventually include the collapse of the constitutional monarchy and the path that would lead to the establishment of the Republic. The crisis was global. The political crisis, the widespread social restlessness, the economic crisis and, with great frenzy, the financial meltdown made up a catastrophe scenario that the writers of the turn of the century predicted and tirelessly denounced. The British *Ultimatum*, in January 1890, concentrated this national feeling of humiliation, which was followed by the first republican revolt, in Oporto, on 31 January 1891, marking the final chapter of the sequence of events that in 1910 led the republicans to power (Rollo 2009: 27).

In Portugal, the nature of the republican political agenda was particularly relevant to the emergence of larger concerns over the progress of the nation, with an intensification of the reflections on the benefits of science and/or scientific culture, in particular as a way to 'break the cultural isolation'³¹ of the country, and specifically the scientific isolation (Costa 1918: 60) – under the idea that, for its more daring proponents, it was possible to entwine the 'high intellectual culture and the national economy' (Raposo 1928: 416–17). Even in the case of using the potential of the technique in the development of the Portuguese colonial empire, this rationale would only be strongly asserted significantly later, as a result of the deepening of scientific research at the University and in the mainland – bearing in mind the nature of the colonial pact, only gradually reworked in the second post-war period.

We believe, therefore, that through the acknowledgement of science as a political instrument (Catroga 1995: 584), republicanism contributed, in some way, to trigger the 'political phase of the scientific revolution', as Dedijer (1975: 490) had contemplated in relation to the twentieth century. Unequivocally influenced by the conjuncture of the Great War – and, as such, not strictly an offspring of the Republic (5 October 1910) – we should at least recognize that the historical circumstances that accompanied the First Republic provided the emergence of a line of thought that was important in the context of 'scientific culture in Portugal, in particular due to the size of the organization of science

and educational role that was assigned to it' (Rollo et al. 2011:110). Such a line of thought included the creation of various bodies, insistently under the legal form of a Junta, which was recurrently proposed.

Thus, Portugal found the right circumstances that resulted in the first attempts to introduce some degree of organization to science in the context of the European conflagration (1914–18). As one of the leaders of a 'medical' generation, Augusto Celestino da Costa,³² called for *scientific orientation* as a fundamental dimension of professional practice as a scientist. Publicly, he in fact called for 'the creation of a Board of pensions and the promotion of scientific research' in conferences held in April 1918 in the wake of a visit to the Madrid premises of Junta para Ampliación de Estudios y Investigaciones Científicas. In the wake of this visit to Madrid, a commission was appointed (ordinance of 20 February 1918), which was entrusted with writing the bases for the creation of a body similar to the National Research Council of the United States, and to the Junta para Ampliación de Estudios y Investigaciones Científicas of Spain³³ – although the commission never held any actual meeting (Costa 1934: 6).

However, the definitive establishment of a body to support scientific research would only happen under a military dictatorship (28 May 1926). Thus, on 16 January 1929, on the eve of the nationalist and authoritarian regime of the New State, the first Portuguese institution of science policy, the National Education Board, was created – its actions would have an undeniable impact on the organization of science in Portugal, particularly as regards the university sphere.

As we have mentioned, the Portuguese model for central organization of science was mainly inspired by the Spanish example, and in particular, the JAE (Fitas 2012: 29), whose organization was regarded as *very similar* to the JEN (General Assembly, Executive Committee and Secretariat).³⁴ Ensuring the training of teaching staff and the continuity of the laboratories was the heart of the mission of such a body.

Therefore, in the first half of the twentieth century, we were still relatively far from the idea of a single central agency for the organization of science. Although, it seems clear to us the existence of a first generation of institutions to deal with several issues of science policy, which provided an institutional structure of financial support for science – henceforth, also initiating a debate among other overlapped or alternative models of institutional support to science (not just pure science but also applied science and technology). (Trillas 1988: viii). Indeed, as we know, in the context of this debate on the institutional support to science, which includes institutions such as the Spanish JAE and the Portuguese JEN, the university itself has taken sides, as it was alarmed with the new solutions of institutionalization and professionalization of modern science. In this respect, therefore, we can say that the idea of 'research separated from teaching' (Blasco and Blanco 1979: 144) opened a prolonged debate in which the university's position against the emergence of a model featuring the autonomy of science in relation to university teaching and against its own imminent subordination to an institution of science policy was clearly felt and expressed by the actors involved.

In Portugal, therefore, between the experience of French cultural elites and the fascination of some elements with the superiority of *German university organization and science* (Fitas 2012: 22), a hybrid model of central organization of science was put forward, not fully independent from universitarian influence – thus going against other proposals that were considered (Baptista 2001; Rollo et al. 2011: 108; Fitas 2012: 23) – but still consecrating a model for

32. After graduating from the Medical School of Lisbon in 1905, Augusto Pires Celestino da Costa (1884–1956) devoted his life to scientific research, being accompanied and guided by another important scholar of this generation, Marck Athias. He completed training in Berlin between 1906 and 1908, and later assumed the chair of Histology and Embryology upon the creation of the Faculty of Medicine of Lisbon. In 1929, he assumed the vice-presidency of the Science section of the JEN, and in 1934, he was appointed chairman of the Executive Committee of the JEN, and was the first chairman of the Institute of High Culture in 1936 – another funding body that followed and inherited JEN functions. In 1947, Celestino remained temporarily away from education, in response to the wave of expulsions from the academic institutions carried out by the authoritarian New State. After he devoted almost all his attention to scientific activity, away from public functions of greater importance. He was, for the greater part of his life, involved in a 'crusade' for the organization of science in Portugal, and advocated the creation of an entity that could promote and support scientific research in Portugal.

33. *Diário do Governo*, Series II, paragraph 93, 20 February 1918 (see also Rollo et al. 2011: 120).

34. Even so, the JEN was more heavily bureaucratized than the JAE. As regarded by a study of the Portuguese Junta de Educação Nacional (JEN) entitled *As*

Country	Date	Designation
Spain	1907	Junta para ampliación de estudios y investigaciones (JAE)
	1908	Asociación Española para el Progreso de las Ciencias (AEPC)
	1931	Fundación nacional para investigaciones científicas y Ensayos de reformas (FNICER)
Germany	1911	Kaiser-Wilhelm-Gesellschaft zur Forderung der Wissenschaften (KWG)
	1920	Notgemeinschaft der deutschen Wissenschaft (NG)
Great Britain	1915	Department of Scientific and Industrial Research (DSIR)
United States	1863	National Academy of Sciences (NAS)
	1915	Naval Consulting Board
	1916	Council of National Defense
	1916	National Research Council (NRC)
		Science Advisory Board
France	1901	Caisse des Recherches Scientifiques Direction des Inventions intéressant la
	1915/1922	Défense Nationale/Office National des Recherches Scientifiques et Industrielles et des Inventions
	1930	Caisse Nationale des Sciences
	1933	Conseil Supérieur de la Recherche
	1935	Caisse nationale de la recherche scientifique
	1938	Centre Nationale de la Recherche Scientifique Appliquée (CNRSA)
	1939	Centre Nationale de la Recherche Scientifique (CNRS)
Belgium	1920	Fondation Universitaire
	1928	Fonds National de la Recherche Scientifique (FNRS)
	1944	Institut pour l’encouragement de la recherche scientifique dans l’industrie et l’agriculture (IRSIA)
Italy	1923	Consiglio Nazionale delle Ricerche
Portugal	1779	Academia das Ciências
	1917	Associação Portuguesa para o Progresso das Ciências (APPC)
	1929	Junta de Educação Nacional

Table 1: Bodies for science and technology: A first generation.

principais instituições culturais espanholas e belgas congêneres da J.E.N. (1935: 9).

the organization of science that clearly included the separation of research in relation to teaching, and quite significantly removing research from the set of responsibilities of the university. The idea of encouraging development, although always subject to other goals, also had some expression in the theoretical formulation and in the assumptions that guided the JEN, particularly visible as regards the project of what was frequently called as the ‘scientific occupation’ of Portuguese overseas territories.

CONCLUSIONS

In short, it is important to understand that the Great War marked the opening of a discussion around the models of institutional support to science. Bearing this in mind is essential to understand and compare the interests of these modalities of institutionalization regarding the central organization of science, already an explicitly science policy already presenting a close relationship with

national and regional development and their potential in terms of science and innovation.

Mentioning a *first generation of institutions of science policy* presupposes a later generation of institutions, and a retrospective view of the history of the organization of science. In fact, the second post-war and Cold War periods introduced important changes in the assumptions of science policies with institutional consequences in terms of the organization of science. Particularly important, given the increasing complexity of scientific and technological life, was the function of coordination – one of the most prolific myths in science policy mileus, since the 1930s – which assumed increasingly new dimensions in the heart of post-war science policies. This development required a new adaptation from established institutions.

It seems to us, however, that the decisive factor that brought about the new rationale were the historical situations and time, their respective eras, with impacts also reported in terms of science and its institutional organization; the circumstances of the time more or less explicitly presided over the intention to create institutions, bodies and agencies of science policy, particularly considering the objectives and missions that historically inspired policies and the protagonists. We should keep in mind how in America the National Research Council emerged from the Great War, the NRF matched the spirit of the 1920s, the SAB and the National Resources Committee were products of the Great Depression and the New Deal and the OSRD were the result of the Second World War. In Portugal, with remarkable similarity to Spain (e.g. the JAE), the willingness of the elites, in harmony with the culture of the time, and the atmosphere of transition within the political regime from the Portuguese military dictatorship (1926) to the New State (1933), mixing different inspiring ideals, the creation of a National Education Board enabled a gap in the country's institutional and organizational conservatism, presenting itself as a possible solution (with elements of synthesis) to the issue of the central organization of Portuguese science.

After all, the generations and their very definition have always depended on time and evolution; in diachrony, the frameworks, ambitions and national and 'individual' strategies change also in light of the international scenarios, and with them the nature and the need for institutions to be created, recreated or not. The logic of models can thus be regarded and examined in a more intellectually and historically stimulating way. In other words, we face a succession of times that involve different models of organization of science, with different models coexisting in the same historical time, and bearing alternative assumptions. This wealth was present in the narrative of this article, as it reveals how several countries, despite some degree of diffusion, have opted for different models in regard to requirements, possibilities and understandings that were present in the thought and action of the national elites since the end of the nineteenth century. Such models were designed in accordance with their ideas, possibilities, economic structure, cultural and scientific texture [...] which is absolutely essential to understand and compare the interest of these modalities in relation to the development of nation-spaces and their potential in terms of science and innovation.

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Culture War

Affective Cultural Politics, Tepid Nationalism and Art Activism
By Camilla Møhring Reestorff



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The culture wars have sparked prominent political debates for many years, but particularly in Europe and America since 2001. Focusing specifically on Denmark, *Culture War* aims to analyse and understand the rise of right-wing nationalism in Europe as part of the globalization and mediatization of the modern nation state and the culture war and politics arising from it.

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