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The State, Science, and *Planification*: The Coproduction of the French State and Science

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This article surveys the changing mode of knowledge production in France before and after two Wars, extrapolating the changed mode of production of scientific knowledge, with respect to the transformed statehood as a specific dispositif of powers. For this purpose, the article first delves into general theoretical framework regarding knowledge production examining Michael Gibbons' Mode II and following important discussions, with special attention given to the transformation of statehood, following Foucault's theory of state. Second, it examines the overall development of the higher education and research, focusing on the Napoleonic university system in France and canvassing its durable functionality in the making of the modern state in France. Third, it deals with the crucial changes in scientific research institutions like the CNRS, the INEED, and the CEA. These institutional changes are very much symptomatic of the changing mode of knowledge production, as both representative and actual model of knowledge production.

Keywords: Dispositif*, Science and Technology Studies, knowledge production, Mode II, CNRS, CEA*

Introduction

The basic physics of nuclear fission discovered by Otto Hahn in 1938 is surprisingly simple. When uranium 235 and uranium 239 are meshed together at critical mass, nuclear fission occurs emitting explosive energy. This simple empirical finding was a culmination of the years of researches initiated by Marie and Pierre Curie. After a series of discoveries of radioactive materials, their international and domestic acclaim spearheaded French scientific research. The University of Paris and the *Institute Pasteur* co-founded the *Institute du Radium* for Marie Curie, which then produced four more Nobel Prize winners including her daughter Irène and son-in-law Pierre Joliot-Curie in nuclear researches. Paris became the de facto capital of nuclear science. The Second World War interrupted nuclear research at a critical juncture, when Pierre Joliot-Curie initiated a process that would have produced the first heavy-water reactor (Goldschmidt 1982: 28-32). The suspended nuclear research was reconvened in 1945, under the institutional guise of *Commissariat à Énergie Atomique* (CEA). Today, France still stands as the premier nuclear power, both militarily and in civic use, with a complete and comprehensive vertical technological tree, from raw materials treatment to the shut-down.

An internal approach to the history of science may capitalize on continuity and seamlessness embedded in this story. The cherished designation of "French science" may be deployed to describe the development of nuclear technology in France, which would be doubtlessly fortified by the Gaullist argument of grandeur. However, there remains a significant issue associated with this unproblematic continuity, because it presumes the persistence of the mode of knowledge production in the pre- and post-war periods. Can the *grands écoles*, the *Institute du Radium* and the CEA be considered as the same kind of institutional base for production of knowledge? Did the state and universities vis-à-vis scientific research remain homogeneous? What different role, if any, did science and/or technology play in the post-war context? The article aims at extrapolating the changed mode of production of knowledge before and after two great Wars, with respect to the transformed nature of the states, their relations among themselves and their relations to science—both natural and social—and technology.

For this purpose, the article breaks into three sections. First, the article delves into general theoretical framework regarding knowledge production. Since Michael Gibbons' problematic proclamation of the Mode II, there has

been several important discussions, which the article traces in close connection to the transformation of statehood. The second section examines the overall development of the higher education and research. The particularity of the Napoleonic university system in France is of great importance here, not only because of its revolutionary nature but also because of its durable functionality in the making of the modern state in France. The third section deals with the crucial changes in the higher education and research, particularly in the institutions like the CNRS, the INEED, and the CEA, and how they became possible in the historical context. The institutional changes are very much symptomatic and conducive of the changing mode of knowledge production, exhibiting how the nuclear technological development was both representative and actual model of knowledge production.

Reconfiguring the State as an Effect of a *Dispositif*

How the scientific knowledge is produced and may be transformed into technological concerns is a central question in the Science and Technology Studies(STS). Now almost defunct is of course the heroic history of geniuses making extraordinary discoveries on their own. Since Steve Shapin and Simon Shcaffer, among others, definitively inserted the societal factors in the account of scientific discovery, the central question of the STS has become how the scientific community navigates between scientific discourses and the strategies of power (Schaffer and Shapin 1985; Heilbron 1989; Jacobs 1999). This "cultural turn" has, however, failed to specify different registers of politics. As Heilbron (1989: 256-257) has persuasively contended, the politics of Britain and that of the Royal Society cannot unequivocally be equated. While it is undeniable that the "society" dictate the terms of scientific researches, which society it is—expert, civil, and/or transnational—and how societal factors actually influence science and technology requires further researches. In the more and more evident tendency of scientific and technological practices shaping social conditions, the social and scientific/technological categories are bound to overlap, necessitating a more careful dissection (Bloor 1976; Barnes 1974; Latour 1987; Latour 2005; Jasanoff 2004).

Michael Gibbons presents the most intriguing—if not necessarily most persuasive—argument about a modern mode of production of scientific knowledge. What he termed as the Mode II production made scientific

knowledge more context-driven, problem-focused and interdisciplinary, as opposed to Mode I knowledge that is academic, investigator-initiated and discipline-based knowledge production (Gibbons et al 1994; Nowontny 2004). While "this new mode…is emerging alongside the traditional disciplinary structure of science and technology," it nonetheless implies that in the post-war context resources for scientific research were socially redistributed and that this process was mediated by the social accountability (Gibbons et al 1994: 14). The juxtaposition of these two modes of knowledge production puts particular emphasis on the latter's idea of "application," which, among other forces like the state and culture, implies strong market intervention. This transformation in turn diversified the institutional venues of scientific research, replacing the university monopoly with various institutional forms.

Many critiques at and supplementary arguments for Mode II have been raised since. For instance, Slaughter and Leslie (1997) have explained in detail the market influence within university researches (cf. Salughter and Rhodes 2009). In a similar vein, Ziman (1994; 2000) has offered the idea of post-academic science, emphasizing increasingly collective and cost-sensitive scientific practices. These and many other endeavors in the aftermath of Mode II have concentrated upon the modification of the concrete production of scientific and technological knowledge. Beyond internal production, Etzkowitz and Leydesdor (1998; 2000) has offered a more comprehensive framework encompassing the state, the market and research institutions. The Triple Helix model does not propose a radical historical break that Mode II has implicitly put forth. It is not really that institutional *loci* have shifted but that a new additional layer, in which the state and market can intervene, "in order to address new problems arising in a deeply changing economic, institutional and intellectual world (Shinn 2002: 600)." The Triple Helix model is then concerned less with the novelty of the knowledge production process but with the intertwined progression of the social and the scientific/technological.

While the inclusion of the state in Triple Helix model and the revival of the historical dimension were important contributions, the state itself remained rarefied. In all the proposed models, the state appears as a spherical entity and a seamless whole and is, conversely, elevated as almost an anthropomorphic agent. This stems from a common problem in the making of a "model," i.e., its reductionist tendency of simplifying the complex. While same can be said of "capital" and "science," the problem with the monolithic state extends further, because of inherently complex and often inter-

conflictual tendencies derived from diverse institutional trajectories of the state. For the state to be introduced as an analytical category in the production of knowledge, the multiplicity of various state practices has to be taken into account. However, this does not imply simple collection and analysis of state policies to science. The reconsideration of the state for this purpose would require deconstructing the state.

Michel Foucault once described dealing with the theory of the state as "an indigestible meal" to be forgone. Any introduction of the state is prone to revert back to the "political universal," resorting back to the state agency (Foucault 2008: 76-77). He instead proposes that the state has to be, if at all, considered as "abstraction" or a "composition" of the multiple deployments of power. Yet his radically deconstructive position may run the risk of eradicating real and representational effects of the state. While the state may well be an empty misnomer, the actions of the apparatuses in the name, authority and undeniable materiality of the state cannot but escape an analysis of the state. Rejecting the state as an anthropomorphic agency *sui generis*, one may think of the state as an effect of a *dispositif*, an arrangement of heterogeneous powers. For Foucault, *dispositif* is not only "a thoroughly heterogeneous ensemble consisting of discourses, institutions, architectural forms, regulatory decisions, laws, administrative measures" but also "the system of relations…between [heterogeneous] elements (Foucault 1980: 194, cf. Agamben 2009; Deleuze 2008)." Appropriating Foucault's terminology, a modern state is a triangular arrangement of sovereignty, discipline and government (Foucault 2004: 102). The triangle is basically oriented towards the modes of power deployment. It should be noted that Foucault did not explicitly equate this triangle with the state presumably for two reasons: first, such equation would bring the state back in as an active agency; second, the modes and the objects of such deployment of power do not exactly correspond to one another. It is then possible to conjecture from this delineation that the corresponding objects—right, power, and truth—are the effects of a certain arrangement of modes of power. This is particularly true in knowledge production. Foucault's central inquiry is "what rules of right are implemented by the relations of power in the production of discourses of truth (Foucault 2003: 93)." Thus it would be salient to conclude that both a state and its knowledge production are the effects of a particular arrangement of different modes of power.

In this understanding, a central question in dealing with the knowledge production would be what different arrangement one might find in specific historical junctures. The university system, industrial researches, and state

institutions that are considered essential to the knowledge production are also effects of the arrangement of powers. If one is to say that there was a fundamental transformation in the production of knowledge, as many authors considered in this section are, it is imperative to account for the changes in the arrangement of powers. This change would be best represented by the change in the imagination of the state, not as a primary agent but as an effect. Stating that the state and, for that matter, capital intervened in science and technology does not amount to much, unless the very arrangement of the state and capital(ism) in knowledge production is accounted for. This precondition requires a thorough historical survey of the state and the arrangement it represents.

Ancien Regime of Science and Technology

The Napoleonic reform of the university system is considered single lasting impact in the production of disciplinary knowledge in France. In one recent overview of the French university, Musselin (2001) comments that Napoleonic reform's "centralizing, standardizing, [and] statist" tendency was accompanied by a strong corporatist tendency, entrenching the French academia in stand-still until 1968. The double centralization—once by the state and then by the *Grand Maître de l'Université and Conséil National des Universités*—"gave rise to a hierarchal, centralized structure that governed the whole of the educational system, discipline by discipline (2001: 11- 12)." The double centralization is, perhaps not coincidentally, accompanied by the dual academic emphases: on the one hand, the technical specialization in concert with the state bureaucracy and industrial demand flourished; on the other, a Comtean conception of sciences was firmly established in the university education, projecting a hierarchy of science that privileges the most abstract sciences like mathematics, while derivative, applied disciplines are entrusted to specialty schools (Comte 1830). While one may find the contradiction underlying these two premises, this duality became the signifying marker of the post-revolutionary French sciences.

The pre-revolutionary scientific, technical and engineering education had been concentrated in successive establishments of the professional schools: the *Ecole des Ponts et Chaussées* (1744), the *Ecole de Génie Militaire* (1748), the *Ecole d'Artillerie* (1765), and the *Ecole des Mines* (1783). In reaction to the clear statecraft tradition of these schools, the Revolution brought two "high," general and elite universities: the *Ecole Polytechnique*

(1794) and the *Ecole Normale Supérieur* (1795), which would become the base for the elite science (natural and social) and literary education. In time, however, both *techniciens* and *normaliens* also became a major source for bureaucratic professions. Throughout the nineteenth century, the elite special schools produced the *corps savants*, state-controlled civil servants group that dominated the French science and technology in nineteenth century. This process, Shinn (1992: 544) has noted, "reinforced the traditional bond between the state, high science, and the social elite." Also as a result, academic professions have become heavily bureaucratized and academic cooperation across disciplinary borders became nearly impossible.

The Napoleonic university system seemed to have gone more or less unchallenged until the Third Republic.[1] There were two important motivations for reform in the Third Republic. First, the emphasis on *lacité*, i.e. the separation of the church and state not just in public education but in general social fabric, was an overriding motivation. Jules Ferry and other republicans further monopolized and standardized degree system, by disallowing catholic schools' right to confer degrees (Zeldin 1967: 58). Second, the influence of the German university reform led by Wilhelm von Humboldt can be cited. Especially after the crushing defeat in the Franco-Prussian war, the German model in every aspect of the French society gained great discursive currency (Mitchell 1979, 1984, 1991). While it has been duly noted that the success the actual range of the Humboldtian model is widely exaggerated, the idea of research university was nonetheless immensely powerful to the policymakers and the academics of the French higher education. Partial acceptance of the German model resulted in the creation of *nontitulaire* positions like the *maître de conference* and the *chargé de cours* and the increase in research funding to the university. Perhaps the most important figure in this university reform in the Third Republic would have been Louis Liard. While serving as the *directeur de l'enseignment supérieur* at the Ministry of Education, Liard initiated a very slow and gradual reform process (Renaut 1995). However, if it is granted that the crux of the university reform lied in the amalgamation of the faculties into universities and thus in reducing corporatist influence, it was only marginally successful. It is true that René Goblet's measure of giving civil status to the faculties and amassing them into *corps de facultés* was successful and Louis Liard's efforts to convert

[1] There were two significant exceptions to be underlined here. Victor Cousin's failed attempt at the university reform in 1840 sought to change *agrégation* system. The Minister of Education Victor Duruy's *faculté* and *lycée* reform in 1865 was much more ambitious but only successful in founding the *Ecole Pratique des Hautes Etudes* (Clark 1973; Mayeur 1985).

them into regional universities met with great acclaim in 1896 (Fox 2012: 253). Yet these measures also allowed independent fundraising for the faculties, strengthening the corporatist tendency. Thus the Third Republic reform in the late nineteenth century was very much piecemeal and lackluster, recalling the much-cited but now defunct image of stagnation.[2]

A much more salient view is that the university reform in this period was a continuation of the Napoleonic reform. For instance, the state-sponsored professional and graduate schools were strengthened by further funding and by founding of new institutions like the *Ecole Libre des Sciences Politiques* (1872), *Ecole des Hautes Etudes Commerciales* (1881), and *Ecole Supérieure de Physique et de Chimie* (1882). Even the most "German" of the French universities, the *Ecole Pratique des Hautes Etudes* (1868) remained very much state-controlled. These creations deepened "the gap between the institutions of basic science and technical schools" already deep in the Napoleonic system (Gilpin 1968: 93). Extremely narrowly defined purview of new professional schools like the *Ecole Supérieur d'Electricité* (1894) and *Ecole Supérieur d'Aéronautique* (1909) delimited general science education. The attempt to establish "true," autonomous universities in France did not come to fruition, not just on institutional level but on sheer number of enrolling students (Lot 1905).

The resistance to the new models of university may be explicable by the relative lack of necessity of such universities. *Grands écoles* furnished most of *grands corps*, which in the state-centered French economy meant that most of available jobs were furnished by the graduates of *grands écoles*. This connection was only strengthened in the sharp enhancement in the range and scale of state actions in the Third Republic. The *Ecole Libre des Sciences Politiques*, for instance, had the distinct intention and result of furnishing functionaries better informed in new social scientific disciplines like comparative politics and political economy. Other engineering schools strengthened the ties through constant exchange between private and public sectors, reproducing *grands écoles*' strong dominance over the French economy. This strands of facts seems to reiterate classic thesis offered by Ben-Davis (1971). The specialty schools, roadblocks to the university reforms, were geared more towards reproducing particular class and professional culture, rather than promoting "pure" research, which was almost exclusively

[2] There have been dissenting voices regarding the lack of scientific research and the mounting gap between France and Germany. Against Shinn (1979)'s argument that the scientific production had declined in the Third Republic, Henry Paul (1972) and Mary Jo Nye (1986) presented evidences of active scientific research.

entrusted to the science faculty (*faculté de la science*) in Paris.

However, one can challenge the very conceptual juxtaposition of "pure" and "applied" science underlying this established historical narrative of French sciences. The boundary demarcating them was often blurred, as evident in the cases of Victor Grignard and Paul Sabatier. Both were "pure" research scientist with engineering background in the regional science faculty, who maintained close connections with the local industries (Nye 1986: 238-242, cf. Lundgren 1980). The proliferating network of professional *grands écoles* can be taken rather as testament to the disciplinization and specialization of scientific knowledge. The issue may not be so much as the lack of "pure" scientific research as the changing structure of the scientific knowledge itself. One symptomatic historical instance may be the creation of the *Caisse des recherché scientifique* (CRS) in 1901. Though concentrated on medical researches, the research fund was the first effort to "encourage research rather than rewarding discovery (JO, Picard and Pradoura 1988)." The fund is significant despite its meager resources—it was funded by taxes on pari-mutuel winnings in horse-racing—, because it established the dissociation of the scientific research and education.

Then the emerging principal demarcating line for the Third Republic science can be drown not so much at "pure" and "applied" as at "research" and "education." In other words, while the rigid, conservative structure of higher education with all its privileges remained largely intact, scientific researches and technological applications began to be dissociated from university education. While the *Institut Pasteur* already opened its doors in 1888 as the first purely research-oriented scientific institution, the subsequent founding of the *Institute du Radium* in 1909 confirmed the trend. Though the founding of both institutes relied much on respective scientists' national and international fame, the independent and research-oriented nature of the two institutes spearheaded the separation of education and research. Interpreting this uncoupling may provide the key to the understanding of the nature of science and technology in the Third Republic and onwards.

The question of the state reenters here. As this brief sketch of the French education and research up until the Third Republic has shown, the state had been central in organizing the development of scientific disciplines. The state as a principal educator and employer dominated the conduction of science and technology. Yet, one should not mistake such dominance as desired or intended on the part of the state. It is rather institutional inertia that drove the state monopoly over science and technology. One possible exception would be public hygiene, where, as Latour (1988) has meticulously traced, the

combined development of Pasteurian and hygienist movements throughout the nineteenth century successfully reoriented the actions of the state. Guizot's idea of *souverainté de la raison* and the persistent interests in the condition of the working class furnished the ample political capital for the rise of public hygiene in both academia and the general public (Guizot 1820, cf. Rosanvallon 1985). However, other scientific disciplines did not enjoy the same amount of public attention, because its public utility beyond symbolic significance was very much limited. Many discussions of the Third Republic automatically take the dominance of the state over the education as the testament to its dominance over the science and technology proper. However, this section has shown that the educational focus put forth by the state was not necessarily translated into research initiative of the state for fiscal reasons as well as the perceived relative importance of science and technology.

The overall strength and pertinence of the French state in the nineteenth century is too complex an issue and well beyond the purview of this article. It suffices to mention that there are competing views, ranging from a relatively strong, omnipresent state to a stagnant heap of corporatist and incapable institutions (Crozier 1864; Hoffman 1963, cf. Nord 1995, 2010). While reserved about its clout, its scope should be scrutinized here: science and technology, especially ones inapposite to the direct maintenance of the state, were outside of the purview of the state actions. Going back to the triangle of sovereignty, discipline and government, the French state was thus imagined as the manifestation of the sovereignty. While public hygiene of course provided a powerful instance of discipline, the arrangement of the state was heavily skewed towards sovereign actions. Other pursuits of knowledge including political economy, the most privileged site of governmentality, were either entrenched in the corporate academia or altogether abandoned to the private proper. Taking this as an evidence to the weakness of the French state would fall into the trap of developmental argument that presumes a smooth linear history of the ideal-typical state. Rather, the article argues for a specific arrangement of deployments of power that negotiated the boundaries of the state actions. What was symptomatically emerging in the first half of the Third Republic was then a shift in this arrangement. Auguste Comte enumerated the hierarchy of sciences in accordance with its "positivity" and scientific certainty in 1830. Far less known is his total reversal of the position in *Sytème de Politique Postive* (1851-4), where Comte reorders sciences along the practicality and immediate normative applicability.[3] What happened after

[3] Due to its religiosity, the work was largely ignored. It was Hans Kelsen and Léon Duguit, perhaps

the First World War would make him an accidental prophet.

Planification, Research and Nuclear Science

In 1929, George Valois, an anarcho-syndicalist, a follower of Georges Sorel and then Charles Maurras, and an important figure of French fascism, defined politics as "the organization of propensity according to science, technology, and syndicalist justice," reorganizing the state as technical state based on functions (Valois 1929: 150, cf. Sternhell 1983). This strong turn to the functionalist understanding reminiscent of Comte and Saint-Simonianism is a product of not only the First World War and its mobilization but also persistent political and ideological debate between liberalism and *étatisme* in the first half of the French Third Republic. Before the war, the majority of radical republicans pursued a solidarist republic, attempting to maintain the balance between the state and individuals, which was the major source of lackluster social reform pace. The balance was tilted decisively towards more strong state intervention in the postwar context.

The most significant outcome of this turn is, the author contends, what is known as *planification*. Still in the heat of the war, Albert Thomas, the minister of armament and wartime production (*ministère de l'Armement et des Fabrications de Guerre*), drafted the first comprehensive plan for economic reconstruction. This curious mix of Taylorism and syndicalism was centered around the ideas of industrial concentration, industrial democracy and selective nationalization (Blaszkiewicz-Maison 2016). While the Thomas plan quickly faded in the quick postwar return to normalcy, the idea survived in a variety of forms. The "*rationalization*" literature called for the industrial reorganization and better, scientific management (Fourgeaud 1929; Roy 1929; Namy 1931). CGT leaders like Leon Jouhaux, Georges Dumoulin, Alphonse Merrheim and other socialist activists (Henri de Man, Pierre Boivin, Robert Marjolin) also followed *rationalization*, capitalizing on the nationalization of industrial base as new strategy for the working class. There were no shortage of liberal economists (Alfred Sauvy, Jean Ullmo, and Robert Gibrat) that were infatuated with the idea, though they sometimes used the term *modernisation*.

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two of the most important legal positivists, that took the notice of Comte's later work. In a sense this is a return for Comte to his Saint-Simonian beginning, whose coupling of industry and state affairs were constant reference to the radical republicans like Émile Littré as well as revolutionary syndicalists like Georges Sorel.

This expansive consensus is a product of many, often inter-conflictual historical contexts. First, the pan-European postwar trauma was expressed in the form of a revolt against bourgeois society in general and liberalism as its ideological expression in particular. In the French context, the radical republican orthodoxy began to be questioned from left and right. Second and related, there emerged new articulations of political organization, most expressively in fascism and communism, both of which took stronger state initiatives as a central feature. While not all the planners were fascists or communists, the popularity of these ideologies at the very least highlighted the importance of the state. Third, the wide proliferation of the already expansive state bureaucracy during the war created a great presence for the state. The institutional inertia, created by personnel employed by various wartime agencies, did not easily vanish. Finally, there had been strong consensus on the leggedness of the French sluggish economic development among industrialists, which provided motivations for rationalization and modernization of the industries. While all of these tendencies certainly overlapped, the internal conflicts make *planification* truly interesting. *Planification* did not simply address the need for state intervention but expressed confluence of heterogeneous emotions and desires. Its inherently intermingled and heterogeneous nature made it difficult for any plans to be actually enacted. The only significant policy in accordance with *planification* was the nationalization of the armament production (Clark 1977).

The eventual "failure" in the 1920s and 1930s does not, however, diminish the importance of *planification* and its relevance vis-à-vis knowledge production. For what was signified and underwritten was rather the fundamental overlapping of the state apparatuses and industry. In the seminal essay on militarization of society, Geyer (1989: 101) pointed out that "this development is closely tied to the rise of the corporate organization of European societies and to the subordination of autonomous individuals under the imperatives of large-scale institutional domination." It seems that the effectiveness of the war economy represented in the watchwords like *planification*, *rationalization* and *modernisation* left an indelible mark in the postwar society. It was the effect of militarization extended beyond warfare capabilities that rearranged the classic division between the state and the economy, private and public. Understanding this amalgamation as simple overriding monopoly of power by the state would be misleading. The *planification* was as state-centered as industry-intertwined vehicle of new arrangement of power.

It was against this backdrop that the new mode of knowledge production

unfolded in the interwar years. Jean Perrin, along with Irène and Frédéric Joliot-Curie, emerged as the central "prophetic" figure in the remaking of French scientific research (Ory 1962). Himself a renowned physicist and a Nobel laureate, Perrin devoted his interwar career to create research initiatives and institutions since 1921. He was instrumental in creating the *Institut de Biologie Physico-Chimique* (IBPC) in Paris in 1927, which was made possible by the six-million-franc funding agreement with the industrialist Edmond de Rothschild. The institute employed the full-time researchers for independent scientific purposes, promoting cross-disciplinary collaborations and "decompartmentalization (*décloisonnement*)."

This "practical" approach, the continuation of the war efforts, continued to dominate the state-sponsored "applied" science in general. The Ministries of Education and Defense jointly created the *Office National des Recherches Scientifiques et Industrielles et des Inventions* in 1919. Its inaugural director Jules-Louis Breton, the self-proclaimed inventor of tanks, purported the *Office*'s functions to be the functions of the *Office* as "stimulation of invention, assistance for patent claims, and fostering of the link between science and industry (Shinn 1992: 557)." The decidedly practical approach, however, proved detrimental, or at least unhelpful for fostering research. The *Office*'s sporadic grants were awarded to inventors and engineers for the projects formulated by public agencies, especially military industry. It did not therefore amount to any lasting effects in terms of research and became the target of criticism by high-minded scientists like Perrin (Paul 1985: 326). The political consequence was the disbanding of the *Office*, brief interlude to the *Centre Nationale de la Recherche Scientifique Appliquée* in 1938 and the eventual absorption to the *Centre Nationale des Rechereches Scientifiques* (CNRS). The fate of Breton's agency also confirms that the dichotomy of pure and applied sciences was a misnomer in the postwar context.

In the meantime, the state decidedly intervened in and organized the "pure" scientific research. The budget for scientific research through CRS already ballooned to 25 million francs in 1925, almost four times more than prewar expenditure. Efforts to restructure scientific research culminated in the proposal for establishing a nation-wide scientific research center. The Ministry of National Education set up the *Conseil Supérieur de la Recherche Scientifique* as the deliberative body of scientific research focus in 1933. (*Journal Officiel*, 8 Avril 1933) It was accompanied by successive reforms of CRS, establishing the *Caisse Nationale de Science* in 1930 and then the *Caisse Nationale de la Recherche Scientifique* in 1935. In the Popular Front government, the position of the undersecretary of the national scientific

research and the associated executive body, the *Service Central de la Recherche Scientifique* was inaugurated. The series of reforms created a chain of command for the national direction of scientific research, from scientific consultation, managerial execution and funding. Despite heavy state involvements, however, the designers of these reforms, including Perrin and Joliot-Curies, took pains to maintain the scientific autonomy. In the petition for the establishment of the *Conseil* signed by the luminaries of science, the likes of Henri Bergson, Marie Curie, Charles Richet and Paul Sabatier, the lexicon associated with science include "disinterested," "pure," "grand progress," and "human power," while the state's role was confined in "facilitating…the most devoted to researches (Guthleben 2009)."

One cannot take this claim of purity outside of the historical context and at its full face value. However, it is also true that these developments eventually culminated in the creation of the CNRS in 1939, obviously teleological undertone notwithstanding. It is then almost fateful, too, that the inauguration coincided with the outbreak of the Second World War. Another, smaller coincidence is that 1938 and 1939 were crucial years in the development of nuclear science. Sustained efforts by and supports—financial and otherwise—to the *Institut de Radium* finally produced an explosive result in Otto Hahn's discovery of nuclear fission. Still a greater coincidence is that the founding of the Centre happened the same year of the devastating defeat in the Second World War. The Second World War and the Vichy regime halted what was imagined to be nascent development of the French science in one of the most technologically fast-paced time in history. However, the meaning of Vichy period remains rather complex. The Vichy regime has recently received great historical and historiographical attentions. There has been a rise of the revisionist account, emphasizing the continuity. The Vichy regime addressed, if not resolved in its own way, many social issues ranging from *dépopulation* to the representation crisis and social welfare (cf. Russo 1994; Muel-Dreyfus 1996). The revisionist scholarship was certainly a timely anecdote to the standard, disjointed historical narrative that left the Vichy period in the void. Overemphasis on the continuity, however, often ran the risk of leveling off many different nuances embodied and even the fundamental changes enabled in the Vichy regime.

One such transformation that is particularly pertinent to the purpose of this article may be found in the resurgence of the *planification* and its permeation into the state agencies. The Vichy regime established in 1940 the *Comité d'Organization*, an umbrella organization of the national plans. The *Comité* oversaw economic and governmental resource redistribution,

covering from professional musicians, theatres, and movies to more heavy industries like automobile, aeronautical and chemical plants (Le Crom 1995). The *Comité* was composed of many former members of the group *X-crise*. The *X-crise* group was founded by the circle of *polytechniciens* in 1930s with strong anti-liberal and technocratic tendencies. While similar in its tenor with other *planification* movement like *rationalisation*, the members of the group met their maturity in professional career in the Vichy period. While there were members like Jules Moch and Louis Vallon that joined the resistance, more major figures of the group, the likes of Raymond Abellio, Jean Coutrot, and Gérard Badet, joined the Vichy government (Dard 1995).[4] The economic, social, and even moral goals of the resultant Vichy plan were geared towards the ideas of social solidarity, anti-Malthusian pronatalism, and strong corporatism, all of which were very conducive to and achievable by *planification*.

The influence of the resurgence of the *planification* movement is rather complex vis-à-vis the production of knowledge. One definitive result was structural in nature. The *planification* in the Vichy regime sought overhauling the economic structure in the ten-year span, which postwar planners like Jean Monnet and Jules Moch continued without significant revision. It should be conceded that the planning did not flourish beyond the Provisional Government and very early years of the Fourth Republic. According to Kuisel (1981: 201), "by the late 1945, the movement to institute economic planning was dying." Yet a score of reforms, most importantly the nationalization of banks, electric power and gas, insurance and coal, had been completed by 1946. These limited nationalizations were, however, no longer associated with the intermittent step of a socialist revolution but rather represented further blend of the state and the industry, which would have significant impact in the knowledge production.

Another, more pertinent byproduct of the *planification* was the dramatic increase in the demand for knowledge. There emerged many information-gathering and/or research bureaus to support planning agency. The *Institut National de la Statistique et des Etudes Economiques* (INSEE) founded by Alfred Sauvy, Claude Gruson, Paul Delouvrier and others would stand out first. The INSEE had a deep connection to the prewar and Vichy endeavors. Pro-natal politics in response to the widely perceived *dépopulation*

[4] One curious case is Alfred Sauvy, who collaborated on a limited scale. His participation can be interpreted as more academic than political, since his population economics bode well with strong Vichy pronatalist politics.

phenomenon during the whole span of the Third Republic is well documented.[5] Two of the Vichy regime institutionalizations of scientific research were the *Institut National à l'Hygiène* and the *Service National de la Statistique*, both of which were founded in 1941 and had strong pronatal leanings. The INSEE succeeded not only personnel but also *problematique* raised by both institutions.[6] Underlying the INSEE and its influence over the parent Ministry of Finance were the Malthusian fear and the belief that the solution lied in "flexible planning" and the *économie concertée* by "constant adjustments…to assure maximum economic growth with social and financial stability (Kesler 1964: 249)." The statistical knowledge was thus further implicated in the state and economy.

A useful case study to examine the impact of *planification* on scientific research is nuclear science, because nuclear science required a very thorough planning of multiple disciplines and organizations. The development of nuclear science was, of course, a result of the confluence of a variety of factors: Charles de Gaulle's nationalist politics of grandeur, complex cold war politics, and Americanization of the scientific research (Zalen 1991; Krige 2006). It was through the *planification* that these elements were congealed and effected in the production of knowledge. Instead of entrusting the research to existing institutions, Charles de Gaulle launched a separate and more-focused organization devoted to nuclear science with Joliot-Curie, the leader of the restored CNRS, as the inaugural director in October 1945 (*Journal Officiel,* Octobre 31, 1945). The early purpose of the *Commissariat à l'Energie Atomique* was limited to the "peaceful use" and pursuit of economic advantages (CEA 1952). The CEA was designed as a strictly research-focused institution that did not have any educational function. Moreover, its projects were far from free and independent research but purpose-driven collaboration over not only physics but also chemistry, material science, and mechanics. The CEA produced an almost instant result, successfully completing the first European nuclear pile, ZOE (*Zéro-énegie Oxyde d'Uranium Eau Loudre*) in 1948. Based on this success, the CEA established a large research complex in Sarclay, which would become the center of nuclear science.

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[5] There is a growing, large body works on the pronatal politics in France that cannot be properly discussed here. However, Karen Offen (1984) remains still canonical. For a more updated policy studies, see Paul Dutton (2005).

[6] It should be noted that the institutional characteristic and the objective of the INH changed in its transition to the *Institut de Santé et de la Recherche Médicale* in 1946, while transition from the SNS to the INEED was rather seamless (Picard 2003).

The initial success of the CEA is usually attributed to the supposedly politically neutral pursuit of science and Joliot-Curie's individual leadership (Rioux 1988). It is true that his political authority as a resistance member shielded the CEA from excessive administrative interventions, while his scientific authority persuaded many scientists, who had emigrated and worked in the British and the Canadian nuclear programs during the war. The initial success of the CEA was also a combined result of the ideal research collaboration outside of politics and nonetheless vigorous state funding. While this condition was what Third Republic scientists were called for a long time, the postwar conditions of science and technology and the particular urgency accorded to nuclear science quickly changed the dynamics of the production of nuclear knowledge. The most immediate problem was whether nuclear research would remain confined to "peaceful use." Many historians have commented on the probably intentional ambiguity of the French political leaders. For instance, Henri Monnet in 1948 called for stricter governmental regulation for the research organizations like the CEA and the *Office National d'Etude et de Recherche Aéronautique* on the ground that the inextricable link between their respective research and national defense. The dismissal of Joliot-Curie in 1950 was partly due to this fundamental debate, which elicited much stronger administrative control over the CEA prerogatives.[7]

The technological choice and possibly research directions in nuclear science in 1950s were, therefore, delimited by complicated combination of administrative structure and state initiatives. For instance, the reactor type after the ZOE was much debated issue. The ZOE was a heavy-water reactor that produced weapon-grade enriched uranium, which the CEA scientists were trying to avoid. Francis Perrin, the son of Jean Perrin, who became the director, led the research wing of the CEA and endorsed a line of gas-graphite reactors that would not produce weapons-grade fissionable materials. On the other hand, Felix Gaillard, the new Minister of Energy, and René Lescop, the newly-appointed secretary general of the CEA, were reluctant to erase the possibility for plutonium production.

What complicated the situation was the intervention of *Electricité de France* (EDF), the mammoth energy company and principal contractor of nuclear piles. Created in 1946, the company enjoyed great political support

[7] Joliot-Curie's dismissal was in fact a complex affair. His identity as a socialist-pacifist was questioned by not only the French government but by the American one. The American opposition was due to his ideological allegiance as well as the open access policy of the CEA, which was regarded as proliferation risk. See Schienman (1965: 38-39).

from the left, as the symbol of the nationalization policy. This political influence coupled with its position as the contractor did not only lead to the gradual permeation of the EDF into the CEA administration but also to a technological direction. The EDF preferred the American-style nuclear piles that can meet the rapidly increasing demand for electricity, which proved decisive in the final decision (Picard 1985; Jasper 1990). In this "industrial war (*la guerre des filieres*)," the intertwined contingencies like the national defense and the weaponization concerns, the EDF and commercial electricity demand, and organizational dynamics shaped the course of the nuclear research.

While the decision itself favored a non-weaponizing option, it also created institutional urgency for weaponization on the part of the CEA, because the weaponization became the organizational *raison d'être*. The famous decision to produce nuclear weapon by Pierre Mendès-France in 1954 was, in reality, a result of these complex political, technological and organizational underpinnings. In the summer of 1954, the Mendès-France government frantically scurried for the ratification of the European Defense Community. The eventual defeat of the proposal elicited total overhaul of French national defense, leading to the weaponization. In the meantime, the restructured CEA was also in search of a new mission, since its technological ingenuity and relevance had been compromised in the struggle with the EDF. The weaponization provided new impetus and even *raison d'être* for the organization that had been adamantly against the option.

While the development of the nuclear science in France may seem to confirm the state-driven research tendency, the actual process was much more complex. The "state" was not a unitary entity but an uneven amalgam of various agencies that embodied constantly shifting and even contradicting positions regarding the direction and the contents of scientific researches. What does this complex history tell us is, on the one hand, a stronger state presence in the planning and execution of scientific research. Particularly in the French context, the *planification* subsumed the orientation and defined the institutional confines within which research can be conducted. The *planification* converted experience of the war-time mobilization of human and material resources into the mobilization of knowledge. On the other hand, one has to concede the complex and different dynamics represented by the postwar nation-state construction. In the national defense, the traditional proper of sovereignty, France became a part of the regional and international collective defense, which, to a certain extent, meant denationalization of defense itself (Matlary and Østreud 2007). Likewise, the state intervention in

the market and industry cannot be considered lopsided, for the "marketization of the state" was equally strong (Brown 2003, 2006). The behaviors of the companies like the EDF may serve as such an example. What kind of new arrangement was emergent in the postwar states is beyond the scope of this article or the time period it deals with. However, one can be certain that whatever new arrangement began producing knowledge in a different constellation in the postwar France.

Conclusion

It may be redundant to say that the corpus of scientific knowledge is socially produced, organized and oriented. How the society produces knowledge is implicated not just in the constitution of the knowledge regimes, such as universities, societies and laboratories, but also in the arrangement of politics, economy and social structure. Conversely, throughout past two centuries, the impact of science and technology had recast the French state and society. This entwinement of the scientific and the social meant the inescapable entanglement of scientific knowledge with the social institutions. However, the society and scientific knowledge came to maintain increasingly complex relationship, because the multiplicity of often inter conflictual social institutions with different organizational culture and goals complicates the knowledge production.

Defining the mode of knowledge production may be even more complicated than understanding the current mode of production. The idea of "flexible production" enumerates that the relations between capital and labor added the extra dimension of the consumer, enabling ever-floating capital (Harvey 1992; Baudrillard 1998). The flexible production suggests that the knowledge production is now susceptible to heterogeneous influences, locating any mode almost impossible. While the history of French scientific research may seem to confirm growing and even dominant presence of the state, a further exploration exhibits that different orientations and interests embodied in the proliferating network of institutions inscribed in the state intervened. In the French case, the *planification* may have been an attempt to organize and manage diverse trajectories of scientific research. However, the "plan" itself was deeply imbued in international, national and local contexts, rendering the central agency of the anthropomorphic state in the understanding of the *planification* less tenable.

If the modern nation-state is a certain *dispositif* of powers at particular

historical juncture, as the article has argued, the *plafication* was an attempt to rearrange powers according to the state directives. Yet the *planification* never functioned as simple *étatisation*, because a variety of personal, organizational, and intellectual/scientific/technological imperatives intervened and interacted with one another. The desire for rationalization of production—of both goods and knowledge—became the impetus for *planification*, which in turn changed the very nature of the imagination of what the state is and its purview of actions are. This "governmentalization" of the state was in fact the dissolution of the myth of the state-as-an-autonomous-agent into dissipated practices (Foucault 1997: 103). The *planification* was, in this sense, an impossible endeavor, attempting to make a sense of a myriad of dissipated global, national, and local practices within the auspices of the national planning. The new, postwar state that takes *planification* as the central *modus operandi* fundamentally rearranged powers, adding the dimension of knowledge in the amalgam of the state, in order to utilize it and to be organized by it. Further studies on the production of knowledge in France and beyond would have to take into consideration that this new arrangement of powers was held together ever so tenuously by the state, while the state itself was also transformed by it.

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