Science for National Development: State-Science Engagements through the Research Exploits of the National Research Council of the Philippines during the Commonwealth Period (1934-1941)

Francisco Jayme Paolo A. Guiang

I. Introduction

"Give the Filipino scientists a chance and they will achieve economic self-sufficiency" said Dr. Hilario Lara (cited in NRCP, 1984, p. 1), president of the Philippine Scientific Society in front of the delegates of the Second Philippine Science Convention on 17 February 1933. Dr. Lara urged the government, still under the tutelage of American colonialism, to establish a national research council that will produce scientific researches that could aid in national development. In the same occasion, Senate President Manuel L. Quezon was the guest speaker and he stressed the potential of science in harnessing development for a nation preparing for independence: "The time has come for the government to utilize to full advantage our scientific men and women, make them come out of their shell, so to speak, and advise us on matters pertaining to their respective fields" (cited in ibid.). The National Research Council of the Philippines (NRCP) was eventually created on 08 December 1933 by virtue of Act No. 4120 approved by the Ninth Philippine Legislature.[1] The council was then inaugurated on 23 March 1934 at the UP School of Hygiene and Public Health in Manila with 114 scientists and technologists as charter members (NRCP, 1935a, p. 1; Baldoza, 2020, p. 96; Guiang, 2021, p. 20). Even before the creation of the Philippine Commonwealth, Filipinos were already exploring means to pave the way for self-government. Evidently, scientific progress was seen as one of the vital components in the process of achieving independence and the NRCP became instrumental in the state's endeavors.

Review of Related Literature

Thus far, academic studies about the NRCP have been chiefly concerned about its institutional history. The earliest work was written in 1935 by Patrocinio Valenzuela entitled, "A Historical Review of Movements to Establish A Research Council for the Philippines"

originally published in the *NRCP Bulletin no. 3* and reprinted in Zoilo M. Galang's tome on science for the *Encyclopedia of the Philippines: The Library of Philippine Literature Art and Science*. In his work, Valenzuela (1936, pp. 31-32) provides an overview of the various institutions that promoted industrial and agricultural development from the Spanish to the American colonial periods. The focal point of the article is a detailed narrative about the efforts of Filipino scientists and scientific organizations that lobbied for a law which gave birth to the council in 1933 (ibid., pp. 36-37). In a recent journal article, Jonathan Victor Baldoza (2020, p. 84) foregrounds the NRCP in the larger context of a prewar scientific community "composed of men and women who were nurtured and trained within the scientific order that in the early part of the twentieth century Americans installed, developed, and managed in the Philippines." Furthermore, he underscores how American colonial scientific institutions and the council became essential in fomenting a Filipino scientific community that saw itself "as bringers of progress and modernity, linking science with nationalist imaginings and presenting a cosmopolitan vision of the future when Filipinos become citizens of the world, thinking and speaking the language of science" (Baldoza, 2020, p. 85). An extensive institutional history of the NRCP was edited and coauthored by Francis A. Gealogo (2021) entitled, *A History of the National Research Council of the Philippines: Research in the Life of the Nation*. The book features essays that trace the council's development amidst various challenges it faced in the context of changing sociopolitical milieus from 1933 up to the present. The book's first chapter, similar to Valenzuela's work, gives an overview of colonial science and the institutions that were crucial to the establishment of the NRCP. The more substantial part of the chapter discusses the achievements of the council under its prewar presidents namely, Manuel L. Roxas, Angel S. Arguelles, and Bienvenido M. Gonzalez (Guiang, 2021, pp. 22-28).

Research Problem and Objectives

This essay takes off from where the aforementioned works left. It intends to show that the state-science nexus during the Commonwealth period mobilized the Filipino scientific community through the NRCP's research exploits despite limited government support and other challenges beyond the council's control. With this assertion, important questions emerge – How can state-science engagements be described during that time? To what extent did the state contribute to the development of scientific research through the council? Moreover, how did the council chart a course for itself and contribute to national development? Did the research outputs of the council have an actual impact on Commonwealth policies? What challenges and issues did the council encounter? These important points will be tackled in the paper's three-part analysis and discussion. In order to understand how

state-science nexus works, the first part provides a general overview of scientific developments in the early 20th century, giving particular focus on German and Japanese sciences and how they were utilized to serve national interests. Though the context is entirely different because Germany and Japan eventually used science for wartime endeavors, this study focuses on the state's relationship with its scientific community which capacitated the latter to do research for the national endeavor. This could give important insights about the nature of state-science nexus and its possible parallelisms in the Philippine setting. The second part probes into the state of government-sponsored science during the Commonwealth period. Taking into account how other countries harnessed science for national interests, what could be said about the Philippine experience? The state was chiefly concerned with preparing its economy for eventual independence; hence the discussion provides a brief background on the Commonwealth government's economic institutions, its programs, and the issues it had to contend with as articulated by American colonial officials and Filipino politicians. Furthermore, this part explores the efforts of the Philippine state in mobilizing science to foment nation-building and economic development through the NRCP. It tackles how the government supported NRCP research-related activities albeit with limitations and challenges. Moreover, it documents the Filipino scientific community's efforts to strengthen the council's research endeavors through interagency cooperation and international linkages. The last part focuses on the specific research outputs that the NRCP produced during the Commonwealth period. The government had obvious preferences for studies on the natural, physical, and medicinal sciences because there was an urgency to respond to the issues that hounded the Philippine economy, a trend observable in the papers published in selected *NRCP Bulletins* from 1934 to 1941.[2] Corollary to this point, the discussion attempts to explain whether the NRCP's research endeavors had an actual influence on policy-making. In doing so, this inquiry could identify the strengths and weaknesses of state-science engagements during the Commonwealth period.

Research Methodology and Scope

This essay uses an institutional history approach which examines the relationship between the Philippine state and the NRCP in the context of achieving economic independence. By doing institutional history, it looks at how the NRCP leadership negotiated with the state in order to accomplish its mandate, the major issues that the council encountered along the way, and the means by which Filipino scientists were able to expand the council during its incipient years. In addition to this methodological approach, this paper employs a comparative analysis of the state-science nexus by foregrounding the nations that

successfully harnessed science for national interests. The comparative approach could provide a localized understanding of how Filipino science was mobilized to fulfill the national agenda in the 1930s. Lastly, this essay only covers the research-related ventures of the NRCP from 1934 up to 1941, instead of solely focusing on the establishment of the council as existing literature have already done.

II. Analysis and Discussion

State-Science Nexus in the Early 20th Century

The capacity of the state to mobilize its scientific community is best exhibited in the case of early 20th century Germany and Japan. During and after World War I, the German state had already established institutions that facilitated the growth of scientific research for Germany's industries (Grunden, et. al., 2005, pp. 83-83). The *Kaiser Wilhelm Gesellschaft* (KWG) or the Kaiser Wilhelm Society was a public-private initiative formed in 1911 which oversaw the establishment of institutes on physical chemistry, chemistry, and experimental medical therapy. The society's first president was Prussian State Library director Adolf Harnack who, with the help of organic chemist Emil Fischer and medical scientist August Wassermann, prepared the rationale for the scientific institution which explicitly expressed that the safeguarding of Germany's global leadership in the natural sciences (Forman, 1973, p. 161). The rationale was echoed in a joint memorandum written by the Prussian Minister of Education Friedrich Schmidt and Reich Interior Minister Theodor Lewald (ibid., pp. 161-162):

> For Germany, the maintenance of its scientific hegemony is just as much a necessity for the state as is the superiority of its army. **A decline in Germany's scientific prestige reacts upon Germany's national repute and national influence in all other fields**, leaving entirely out of account the eminent importance for our economy of superiority in particular fields of science, such as chemistry, especially. [emphasis added]

The global scope of scientific leadership was, therefore, a source of national pride for the Germans. This national pride even matched the state's high regard for its military, the backbone of the state's empire-building aspirations. The conclusion of World War I, however, brought domestic crisis to Germany and it was scientific and scholarly prestige that remained untouched by the repercussions of war. Max Planck, the second president of the KWG, conveyed this message in an address to the members of the Prussian Academy of Sciences on 14 November 1918 (ibid., p. 163):

> If the enemy has taken from our fatherland all defense and

> power, if severe domestic crises have broken in upon us and perhaps still more severe crises stand before us, **there is one thing which no foreign or domestic enemy has yet taken from us: that is the position which German science occupies in the world.** Moreover, it is the mission of our academy above all, as the most distinguished scientific agency of the state, to maintain this position and, if the need should arise, to defend it with every available means. [emphasis added]

Even the Union of German Universities recognized that after the implementation of disarmament measures and the deterioration of the German economy, "German science is just about the only asset which Germany has to throw onto the scales" (ibid.). Several Reichstag parliamentarians also became vocal in campaigning for more budget allocations for the development of German science. Julius Moses of the Social Democrats urged his fellow parliamentarians (ibid., p. 164):

> The former Minister of the Interior Koch once said in the Reichstag: "German science is the one thing for which the world still envies us." Well, it seems to me that if you don't want the one thing for which the world still envies us to go miserably to ruin, then strike billions from the military budget, and re-employ these unproductive billions for the purposes of culture and of German science.

The apparent high regard for science efficiently mobilized the German scientific community in the interwar years. The German state realized that science was an indispensable tool in developing military weaponry and mobilizing resources for war. Hence, industrial enterprises began to establish their own research and development (R&D) units from the 1920s onwards (Grunden, et. al., 2005, pp. 85-86). In 1939, even the German air force built its own R&D center whose employment expanded to 6,700 by 1945 (ibid., p. 89). In sum, the approach of National Socialist Germany was decentralized but not inefficient. As German scientists made huge leaps towards advancing weapons technology, the state slowly imposed centralization of science policies as World War II unfolded (ibid., p. 92).

Japan, unlike Germany, was not a world leader in scientific innovation at that time. To introduce itself to the modern world and sever traces of the feudal *ancien regime*, the Japanese state imposed a centralization of policies that could hasten the modernization process. The government even replaced "traditional intellectual scholarship that was mainly based on schools of learning in the Chinese tradition" to entertain scientific disciplines coming from the West (Fukasaku and

Ishizaka, 2009, p. 168). In short, Japan depended on the importation of foreign technology for modernization. For example, universities and educational institutions adopted polices that were grounded on Western scientific knowledge (Grunden, et. al., 2005, p. 93). Furthermore, European and American scientists were employed in private and public industrial enterprises thus, giving way to Westernization (Fukasaku and Ishizaka, 2009, pp. 168-169).

Research institutes and professional societies were also structured according to European standards. One of Japan's research institutes that played a crucial role in its imperial quest was the Institute for Physical and Chemical Research or Riken established in 1917. In-house laboratories that responded to Japan's needs during World War II included the state's industrial combines or *zaibatsu* such as Mitsubishi and Sumitomo (Grunden, et. al., 2005, p. 93). Akin to the initiatives of the German air force, the Japanese military developed its own research centers like the Army Technical Department and the Army Institute of Scientific Research both established in 1919, and the Naval Technical Research Institute established in 1923. The government also formed the Japan National Research Council in 1920 to coordinate local research endeavors with the International Science Council. Aside from this national research council, government agencies were formed to oversee the sustainability of wartime resources (ibid.). For instance, the Science Mobilization Council was established in 1938 for the purpose of harmonizing science policies across different government ministries. The government's Planning Agency formed a science council in the same year to address the deficiencies in the resources and materiel industry. The same agency established a Science Department in 1939 to heed the military's technological needs in sustaining the war in China (ibid., p. 95). In retrospect, Japan can best be described "as a 'late-comer' to industrialization and modern scientific and technological development" but the strategy it adopted in the second half of the 19th century "was catching up to the advanced countries of the West through transplantation of western scientific inquiry and technology transfer" (Fukasaku and Ishizaka, 2009, p. 168). Comparing the contributions of German science in weapons technology, Japan's science mobilization did not really impact the production of advanced weaponry for its military because the latter depended on its unique fighting style like guerilla and suicide tactics (Grunden, et. al., 2005, p. 98).

Indeed, both the German and Japanese states were successful in rallying their respective scientific communities to develop the crucial industries instrumental to their wartime efforts. The state's partnership with the private sector became one of the key factors that efficiently mobilized science for national interests. Germany and Japan also encouraged the development of independent R&D

units or research divisions within government instrumentalities and industrial corporations. More importantly, the strength of the German and Japanese state's interventions in the early 20th century would not be feasible without the participation of scientists affiliated with professional organizations and educational institutions. These aspects that illustrate the nature of state-science nexus are likewise evident in the United States (U.S.) government's nuclear weapons development when it belatedly entered the war in 1941. The Manhattan Project which lasted from 1942 to 1946 involved not only the U.S. military and related government agencies but also scientists affiliated with American universities and research laboratories (see Gosling, 2010).

What can then be said about the state-science nexus in the Philippines during the early 20th century? It is essential to note that the aforementioned discussions underscored the nature of German, Japanese, and, to some extent, American state-science engagements in the context of an impending war. The Philippines had a completely different context during those years because the state was primarily concerned about economic independence. With these considerations, the state-science nexus in the Philippine experience can be seen in government efforts to establish institutions that charted economic development. This includes the formation of the NRCP which mustered the Filipino scientific community to contribute to the national endeavor.

Economic Independence and State-Sponsored Science in Commonwealth Philippines

To illustrate how the Philippine state mobilized its scientific community, it is essential to understand the context of prewar Philippines and the vital issues therein. Economic development was one of the many concerns of the Philippine Commonwealth as it paved the road for independence. "The 1935 Constitution" (n.d.) asserts this idea by mandating the state to promote "social justice to insure the well-being and economic security of all people…" Indeed, Quezon's government established agencies and programs that secured social justice in line with the state's vision for economic self-dependence. In his first annual report to the United States (U.S.) President and the U.S. Congress, Quezon (1938, p. 6) outlined the economic plan of his government:

> Of vital importance to the nation is a national economy that meets the new conditions brought about by the change in our political status as well as those that will obtain when the Philippines shall have become a completely sovereign state. One of the first tasks, therefore, of the new administration was to formulate plans for economic adjustment and reconstruction and to provide the means of carrying out

such plans.

In fact, when Quezon officially assumed office as Commonwealth President, he stressed in his inaugural address the urgency of improving the Filipino living standards within the 10-year transition period:

> To enable us more adequately to meet new responsibilities of the Commonwealth and to raise the living conditions of our people, we must increase the wealth of the nation by giving greater impetus to economic development, improving methods of agriculture, diversifying our crops, creating new industries, and fostering our domestic and foreign commerce. (cited in Hartendorp, 1958, p. 42)

In order to do this, the National Assembly[2] enacted Commonwealth Act no. 2 which created the National Economic Council in charge of overseeing affairs concerning (1) agriculture and natural resources, (2) industry, (3) foreign trade and tariff, (4) domestic trade, (5) transportation and communication, (6) taxation, (7) labor and immigration, and (8) banking and finance (Quezon, 1938, p. 6). One of the most important concerns about the economy was agrarian and labor matters. In a move to provide food security, the National Economic Council and the Rice Commission formed the National Rice and Corn Corporation to supervise the sustainability of agricultural produce and help boost the domestic economy (Quezon, 1938, p. 6). The Commonwealth government's pledge to raise the living conditions of Filipino workers materialized through the establishment of the Court of Industrial Relations which monitored the conditions of the working class (ibid., p. 23). Governor-General Frank Murphy (1937, p. 14), who eventually became the first U.S. High Commissioner to the Philippine Islands, commended Quezon's efforts in underscoring social justice in the Commonwealth's economic agenda: "The Commonwealth President not only expressed himself strongly in favor of social justice, but he took executive action and had laws passed to ameliorate the condition of the underprivileged, with a view to allay discontent and forestall disorders." The aforementioned measures are some of the Commonwealth government's means to directly address the pressing agricultural and labor issues put to the fore by social movements like the *Sakdaista* and the *Partido Komunista ng Pilipinas* (cf. Terami-Wada, 2014 and Richardson, 2011). However, Theodore Friend (1965, p. 156) argues that Quezon merely promised "bread" to his constituents through rhetorical statements on social justice programs because the Commonwealth President prioritized improving the country's trade relations with the U.S. above all else. This was evident in the series of negotiations facilitated by the Joint Preparatory Committee on Philippine Affairs "aimed at softening and stretching the period of

economic adjustment" concerning tariffs imposed on exports from the Philippines to the U.S. and vice-versa during the transition period (ibid.).

While the economic landscape was being remolded according to the Commonwealth's vision of economic independence, both American and Filipino government officials recognized the important role of science in aiding economic progress. In fact, as early as the late 1920s, Filipino politicians like Quezon already saw scientific research as a means to provide solutions for the country's technical and agricultural problems (Anderson, 2007, p. 308). When he became Commonwealth President, Quezon (1938, p. 18) even indicated in his first annual report to the U.S. President and the U.S. Congress how research was being utilized for practical purposes:

> With the prospect of curtailment of free entry of Philippine products in the American market, the Philippines cannot depend, as it now does, almost entirely on crops enjoying tariff protection in the United States. The situation calls for a program of crop diversification and the Bureau of Plant Industry of the Department of Agriculture and Commerce has concentrated its efforts on the production of crops that are not dependent upon such tariff protection. **Along with crop diversification experiments in plant utilization are being intensified by the Plant Utilization Division of the Bureau of Plant Industry in order that farm products, from old and new crops, may find greater utilization.** [emphasis added]

Indeed, the role of the incipient Filipino scientific community was essential because the state needed scientific research in order to produce technical and agricultural industries that were reliable enough to prepare the country for economic self-dependency. This idea was not surprising because support for scientific institutions is clearly stipulated in one of the general provisions of "The 1935 Constitution" (n.d.): "**The State shall promote scientific research and invention** [emphasis added]. Arts and letters shall be under its patronage. The exclusive right to writings and inventions shall be secured to authors and inventors for a limited period." Additionally, scientific institutions established by the Americans, like the Bureau of Science, were seen as essential partners in developing the Commonwealth economy. In fact, Governor-General Murphy (1937, p. 118) expressed that the scientific work conducted through the Bureau of Science remains vital in assisting the improvement of the general health of the people, producing research to develop natural resources, and contributing to improve Philippine industries. He even detailed that "copra production

has become doubly profitable through elimination of wasteful methods, and similar assistance to the sugar industry has produced additional millions" because of the bureau's expert assistance (ibid.). Angel S. Arguelles (1936, p. 18), the first Filipino director of the Bureau of Science, concurred when he wrote that "economic progress is best attained when accompanied by scientific research."

The positive outlook for the potential of Filipino science is likewise evident in the efforts of various government officials and politicians who helped create the NRCP. As the country's first state-supported scientific council governed by Filipino scientists, one of its important mandates is to produce research outputs that could guide future legislation and policies for national development (NRCP, 1934, p. 1). In a memorial submitted by the Philippine Scientific Society (PSS)[34] to Governor-General Murphy in 1933, the PSS underlined the urgency of passing a law which authorized the creation of a national research council: "Everybody recognizes the great importance of improving the means and raising the standard of living of the average Filipino so that he may enjoy a higher measure of happiness and comfort… For the solution of these momentous national questions, the searchlight of science is essential" (NRCP, 1935b, p. 977; Guiang, 2021, p. 20). During the Second Philippine Science Convention of the PSS in 1933, Quezon who was still Senate President at that time, cast his support for the creation of the council: "leaders of the Legislature are seriously considering the suggestion made by one of the Department Secretaries some years ago regarding the creation of a National Research Council similar to the ones in the United States, Australia, Japan and other countries" (NRCP, 1935d, p. 973). The combined efforts of Filipino politicians and scientists culminated in the passage of Act. No. 4120 which formally gave birth to the NRCP.

As if echoing the views of Quezon and the PSS, Governor-General Murphy reiterated his optimism for Filipino science and the NRCP in leading the country towards economic independence. He conveyed this message through an address delivered at the NRCP's first meeting on 03 April 1934 at the UP School of Hygiene and Public Health: "The fact that you are mustered together, planning to make up this Government through this body a great instrumentality of inquiry and research proves this. That is what the Government should be if its aim is to reveal all the hidden treasures and the possibilities dormant in a nation" (NRCP, 1934, p. 2). Dr. Manuel L. Roxas, the NRCP's first president and undersecretary of agriculture and natural resources, expressed the same in his address delivered at the Third Philippine Science Convention held on 26 February to 02 March 1935: "The National Research Council of the Philippine Islands created by Act No. 4120 gives the scientists of the Philippines a means to make their voice

heard officially in the consideration by the Government of national problems requiring scientific and technical knowledge" (NRCP, 1937a, p. 50). Clearly, economic advancement could be attained if those in government were guided by the well-researched recommendations of the scientific community. To ignore the impact of science on policy-making would be detrimental to the Commonwealth government. UP President Jorge Bocobo stressed this warning in his message delivered before the delegates of the abovementioned science convention: "The more the government will rely on technical men and less on the generalities and vagaries and prejudices of those who look down upon scientific research as useless, the greater will be the assurance that the Commonwealth and the Republic will cope with their problems in an intelligent manner" (ibid., p. 65).

Science for nation-building was definitely the battle cry of the Filipino scientific community in the 1930s. This is evident in the state's high regard for the potential of Filipino science, made manifest in the newly established NRCP. But what type of nation-building and nationalism did Filipino scientists exhibit? Surely it was not the militant or anti-colonial form because Filipino scientists depended on American colonial institutions to pursue their own scientific work. In studying the formation of Filipino nationality under American colonial rule, National Artist Resil B. Mojares (2006, p. 25) explains that Filipinos observed "civic nationalism" – a nationalist expression that was constrained by the conditions of colonialism and complicit of the political, economic, and cultural realities of the time. Civic nationalism was quite paradoxical because it affirmed colonialism while seeking to negate it (ibid.). Moreover, it promoted "civic formation, citizenship-training, and 'preparation for nationhood'" (ibid., p. 22). The endeavors undertaken by the Filipino scientific community during the Commonwealth period reflected the essence of this type of nationalism. Filipino scientists used the foundations laid by the Americans, expanded it, and developed the science to suit Philippine national interests. In turn, the government engaged with the local scientific community by providing financial support for its research council.

Clearly, there were high hopes for the NRCP to deliver in terms of producing scientific research that could muster the country's agricultural, industrial, and commercial sectors. Reliable scientific work, however, would only be possible if there was tangible support from the state. Naturally, the government needed to ensure that its research council had everything that it needed in order to produce scientific studies that could contribute to economic growth. As stated in the NRCP's objectives, the council was expected to (1) stimulate research in the natural and physical sciences, including the related arts, in order to solve national problems and promote public welfare, (2)

expand research capabilities by tapping into the technical and scientific resources of the country, (3) promote research collaborations between individuals and scientific groups/organizations in the country and abroad, and (4) collate important scientific and technical knowledge and collaborate with essential government institutions (NRCP, 1934, p. 3). The accomplishment of these objectives was contingent on the funding that the council received from the government. After the induction of charter members on 23 March 1934, the Department of Agriculture and Commerce provided the council with P10,000 for initial operations (NRCP, 1984, p. 2; Guiang, 2021, p. 20). The council was also exempted from all internal-revenue taxes and other government fees and charges as mandated by the law (Baldoza, 2020, p. 96). Governor-General Murphy and the Tenth Philippine Legislature saw the ratification of Act No. 4190 which provided another P20,000 for general expenses. On top of these incentives, Dr. Roxas reported that the council received its first endowment in the amount of P360 from Victoriano Elicaño of the Consolidated Mines, Inc. which was used as a fellowship – the Elicaño Fellowship – awarded to qualified researchers (NRCP, 1935a, pp. 66-67). On 12 October 1934, Dr. Roxas and the executive board of the council forwarded to Governor-General Murphy, Senate President Quezon, and House Speaker Quintin Paredes a comprehensive list of research projects and activities. The list boasted a total of 309 research projects proposed by the 45 sections under the seven main divisions of the NRCP (ibid., pp. 48-66). In order to achieve the scientific work needed for the council's extensive research programs, Dr. Roxas and the executive board requested "the amount of two million pesos (P2,000,000) out of the amount of forty-seven million pesos (P47,000,000) that the Philippine Government will receive from the United States as a result of the gold devaluation," to be given to the NRCP as a trust fund. If this proposal was not feasible, the council would request the same amount to be obtained from the government's coconut excise tax (ibid., pp. 67-68). Despite the government's promise that a hearing would be scheduled for this particular matter, the *NRCP Bulletins* from 1934 to 1941 have not reported that the requested amount was ever disbursed to the council for the purpose of its research programs.

Aside from obtaining research funds for the council's activities, one of the most important tasks of Dr. Roxas as the NRCP's first president was to look for an institutional partner that could facilitate the loan of equipment and space for the perusal of council members. Incidentally, many staff members of the Bureau of Science became NRCP members. Hence, cooperation between these two institutions made scientific work for the council possible (Baldoza, 2020, p. 89; Guiang, 2021, p. 24). The NRCP annual report in 1935 describes how the bureau assisted the council in its early years:

> A small space was first provided for the present quarters (Room No. 213) which were formerly occupied by the National Museum. Within a short period, the exhibits of the Museum were removed and the entire big rooms were given for the use of the office of the National Research Council of the Philippine Islands. The limited resources of the Council have been greatly helped by the Bureau of Science by the furnishing of some equipment and furniture. (NRCP, 1935a, p. 26)

The entire *NRCP Bulletin* volume 8 was devoted as an inventory of the "laboratories and some of the special equipment available for research" by council members (NRCP, 1935d, pp. 903-964). Because of the NRCP's partnership with the bureau, the council had access to its "well-equipped biological and chemical laboratories" and "laboratory facilities for work on physical tests, on standards, metallurgical analysis, fire assaying, mineral and other determinations" (ibid., p. 903). Aside from the Bureau of Science, the council forged a fruitful partnership with the University of the Philippines (U.P.) because the majority of its members were also employees of the state university (NRCP, 1935a, pp. 26-27; Guiang, 2021, p. 24; cf. Baldoza, 2020, pp. 87-88). Thus, NRCP members had access to the "different scientific departments of the University of the Philippines, including those located on the Agricultural College campus at Los Baños, Laguna" (NRCP, 1935d, p. 903). Because the council was a government entity, it was also allowed the usage of state-owned laboratories and equipment from the following agencies: (1) the Department of Agriculture and Commerce; (2) the Bureaus of Plant Industry, Animal Industry, Forestry, and the Weather Bureau; and (3) San Lazaro Hospital in Manila and the Cebu and Cullion Leprosaria under the Bureau of Health (ibid.). (Fig. 1 to 5)

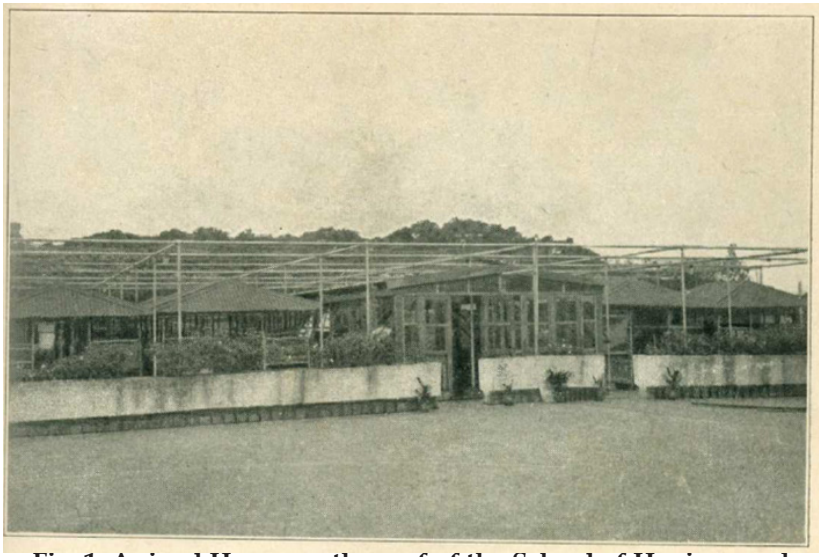


Fig. 1. Animal House on the roof of the School of Hygiene and Public Health, University of the Philippines. (NRCP, 1935d, p. 913)

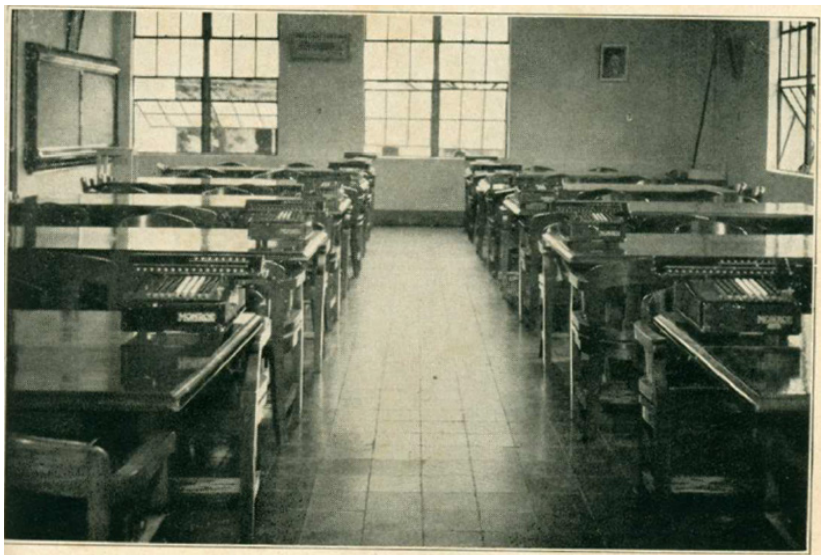


Fig. 2. Statistical and Epidemiological Laboratory of the School of Hygiene and Public Health, University of the Philippines. (NRCP, 1935d, p. 913)

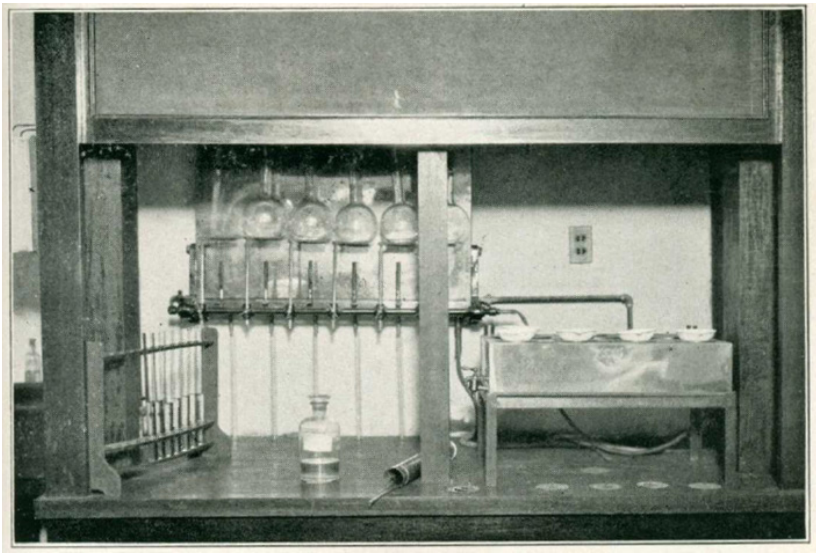


Fig. 3. Kjeldahl distilling apparatus, wall type, for six distillations, 24x90x75 cm. Water bath for eight evaporating dishes, 35x65x35 cm. (NRCP, 1935d, p. 919)

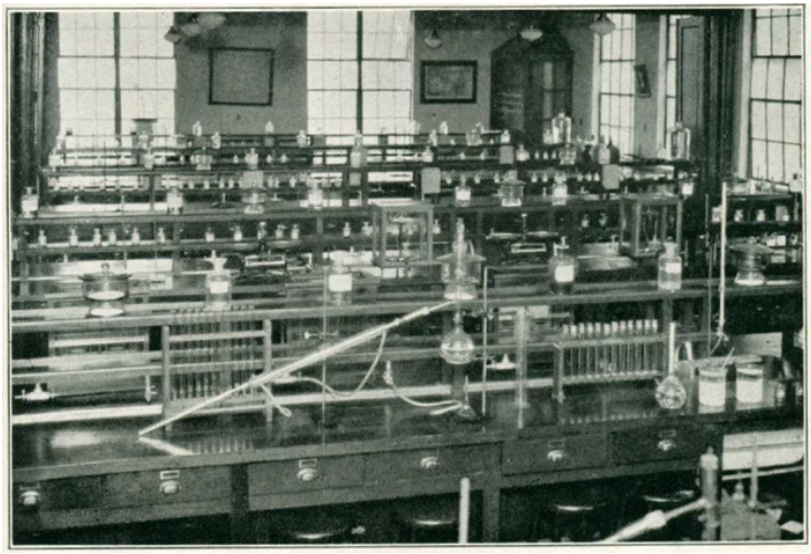


Fig. 4. Chemical Hygiene Laboratory, Department of Sanitary Engineering, Industrial Physiology and Chemistry. (NRCP, 1935d, p. 919)

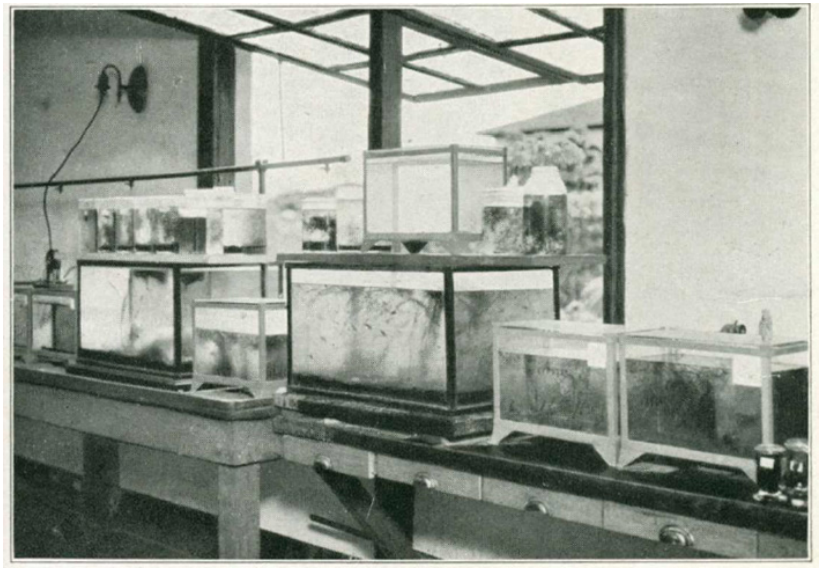


Fig. 5. Aquarium: Length, 195 cm.; Width, 27 cm.; Height, 33 m. (NRCP, 1935d, p. 928)

As important as the access to scientific facilities was the permission given to NRCP members to use the scientific library of the Bureau of Science. The library was established by the American colonial government in 1902 to serve as an important repository of scientific knowledge about the tropics (Russell, 1935, p. 123). By the 1930s, the library already had visitors from China, Japan, Malaya, and the Dutch East Indies because it boasted of having over "163,000 bound and unbound volumes, parts and pamphlets, the bound volumes alone numbering 86,150" (Arguelles, 1936, p. 29; Anderson, 2007, p. 306). In addition, it had collections donated by the Colegio-Medico-Farmaceutico containing "826 bound volumes and several thousand parts and pamphlets" and a portion of Dr. Jose Albert's library containing "526 bound volumes and over 3,000 unbound volumes, parts and pamphlets." Furthermore, the library had around 3,126 periodicals that included the issues of the *Philippine Journal of Science* (Arguelles, 1936, p. 29). More than 80% of the scientific library's selections covered topics pertaining to the various fields of science like mathematics, astronomy, physics, chemistry, geology, natural history, botany, zoology, human anatomy, physiology, bacteriology, medicine, and agriculture, while around 20% of the materials were on history, geography, anthropology, social science, political science, education, and library science (ibid.). The NRCP, however, thought that the library's scientific journal subscriptions were insufficient.

During the Fourth Philippine Science Convention in 1937, the council commented that the library "subscribes only to 542 scientific journals out of over twelve thousand scientific and technical journals being published annually." Hence, the NRCP submitted an official resolution to Quezon that pushed to increase the annual appropriation for the library's scientific journal acquisitions from P15,000 to P30,000 (NRCP, 1938c, pp. 44-45).

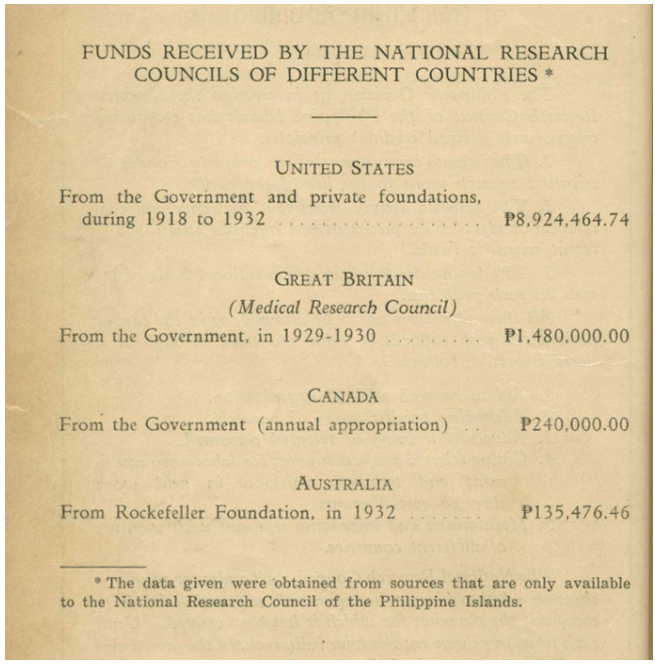
Government support was indeed crucial to allow the NRCP to fulfill its mandate during its incipient years. The potential of Filipino scientists is evident in the astounding amount of research projects that they have proposed, notwithstanding the challenges of acquiring sufficient funds. More so, the council's interagency partnerships and its members' professional networks became useful in accessing laboratories and equipment essential for scientific work. The NRCP was also able to forge international linkages necessary to produce updated and reliable scientific work that could benefit the state in one way or another. The council produced two official resolutions in the abovementioned science convention which requested more funding for fellowships abroad and financial aid to send delegates to international scientific conferences. "The contact with fellow workers from different parts of the world and the mutual exchange of ideas provide the stimulus that cannot but have a most wholesome effect on scientific work in the Philippines," the NRCP's resolution stated (ibid.). The efforts to create regional and transcontinental networks were not only a way to keep Filipino science in sync with recent trends, but it was also a means to locate the Philippines' place in the global scientific community composed of independent nations. Baldoza (2020, p. 100) explains it best when he opined that:

> Contact with foreign scientists exposed Filipino scientists to a transnational circuit of scientific knowledge production and exchange. Such contact expanded their scientific professional networks through affiliations, research collaborations, advanced trainings and fellowships, and participation in local and international scientific congresses and conferences. These developments cultivated their sense of cosmopolitanism, a perspective that they would hold especially in conceptualizing plans and visions for preparing the Philippine nation for independence.

The NRCP's cooperation with different international scientific organizations has been documented in several volumes of the *NRCP Bulletins*. As early as 1934, the council had already established connections with the *Pacific Science Association*, the *Far Eastern Association of Tropical Medicine*, and the national research councils of the U.S.,

Canada, Japan, and Australia (NRCP, 1935a, pp. 22-23). Comprehensive reports written by members who attended important international scientific conferences and congresses have been published in some *NRCP Bulletins*, as well. These write-ups include proceedings on the Cairo Leprosy Congress in 1938 by Dr. Herbert Windsor Wade, a report on the First American Congress on Obstetrics and Gynecology in 1939 by Dr. Honoria Acosta-Sison, plant pathology studies featured in the Sixth Pacific Science Congress in 1939 by G. O. Ocfemia, proceedings on the Third International Cancer Congress in 1939 by Dr. J. Z. Sta. Cruz, among others (NRCP, 1938b; NRCP, 1941). The participation of local scientists in these international gatherings shows the global perspective of Filipino science that had "inadvertently crafted the blueprint for nationalism" (Guiang, 2021, p. 31).

The NRCP and its research endeavors clearly reinforced the pillars of scientific progress which began under the tutelage of the Americans. In the midst of crucial changes in the political landscape, Filipino politicians and government officials gave their support to the council because they saw scientific research as a tool which could advance the nation. This was, indeed, a concrete manifestation of the Filipinos' expression of civic nationalism. More importantly, the engagements between the government and the Filipino scientific community indicate the disposition of state-science nexus during the Commonwealth period. Despite the state's financial support for the initial operational expenses of the NRCP, the council's requests for increased budgetary allocations for research activities and journal subscriptions did not materialize. Compared to the research councils in the U.S., Great Britain, Canada, and Australia, the financial backing that the NRCP received was significantly low (Fig. 6). Nonetheless, the council had full access to existing government facilities, particularly in the U.P. and the Bureau of Science, because it was a government entity. Yet, it would have been ideal if the government had constructed for the NRCP its own building with facilities that council members could exclusively use. In spite of these limitations, the council was able to chart a course towards forging an identity for Filipino science through research-related endeavors within the country and outside.



FUNDS RECEIVED BY THE NATIONAL RESEARCH COUNCILS OF DIFFERENT COUNTRIES *

UNITED STATES

From the Government and private foundations, during 1918 to 1932 ..... ₱8,924,464.74

GREAT BRITAIN

(Medical Research Council)

From the Government, in 1929-1930 ..... ₱1,480,000.00

CANADA

From the Government (annual appropriation) .. ₱240,000.00

AUSTRALIA

From Rockefeller Foundation, in 1932 ..... ₱135,476.46

* The data given were obtained from sources that are only available to the National Research Council of the Philippine Islands.

Fig. 6. Financial support for the research councils in the U.S., Great Britain, Canada, and Australia. (NRCP, 1935a)

Research Output of the NRCP and its Impact on Commonwealth Policies

The last part of this essay's discussion and analysis focuses on the research papers published in different volumes of the *NRCP Bulletins* from 1934 to 1941 which attempted to respond to the pressing issues of the Philippine economy. Of the 18 prewar bulletins available in the NRCP archives, the most notable was a specific volume published in 1935 which served as a database of research works produced by its members and associate members throughout their respective professional careers. The database recorded that from 1905 to 1934, the council's 114 members produced an astounding 2,109 books, reports, manuals, monographs, and journal articles written in either English or Spanish (NRCP, 1935c, pp. 613-765). Meanwhile, the council's 265 associate members produced 1,546 books, reports, manuals, monographs, and journal articles written in either English or Spanish for the same time period (ibid., pp. 765-902). Considering other *NRCP Bulletins*, what stands out are the bulletins which feature research papers that: (1) trace the historical roots of the various scientific fields in the Philippines, compiled in volumes 3 to 6 and (2) explore the agricultural,

industrial, and commercial conditions of the country, compiled in volumes 15 and 17.

Since the mandate of the NRCP is to develop and use scientific research for national development, one of the council's first publication outputs was a comprehensive survey of all scientific fields covered by its seven divisions. *NRCP Bulletin* volumes 3 to 6 that was published in 1935 feature a total of 62 papers written by 56 NRCP members who discussed the historical development and current status of their fields of specialization in the physical, natural, and medicinal sciences. This ambitious work was clearly an attempt by the NRCP to provide the Filipino scientific community with literature conveying an important historical hindsight that their specific expertise has historic roots in the Spanish or even the precolonial periods. It is also remarkable to note that as early as the 1930s, Filipinos scientists have collaborated with one another in order to produce an immensely exhaustive history of Philippine science which covered topics such as scientific research in educational institutions, foreign linkages of Philippine science, the development of public health in the country, Philippine paleontology, biological and agricultural chemistry, veterinary science, among many others. Because of the relevance of these research papers, a handful of them were selected and included in the Science volume of the *Encyclopedia of the Philippines: The Library of Philippine Literature Art and Science* published in 1936. Some of the most notable papers in this tome include "A Historical Review of Movements to Establish A Research Council for the Philippines" by Patrocinio Valenzuela (1936, pp. 31-44; NRCP, 1935b, pp. 77-85), "Brief Observations on Science in the Philippines in the Pre-American Era" by Eulogio B. Rodriguez (1936, pp. 52-107; NRCP, 1935b, pp. 86-128), and "Pioneers in Philippine Science" by E. B. Copeland (1936, pp. 45-51; NRCP, 1935b, pp. 129-133). These works not only retell the efforts of the Filipino scientific community to establish a government-supported research council, but they also trace the untapped potential of Filipino science before the American colonial system modernized scientific work in the Philippines. Rodriguez (1936, p. 91; NRCP, 1935b, p. 155) narrates that throughout time "its [science] progress has met with many difficult obstacles although it has emerged not without important achievements…" Despite these challenges, Filipino science has vastly developed with, of course, the guidance of the Americans. The feats in the development of Filipino science, according to Rodriguez's conclusion, culminated in a particular moment when "the part of science in the economic and industrial development of the country is recognized and our scientists are being given enthusiastic encouragement" (ibid.).

Related to Rodriguez's foregoing statements, several papers in volume 6 of the *NRCP Bulletin* (1935e) were written not only as historical

accounts but as investigations into the pressing issues concerning Philippine agriculture and industry. For example, "The Need for Research in Agricultural Economics" by Hilarion S. Silayan discusses how sufficient knowledge in agricultural economics could eradicate problems in land administration and help craft better government policies to benefit both farmers and land owners. According to Silayan (1935, pp. 515 & 521):

> The problems of economics of agriculture assume increasing importance as the country becomes developed and the problems of production, marketing, credit, transportation, taxation, tariff, currency, rural finance, and competition, begin to affect the object and profit of every agricultural enterprise.

A government office is greatly needed to give due attention to the problems… to undertake research and survey, to secure and make the information available in practical form that it may be useful in the daily problems of agriculture and their solution as well as in framing sound governmental policies.

In another paper from the same *NRCP Bulletin* volume, A. L. Teodoro wrote "Status of Farm Mechanization in the Philippines" to assess the Bureau of Agriculture's official introduction of mechanized farming since 1904. Teodoro (1935, p. 602) opines:

> Publications that might show definitely the relative merits and faults of farm mechanization are not available. Apparently, there have been no reliable and extensive tests on the use of modern mechanical equipment, of labor-saving devices on farm, and on the relation between cost of crop production and the use of machines. Extensive experimental studies are necessary to establish the basic facts and principles of methods that will meet the mechanical requirement of present agricultural practice in the Philippines.

These papers which provide expert and technical advice have similarities with the scientific works featured in volumes 15 and 17 published in 1937 and 1938, respectively. The council presidents at that time were Angel S. Arguelles in 1937 and Bienvenido M. Gonzalez in 1938 whose terms focused on scientific research that could help the government solve problems in key sectors crucial for economic growth (Guiang, 2021, pp. 25-28). Volume 15 contains technical reports written by the NRCP's scientists who were also members of the newly established Industrial Committee under the Commonwealth government's Department of Agriculture and Commerce (NRCP, 1937b,

pp. 3-5). The technical reports explored the possibilities of recalibrating the glass industry, meat packing industry, vitrified clay pipe industry, paper industry, and home weaving industry, among others (ibid.). Volume 17 focused on technical papers that surveyed the problems in major industries like sugar, rice, abaca, coconut, lumber, fishing, and mining. Other papers in the same volume explored the prospects of foreign and domestic trade (NRCP, 1938a, pp. v-vii).

Clearly, there was an apparent preference for research works on the natural, physical, and medicinal sciences. At this junction, it is interesting to inquire about the role of the social sciences in the national endeavor. After all, the NRCP has a Division of Government, Foreign, and Educational Relations that could oversee research-related activities in the social sciences. The said division unfortunately focused on interagency cooperation and networking with local and international institutions. Research papers on the social sciences are intensely scant across all 18 prewar bulletins. In fact, there are only three social science papers published in two specific volumes. Volume 12 includes a paper read at the Third Philippine Science Convention in 1935 entitled, "Review of Educational Research in the Philippines" written by Manuel L. Carreon of the Bureau of Education wherein he explores the problems of education research in the Philippines (NRCP, 1937a, p. 104). Volume 19 features another paper by the same author, read at the Fourth Philippine Science Convention in 1937 entitled, "A Sampling of Studies in Philippine Public Education" which underscores the best practices in the public education system (NRCP, 1938c, pp. 101-102). U.P. professor Gabriel A. Bernardo's paper was published in volume 12 entitled, "The Role of the Library in the Promotion of Research" which talks about the indispensable contributions of libraries in the country's research tradition (NRCP, 1937a, p. 105). Unlike the research works on the physical, natural, and medicinal sciences, the cited papers above are not really related to the augmenting vital industries that could initiate economic progress. Nonetheless, these social sciences papers are important because they highlight the issues relating to education and academic research.

Going back to the scientific papers in volumes 15 and 17, these research outputs seem to align with the Commonwealth's vision at promoting social justice. Republished in volume 17 is a speech delivered by Manuel A. Roxas who, at that time, served as chairman of the National Economic Council. Underscoring the need to meet the demands of social justice, Roxas argues against the existing inequalities in the agricultural sector (NRCP, 1938a, pp. xvi-xvii):

> Glaring inequalities and injustices exist in the situation that prevails in many of our rural districts, particularly in the rice,

> sugar, and tobacco regions. Many of these places where the system of tenancy obtains, a relationship between landlord and tenant prevails not very much different from the feudal system which existed in Europe in the middle ages… **The tenancy system in the Philippines, if it is to survive, must be remodeled and changed. It must accept the demands of social justice and insure a more enlightened and just treatment of the tenant.** [emphasis added]

A specific example of a technical report that did a survey on government policies concerning the economy, social services, and standard of living was the one written by Eustaquio G. Aquino entitled, "An Outline of Our Economic Objectives and the Present Governmental Set-up." Here, Aquino (1938-, pp. 139-148) lists down the Commonwealth's programs which responded to the following: (1) self-sufficiency of Filipino basic needs like food, clothing, and shelter, (2) utilization of natural resources vis-à-vis the current economic demands, (3) establishment of key industries and the technical knowledge and skilled labor required for them, (4) development of a sustainable technical and scientific knowledge among Filipinos, (5) creation of employment opportunities that can provide Filipinos a decent standard of living, (6) production of sufficient export goods in order to sustain national defense and industries, and (7) ensuring enough government income that can support basic social services. However, Aquino's report and other papers in volumes 15 and 17 seem to be investigative or recommendatory in nature. It is thus interesting to know whether these outputs influenced actual policy-making that could have made an impact on the economy. The prewar volumes of the *NRCP Bulletins*, along with other scholarly studies about the council, are unfortunately silent when it comes this matter. What is only documented in the bulletins and academic works are the interventions of government agencies in the council's research activities.

What can probably be assumed at this point is that sources about the NRCP do not detail the influence of their research outputs because there was no significant impact on state-level decision-making. Perhaps, the architects of the Commonwealth's economic and social justice programs did not heed the scientific papers and technical reports of the council thereby failing to achieve the economic progress that the Philippine state envisioned. These are all conjectures but what is factual is that the economy was not in good shape before the outbreak of World War II. Friend (1965, p. 160) argues that "the Commonwealth of the Philippines from 1935 to 1941 enjoyed one of the earliest genuine possibilities of economic decolonization in modern history, but in those six years one finds little economic development externally stimulated or natively sought." He further explains that while American policies

seem insensitive towards the economic problems of the Philippines, much of the blame has to be directed at the country's enterprises and the Commonwealth government's economic policies (ibid., p. 159). Despite the high expectations from major industries, Alfred W. McCoy (1989, pp. 141-142) explains that by 1938 "the U.S. Government's transfer of its excise collections on Philippine coconut imports… was providing about one-third of the Commonwealth's revenues. The sugar industry, which absorbed over 50 percent of the country's banking capital, sent 100 percent of its exports to the United States and was barred by its inefficiency from competing in the world market." Norman G. Owen (1971, p. 121) documents that sugar exports to the U.S. from 1933 to 1937 amounted to 47% of the total valued at 56.5 million dollars, followed by coconut products that amounted to 25% or 29.9 million dollars. He adds that from the late 19th century up to the 1950s, the same four crops – sugar, abaca, tobacco, and coconut – accounted for about 90% of all Philippine exports (ibid., p. 115). Clearly, the Commonwealth economy was grounded on the agricultural industry and was dependent on its free trade relationship with the U.S. Owen (1971, p. 112) asserts that by 1941, the Philippine economy was still hounded by problems such as "overdependence on a few exports, tenantry, indebtedness, low productivity, corruption and inefficiency, undercapitalization, miserable working conditions" (ibid.). On the Commonwealth's social justice programs, McCoy (1989, p. 140) contends that everything appeared to be a mere "rhetorical feint masking State repression of the radical peasant movement." Quezon, in fact, dismantled radical peasant organizations from 1940 to 1941 by repealing the tenancy legislation and heightening antiradical rhetoric, among other repressive machinations (ibid.). The political clout of the landed elite had a lot to do with this problem. Quezon's reform programs which attempted to change the agricultural industry were not radical enough to match the influence of the local barons over the Philippine legislature. In assessing the attempts at agricultural reform, Owen (1971, p. 113) states that "the most symptomatic and profound failure of the American period was an inability or unwillingness to curb the Filipino agricultural elite, and to redefine Philippine interests as progressive rather than static."

If the Philippine economy was in this condition at the concluding of the Commonwealth period, then it can be said that the Philippine state's ultimate purpose behind its mobilization of the scientific community was not attained. The government was moving in the correct direction when it initiated the formation of a research council and supported its activities despite obvious shortcomings. But the political dynamic at that time was beyond the NRCP's control. Whether or not Quezon's reform programs and economic policies were based on the research work of the council, making sure that these get legislated

was entirely contingent on the political powerplay in Congress where discourse was affected by patronage politics and the landed elite's influence. Nevertheless, these criticisms do not discount the hard work of the Filipino scientific community in order to advance Filipino science and provide the government with the essential scientific studies it needed. The NRCP was able to muster the best Filipino scientists and produce research papers that could have potentially solved the country's economic problems at that time.

III. Conclusion

This essay has thus shown two things: (1) the state-science nexus during the Commonwealth period had successfully mobilized the Filipino scientific community in producing vital research works that envisioned economic progress and (2) the limitations in government support and, to some extent, the politics of the time have probably hindered the council's influence on actual policy-making. The nature of state-science engagements as seen in the examples of Germany and Japan were formidable enough to prepare their respective industries for war. Despite a very different context for the Philippines that was anticipating independence, science was likewise highly regarded by important American colonial officials and Filipino politicians. The strength in Philippine state-science engagements became apparent in 1933 when the government supported the establishment of the NRCP, receiving not only moral but also tangible support. But as what was mentioned in the foregoing discussions, there were limitations in terms of financial backing for the council's research projects and activities. Nonetheless, as a display of civic nationalism, the council members made efforts to consolidate their scientific work in order to contribute to the national endeavor of augmenting the economy. Much credit has to be ascribed to the institutional networks and connections provided by the charter members of the NRCP. Collaborative efforts with well-established institutions like the Bureau of Science and the University of the Philippines, as well as the transnational linkages created through international conferences and congresses, facilitated the growth of scientific work under the auspices of the council. More so, scientific progress is evident in the quality and quantity of research produced by individual council members. It is true that several of the council's research papers and technical reports were crafted as a guide for policy-making, yet the literature and primary sources consulted for this study are silent in determining which of the council's scientific contributions had a direct influence on policy-making. Whether or not their research work shaped actual government policies was beyond the control of the council because it was the Commonwealth politicians who had to ensure that scientific advice translate into legislation.

Indeed, the state-science nexus in Commonwealth Philippines had initially created a formidable partnership between state instrumentalities and the scientific sector but was challenged by several issues abovementioned. Today, the NRCP still enjoys government support by working hand-in-hand with the Department of Science and Technology. The present-day council supports research work not only in the physical, natural, and medicinal sciences but also in the social sciences and humanities. What can be discerned from the historical experience of the council is that strong state-science engagements could yield progressive solutions to the country's existing problems. Strengthening this nexus would only be possible if there are constant partnerships between legislators, government agencies, and the NRCP when it comes to state-level decision-making where council members could give expert advise. The council should never be insulated from crucial political and economic issues of the country; hence its members should always be included in technical working groups that brainstorm policies for national progress. Lastly, the problem of financial backing has been a primary concern for the NRCP ever since its inception thus, continuous lobbying efforts for more budgetary appropriations should always be prioritized.

Notes

[1] Before Act No. 4120 was ratified by the Ninth Philippine Legislature, it was originally House Bill 876 introduced by Nueva Ecija Representative Manuel Gallego. The legislation was then amended as House Bill 3276 by Gallego and Batangas Representative Leonardo Farol. This final version of the bill was enacted by the Philippine Congress on 08 December 1933, thereby officially establishing the NRCP (Valenzuela, 1936, p. 37; Guiang, 2021, p. 20).

[2] The National Assembly of the Philippines was the legislative branch of the Commonwealth of the Philippines.

[3] The Philippine Scientific Society (PSS) was an organization established in 1923 composed of Filipino scientists from the public and private sectors. Before the NRCP, the centralization of scientific activity conducted by Filipino scientists was done under the auspices of the PSS (Baldoza, 2020, pp. 92-94; Guiang, 2021, p. 17).

References

Anderson, W. (2007). Science in the Philippines. *Philippine Studies: Historical and Ethnographic Viewpoints*, 55(3), pp. 287-318.

Aquino, E.G. (1938). An Outline of Our Economic Objectives and the Present Governmental Set-up. In *National Research Council of the Philippines Bulletin no. 17* (pp. 139-148). Manila: NRCP.

Arguelles, A.S. (1936). Progress in the Philippines. In Z.M. Galang (Ed.), *Encyclopedia of the Philippines Vol. 7: Science* (pp. 17–30). Manila: P. Vera and Sons.

Baldoza, J.V. (2020). Under the Aegis of Science: The Philippine Scientific Community before the Second World War. *Philippine Studies: Historical and Ethnographic Viewpoints*, 68(1), pp. 83-110.

Copeland, E.B. (1936). Pioneers in Philippine Science. In Z.M. Galang (Ed.), *Encyclopedia of the Philippines Vol. 7: Science* (pp. 45–51). Manila: P. Vera and Sons.

Forman, P. (1973). Scientific Internationalism and the Weimar Physicists: The Ideology and Its Manipulation in Germany after World War I. *Isis*, 64(2), pp. 150-180.

Friend, T. (1965). *Between Two Empires: The Ordeal of the Philippines, 1929-1946*. New Haven: Yale University Press.

Fukasaku, Y. & Ishizaka, S. (2009). Science and Technology Policy in Japan. In R. Arvanitis (Ed.), *Science and Technology Policy Vol. 2* (pp. 167-184). UNESCO and EOLSS Publishers.

Galang, Z.M. (Ed.). (1936). *Encyclopedia of the Philippines: The Library of Philippine Literature Art and Science Vol. 7: Science*. Manila: P. Vera and Sons.

Gealogo, F.A. (Ed.). (2021). *A History of the National Research Council of the Philippines: Research in the Life of the Nation*. Taguig: National Research Council of the Philippines.

Gosling, F.G. (2010). *The Manhattan Project: Making the Atomic Bomb*. Washington D.C.: Department of Energy.

Grunden, W.E., Kawamura Y., Kolchinsky E., Maier H. & Yamazaki M. (2005). Laying the Foundation for Wartime Research: A Comparative Overview of Science Mobilization in National Socialist Germany, Japan, and the Soviet Union. *Osiris*, 20(2), pp. 79-106.

Guiang, F.J.P.A. (2021). The Development of Colonial Science and the Council under American Tutelage. In F.A. Gealogo (Ed.), *A History of the National Research Council of the Philippines: Research in the Life of the Nation* (pp. 7-32). Taguig: National Research Council of the Philippines.

Hartendorp, A.V.H. (1958). *History of Industry and Trade of the Philippines*. Manila: American Chamber of Commerce of the Philippines, Inc.

McCoy, A.W. (1989). Quezon's Commonwealth: The Emergence of Philippine Authoritarianism. In R.R. Paredes (Ed.), *Philippine Colonial Democracy* (pp. 114-160). Quezon City: Ateneo de Manila University Press.

Mojares, R.B. (2006). The Formation of Filipino Nationality Under U.S. Colonial Rule. *Philippine Quarterly of Culture and Society*, 34(1),

pp. 11-32.

Murphy, F. (1937). *Message from the President of the United States transmitting the First Report of the United States High Commissioner to the Philippine Islands covering the period from November 15, 1935, to December 31, 1936*. Washington: United States Government Printing Office.

National Research Council of the Philippines (NRCP). (1934). *National Research Council of the Philippines Bulletin no. 1*. Manila: NRCP.

National Research Council of the Philippines (NRCP). (1935a). *National Research Council of the Philippines Bulletin no. 2*. Manila: NRCP.

National Research Council of the Philippines (NRCP). (1935b). *National Research Council of the Philippines Bulletin no. 3*. Manila: NRCP.

National Research Council of the Philippines (NRCP). (1935c). *National Research Council of the Philippines Bulletin no. 7*. Manila: NRCP.

National Research Council of the Philippines (NRCP). (1935d). *National Research Council of the Philippines Bulletin no. 8*. Manila: NRCP.

National Research Council of the Philippines (NRCP). (1935e). *National Research Council of the Philippines Bulletin no. 6*. Manila: NRCP.

National Research Council of the Philippines (NRCP). (1937a). *National Research Council of the Philippines Bulletin no. 12*. Manila: NRCP.

National Research Council of the Philippines (NRCP). (1937b). *National Research Council of the Philippines Bulletin no. 15*. Manila: NRCP.

National Research Council of the Philippines (NRCP). (1938a). *National Research Council of the Philippines Bulletin no. 17*. Manila: NRCP.

National Research Council of the Philippines (NRCP). (1938b). *National Research Council of the Philippines Bulletin no. 18*. Manila: NRCP.

National Research Council of the Philippines (NRCP). (1938c). *National Research Council of the Philippines Bulletin no. 19*. Manila: NRCP.

National Research Council of the Philippines (NRCP). (1941). *National Research Council of the Philippines Bulletin no. 28*. Manila:

NRCP.

National Research Council of the Philippines (NRCP). (1984). *Bulletin of Information*. Taguig: NRCP.

Owen, N.G. (1971). Philippine Economic Development and American Policy: A Reappraisal. In N.G. Owen (Ed.), *Compadre Colonialism: Studies in the Philippines under American Rule* (pp. 103-128). Michigan: University of Michigan Press.

Paredes, R.R. (Ed.). (1989). *Philippine Colonial Democracy*. Quezon City: Ateneo de Manila University Press.

Quezon, M.L. (1938). *Message from the President of the United States transmitting the First Annual Report of the President of the Philippines to the President and the Congress of the United States covering the period November 15, 1935, To December 31, 1936*. Washington: United States Government Printing Office.

Richardson, J. (2011). *Komunista: The Genesis of the Philippine Communist Party, 1902-1935*. Quezon City: Ateneo de Manila University Press.

Rodriguez, E.B. (1936). Brief Observations on Science in the Philippines in the Pre-American Era. In Z.M. Galang (Ed.), *Encyclopedia of the Philippines Vol. 7: Science* (pp. 52–107). Manila: P. Vera and Sons.

Silayan, H.S. (1935). The Need for Research in Agricultural Economics. In *National Research Council of the Philippines Bulletin no. 6* (pp. 515-522). Manila: NRCP.

Terami-Wada, M. (2014). *Sakdalistas' Struggle for Philippine Independence, 1930-1945*. Quezon City: Ateneo de Manila University Press.

The 1935 Constitution. (n.d.). Retrieved from https://www.officialgazette.gov.ph/constitutions/the-1935-constitution/

Teodoro, A.L. (1935). Status of Farm Mechanization in the Philippines. In *National Research Council of the Philippines Bulletin no. 6* (pp. 600-602). Manila: NRCP.

Valenzuela, P. (1935). A Historical Review of Movements to Establish A Research Council for the Philippines. In *National Research Council of the Philippines Bulletin no. 3* (pp. 77-85). Manila: NRCP.

Valenzuela, P. (1936). The National Research Council of the Philippine Islands. In Z.M. Galang (Ed.), *Encyclopedia of the Philippines Vol. 7: Science* (pp. 31–44). Manila: P. Vera and Sons.