

## Chemistry in Mexico in the first decades of the twentieth century: establishment of the first School of Chemical Sciences (1917)

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### Abstract

In Mexico, the absence of significant foundational moments and heroic characters in the development of chemistry in the first quarter of the twentieth century made this period pass almost unnoticed in the historiography of Mexican chemistry. However, attention to some individuals, mostly pharmacists, scarcely studied and considered to be secondary, allowed identifying and analyzing the spaces where chemistry was produced, taught, practiced and professionalized. My purpose is to discuss how and where chemistry developed during this period and the main social actors involved in this process.

### Keywords

History of chemistry; Nineteenth century; Mexico

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## Introduction

The historiography of Mexican chemistry and pharmacy in the first two decades of the twentieth century often portrays this period as obscure and dull, specifically the years prior to the inauguration of the National School of Chemical Industries in 1916. However, I do not believe this is the case. In this paper I do not approach the history of chemistry in early twentieth-century Mexico as an extension of what occurred in Europe to account for the reasons behind the delay in its development. My purpose is to discuss how and where chemistry developed during this period, and the main social actors involved in this process. This study is relevant because it presents, articulates and interprets the primary and secondary sources which inform this complex subject of research. My approach placed less known chemists at the center of the discussion to understand the context in which chemistry developed, and dismantle the myth of the creation of the National School of Chemical Industries as an event exclusively linked to its first director, Juan Salvador Agraz.<sup>1</sup>

In the second half of the nineteenth century, pharmacy and chemistry underwent rapid expansion, which transformed scientific, professional, industrial and business activities. New developments in chemistry and the rise of European and American industrial pharmaceutical companies led to the conversion of pharmacies from small businesses dedicated to the preparation of remedies to major factories in the United States and Europe.<sup>2</sup> However, this process did not occur in Mexico until the 1930s. Throughout the nineteenth and the beginning of the twentieth century, teaching, research and public and private services related to chemistry were mainly provided by pharmacists, particularly the ones who had graduated at Escuela Nacional de Medicina–ENM (National School of Medicine) where pharmacy was established as a field in 1833.<sup>3</sup>

These scientists belonged to diverse professional associations and prestigious research institutes. Experimental chemistry during this period revolved around medicinal plants and reached its peak at Instituto Médico Nacional–IMN (National Medical Institute) established in 1888. A Department of Industrial Chemistry was created at IMN in 1903 to develop the national chemical and pharmaceutical industries. However, this initiative did not succeed. A few years later, in 1910, the first Mexican Chemical Society–MCS- was founded, which mostly included pharmacists who were also members of the Mexican Pharmaceutical Society (1871) and later played a fundamental role in the constitution of the School of Chemical Sciences and Pharmacy in 1919. These scientists built a complex network, which gave them

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<sup>1</sup> This paper is part of a larger ongoing project on the local circumstances and context surrounding the establishment of chemistry in Mexico during the early decades of the twentieth century, and the fundamental role of pharmacists in this process. See Liliana Schifter, & Patricia Aceves, “Los farmacéuticos y la química en México (1903-1919): prácticas, actores y sitios,” *Estudios de Historia Moderna y Contemporánea de México* 51 (2016): 72–92.

<sup>2</sup> See Raúl Rodríguez, & Antonio González Bueno, *Entre el arte y la técnica: los orígenes de la fabricación industrial del medicamento* (Madrid: CSIC, 2005), 82; Rogelio Godínez, & Patricia Aceves, *Proyectos, realidades y utopías: la transformación de la farmacia en México, 1919-1940* (México: UAM-X/División de CBS, 2014), 13-20.

<sup>3</sup> See Patricia Aceves, “La crisis de la farmacia en México en el cambio de siglo (XIX-XX),” in *Continuidades y rupturas: una historia tensa de la ciencia en México*, eds. Francisco J. Dosil, & Gerardo Sánchez (Morelia: Instituto de Investigaciones Históricas, 2010), 261–311.

visibility and allowed them take the necessary initiatives to create new spaces where chemistry-related work was performed, taught, practiced and eventually professionalized.<sup>4</sup>

Within this context, to understand the development of chemistry and related activities in Mexico, as well as the means by which its practitioners gradually gained confidence, credibility and legitimacy within the contemporary society, it is necessary to identify the sites of chemistry from the material, intellectual, social and cultural perspectives.<sup>5</sup> It is also important to expand the notion of scientific practice and associated locations.<sup>6</sup> In this regard, over the last two decades, the importance of considering the multiple ties of science to the sites and areas of practice to understand its local nature has become increasingly clear. Science is not a concept ordered in advance to meet a set of necessary and sufficient conditions for its existence, but a human enterprise situated in space and time, which are persistently subjected to negotiation. Like other elements of human culture, science bears the imprint of where it exists.<sup>7</sup> The fact that nations, or regions, have unequal development, are socially diverse and were constructed by overlapping networks of social relationships which produce and reproduce local meanings of place, power, and personality at different scales must be considered. These regional cultures appropriated scientific knowledge in different ways according to their own understanding and used it for different purposes.<sup>8</sup>

Along this line of thinking, studies which challenge the historiographic archetype of considering great discoveries and scientific leadership as processes which extend widely regardless of national barriers and cultural differences become relevant. From this perspective, the influence of national stereotypes stands against the view which asserts the inevitable transmission of knowledge from a research center to the rest of the world.<sup>9</sup> Other sources reviewed include the ones which approach the conformation of European chemical societies in the eighteenth century and historiographical approximations to the structuring of scientific disciplines as a nineteenth-century European invention.<sup>10</sup> According to this view, a

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<sup>4</sup> See Patricia Aceves, & Sandra Martínez, "Los farmacéuticos y los químicos mexicanos en la búsqueda de su identidad en los inicios del siglo XX," in *Historia y filosofía de la química: aportes para la enseñanza*, ed. José A. Chamizo (México: Siglo XXI, 2010), 114–25.

<sup>5</sup> Antonio García-Belmar, "Introduction of the Special Issue Sites of Chemistry in the Nineteenth Century," *Ambix* 61, no. 2 (2014): 109-14.

<sup>6</sup> These include teaching, learning, research, professional work, trade, industrial application, routine analysis, theoretical debates and the popular dissemination of chemistry, as well as the interactions between practitioners and external sites around them.

<sup>7</sup> David N. Livingstone, *Putting Science in its Place: Geographies of Scientific Knowledge* (Chicago: University of Chicago Press, 2003), 6-13; Steven Shapin, "Placing the View from Nowhere: Historical and Sociological Problems in the Location of Science," *Transactions of the Institute of British Geographers* 23, (1998): 5-12; Adi Ophir, & Steven Shapin, "The Place of Knowledge: A Methodological Survey," *Science in Context* 4, (1991): 3-22.

<sup>8</sup> Livingstone, 88-9.

<sup>9</sup> See Josep Simon, *Communicating Physics: The Production, Circulation and Appropriation of Ganot's Textbooks in France and England 1851-1887* (London: Pickering and Chatto, 2011), 19; Bernadette Bensaude-Vincent, "Chemistry," in *From Natural Philosophy to the Sciences: Writing the History of Nineteenth-century Science*, ed. David Cahan (Chicago: University of Chicago Press, 2003), 45-53.

<sup>10</sup> Anita K. Nielsen, & Sona Strbanova, "Creating Networks in Chemistry-Some Lessons Learned," in *Creating Networks in Chemistry: The Founding and Early History of Chemical Societies in Europe*, eds. Anita K. Nielsen, & Sona Strbanova (London: RSC Publishing, 2008), 328- 48.

system of communication was established between the emerging communities of academic specialists based on common thematic interests in the 1800s. Disciplines, as units of internal differentiation of science, led to the emergence of different curricula and specialized academic and professional roles.<sup>11</sup>

The present study is demarcated by the period from 1903—when the Department of Industrial Chemistry at IMN was created— to 1919, when pharmaceutical studies began at the School of Chemical Sciences and Pharmacy. This event defined the curricula of chemistry and pharmacy as independent and autonomous disciplines.<sup>12</sup>

### Sites for scientific specialization in Mexico at the end of the nineteenth century

The Porfiriato regime was characterized by a political dictatorship in Mexico from 1876 to 1911. Over time, social inequality grew, while a new model of economic development was established based on foreign investment and export of raw materials. The intention was to boost the country's industrial growth, especially activities involving extraction and transformation of natural resources such as metals, rubber, oil and sugar, among others.<sup>13</sup>

Within this context, scientific and academic institutions were established to train specialized professionals who would enforce the regime's economic, health and educational policies.<sup>14</sup> As consequence, science and education were actively promoted.<sup>15</sup> At least a dozen institutions related to geography, geology, natural history, astronomy, physics and mathematics were established between 1876 and 1910.<sup>16</sup> New spaces for the development of chemistry, pharmacology and medicine were also created. In these new institutions, serious efforts were undertaken to build a national scientific tradition. Several generations of specialists developed along this process, for example, the analytical chemists at IMN.

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<sup>11</sup> Rudolf Stichweh, "La structuration des disciplines dans les universités allemandes au XIXe siècle," *Histoire de L'éducation* 62 (1994): 55–73; Rudolf Stichweh, "Differentiation of Scientific Disciplines: Causes and Consequences," in *Encyclopedia of Life Support Systems* (Paris: UNESCO, 2003), 1-4; Josep Simon, 1-17.

<sup>12</sup> Nina Hinke, *El Instituto Médico Nacional: la política de las plantas y los laboratorios a finales del siglo XIX* (México: Cinvestav/UNAM, 2012), 91; Sandra Martínez, Patricia Aceves, & Alba Morales-Cosme, "Una nueva identidad para los farmacéuticos: la Sociedad Farmacéutica Mexicana en el cambio de siglo (1890-1919)," *Dynamis* 27 (2007): 263–85, on 264.

<sup>13</sup> See: Mauricio Tenorio-Trillo, *Artifugio de la nación moderna: México en las exposiciones universales, 1880-1930* (México: Fondo de Cultura Económica, 1998), 92-105; Daniel Cosío-Villegas, *Historia moderna de México: el Porfiriato* (México: Hermes, 1956), 7-54.

<sup>14</sup> François-Xavier Guerra, *México, del antiguo régimen a la Revolución*, trans. Sergio Fernández Bravo (México: Fondo de Cultura Económica, 1988), 23-45.

<sup>15</sup> Javier Garciadiego, *Rudos contra científicos: La Universidad Nacional durante la revolución mexicana* (México: Colmex/UNAM, 1996), 22.

<sup>16</sup> Luz-Fernanda Azuela, *Tres sociedades científicas en el Porfiriato: las disciplinas, las instituciones y las relaciones entre la ciencia y el poder* (México: Sociedad Mexicana de Historia de la Ciencia y de la Tecnología, 1996), 77; Milada Bazant, *Historia de la educación durante el Porfiriato* (México: El Colegio de México, 1993), 15-40

At the turn of the century, institutions such as IMN and its laboratories contributed to the training of naturalists, physicians and pharmacists in different fields of experimental research. These new specialists were ready to participate in Díaz's scientific and academic projects. Pharmacists who were members of the Mexican Pharmaceutical Society since 1871 played an important role in the scientific and educational institutions of the Porfiriato, and were in a better position to negotiate their own agenda compared to previous decades.<sup>17</sup> Some members, such as José Donaciano Morales, Victor Lucio and Andrés Almaraz, were part of a group known as 'the scientists.' A small cluster of wealthy individuals who were part of the national oligarchy, and held senior positions within the government.

Lucio, Morales and Almaraz enjoyed the favor of President Díaz, as also had their parents before them. They remained within his social circle and mingled with the wealthy in salons and the various social events. In this way, they expanded their circles of communication, and obtained benefits for their personal projects on chemistry—which was a fashionable branch of science at that time. However, the numerous occupations these individuals had throughout their lifetime—sometimes simultaneously—is an indicator of the incipient status of the professionalization of chemistry in Mexico. Only a small number of individuals had the sufficient qualifications to work in the few positions that were slowly being offered. This accumulation of employments in different institutions also points to the high mobility of these professors, who were propelled by their prestige, and the fact they belonged to social circles which enjoyed the favor of the authorities.

Their pupils inherited these privileges, and held key positions in the most important academic and research institutions. Among them were the young pharmacists Adolfo P. Castañares, Ricardo Caturegli and Roberto Medellín. These three men eventually became university professors and directors of the School of Chemical Sciences and Pharmacy founded in 1919. Despite their fundamental contributions to the professionalization of chemistry, they are virtually unknown in the present time. This is why it is essential to reconstruct the main features of their network, relationships and interactions, as well as the places and institutions where chemical knowledge circulated, and the mechanisms by which these scientists gained prestige and visibility with the authorities and society at that time.

### **The circulation of a chemical network: the Mexican Chemical Society of 1910**

In the nineteenth century, Mexico City was a flourishing center for chemistry education. Departments and laboratories were set up at the National School of Medicine, National School of Agriculture, National Preparatory School, and Military College, among others. Professors were mostly pharmacists, which is not surprising given that teaching and research in chemistry was mainly performed by pharmacists in the late nineteenth and early twentieth century. These professors consolidated a scientific network throughout academic institutions such as the abovementioned ones, professional associations such as the Mexican

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<sup>17</sup> See Liliana Schifter, Francisco J. Puerto, & Patricia Aceves, "Las farmacopeas de México y Estados Unidos," *Anales de la Real Academia Nacional de Farmacia* 75, no. 4 (2009): 923–46.

Pharmaceutical Society, and research institutes and chemical laboratories, most of which were linked to health services.

The increasing specialization of pharmacists in various fields of chemistry led to the creation of the Mexican Chemical Society in 1910. The aim of MCS was "to cultivate the studies of chemical science in Mexico and to build relationships with all similar societies in the world."<sup>18</sup> On 3 March 1910, a nationwide newspaper, *El Tiempo*, reported that several chemistry professors had founded a Mexican chemical society. Some of the most distinguished members were Ricardo Caturegli, Luis Manuel Sánchez, Guillermo López, Alfredo Pablot, Manuel Urbina, Francisco Lisci, Mariano Lozano and Castro and Hanz Hitti.

It is important to note that the emergence of chemical societies in Europe clearly preceded MCS. For example, the Chemical Society (England) was founded in 1841, the Société Chimique de Paris (France) in 1855, and the Deutsche Chemische Gesellschaft (Germany) in 1866.<sup>19</sup> It should also be noted that from a historiographical perspective, chemistry has been classified as a European science for two main reasons: Europe was the main stage for its scientific and industrial development, and the academic curricular model consolidated in European schools and universities was emulated in the rest of the world. These two issues led to the establishment of national chemical societies, which main objectives were publishing journals, organizing meetings to unify scientific criteria, disseminating the latest advances in chemistry, and promoting connections between members and with other societies abroad.<sup>20</sup>

The main requirement for membership in European chemical societies was to have a degree in chemistry or to be a chemistry student; in most cases, pharmacists were excluded. In Europe, at this time, there was an absolute professional demarcation between pharmacy and chemistry, and each field had its own associations and interests. In the case of the chemical societies, the members' profile depended on the branches of the chemical industry in which they worked (chemical products, mining, fertilizers, soaps and candles, edible oils, ignition products, etc.). There were numerous representatives of the academic milieu from all levels; also civil servants and small business entrepreneurs were present, although in lesser degree.

In 1910, the year when MCS was founded it had less than 20 members. Its English counterpart had 3,073 members (43% with a university degree) and the Society of Chemical Industry, also established in England, had 4,299.<sup>21</sup> These figures evidence major differences in membership and organization between these English societies and the Mexicanone.

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<sup>18</sup> "Sociedad Química Mexicana," *El Tiempo*, 3 March 1910, 32. The same announcement was published in *Gaceta de Guadalajara*, 3 May 1910.

<sup>19</sup> Aaron J. Ihde, *The Development of Modern Chemistry* (New York: Harper and Row, 1964), 274-5.

<sup>20</sup> Ulrike Fell, & Alan Rocke, "France: The Chemical Society of France in Its Formative Years, 1857-1914: Disciplinary Identity and the Struggle for Unity," in *Creating Networks in Chemistry: The Founding and Early History of Chemical Societies in Europe*, eds. Anita K. Nilesen, & Sona Strbanova (London: RSC Publishing, 2008), 91-160.

<sup>21</sup> Robin Mackie, "Great Britain: Chemical Societies and the Demarcation of the British Chemical Community, 1870-1914," in *Creating Networks in Chemistry: The Founding and Early History of Chemical Societies in Europe*, eds. Anita K. Nielsen, & Sona Strbanova (London: RSC Publishing, 2008), 140-61.

Records of the activities of MCS are scarce, and only report its involvement in a series of lectures.<sup>22</sup> This lack of news seems to indicate that the society disappeared shortly after its foundation. However, valuable information on some of its members was located in newspapers, as well as in the institutional records of the organizations in which these scientists worked.<sup>23</sup>

It is important to remember that in 1910 there were no professional studies on chemistry in Mexico; the first school was established in 1916. One could argue, then, that these scientists were self-appointed 'chemists;' most held pharmacy degrees delivered by the National School of Medicine. However, it cannot be denied they were identified as chemists by the national authorities and society in general. Their extensive participation and experience in all chemical matters in various areas and institutions were most likely the cause for this public impression.

### Pharmacists and chemistry at the National School of Medicine

Pharmaceutical practice at the end of the eighteenth century in Mexico was not part of the curriculum of any school, and instruction was provided by physicians. It was not until 1833 that the pharmacist profession was created at the National School of Medicine. Then the long process of transformation from pharmacists to pharmaceutical chemists began.<sup>24</sup> This identity conversion developed as a strategy to achieve scientific legitimacy, and to be included within the emerging professional fields, which would eventually occur in the early decades of the twentieth century.<sup>25</sup> In 1839, pharmacists organized around the Academy of Pharmacy, and subsequently the Mexican Pharmaceutical Society (MPS) in 1871, to improve the conditions of their field. At that time, they were considered second-rate professionals, and had virtually no protection against competing pharmacies ran by charlatans and drug dispensers without formal education. These issues and others were discussed in the pages of *La Farmacia*, a journal published by MPS, "devoted to the circulation of scientific knowledge in the field and to uphold the rights of pharmacy professors."<sup>26</sup>

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<sup>22</sup> Adolfo P. Castañares, "Evolución de la química en México durante el primer siglo de nuestra independencia," in *Concurso científico y artístico del centenario*, ed. Academia de Jurisprudencia y Legislación (México: Viuda de F. Díaz de León, 1911), 80-90.

<sup>23</sup> Schifter & Aceves, "Farmacéuticos y la química," 80.

<sup>24</sup> See Patricia Aceves, *Química, botánica y farmacia en la Nueva España a finales del siglo XVIII* (México: UAM-Xochimilco, 1993), 30-45; Patricia Aceves, "Échanges scientifiques: controverses autour de la nomenclature chimique moderne dans la Vice-Royauté de la Nouvelle Espagne," in *Lavoisier in European Context: Negotiating a New Language for Chemistry*, eds. Bernadette Bensaude-Vincent, & Ferdinande Abbri (Canton: Watson Publishing International, 1995), 193-206.

<sup>25</sup> Martínez, Aceves & Morales-Cosme, 270; Bernadette Bensaude-Vincent, & Isabelle Stengers, *Histoire de la chimie* (Paris: La Découverte, 1993), 9-12.

<sup>26</sup> *La Farmacia* was a monthly publication and had nationwide circulation. From 1871 to 1907 and from 1917 to 1940, this journal was the voice of the Mexican Pharmaceutical Society both in Mexico and abroad, it was also an effective instrument to extend the communication within the network and promote scientific exchanges among the Mexican pharmaceutical community. Liliana Schifter, "Las

In Europe, along the nineteenth century, technological advances in chemistry enabled the production of synthetic drugs and the study of products isolated from different natural sources, thus facilitating the advancement of experimental pharmacology and new fields of industrial research and development.<sup>27</sup> These events, however, did not reflect on the education of Mexican pharmacists. Different from the situation in Europe, chemistry as a discipline was in an incipient stage. Events on the other side of the Atlantic did not translate into significant advances in the organization of academic studies or their professionalization. Chemistry remained restricted to a few courses for medicine and pharmacy students.<sup>28</sup>

From 1833 to 1867, the pharmacy program at the National School of Medicine in Mexico City included a single two-year course: Theoretical and Practical Pharmacy. Students further had to spend two additional years as apprentices in a pharmacy before taking an exam to obtain their degree.<sup>29</sup> In 1867, the curriculum content improved, with the establishment of three annual courses: Theoretical and Practical Pharmacy, Natural History of Simple Drugs, and Chemical Analysis. These three courses, which were also part of the medical curriculum, considered different features of chemistry, including the identification, properties, analysis, and obtainment of pharmaceutical dosage forms, and determination of the therapeutic uses of natural and synthetic products.

The course on Chemical Analysis was extended to two annual courses in 1893. This is an indication of the structural progress of chemistry as a discipline within the pharmacy program. The faculty believed that new opportunities for students in chemistry-related work following graduation was available. However, in the late nineteenth century, the incipient state of the national chemical industry did not provide sustained demand for the occupational role of chemists. In contrast, as noted earlier, the presence of a strong and diverse chemical industry in Europe gave rise to the professionalization of chemistry.

### **The arrival of chemistry in middle and high school classrooms**

In nineteenth-century Europe, the introduction of science in middle and high schools was the most important factor for the popularization of science. This phenomenon also included chemistry, which was a fashionable and favorite area of study at that time due to the growing success of its industrial and useful qualities. As a result, it became an integral part of the public culture in industrialized countries. Chemistry instruction in higher learning institutions and universities, as well as the appearance of textbooks and scientific associations,

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Farmacopeas Mexicanas en la construcción de la identidad nacional," *Revista Mexicana de Ciencias Farmacéuticas* 45, no.2 (2014): 43-54, on p. 50.

<sup>27</sup> Stichweh, "Differentiation of scientific disciplines: Causes and consequences," 3.

<sup>28</sup>The first medicinal chemistry course was taught at the National School of Medicine in 1845, as a part of the preparatory studies for medical students. The appointed teacher was the physician and pharmacist Leopoldo Río de la Loza. See Carlos Viesca, & Maria Blanca Ramos, "Leopoldo Río de la Loza y la química médica," in *Leopoldo Río de la Loza y su tiempo*, ed. Patricia Aceves (México: UAM, 2011), 237-56.

<sup>29</sup> Martínez, Aceves & Morales-Cosme, 280.

also contributed to the rise in its popularity, and created a connection between elementary, secondary and higher education.<sup>30</sup>

Several chemistry courses were introduced at the high school level in Mexico at the end of the nineteenth century, e.g., the Escuela Nacional Preparatoria–ENP (National Preparatory School), Military College and School of Arts and Crafts for Men, among others. In these institutions classes were theoretical and practical, and included general concepts of chemistry for a young audience. To facilitate learning, teachers typically wrote small manuals or textbooks.<sup>31</sup>

### *Chemistry at the Escuela Nacional Preparatoria, 1867*

ENP was created in 1867 and was located in San Ildefonso.<sup>32</sup> The General Chemistry course was unique in that it replaced all others in high schools and equivalent schools as mandatory prerequisite for students considering careers in medicine, pharmacy, agriculture, engineering, architecture, veterinary medicine and metallurgy. The chemistry classes were taught during the fourth year of preparatory studies. Leopoldo Río de la Loza was appointed the course professor in 1868.<sup>33</sup>

Río de la Loza was replaced years later by Andrés Almaraz, a prominent pharmacist and professor, who also taught at other institutions and held different political, public and private positions along his life. He was associate professor of Chemical Analysis at the National School of Medicine (1887) where he taught both physicians and pharmacists. He was also Chief Pharmacist of the Armed Forces, and the founder of the Medicinal Chemistry course at the Military College.<sup>34</sup> Hundreds of young students attended his courses during the

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<sup>30</sup> Simon, 54-60.

<sup>31</sup> Some examples are *Introducción al estudio de la química* by Leopoldo Río de la Loza, and *Historia natural de las drogas* by Juan Manuel Noriega, as well as and the manuals produced by Andrés Almaraz, José Donaciano Morales and Roberto Medellín.

<sup>32</sup> See Clementina Díaz-de Ovando, *La Escuela Nacional Preparatoria: los afanes y los días, 1867-1910* (México: Instituto de Investigaciones Estéticas, UNAM, 1972), 34-60.

<sup>33</sup> Leopoldo Río de la Loza was born on 15 November 1807 in Mexico City. He attended the School of Surgery, and also enrolled in the botany course taught by Vicente Cervantes at Palacio Nacional, where he studied the works of Linné and Lavoisier. After obtaining a surgeon degree, he studied medicine and pharmacy. In time he was appointed Inspector of Botany, Medicine and Industrial Establishments, and became Secretary of the Superior Health Council. He taught chemistry at many institutions of different academic levels such as the National School of Medicine, National Preparatory School and National School of Agriculture, among others. He founded and presided the Academy of Pharmacy (1839) and the Mexican Pharmaceutical Society (1871) which published six editions of the Mexican Pharmacopoeia (1846-1925). Río de la Loza was also the author of the first textbook on chemistry written by a Mexican, and the founder of the first factory of acids in Mexico, among many other distinctions and merits. This man was a consummate patriot, a dedicated professor, and a brilliant scientist and businessman. He died on 2 May 1876. See Guadalupe Urban, *La obra científica del Dr. Leopoldo Río de la Loza* (México: UAM-X/IPN/CNQFB, 2000).

<sup>34</sup> Personal file of Professor Andrés Almaraz, n.d, Archivo General de Personal, Universidad Nacional Autónoma de México, Mexico City, Mexico (hereafter cited as AGPUNAM).

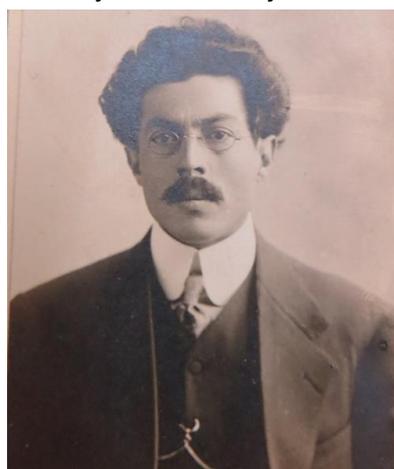
years he taught at these major institutions. One of these students was Adolfo P. Castañares (Fig. 1) who unquestionably occupies a special place in the modern history of chemistry in Mexico.

**Figure 1.** Professor Adolfo P. Castañares ca. 1917

Little is presently known about Castañares' life and work, and further research on this matter is pending.<sup>35</sup> He joined ENP staff in 1899, before finishing his pharmaceutical studies. He was appointed laboratory assistant at the Department of Chemistry, where he was later promoted to Chief Laboratory Chemist. In 1904, the Ministry of Justice and Public Instruction granted him a leave and a stipend of 400 francs per month to pursue further learning of chemistry in Berlin.<sup>36</sup>



In January 1908, Castañares took his professional exam at the Chemistry Institute of the Royal University of Berlin, and formally received his doctorate in chemistry. Upon his return to Mexico, he resumed his former position at ENP, and eventually became the head of the chemistry department. At the time, he was also professor of General Chemistry at the Military College, following in the steps of his teacher, Andrés Almaraz.



**Figure 2.** Professor Roberto Medellín ca. 1915

Another prominent student of Almaraz's was Roberto Medellín (Fig. 2). He was also a pharmacist, and later a faculty member at ENP, where he taught Botany and Natural Sciences.<sup>37</sup> In 1916, he was appointed professor of General

<sup>35</sup> Castañares was born on 22 January 1880 in Villahermosa, Tabasco, and died on 15 August 1919 in Mexico City. As an adolescent, he interrupted his studies at ENP to enroll at the Military College. However, he eventually abandoned the idea of a career in the armed forces, and returned to ENP in 1898. The following year he entered the pharmacy course, and graduated with honors in 1902. In 1910 he presided the first Mexican Chemical Society, and in 1918 he became the first pharmacist to be appointed Director of the School of Chemical Sciences. He died prematurely in 1919 at the age of 41. Personal file of Professor Adolfo P. Castañares, n.d., AGPUNAM.

<sup>36</sup> In 1906, while he was studying in Europe with government grant, Castañares was appointed Delegate of the Mexican Government to the 6th International Congress of Chemistry held in Rome, where he presented a paper entitled "Quantitative Separation of Mercury and Bismuth." He was also commissioned to purchase equipment and instruments for ENP before returning to Mexico.

<sup>37</sup> Roberto Medellín Ostos was born on 29 April 1881 in Tantoyuca, Veracruz. His parents were Jesús María Medellín and Leonila Ostos. He studied at ENP and the National School of Medicine, where he graduated as pharmacist with excellent grades in 1908. He worked as laboratory assistant to the Pharmacy and History of Drugs course at the National School of Medicine while he was still a student. In 1912, he was appointed Director of the School of Chemical Sciences. Personal file of Professor Roberto Medellin Ostos, n.d., AGPUNAM.

Chemistry, but he resigned shortly after to join other higher learning institutions, where he became a key player in the advancement of chemistry and science in general in Mexico.

It is important to discuss the relationship between the professors at ENP and the Mexican Chemical Society. In 1910, the year when MCS was founded, the Chemistry Department at ENP included Adolfo P. Castañares and Julián Sierra as professors, Ricardo Caturegli and Roberto Medellín as laboratory technicians, Emilio Castañares and Joaquín Peralta as assistants, and Guillermo López as laboratory cabinet manager. At the same time, Castañares was the President of the Board of Directors of MCS, while Lopez and Caturegli were Secretary and First Delegate respectively. It is also necessary to emphasize that the same pharmacists who were high school or technical school chemistry teachers also taught at higher education institutions. This reflects the existing interconnection between these two levels, and the notable mobility of students, as then they became teachers at different academic levels. There were no full-time professorships (or research positions) at any level, and one and the same person could have different jobs in different institutions simultaneously. Possibly only very few were qualified to fill these positions, or the institutions did not consider full-time professorships an important component of their programs. This situation did not change until the 1930s.

#### **Chemical research at the Instituto Médico Nacional (IMN), 1888-1915**

Knowledge and scientific practice are not exclusively shaped according to regional and national factors, but they contribute to the construction of regional and national identities. Activities such as collecting plants, drawing maps and conducting censuses enable people to build a national identity based on the discovery of their national space and its features. Becoming acquainted with this collective space and adapt it to the needs of the state involves the recognition of its national and regional wealth. Scientific research is a patriotic endeavor, because it contributes to the construction of the nation and of a national identity.<sup>38</sup>

These considerations apply to IMN, created in 1888, during the government of Porfirio Díaz. Over a short period time, it became a key institution for the development of pharmacology and analytical chemistry at the end of the nineteenth and beginning of the twentieth century. The main objective of the institution was to investigate national medicinal plants, as well as their possible application and marketing. Another important aim of the institute was to contribute to the development of a national therapeutic system based on Mexican medicinal plants. In addition, IMN was commissioned by the government to analyze the quality and composition of soil and water samples from lakes, wells and rivers, among

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<sup>38</sup> Livingstone, 18.

others.<sup>39</sup> Chemical analyses were usually performed by the Department of Analytical Chemistry staff, who frequently also had jobs at the Superior Health Council.<sup>40</sup>

In 1901, research on plants with industrial uses (fibers, wood, rubber, wax) as well as other studies related to the production of medicines and the professionalization of the agents involved in the collection, processing and circulation of drugs with region-specific components also became part of the Institute agenda.<sup>41</sup> To support these emerging studies, the director of the institution, Fernando Altamirano, presented to the Secretary of Development a proposal to create a department of Industrial Pharmaceutical Chemistry at IMN.<sup>42</sup> His efforts resulted in the establishment of the Department of Industrial Chemistry in 1903.<sup>43</sup> The English chemist James McConnell Sanders was appointed manager.<sup>44</sup>

IMN staff had freedom to choose what they wanted to investigate. They developed appropriate methods to solve scientific issues, as well as codes to interpret them. Shortly, they absorbed the values, beliefs and conventions associated with the research necessary for the specialization of analytical chemistry in Mexico. IMN was a fundamental institution in this process.

Therefore, it is not by coincidence that Morales, Lozano y Castro, del Raso, Caturegli, Castañares and Medellín were members of IMN staff. As mentioned, the mobility of these pharmacists devoted to chemistry, and their movement across different sites related to this discipline were constant along this period.

By the time IMN closed in 1915, the attempts to industrialize natural resources available in the country had not been successful, because the institution lacked national partners from the industrial and commercial sectors.<sup>45</sup> However, the results of the research conducted at IMN were published in several books, such as *Farmacología Nacional* (National

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<sup>39</sup> Liliana Schifter, & Patricia Aceves, "The Development of Industrial Chemistry at the National Medical Institute (1904-1915): The Study of Mexican Medicinal Plants," in *Crossing Oceans: Exchange of Products, Instruments and Procedures in the History of Chemistry and Related Sciences*, eds. Ana M. Alfonso-Goldfarb et al (Campinas: CLE, 2016), 285-98.

<sup>40</sup> In the late nineteenth century, the pharmacists José Donaciano Morales, Francisco Río de la Loza, Mariano Lozano y Castro and Federico Villaseñor were members of IMN Department of Analytical Chemistry staff and worked simultaneously at the Superior Health Council as analytical chemists. In the early twentieth century, also Ricardo Caturegli, Roberto Medellín, Emilio del Raso and James Mc Connell Sanders also simultaneously worked at both institutions.

<sup>41</sup> See Angélica Morales-Sarabia, & Patricia Aceves, "Datos para la Materia Médica Mexicana (1894-1908): plantas medicinales, terapéutica y nacionalismo," *Circumscribere* 9 (2010):11-28.

<sup>42</sup> Fernando Altamirano, "Apuntes para la historia del IMN," *Anales del Instituto Médico Nacional* 5 (1902): 282-9.

<sup>43</sup> "Iniciativa presentada al señor Secretario de Fomento por el Director del Instituto Médico Nacional para establecer en dicho Instituto una sección más de trabajos científicos que se denominará de Química Industrial Farmacéutica," 9 May 1903, v. 53, exp. 7, fs. 5-11, Industrias nuevas, Fomento, Archivo General de la Nación, Mexico City, Mexico.

<sup>44</sup> "Informe mensual de las actividades realizadas en el instituto durante el mes de julio de 1904," *Anales del Instituto Médico Nacional* 6, (1904): 213-4.

<sup>45</sup> See Paul Hersch, "La industrialización químico-farmacéutica mexicana y la flora: el caso de los Laboratorios Garcol," *Boletín de la Sociedad Química de México* 5, no. 2 (2007): 5-12.

Pharmacology) (1913),<sup>46</sup> *Datos para la materia médica Mexicana* (Notes on the Mexican materia medica) (1894-1907)<sup>47</sup> and various editions of *Farmacopea Mexicana* (Mexican Pharmacopoeia) published by the Mexican Pharmaceutical Society between 1896 and 1904.<sup>48</sup>

### Pharmacists and chemistry in university spaces

In Europe, the introduction of chemistry in higher education curricula was the cornerstone of the process of the professionalization of chemistry in the nineteenth century. University professors were required to perform scientific research in addition to teaching. The pairing of these two activities was a key element of the process, and resulted in the creation of full-time university professorships.<sup>49</sup> Chemistry came to be considered an independent and autonomous system within the university culture.<sup>50</sup> In time, chemistry curricula became disciplinary, specific and numerous courses were established in schools, colleges and universities devoted to the various fields in which a professional chemist could now act.

At this time, professors in Mexico taught simultaneously at various institutions (schools, colleges and military academies) and were not exclusively affiliated with universities. A process similar to the European one did not occur until the 1930s.

The fact that the chemical industry in the United States and Europe was profoundly transformed between 1875 and 1925 is also relevant. Small factories, chemical and pharmaceutical laboratories disappeared, while multinational corporations and the major companies we know today became consolidated. The situation in Mexico was much different. The period of the Porfiriato was characterized by growing industrialization confined mainly to petroleum and mining. The industrialization of chemistry did not start until the mid-1930s. In turn, productive sectors such as the sugar, yarn and fabric industries developed partially at that time. However, there were not local specialists or technicians to work in these fields, for which reason chemists were often hired abroad—i.e., an expensive solution.<sup>51</sup> Mexican specialists were urgently needed.

This is the context within which Escuela Nacional de Altos Estudios–ENAE) (National School of Superior Studies) was created in 1910. A few years later, in 1916, Escuela Nacional de Industrias Químicas–ENIQ) (National School of Chemical Industries) was founded. In

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<sup>46</sup> *Farmacología Nacional* (1913) reunites almost 15 years of research conducted at IMN to establish a national therapeutic system based on Mexican medicinal plants. See Patricia Aceves, Liliana Schifter, & Angélica Morales-Sarabia, “La farmacología nacional y la farmacopea mexicana,” *Revista Estudios do Século XX* 12 (2012): 199–216.

<sup>47</sup> *Datos para la materia médica mexicana* is a collective work published in five volumes between 1894 and 1907. It is divided in articles, which include numerous descriptions of native medicinal plants and their therapeutic applications. Aceves, Schifter & Morales-Sarabia, 207.

<sup>48</sup> See Liliana Schifter, *Espíritu e identidad farmacéuticos: la construcción de la Farmacopea Mexicana (1846-2011)* (México: UAM-X, 2014).

<sup>49</sup> Bensaude-Vincent, 196–220.

<sup>50</sup> Stichweh, “Structuration des disciplines,” 60.

<sup>51</sup> Godínez & Aceves, 45.

1917, ENIQ became part of the National University as the new Facultad de Ciencias Químicas (School of Chemical Sciences) which became Facultad de Ciencias Químicas y Farmacia (School of Chemical Sciences and Pharmacy) in 1919.

### *Escuela Nacional de Altos Estudios (ENEA)*

The inauguration of the ENAE in 1910 contributed to the specialization of chemistry and fields of science and the humanities. This institution was designed to fulfill two main objectives: training of specialized professors in scientific areas for different levels of education, and provision of technical skills for these professors to conduct physical-chemical and industrial projects.<sup>52</sup> The courses mainly targeted graduate students. ENAE was divided into three sections: Humanities, Exact Sciences, and Social, Political and Legal Sciences.<sup>53</sup>

The beginnings of the institution were uncertain due to shortage of human and material resources. For this reason, the second section was not established until 1913. Once this section became active, two courses in chemistry were created: Theoretical and Experimental Inorganic Chemistry and Practical Inorganic Chemistry, under the direction of Professors Adolfo P. Castañares and Ricardo Caturegli, respectively. The two subjects were taught at the National School of Medicine, where both professors also taught other courses.<sup>54</sup>



In the 1914-1915 schoolyear, Juan Salvador Agraz joined the staff. Born in Jalisco, Agraz had just returned from a long season in Europe after earning a bachelor's degree in France and a doctorate in chemistry from University of Berlin.<sup>55</sup> Upon returning to Mexico, Agraz was keenly intent in creating a School of Chemistry and Chemical Sciences. ENAE seemed to be a good place where to start, however, this soon proved not to be the case, as chemistry was only one among various disciplines allocated to the Exact Sciences section. Therefore, Agraz chose to diversify his efforts upon the completion of his task, and left the school shortly after his arrival.

**Figure 3.** Professor Juan Salvador Agraz ca. 1916

<sup>52</sup> Maria de la Paz Ramos, "La química en los inicios de la Escuela Nacional de Altos Estudios," in *Aportes recientes a la historia de la química en México*, eds. Maria de la Paz Ramos, & Felipe León (México: UNAM, 2014), 173-86, on 176.

<sup>53</sup> "Universidad Nacional de México: Escuela de Altos Estudios," *Periódico Oficial del Estado de Tamaulipas*, 1 August 1913, 9.

<sup>54</sup> On 28 May 1914, Castañares was appointed Industrial Technical Inspector of the Artillery Department, Commissioner of the National Gun Foundry and Commissioner of the National Gunpowder Factory by direct presidential decree. He was granted a temporal leave from his academic activities to fulfill his new duties. Personal file of Professor Adolfo P. Castañares, n.d., AGPUNAM.

<sup>55</sup> Ramos, 176.

### *On the way to the School of Chemical Sciences and Pharmacy (1919)*

The first revolutionary governments inherited a manufacturing **inf**rastructure that had been in place since 1890, and was concentrated on a small number of industries which targeted a weakened domestic market: railways—which were ineffective due to their limited extension and distribution—and a few urban construction projects in a small number of cities. As a rule, the existing industrial sector was oriented to the production of consumer goods, and was located mainly in Veracruz, Puebla, Monterrey and Mexico City.<sup>56</sup> The country was still far from attaining the industrial development level reached by other countries. The government believed that professional education was the key to decrease this distance and boost economic and social progress. In their opinion, the university curricula were the main agents of change.

In contrast to their predecessors, who had seen the university as a future paradigm of academic and cultural excellence, the revolutionaries believed that professional studies should empathize with the social problems of the people, and focus on the economic progress of the country. Thus, utilitarian and industrial educational programs were promoted, such as accounting, economics and chemistry.<sup>57</sup>

This was the context within which Juan Salvador Agraz developed an initiative for the establishment of a National School of Chemical Industries. Simultaneously, a committee formed by members of the Mexican Pharmaceutical Society analyzed the feasibility of severing the pharmacy program from the National School of Medicine, where it had been located since 1833, and creating a separate school for chemistry and pharmacy. These two proposals were completely independent one from another.

By 1915, the relevance of creating a National School of Chemical Industries began to be seriously considered by the authorities. To this end, in September, Professor Juan León, General Director of Technical Education, appointed Roberto Medellín to plan the appropriate curriculum. Medellín, who was a member of the Mexican Pharmaceutical Society, collaborator at IMN and professor of Chemistry at ENP and the National School of Medicine, requested the participation of his colleagues, Ricardo Caturegli, Francisco Lisci, Julián Sierra and Adolfo P. Castañares, for the design of three professional profiles, to wit, the ones of industrial chemists, industrial experts and industrial practitioners. The central purpose of the school was to provide training for the promotion of industry through circulation of theoretical and practical knowledge of chemistry, aiming to capitalize on the natural resources of the country. Dr. Agraz drafted and submitted his own proposal around the same time.

Ultimately, Medellín's project was accepted, and he was appointed as school director in September 1915. However, two months later, for reasons which are not clear, he was

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<sup>56</sup> Luis Medina-Peña, *Hacia el nuevo Estado: México, 1920-1994* (México: Fondo de Cultura Económica, 1995), 113-5.

<sup>57</sup> Garciadiego, 317-8.

replaced by Juan Salvador Agraz, who immediately hired new staff and all but forsook Medellín's plans.<sup>58</sup>

The National School of Chemical Industries was inaugurated on 23 September 1916, having Agraz as director. Three degrees were offered: in industrial chemistry, industry expertise studies, and practical chemistry. As it was a technical school, students were not required to have completed the preparatory studies. Some of the industrial applications included fermentation, tanning, latex, resins, oils and perfumes, among others.<sup>59</sup> Almost immediately, Agraz began making arrangements for the school to be incorporated into the National University. This came to be on 5 February, under the name of School of Chemical Sciences. The degrees offered were on Chemical Engineering, Industrial Chemistry and a Chemistry doctorate.<sup>60</sup>

Despite its higher hierarchy as a university school, the working conditions did not improve as was expected. In 1918, most political sectors argued that basic and preparatory education had to be prioritized, while university instruction was secondary. As a result, the budget for infrastructure and laboratory materials was low.<sup>61</sup> In addition, student's complaints against the incompetence of some professors began to surface starting 1917.

Aware of the importance of the School, pharmacists deployed a strategy to obtain positions. They approached and convinced the Dean that the students could not develop the necessary skills for work as chemistry professionals mainly because they lacked proper practical instruction. On 8 May 1918 the Student Council requested the resignation of the Director, the Secretary and some faculty members who were considered unfit for their positions. The students argued that they were not developing the skills needed for their professional aspirations, and that some professors were inadequate. In turn, they requested the appointment of Professors Julián Sierra and Adolfo P. Castañares from ENP and the National School of Medicine to teach the courses on Metalloids and Organic Chemistry.

As a result, Agraz was replaced by Adolfo P. Castañares as School Director in December 1918. In January 1919, with the Dean Office's support, he submitted a plan to establish a degree in Pharmacy.<sup>62</sup> The proposal was accepted the following month. The pharmacists had not only succeeded in having one of them be appointed Director, but also

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<sup>58</sup> See Felipe León, "Génesis de la formación de químicos en México," in *Aportes recientes a la historia de la química en México*, eds. María de la Paz Ramos, & Felipe León (México: UNAM, 2014), 87-94.

<sup>59</sup> Horacio García, *Historia de una facultad: Química 1917-1983* (México: UNAM, 1985), 263-90; "Convocatoria para la inscripción a la Escuela Nacional de Industrias Químicas," 17 February 1917, box 264, folder 3, Escuela de Medicina y Alumnos, Archivo Histórico de la Facultad de Medicina, Universidad Nacional Autónoma de México, Mexico City, Mexico.

<sup>60</sup> Javier Padilla, "Génesis de una facultad," *Journal of the Mexican Chemical Society* 45, no. 3 (2001): 104-8, on 104.

<sup>61</sup> "Historia de la Facultad de Química y Farmacia y Escuela Práctica de Industrias Químicas, 1915-1917," May 1927, box 5, folder 78, Ciencias Químicas, Archivo Histórico, Universidad Nacional Autónoma de México, Mexico City, Mexico (hereafter cited as AHUNAM).

<sup>62</sup> "Informe de Adolfo P. Castañares a Juan N. Macías relativo a la fusión de la Carrera de Farmacia con la Facultad de Química," 24 January 1919, box 1, folder 3, Ciencias Químicas, AHUNAM.

combined Chemistry and Pharmacy into a new degree program: Pharmaceutical Chemistry.<sup>63</sup> In consequence, changes were introduced in the curricula, and the institution was renamed School of Chemical Sciences and Pharmacy. The arrival of pharmacists in the National University represented the end of a long struggle to attain professional status. Yet, along this process, they shifted their identity from pharmacists to pharmaceutical chemists.



**Figure 4.** Professor Ricardo Caturegli, ca. 1919.

Also many of the directors after Castañares were pharmacists, as e.g., Ricardo Caturegli (Fig. 4) and Roberto Medellín. As a result, close ties were kept with the Mexican Pharmaceutical Society.<sup>64</sup>

After the untimely death of Adolfo P. Castañares in 1919, the School direction was undertaken by Roberto Medellín, who taught Industrial Raw Materials. Shortly after, Medellín was appointed General Secretary of the University by the new Dean, José Vasconcelos.<sup>65</sup> Medellín's closeness to the circles of power proved to be helpful to the School, which did not only increase its budget and expanded its facilities, but also boosted the number of enrolled students.<sup>66</sup> In the following decades, under the administration of other devoted pharmacists and the first chemists, the School flourished to become one of the most prestigious institutions of its type in the Americas.

So far, we observed that the creation of the School of Chemical Sciences was fundamentally influenced by the pragmatism and nationalism of the revolutionary government.<sup>67</sup> It also became clear that the participation of pharmacists was crucial in the long journey of chemistry toward the university. Without detracting from Juan Salvador Agraz's work, it is clear that the establishment of this school, more than a foundational moment, was

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<sup>63</sup> Aceves, & Martínez, 120.

<sup>64</sup> Caturegli was professor at the **School** of Chemical Sciences for forty years, as well as its director three times (1924, 1931, 1944). In 1945 he was appointed to the University Government Board, a distinction reserved to the most prestigious representatives of the academic community. Personal file of Professor Ricardo Caturegli, n.d., AGPUNAM.

<sup>65</sup> In 1921, José Vasconcelos was appointed Director of the Ministry of Public Education created that same year by President Alvaro Obregón. Vasconcelos appointed Roberto Medellín Chief of Technical Schools, a position he occupied until 1925 when he was appointed Director of the Ministry of Health.

<sup>66</sup> Roberto Medellín was the Director of the School of Chemistry and Pharmacy from 1921 to 1925 while simultaneously fulfilling his duties at the Ministry of Public Education. To compensate for his absence during this period, Julián Sierra and Ricardo Caturegli were appointed interim directors. In the following years, Medellín was appointed School Director again, General Secretary of the National University, and finally its Dean in 1932. In 1939 he was appointed director of another fundamental institution, to wit, the National Polytechnic Institute. All in all, his contribution to the advancement of science and the consolidation of academic institutions of all levels in Mexico was remarkable. His support to fellow chemists and institutions was relentless and irreplaceable.

<sup>67</sup> Garcíadiego, 395.

the culmination of a process initiated many years earlier by the pharmaceutical community to ensure systematic organization to the academic and occupational roles of chemistry, and consequently its professionalization.<sup>68</sup> Different from the situation in Europe, this school did not come to exist to fulfill the requirements of an emerging chemical industry. Instead, the driving engine was a combination of governmental interests and the professional needs of a small group of scientists, mainly pharmacists.

### Conclusions

In the nineteenth century, Europe witnessed the specialization, popularization, professionalization and institutionalization of chemistry. Pharmacy and chemistry became two autonomous disciplines, and a strong and diversified chemical industry emerged. The requirements of the latter favored the creation of schools, colleges and degrees in chemistry, as well as the emergence of influential chemistry societies.

In Mexico, the lack of significant foundational moments and heroic characters in the development of chemistry in the first quarter of the twentieth century made this period pass almost unnoticed in the historiography of Mexican chemistry. However, attention to some individuals, mostly pharmacists, scarcely studied and considered secondary, allowed identifying and analyzing the spaces where chemistry was produced, taught, practiced and professionalized. Thus, the following conclusions are drawn:

The separation between pharmacy and chemistry did not occur in Mexico as in Europe. The pharmacists discussed in the present study shared a common background, since all of them had graduated at the National School of Medicine. In the late nineteenth and early twentieth century, they were identified as chemists due to their active roles in several fields which involved chemistry work, such as schools, research institutes and public and private laboratories, as well as in the configuration of scientific societies and academic institutions. This handful of pharmacists from different generations established extensive social networks and promoted the emerging specialties of chemistry. The closeness and solidarity between these individuals with colleagues, and the increase of their political power facilitated their appointment to distinct institutions, and allowed them achieve their goals despite being part of a professional group in crisis.

From the analysis of the processes of specialization of chemistry in Mexico prior to the creation of the National School of Chemical Industries, it becomes clear that middle and higher learning institutions such as ENP, the School of Arts and Crafts for Men, the National School of Medicine, the Military College and ENEA were fundamental. In these institutions pharmacists were in charge of practically all subjects and courses related to chemistry. The contact between teachers and students favored the consolidation of close ties between generations in the professional, academic and social dimensions.

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<sup>68</sup> Stichweh, "Differentiation of scientific disciplines," 4.

The closeness of these pharmacists to Diaz's regime ensured them relative freedom to promote their initiatives and create the new spaces required for the rising field of chemistry. When chemistry became an interest of the state, courses, jobs, laboratories, research institutes, middle-level and higher education schools were created. This was the case of the establishment of the laboratories at IMN Department of Analytical Chemistry, where pharmacists developed and published studies of much significance on the chemistry of natural products—which was one of the priorities in Porfirio Diaz's agenda. Another important moment was the creation of the Department of Industrial Chemistry, the first organization of its type specifically devoted to industrial pharmaceutical chemistry, where a generation of specialists came together and was widely recognized by their contemporaries.

This cluster of chemistry -related activities started with the creation of the first Mexican Chemical Society in 1910. In accordance to the political and economic transformations underwent by the country, pharmacists developed a project which brought their academic and professional interests into a plan of industrialization which was critical for the country's development. Thus they renegotiated their relationships with neighboring disciplines—chemistry and life sciences—and settled at the School of Chemical Sciences. In this process, they forged for themselves a new identity as chemists, in which pharmaceutical interests became secondary.