Introduction

In his novel *Cat's Cradle* (1963), American writer Kurt Vonnegut (1922–2007) drew inspiration from his own personal experience working at the public relations department of General Electric (GE). He noticed that many GE expert scientists often felt indifferent to the applications of their own discoveries.[1] Nobel Prize winner for chemistry, Irving Langmuir (1881–1957), who spent a good part of his career at GE, inspired the novel's main character, Dr Felix Hoenikker. In an interview in 1980, Vonnegut emphasised that 'Langmuir was absolutely indifferent to the uses that might be made of the truths he dug out the rock and handed out to whoever was around'.[2] Vonnegut's criticism was very much in tune with the Cold War context in which no moral values were attributed to 'pure' chemistry, and even its application to industry and war was often justified through the need for national economic prosperity and patriotism, particularly in totalitarian regimes.[3] Some years earlier, in 1958, the philosopher Hannah Arendt had published *The Human Condition*,[4] a book that continued her earlier intellectual struggle against the consequences of the totalitarianism of the Second World War. Arendt denounced the risks of holding back from civic responsibilities, leaving control of the public world to technocratic experts, and therefore promoted the need to preserve a 'civilized life' with a tangible expression of human freedom.[5]

Arendt's reflection on civic responsibility could even be extrapolated to any kind of political regime and extended half a century to the present. In fact, historians of science and science and technology studies (STS)

[1] I am indebted to Jaume Sastre for making me aware of this novel.
[2] Robert Musil, 'There Must Be More to Love than Death: A Conversation with Kurt Vonnegut', *The Nation*, 231(4) (1980), 128–32, p. 129. See also: Tom McCartan (ed.), *Kurt Vonnegut: The Last Interview and Other Conversations* (New York: Melville House, 2012).
[3] Robert Bud, 'Introduction', *Isis, Focus: Applied Science*, 103 (2012), 515–17.
[4] Hannah Arendt, *The Human Condition* (Chicago: University of Chicago Press, 1958).
[5] Dana R. Villa (ed.), *The Cambridge Companion to Hannah Arendt* (Cambridge: Cambridge University Press, 2000), p. 5.

scholars largely agree that the ways in which we know and represent the world (nature and society) are inseparable from the ways in which we choose to live.[6] So in our case, chemistry, just like any other human activity, must be deeply embedded in the social practices that shape its identity (being a chemist), norms (nomenclature, academic disciplines), conventions (research funds, grants), discourses (public addresses, publications), instruments (labs, experimental culture) and institutions (universities, research centres, academies). Therefore, 'doing' chemistry merges into 'doing' politics. Since chemists create a political context for their own practices, the chemical product becomes a political element in a specific context.[7] Similarly, factories, laboratories and other places of chemistry act as mediators between experts, political ideology and propaganda in a technology-based consumer society.[8]

This book analyses the ways in which, from the early years of the formation of a modern scientific community, twentieth-century Spanish chemists talked about the natural world – chemicals, reactions, industrial processes – and then immediately faced issues of authority, credibility and power in society.[9] It approaches the conflicting views about professional identity and also provides conflicting views of the political identity of Spain throughout the twentieth century: from the Bourbon Restoration, which provided low levels of liberal democracy, and Primo de Rivera's dictatorship (1923–30), to the liberal values of the Second Republic (1931–39), the Civil War (1936–39), the totalitarian scientific culture of Franco's dictatorship (1939–75) and the resistance to it.[10]

Beyond discussion about chemistry and chemists on one side and political regimes on the other, the book attempts to build up a narrative in which politicians and chemists, as historical actors, often merge into a single character, making both dimensions indistinguishable, in a crucible that fired the real power of chemistry.

[6] Sheila Jasanoff, *States of Knowledge. The Co-Production of Science and Social Order* (London: Routledge, 2004).
[7] Ibid., p. 29.
[8] Carsten Reinhardt, 'Sites of Chemistry in the Twentieth Century', *Ambix*, 62(2) (2015), 109–13. See also Carsten Reinhardt, Harm Schröter, 'Academia and Industry in Chemistry: The Impact of State Intervention and the Effects of Cultural Values', *Ambix*, 51(2) (2004), 99–106.
[9] Jasanoff, *States of Knowledge*, p. 29. In this discussion, Jasanoff draws inspiration from Simon Schaffer and Steven Shapin's *Leviathan and the Air Pump. Hobbes, Boyle, and the Experimental Life* (Princeton: Princeton University Press, 1985). The book has been re-edited with a new introduction by the authors (a paperback edition appeared in 2017).
[10] 'Historical work may gain profundity and relevance through more explicit attention to questions of power, culture and normativity'. Jasanoff, *States of Knowledge*, p. 5. See, in particular, chapter 2: 'Ordering Knowledge, Ordering Society'.

Biographies of Power

Why did Italian chemists such as Giovanni Battista Bonino (1899–1985) so enthusiastically embrace Mussolini's fascism? In the First World War, patriotic (nationalist) values placed chemistry and its uses in war and industry at the service of the nation, so many scientists had a prominent position in the *Consiglio Nazionale delle Ricerche* (CNR)[11] and comfortably supported Mussolini's regime when he came to power in the 1920s.

Some years ago, historian Mark Walker defined scientists working under Nazi Germany as 'fellow travellers' in the following terms:

> If we want to understand how National Socialism affected German science, we cannot restrict ourselves to the few scientists who enthusiastically embraced the Third Reich, and those even fewer scientists who actively and consistently resisted it. Instead we must also include those many scientists who neither resisted nor joined Hitler's movement, rather who *went along for the ride*.[12]

Walker added that 'Expert advice [. . .] can hardly be divorced from all civil responsibility'.[13] Similarly, as Robert Proctor has rightly pointed out for Nazi Germany, political initiatives arose very often from within the scientific community, so scientists (and chemists in our case) designed and enforced the regime. Thus, 'science is, among other things, a social activity and the politics of those who practice it is part of that science'.[14]

Ute Deichmann has presented a prosopographic approach to biologists during the Nazi era that, without going into intricate detail, allows her to provide a very useful picture of levels of collaboration with the regime, freedom of research and continuities and discontinuities in scientific practices.[15] Nazi Germany also provides similar big pictures for the case

[11] Andreas Karachalios, *I chimici di fronte al fascismo. Il caso di Giovanni Battista Bonino (1899–1985)* (Palermo: Istituto Gramsci Siciliano, 2001). Roberto Maiocchi's work on the role of chemistry during the Italian autarchy will be particularly valuable. Roberto Maiocchi, *Scienza e fascismo* (Rome: Carocci, 2004).

[12] Mark Walker, *Nazi Science. Myth, Truth and the German Atomic Bomb* (Cambridge, MA: Perseus, 1995), p. 4 (emphasis added).

[13] Marc Walker, *German National Socialism and the Quest for Nuclear Power* (Cambridge: Cambridge University Press, 1989), p. 5.

[14] Robert Proctor, *Racial Hygiene. Medicine under the Nazis* (Cambridge, MA: Harvard University Press, 1988), p. 9; Kristie Macrakis, *Surviving the Swastika. Scientific Research in Nazi Germany* (Oxford: Oxford University Press, 1993). Other studies, such as Jeffrey Allan Johnson's analysis of chemists in Imperial Germany, have reflected different 'adaptations' to specific political regimes. Jeffrey Allan Johnson, *The Kaiser's Chemists. Science and Modernization in Imperial Germany* (Chapel Hill: University of North Carolina Press, 1990). Johnson discusses the chemists' 'conservative modernization' in the early twentieth century and the continuity of many chemical practices pre- and post-First World War.

[15] Ute Deichmann, *Biologists under Hitler* (Cambridge, MA: Harvard University Press, 1996).

of physicists[16] and medical doctors,[17] but again chemists seem to be thin on the ground when looking for an overview of the behaviour of the chemical community under a particular political regime.

What was the impact of the expulsion of Jewish scientists? What sort of influence did National Socialist ideology and politics come to exert on scientific research in Germany? In what way did scientists during this time participate in the crimes of National Socialism? What impact did Nazi rule have on the development of science after 1945? Using Deichmann's framework, we could easily apply these questions to the community of chemists in Spain: what was the impact of the exiled chemists after the Civil War? What sort of role did dictatorial regimes (Primo de Rivera, Franco and also liberal periods) play in the scientific achievements of Spanish chemists? How responsible were Spanish chemists during Franco's repressive dictatorship after the Civil War?[18]

As this book will make clear, the political positions of many of our chemists had a lot to do with their biographical profiles,[19] family origins, religious backgrounds, social classes and ideologies, early training, the professional networks in which they were integrated in permanent tension between their individual aspirations and dreams and their final contributions to specific collective endeavours.[20] It is therefore perhaps not too late to refer once again to Steven Shapin and Arnold Thackray's seminal paper on the use of prosopography in the history of science, the spirit of which is very much present here when trying to describe the complex and as yet unknown landscape of twentieth-century Spanish chemistry.[21]

There has not been a great deal of research on the history of specific chemical communities and chemical societies in the twentieth century. Anita K. Nielsen and Sona Strabonova have recently analysed European chemical societies in terms of their chronology, membership figures, journals, financial support, professionalisation profiles, debates about

[16] Walker, Mark, *Nazi Science*; Phillip Ball, *Serving the Reich. The Struggle for the Soul of Physics under Hitler* (London: Vintage Books, 2013); John Cornwell, *Hitler's Scientists. Science, War, and the Devil's Pact* (London: Penguin Books, 2003).
[17] Proctor, *Racial Hygiene.* [18] Deichmann, *Biologists under Hitler*, pp. 319–20.
[19] On the historiography of scientific biographies, see: Michael Shortland, Richard Yeo, *Telling Lives in Science: Essays on Scientific Biography* (Cambridge: Cambridge University Press, 1996); Theodore Porter, 'Is the Life of the Scientist a Scientific Unit?', *Isis*, 97(2) (2006), 314–21; Mary Jo Nye, 'Scientific Biography: History of Science by Another Means', *Isis*, 97(2) (2006), 322–9; Mott Green, 'Writing Scientific Biography', *Journal of the History of Biology*, 40(4) (2007), 727–59.
[20] Steven Shapin, *The Scientific Life: A Moral History of a Late Modern Vocation* (Chicago: University of Chicago Press, 2008), p. xvii
[21] Steven Shapin, Arnold Thackray, 'Prosopography as a Research Tool in History of Science: The British Scientific Community, 1700–1900', *History of Science*, 12 (1974), 1–28.

'pure' and 'applied' chemistry, discipline-making and foreign relations. Their coverage extends to 14 European countries, from the Big Three (France, Germany and the United Kingdom) to Austria, Belgium, Denmark, Hungary, the Netherlands, Norway, Poland, Portugal, Russia, Sweden and the Czech Republic, but the case of Spain (together with Italy) is regrettably absent.[22] In the 1990s, in a collective volume devoted to the professionalisation of chemistry in the nineteenth century,[23] historian Helge Kragh highlighted a series of issues to be taken into account when approaching the history of a European chemical community in the twentieth century: the growing influence of the United States from the 1920s onwards, and even more evident after 1945; and the progressive emancipation of chemistry from pharmacy, medicine and industry, but at the same time its continuous changing status and boundaries with physics, the life sciences, the new petrochemical industry and many other intersections occurring in the last decades of the century, which are beyond the scope of this volume. To that complex picture, Kragh added the never-ending tension between the science faculties and engineering and polytechnic schools, which, in a way, reflected the interests of different groups regarding their professional hegemony with specific academic or industrial interests.[24]

In fact, professionalisation is a dynamic process in which concepts such as education, organisation, status, autonomy, power and influence have to be taken into account in different historical contexts.[25] In the early 1990s, Mary Jo Nye used several parameters to analyse the *identity* construction of a chemical community: (1) the genealogy of the group, and

[22] Anita K. Nielsen, Sona Strabonova (eds.), *Creating Networks in Chemistry. The Founding and Early History of Chemical Societies in Europe* (Cambridge: RSC Publishing, 2008).

[23] David Knight, Helge Kragh (eds.), *The Making of the Chemist* (Cambridge: Cambridge University Press, 1998). In the 1970s, a pioneering study on the history of the Royal College of Chemistry in Britain perceived professional chemists as fulfilling certain requirements, such as acquiring academic qualifications, social responsibility, stable remuneration, corporate identity and scientific authority in society. Colin A. Russell, Noel G. Coley, Gerrylynn K. Roberts, *Chemists by Profession. The Origins and Rise of the Royal Institute of Chemistry* (Milton Keynes: Oxford University Press and the Royal Institute of Chemistry, 1977), p. 3. For a more recent approach to the British community of chemists, see: Gerrylynn K. Roberts, Anna E. Simmons, 'British Chemists Abroad 1887–1971: The Dynamics of Chemists' Careers', *Ambix*, 60(1) (2009), 103–28.

[24] Helge Kragh, 'Afterword: The European Commonwealth of Chemistry', in Knight, Kragh (eds.), *The Making of the Chemist*, pp. 329–341, 329.

[25] In the 1990s, Jack Morrell defined science professionalisation according to the following elements: (1) full-time positions linked to particular knowledge; (2) specialist qualifications and examinations; (3) standard training procedures; (4) boundaries and specialisation; (5) solidarity and self-awareness; and (6) reward systems for best practices. Jack Morrell, 'Professionalization', in Robert Olby et al. (eds.), *Companion to the History of Modern Science* (London: Routledge, 1990), pp. 980–9.

therefore its own history – and the way in which the members of the community themselves perceived it; (2) a core literature of publications – academic papers, textbooks, popular articles and all sorts of publishing strategies; (3) specific rituals of commemoration, anniversaries, obituaries, festivals, public lectures and exhibitions that provide excellent data for the understanding of a particular worldview of a group and of some of its most significant members; (4) a home base of teaching and research institutions (laboratories and lecture halls, but also industrial plants); (5) external recognition by members of other competing scientific communities at home and abroad; and (6) shared values in terms of the genuine scientific culture of the group, but also in terms of political ideology and research priorities.[26]

Therefore, it is within this framework that this book approaches the professional identity of Spanish chemists in the twentieth century. They became active, constant creators of historical accounts of their own professional status under different political regimes and audiences – from the chemistry 'heroes' of the Latin American colonial period to the supposedly glorious experiments on the composition of atmospheric air during the Enlightenment.[27] Inaugural lectures for new academic years, commemorative practices, autobiographies, public addresses, popular lectures, textbooks and popular articles were extensively used to discuss the core identity of their profession.[28] Many of our Spanish chemists behaved as nineteenth-century 'chemist–historians', as Colin A. Russell depicted them some decades ago,[29] often for the legitimation of their discipline and its professional boundaries in order to please or even to endorse ideological guidelines of contemporary politics, or in other cases even as a way to justify their research lines and scientific production. As discussed some years ago by Pnina G. Abir-Am, commemorative practices in science – in chemistry, in our case – often use 'the past in the service of political agendas of the present while appealing to a captive audience: academic and administrative, officers, alumni, students, and

[26] Mary Jo Nye, *From Chemical Philosophy to Theoretical Chemistry: Dynamics of Matter and Dynamics of Disciplines, 1800–1950* (Berkeley: University of California Press, 1993). For a study into the identity of a chemistry discipline, see the case of polymer science. Yasu Furukawa, *Inventing Polymer Science. Staudinger, Carothers and the Emergence of Macromolecular Chemistry* (Philadelphia: University of Pennsylvania Press, 1998), p. 9.
[27] Jan Golinski, *Science as Public Culture: Chemistry and the Enlightenment in Britain, 1760–1820* (Cambridge: Cambridge University Press, 1992).
[28] Mary Jo Nye, *From Chemical Philosophy to Theoretical Chemistry*.
[29] Colin A. Russell, '"Rude and Disgraceful Beginnings": A View of History of Chemistry from the Nineteenth Century', *The British Journal for the History of Science*, 21(3) (1988), 273–94.

the science-education conscious public'.[30] In the search for its own identity, groups and nations look for the sense of themselves through subjective narcissistic narratives, just as regimes use historical myths to legitimise their established power.[31] It is precisely in the actors' accounts that we find reflections on the continuity or discontinuity of historical actors, scientific institutions, intellectual traditions and material resources. They also inform us about the progressive evolution or sometimes sudden breakdowns in a particular chemical culture, in our case in the context of the colonial crisis of 1898, Primo de Rivera's dictatorship of 1923, the Republican regime in 1931, the Civil War and the different periods of Franco's dictatorship from 1939 to 1975.

Historians have not sufficiently explored the role of chemistry in twentieth-century Spain. There is still a lot to do in terms of prosopography, institutions and teaching and research practices.[32] A brief look at the final chapter of Manuel Lora-Tamayo's *La investigación química española* (1981) clearly shows the crucial importance of that prosopography and the enormous amount of historical research that has still to be done.[33] There is considerable research on the dynamism of the early decades of the century up to the Republican 1930s,[34] as well as more recent work on the role of science in the Francoist regime,[35] but chemistry has been notably absent from all of these narratives, with only some minor references to its intersection with physics in science faculties at the *Junta para Ampliación de Estudios e Investigaciones Científicos* (JAE) and the *Instituto Nacional de Física y Química* (INFQ), as well as some quantitative studies.[36] In the recent

[30] Pnina G. Abir-Am, Clark A. Elliot (eds.), *Commemorative Practices in Science, Osiris (2nd Series)*, 14 (1999), p. 15.

[31] Adam Budd (ed.), *The Modern Historiography Reader. Western Sources* (London: Routledge, 2009), pp. 43–6; Michael Ignatieff, 'The Nightmare from Which We Are Trying to Awake', in *The Warrior's Honor: Ethnic War and the Modern Conscience* (London: Chatto and Windus, 1998), pp. 166–99.

[32] As José Manuel Sánchez Ron stated some years ago, there is still not enough historical research on chemistry in the first half of the twentieth century in Spain. José Manuel Sánchez Ron, *Cincel, martillo y piedra. Historia de la ciencia en España (siglos XIX y XX)* (Madrid: Taurus, 1999), p. 244. See also: José Manuel Sánchez Ron, *Un siglo de ciencia en España (Diciembre de 1998–Marzo de 1999)* (Madrid: Residencia de Estudiantes, 1998).

[33] Manuel Lora-Tamayo, *La investigación química española* (Madrid: Alhambra, 1981); Joaquim Sales, *La química a la Universitat de Barcelona* (Barcelona: Publicacions i Edicions de la Universitat de Barcelona, 2011).

[34] Luis Enrique Otero Carvajal, José María López Sánchez, *La lucha por la modernidad. Las ciencias naturales y la Junta para Ampliación de Estudios* (Madrid: Residencia de Estudiantes, 2012).

[35] Lino Camprubí, *Engineers and the Making of the Francoist Regime* (Cambridge, MA: MIT Press, 2014).

[36] See, for instance, Gerardo Palao, 'Influencias extranjeras en la investigación química española (1904–1965)', *Llull*, 13 (1990), 131–52.

commemorative book *Tiempos de investigación*, which aimed to celebrate – not without controversy – the 'continuity' of 100 years (1907–2007) of scientific research in Spain, there is no single chapter devoted to chemistry, nor is there a chapter on the chemistry of the post-war Francoist period.[37] We have details about university academic chairs and positions in all fields of knowledge in the early decades of the century, but there is no focused analysis of the chemical community and its identity.[38]

In the history of physics, seminal work on the JAE period by José Manuel Sánchez Ron and Antoni Roca-Rosell has been recently complemented by the fresher approach of Xavier Roqué and Néstor Herrán on the ways in which physics and physicists co-produced Franco's regime, moulded that scientific community and controlled scientific institutions under the values of the dictatorship.[39] In the history of the biological sciences, María Jesús Santesmases has published prolifically on the ways in which new disciplines such as biochemistry emerged and were 'accommodated' in the context of the dictatorship, as well as the role played, for instance, by the 1959 Nobel Prize winner, Severo Ochoa.[40] Amparo Gómez, Antonio Canales and Brian Balmer have discussed extensively the science policies that were in force in twentieth-century dictatorships, including Franco's Spain.[41] Antoni Malet has described in detail the complex process that led to the creation of the *Consejo Superior de Investigaciones Científicas* (CSIC) in 1939 and the role of José María Albareda as a science policy-maker of the regime. Equally, Albert Presas has focused his research on the German scientific relations with Franco's Spain and the ways in which nuclear power and 'atoms for peace' campaigns co-produced part of the values of the regime.[42] The nuclear question has also drawn the attention of other scholars such as Ana Romero, Sánchez Ron and, more recently, Roqué and Herrán.[43] They have all described in detail the ways in which expertise and power intersected in the local context during Franco's dictatorship, but also at

[37] José Manuel Sánchez Ron provided some data on chemists. J. M. Sánchez Ron, 'Las ciencias físicas y químicas en la JAE', in Miguel Ángel Puig-Samper (ed.), *Tiempos de investigación JAE–CSIC. Cien años de ciencia en España* (Madrid: CSIC, 2007), 103–44.
[38] Otero Carvajal, López Sánchez, *La lucha por la modernidad*.
[39] Xavier Roqué, Nestor Herrán (eds.), *La física en la dictadura. Físicos, cultura y poder en España 1939–1975* (Bellaterra: Universitat Autònoma de Barcelona, 2012).
[40] María Jesús Santesmases, 'Severo Ochoa and the Biomedical Sciences in Spain under Franco, 1959–1975', *Isis*, 91 (2000), 706–34.
[41] Amparo Gómez, Antonio Canales, Brian Balmer (eds.), *Science Policies and Twentieth-Century Dictatorships: Spain, Italy, and Argentina* (Farnham: Ashgate, 2015).
[42] Albert Presas, 'Science on the Periphery. The Spanish Reception of Nuclear Energy: An Attempt at Modernity?', *Minerva*, 43 (2005), 197–218.
[43] Roqué, Herrán (eds.), *La física en la dictadura*.

the international level during the Cold War as an excellent way to place Spanish examples in the mainstream historiography.[44]

From history of technology, Lino Camprubí has recently reconstructed the role of engineers in the making of Francoist Spain after the Civil War.[45] In his view, far from the old analysis of the role of scientists in dictatorships as 'autonomous' actors who 'resisted' the regime's hostility, engineers in particular co-constructed and co-produced the regime's power: 'It is through concrete material products [dams, churches, coal silos, agronomy labs] that the state takes over its territory and that becomes part of the landscape'.[46] In a similar vein, Tiago Saraiva's recent book on the technoscience of fascism focuses on the ways in which these regimes (in his case, Italy, Portugal and Germany) created a new material world through science. Food, plants and animals – fascist pigs – are described as a material, alternative modernity that opposed that of liberal democracies and communism.[47]

From Saraiva's reification of fascism to Camprubí's structural assemblage of early Francoism, and borrowing from other ideas of co-production (also from Roqué and Herrán), this book focuses more on specific historical actors, their biographical profiles and their political positions in everyday scientific practice, as well as on their statements in the public sphere. It covers a longer historical period, with different political regimes – liberal and dictatorial – and times of deep turbulence (such as the Civil War), and contrasts the ethos of the chemical community with a particular emphasis on conflicting and even fiercely opposing views on the ways in which chemistry (but also society) had to evolve. It also attempts to enrich the present historiography of Francoism through a systematic analysis of the chemists' political positions.[48]

In the framework of that complex intersection between science and ideology, it is time to revisit historian Thomas Glick's old thesis of the 'civil discourse' of Spanish science in the early twentieth century. In Glick's view, which many other historians of Spanish science have

[44] Lino Camprubí, Xavier Roqué, Francisco Sáez de Adana (eds.), *De la Guerra Fría al calentamiento global. Estados Unidos, España y el nuevo orden científico mundial* (Madrid: La Catarata, 2018).

[45] Camprubí, *Engineers and the Making of the Francoist Regime*. [46] Ibid., p. 164.

[47] Thiago Saraiva, *Fascist Pigs. Technoscientific Organisms and the History of Fascism* (Cambridge, MA: MIT Press, 2016), pp. 3–6.

[48] Paul Preston, *Franco* (London: Fontana Press, 1995); Enrique Moradiellos, *La España de Franco (1939–1975). Política y sociedad* (Madrid: Síntesis, 2000); Borja de Riquer, *Historia de España (IX): La dictadura de Franco* (Barcelona/Madrid: Crítica/Marcial Pons, 2010), p. xxiii; Ismael Saz, *Las caras del franquismo* (Granada: Comares, 2013); Enrique Moradiellos, *Franco: Anatomy of a Dictator* (London: I. B. Tauris, 2018). Although in recent decades this historical period has become a main target of research for historians, the role of chemistry in the shaping of the regime needs further study.

endorsed for decades, at the beginning of the twentieth century, Spanish society decided to place science apart from political struggle. Memories of the devastating consequences of late nineteenth-century debates on Darwinism and their political appropriations were still fresh, together with the appropriation of science as being the main cause of the crisis of 1898 and the further-reaching image of the backwardness of the country. Glick defended the case that scientific policies of the early twentieth century had achieved considerable 'autonomy' from political upheaval, in a sense preserving scientific knowledge in a cage or ivory tower to avoid contamination with the miseries of everyday life, which led to notable developments in 'pure', 'academic' research.[49] It is, however, hard to subscribe to Glick's thesis of political neutrality, even in the supposedly liberal, cosmopolitan, 'modern' ethos of the JAE chemists. Moreover, we can easily trace the temptations of the rhetoric of an apolitical chemistry among our chemists in dictatorial periods, such as that of Primo de Rivera's dictatorship (1923–30) and during several periods of Franco's dictatorship, particularly in the 'technocratic' trends of the 1960s. Even in the totalitarian dreams of the early autarky of the 1940s, chemistry – and the chemical industry in particular – served and shaped the regime through public statements of 'technical' or 'objective' competence. Therefore, the supposed neutrality of the 'civil discourse' should now be replaced by an approach focusing on the scientists' (chemists' in our case) 'civic responsibility' in the building of any particular political regime. As Robert Proctor discussed some decades ago in his *Value-Free Science?*, chemistry is political because it is closely linked to industrial and military power, because there are always alternative research fields, production processes and consumer choices and, finally, because chemistry is mainly devoted to the making of materials for our everyday lives.[50]

A Political Chemistry

Although historians have paid considerable attention to the role of chemistry in the second Industrial Revolution,[51] there is still a lot of work to be

[49] Thomas Glick, *Einstein in Spain: Relativity and the Recovery of Science* (Princeton: Princeton University Press, 1988), ch. 1. See also: Thomas Glick, 'Dictating to the Dictator: Augustus Trowbridge, the Rockefeller Foundation, and the Support of Physics in Spain, 1923–1927', *Minerva*, 43(2) (2005), 121–45.

[50] Robert Proctor, *Value-Free Science? Purity and Power in Modern Knowledge* (Cambridge, MA: Harvard University Press, 1991), p. 266.

[51] For the German science-based industry, see: Georg Meyer-Thurow, 'The Industrialization of Invention: A Case Study from the German Chemical Industry', *Isis*, 73(3) (1982), 363–81; John Lesch (ed.), *The German Chemical Industry in the Twentieth Century* (Dordrecht: Kluwer, 2000).