

## Constructing “Pure” and “Applied” Science in Early Francoism

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**ABSTRACT:** The paper discusses several appropriations of the categories of “pure” and “applied” science (mainly in chemistry) in early Francoism. At the height of a crusade that criminalized “pure” science as inherently attached to the culture of the Second Spanish Republic, the category of “pure” assumed spiritual, religious and anti-materialist values in the early education policies of the new regime, in the context of the newly founded national research centre, the *Consejo Superior de Investigaciones Científicas* (CSIC). At the same time, relevant Francoist scientists stressed the high moral status of a new utilitarian, “applied” science, to efficiently serve the material needs of the country. As a result, the categories of “pure” and “applied” science, and their rhetorical use in public addresses and propaganda, became useful tools for building a strong alliance between science and power that cemented the dictatorship.

**KEYWORDS:** Pure science; Applied science; Francoism; Spain; Dictatorship; Fascism; Industry; Liberalism; Physics; Chemistry; Technology.

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**RESUMEN:** *La construcción de la ciencia “pura” y “aplicada” en el primer franquismo.*— El artículo discute diversas apropiaciones de las categorías de ciencia (principalmente química) “pura” y “aplicada” en el primer Franquismo. En el núcleo de una cruzada que criminalizaba la ciencia “pura” como intrínsecamente vinculada a la cultura de la Segunda República Española, la categoría “pura” se identificó con valores espirituales, religiosos y antimaterialistas en las primeras políticas educativas del nuevo régimen, en el contexto del Consejo Superior de Investigaciones Científicas (CSIC), el recién creado centro nacional de investigación. Al mismo tiempo, científicos franquistas relevantes destacaron el elevado estatus moral de una nueva, utilitaria ciencia “aplicada”, para atender de manera eficaz las necesidades materiales del país. En consecuencia, las categorías ciencia “pura” y ciencia “aplicada”, y su uso retórico en discursos públicos y en la propaganda política, se convirtieron en herramientas útiles para la construcción de una fuerte alianza entre ciencia y poder en aras de la consolidación la dictadura.

**PALABRAS CLAVE:** Ciencia pura; Ciencia aplicada; Franquismo; España; Dictadura; Fascismo; Industria; Liberalismo; Física; Química; Tecnología.

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## INTRODUCTION

As historian of science Robert Bud recently discussed: “applied science and pure science can be thought of as ‘ideological’. They have been contested in the public sphere, exposing long-term intellectual commitments, assumptions, balances of power and material interests” (Bud, 2012, p. 537). Baconian utilitarianism, for instance, shaped the way in which seventeenth-century scholars legitimized a natural philosophy for the improvement of mechanical arts, trade, navigation, war and manufacturing. Likewise, the *utilitas* of the Enlightenment played a key role in the rhetoric of scientific academies across Europe, and influenced French post-revolutionary teaching reforms. In nineteenth-century Britain, “applied science” was a hybrid category, which, in Bud’s terms, overcame “the epistemological hierarchy introduced by Immanuel Kant, which declared the lesser certainty and truth value of *a posteriori* knowledge” (Bud, 2012, p. 545; Kaldewey and Schauz, 2018). Early twentieth-century American engineers aimed to gain public prestige as masters of “applied science”, but they often appeared in public as experts in “pure”, abstract physics, and mathematics, for the sake of their own professional prestige (Kline, 1995). These were times in which the pure-applied dichotomy served scientists’ professional interests in titles, institutions, and journals for the sake of their public approbation and prestige (Galison, 2008). After the 2<sup>nd</sup> World War, the “elusive” nature (Gooday, 2012) of the dichotomy persisted, but was formulated in different terms. It played a key role in detaching scientific research from controversial “applications” to nuclear power, and war, and from political issues such as nationalism and communism in the liberal, Western post-1945 logic (Krige, 2006; Schauz, 2014).

In recent decades, the categories of pure-applied science have been submitted to revision and criticism. What Richard Gibbons et al divided in the early 1990s into two separate spheres—mode 1 as the academic, autonomous, institutional knowledge; and mode 2 as the industrial applications by new experts that escaped academic control (Gibbons et al., 1994)—, was later considered merely a “rhetorical creation on the past of scientists anxious to justify their personal position” (Godin, 1998). In addition, Dominique Pestre pointed out the difficulty of maintaining a rigid distinction between pure and applied science as the 20<sup>th</sup> century progressed (Pestre 2003), since the concepts of basic and applied research seldom represent actual research practices (Schauz, 2014).

We shall therefore approach the pure-applied science divide in a more dynamic manner, with multiple feedback between expertise and material culture in different historical contexts (Agar, 2012). In all cases, “pure” and “applied” were controversial categories, which served particular political, intellectual and professional agendas. Beyond essentialist, often sterile discussions on the abstract nature and meaning of such words as “pure”, “applied”, “basic”, “academic”, “industrial”, and “useful”,

historical investigation should seek to trace what the actors actually said and describe their use of the pure-applied rhetoric in detail (Roberts, Schaffer, and Dear, 2007). This paper aims to reconstruct the rhetoric of the pure-applied science dichotomy in a very particular historical period, i.e. the first two decades of General Francisco Franco’s dictatorship (1939-1959). The outcome of a highly ideological Civil War (1936-39), in which republican, liberal, secular values (including anarchism and communism) fought on the battlefield against right wing, fascist, Catholic conservatism, the new regime imposed totalitarian values on Spanish society through the use of high levels of violence, cruelty and repression, but also with aggressive programmes of political propaganda and ideological coercion (Richards, 1998; Preston, 2012; Cazorla-Sánchez, 2005). This was a particular context in which, as part of the “political culture” of the dictatorship, the “pure-applied” science divide gained major political weight. This included its cultural roots and historical narratives, its ideological foundations, and also a huge range of social practices and symbolic codes (Saz, et al., 2019; Box, 2010).

Issues such as the role of science, technology and progress became particularly relevant in the construction of a new image of the country, which under the new fascist elites was far removed from the liberal values of the 1930s. Nevertheless, as in other historical contexts, the rhetoric of the pure-applied divide was full of paradoxes and contradictions, which I shall try to analyse through the accounts of certain scientists, intellectuals and politicians from Franco’s regime, especially in the aftermath of 1939, when the new state was built amidst an atmosphere of fascist euphoria and hunger for revenge. The policies of the new regime stressed the dangers of “pure” research as a result of a supposedly too libertine, “ideological”, liberal scientific culture that the new fascist elites aimed to irreversibly erase. A new “pure” science therefore became a tool for political propaganda, for instance in the revisionist approach of José Ibáñez Martín (1896-1969), the minister of education and president of the CSIC, who introduced new aspects of spirituality, anti-materialism, and unity. Nevertheless, Ibáñez Martín’s science policies and the public rhetoric they involved, inevitably left room in practice for the promotion of material progress and industry, that is to say, an “applied” science that many scientists and policy makers particularly praised, and considered to have been lacking in the pre-war period. In practice, the pure-applied divide therefore became a complex, ambiguous rhetorical tool to spread a new cultural hegemony that stressed the new modernity of Francoism through science. It efficiently complemented the material repression of the losers of the Civil War by spreading new values in order to break from the past. In my view, an analysis of the political weight of the scientists’ rhetoric as a powerful tool in the construction of the new regime, its main values and worldview, and its role in terms of social control and political stability, adds new, useful examples that can enrich the historiography of science under Francoism.<sup>1</sup>

## ERASING THE REPUBLICAN PAST

In 1950, in his opening speech of the 2nd national conference of engineering, General Francisco Franco addressed the audience with the following words: “That ‘laissez faire’, that recklessness of any plan or path, which grounded the life of liberal political societies, is already incompatible with the progress and the improvement of old nations.”<sup>2</sup> More than a decade after the end of the Civil War and the victory of the nationalist troops, opposition to liberalism and communism were two of the most powerful ideological tools of propaganda. In fact, Franco’s address to engineers, as key agents for a supposedly “applied science” or technology, and co-producers of the new state (Camprubí, 2014, 2017; Camprubí and Glick, 2020), bitterly questioned the “laissez-faire” values of the liberal tradition as a weakness in terms of the capacity for leadership and control of the country. When addressing science and technology issues, fierce criticism arose against the supposedly “useless”, “pure” science of the *Junta para Ampliación de Estudios e Investigaciones Científicas* (JAE), the research board that, since the early twentieth-century, and in particular during the Second Spanish Republic (1931-1939), had promoted scientific research and education under the liberal values of *Institución Libre de Enseñanza* (ILE). Likewise, the kind of research conducted at the *Instituto Nacional de Física i Química* (INFQ), founded in 1932 -and funded by the Rockefeller Foundation-, became a key target (Artigas et al., 1940). The analogy between “pure” science and liberalism as two evils of the country frequently appeared in public addresses and printed documents. The new scientific intelligentsia considered the JAE scientists to be “ideologically” biased and to practice a “politicized” science, whereas, strikingly, members of the new elite were introduced, in a highly censored public sphere, as “non-political” actors at the service of the nation. Despite the international reputation of some of its research schools and their leaders, research at the INFQ was perceived, at least in public, as particularly damaging to the interests of the new Spain, the “old nation”, as Franco called it, the aim being to achieve a new “reactionary modernity” (Herf, 1984). Blas Cabrera’s (1878-1945) topical research on magnetism, Miguel Catalán’s (1894-1957) contributions to spectroscopy, the international impact of Enrique Moles’ (1883-1953) experimental determination of atomic weights, among other key INFQ contributions to “pure” science, were considered too elitist, too narrowly focused and extremely expensive in comparison with the research funds invested in universities and institutes in peripheral cities.

José María Albareda (1902-1966) was the powerful general secretary of the *Consejo Superior de Investigaciones Científicas* (CSIC) from its foundation in 1939 to his death in 1966, and a well-known expert on soil chemistry (edaphology). Albareda argued that, since they were obsessed with pure, basic research, JAE scientists never took technology, economy (in particular agronomy and its soil chemistry), and, in general, applied, practical matters seriously (Malet, 2009; Gutiérrez Ríos, 1970). Antonio de

Gregorio Rocasolano (1873-1941), one of the great luminaries of chemistry from the 1920s, and the leader of a prestigious research school of biological chemistry in Zaragoza, also bitterly criticized the “pure” research at the INFQ in Madrid. Rocasolano’s school had achieved major prestige, produced remarkable international publications, and played a leading role in the foundation of a Science Academy in Zaragoza.<sup>3</sup> Nevertheless, as reflected in his contributions to the anti-Republican, conservative journal *Acción Española*, he fiercely opposed the secular, liberal values of the JAE. In the Civil War, Rocasolano defended Franco’s coup d’état for the sake of the preservation of the values of the so called “Western Christian Civilization” (Gregorio Rocasolano, 1937).<sup>4</sup>

In a similar vein, Emilio Jimeno (1886-1976), a prestigious inorganic chemist and one of the leaders of industrial metallurgy in the 1920s, was worried about the dangers of liberalism in economic terms and reinforced a programme of applied, practical, industrial chemistry for the new regime. His conservative Catholic ideology and his personal friendship with Franco helped get him appointed Rector of the University of Barcelona in 1939. As a result, campaigning in favour of applied science and the promotion of industry became powerful political tools to denigrate the generation of pre-Civil War scientists (Nieto-Galan, 2019). Likewise, chemist Luis Bermejo (1880-1941) considered Moles and the Rockefeller fellows to merely be repeating experiments they had learned abroad as JAE “pensionados”, with unnecessary precision, which was useless for pure but also for applied science.<sup>5</sup> From an ideological point of view, it was a fear of basic scientific training as a potential tool for individual freedom when choosing different research fields and strategies that lay beneath such anti-JAE campaigns.

Accusations by his fellow scientists, and a lawsuit against Moles, who lost his university chair on inorganic chemistry and his position at the INFQ after the war, and ended up in jail, were at the core of the aggressive rhetoric against his “pure” science of the atomic weights. Years before, Moles had publicly defended the compatibility of pure research with high international standards, and efficient, successful applications to industry. Since atomic weights played a key role in stoichiometry and chemical analysis, Moles easily linked demanding, pure research training with further applications to trade, quality control and customs laboratories, in his view, pure and applied chemistry being fully compatible and complementary (Moles, 1930).

Personal hostility and professional jealousy probably explain Moles’ marginalisation from the academic system after the war, but the words used, for instance, by Albareda and others against him had a lot to do with the aggressive rhetoric against the “pure”, “liberal” science of the 1930s. José María Otero Navascués (1907-1983), a key figure in the science policies of the new regime and future president of the *Junta de Energía Nuclear* (JEN) denounced that, under Moles’ direction, the INFQ had become a factory for making war weapons for the “reds” and a hostile place for the followers of the *Movimiento Nacional* (Sales

and Nieto-Galan, 2019).<sup>6</sup> Also in the trial, Francisco Navarro Borrás (1905-1974), professor of Mathematics and Dean of the Science Faculty in Madrid, severely questioned the process whereby Moles had been selected for his position at the INFQ, with support from “unwelcome elements of the *Institución Libre de Enseñanza* [ILE] and the notorious abuse of a more capable candidate”.<sup>7</sup> Navarro Borrás accused Moles, with no evidence, of being a mason, which was often associated with freethinking and secularization and viewed as one of the *bêtes noires* of the dictatorship. Demolishing Moles (his “pure” science and his atomic weights) in trials and in public addresses was a way to build up a huge divide between the new scientific culture that emerged in the new regime and the pre-Civil War era, the years of liberalism that needed to be washed out of public memory.

### APPROPRIATING “PURE-APPLIED SCIENCE” FOR NEW POLITICS

Despite that overwhelming campaign against pure science, the new elites also appropriated the category in their own way, but now for different purposes. This was for instance the case of José Ibáñez Martín, a key figure in the culture and science policies of early Francoism (Fig. 1). Ibáñez Martín was Minister of Education from 1939 to 1951, and president of the CSIC, founded at the end of the War, in 1939 (Lora-Tamayo, 1970; Romañá, 1970; Malet, 2009). In close collaboration with Albareda, he also led the new totalitarian organization of Spanish Universities through the 1943 “*Ley de Ordenación Universitaria*” (LOU), which involved very strict ideological control of academic governing bodies and teaching staff. He was also a key figure of the urban reshaping of the “*Colina de los Chopos*” in Madrid and the University Campus, where the CSIC and the new Francoist buildings physically erased the 1930s atmosphere of the *Residencia de Estudiantes* (Camprubí, 2014).

Like Rocasolano, Ibáñez Martín was another distinguished member of *Acción Española*, the right-wing movement, which in the 1930s had strongly campaigned against secular, Republican values. He sought inspiration in the work of the conservative intellectual Marcelino Menéndez Pelayo (1856-1912) in his quest for a glorious historical past of a science that could be considered genuinely Spanish. This was a tool to fight a longstanding tradition of dismissing Spaniards’ capabilities for scientific creativity, the so called “*polémica de la ciencia española*”, which had its roots in the 18<sup>th</sup> century (Nieto-Galan, 1998). In *La Ciencia Española*,<sup>8</sup> Menéndez Pelayo aimed to recover the names of the great Spanish luminaries of science, which late nineteenth-century modernity and, in his view, the exaggerated obsession with Europe, had dramatically marginalized. In Ibáñez Martín’s view, the regime’s new reactionary modernity had to oppose the scientific policies of the JAE and the ILE, which had been emerging since the early twentieth century under the leadership of scientific luminaries such as Santiago Ramón y Cajal (1852-1934), Nobel Prize in Physiology or Medicine in 1906.

By analogy with Mussolini’s programme of “*scienza universale*” (Somsen, 2017), which looked back through Italian history at the golden era of the Roman Empire and the geniuses of Leonardo, Galileo, Volta and more, Ibáñez Martín defended the universality of Spanish science as a restoration of the “*Siglo de Oro*”. In his view, Spanish universal science—“*Hispanidad universal*”—was Catholic, opposed to Kantian rationalism and the Enlightenment, and pro Thomas Aquinas. He praised the genius of Spanish theology and the harmony between science and faith. Spanish science supposedly possessed truth, and aspired to God and a unified philosophy (Ibáñez Martín, 1940: 7-11). In tune with the regime’s crusade, Ibáñez Martín abhorred liberal intellectuals. He perceived them as representatives of individual freedom, anarchy, the licentiousness of science and the prostitution of the nation, and supported new scientists who worked at the service of the nation (Ibáñez Martín, 1940: 14; Consejo Superior de Investigaciones Científicas, 1942: 36-37). In his view, the restoration of Spanish science after the “evil”, liberal years of the Republic, had to be linked to the glories of the Middle Ages and the Renaissance— what Rocasolano called the “*Falange Renacentista*”, an intellectual army whose name matched the fascist party, *Falange Española*, which ideologically led the coup d’état-, to the quest for a unity of knowledge that traced a path to God, in a joint programme for the natural sciences and the spirit (Consejo Superior de Investigaciones Científicas, 1942: 28; Romañá, 1970). From a strong nationalist perspective, Ibáñez Martín praised the victory of Don Marcelino: “over the pygmies who only managed to scratch the centenary crust of the nation”.<sup>9</sup>

Liberal democracies found this research policy hard to accept, as the Jesuit Antonio Romañá (1900-1981) regretted, many years later, in his homage to Ibáñez Martín. Romañá introduced Ibáñez Martín as a sort of “hero” who resisted international isolation in the early years of the dictatorship, at least until the US officially recognised and supported Franco’s regime in 1953. In Romañá’s words:

We learned of the contempt or unqualifiable sectarianism with which entire drawers of publications by the Consejo [CSIC], which we sent as gifts for the establishment of collaborations with scientific institutions in other countries, had been systematically thrown into the sea from certain positions, because many wanted absolutely nothing with us.<sup>10</sup>

In fact, although, the regime used scientific research from the beginning as a diplomatic tool to re-establish pre-Civil War international relations and to create new ones, reluctance to Ibáñez Martín’s “pure”, spiritual Spanish science was frequent, at least in the late 1940s, and early 1950s. For liberal democracies, with an academic peer-review system and a cosmopolitan scientific culture, it was hard to understand the logic of the famous offerings of books and journals to the Caudillo and the Francisco Franco prizes as a homologated system for the assessment of scientific quality.<sup>11</sup> However, despite that international



Figure 1. José Ibáñez Martín’s portrait in a special issue in his honour in the journal *Arbor*. *Arbor*, 1970, 289, p. 8. Reproduced with permission of the Biblioteca de Catalunya (Barcelona).

hostility, Ibáñez Martín stressed the Christian aspect of the *Movimiento* and the aim to transform Spain into the spiritual reserve of the West—“*la reserva espiritual de Occidente*” (Ibáñez Martín, 1942). Matter, life and spirit constituted the three pillars of the CSIC, the three branches of the *Arbor Scientiae*, and the ideal balance of that new totalitarian science (Ibáñez Martín, 1942: 22; 1950). Democracy and liberalism weakened the state, whereas, in his view, unity among several basic principles – religion, Hispanidad, hierarchy, obedience, nationalism and morality – from his totalitarian view– strengthened it. In his words:

Science is one, surrendered to the truth and the good, conceived as a service to God and the Fatherland, demanded by the State for the common good of its material and spiritual needs, produced as a contribution to human progress and to the prestige, aggrandizement and prosperity of Spain.<sup>12</sup>

Despite Ibáñez Martín’s delirious approach to a new, “pure”, Francoist science, he inevitably supported “progress”, the latter being a tacit endorsement for applied science and industry from a more pragmatic perspective. Ibáñez Martín constructed a new “modernity” for the new regime, a reactionary one—a *la Herf*—, that was at the

core of the scientific policies of the CSIC, its *Patronatos* and *Institutos*.<sup>13</sup> In his view, a certain “universalism”, linked to the tradition of *Hispanidad*, could be compatible with the new applied science policies. The spirit of the new, “pure” science provided national pride and was deep-rooted in the identity of the new Francoist Spain. However, in practical terms, it was the applied science programme of the CSIC that called on industrialists and technicians to work for the good of economic growth, as a way of defending the regime from foreign dependence and international attacks, especially before its admission to the UN in 1955.

Nevertheless, even in the euphoric early fascist years, others discussed the value of pure science in more pragmatic, strategic ways. Note, for instance, how a section for foreign information (*Sección de información extranjera*) of the *Patronato Juan de la Cierva* (PJC), one of the key branches of the CSIC from a utilitarian perspective, systematically described the science policies of other countries. In 1947, just two years after the end of the Second World War and the defeat of Franco’s fascist allies, a report on the new scientific organization of the United States appeared as part of the publishing programme of the *Patronato* (*Patronato Juan de la Cierva*, 1947). The report admitted that the US, being a country with a strong technological identity, and a liberal democracy, praised pure science and pure research as basic pillars of its development. The report described in detail Vannevar Bush’s report to president Roosevelt, *Science. The Endless Frontier* (1945), in which, paradoxically for the Francoist authorities, “pure” science appeared as a basic pillar for industrial growth. The Spanish report stressed Bush’s idea that: “The simplest and most effective way in which the Government can strengthen industrial research is to support pure research and encourage the development of well-endowed individuals for scientific work” (*Patronato Juan de la Cierva*, 1947: 107). Even in that period of international isolation of the new regime, there is historical evidence of the contacts established by the US with Franco’s Spain (Guirao, 1998). As reflected in the former report, in the emerging culture of ‘big science’, American rhetoric presented basic, pure research as the friendly face of ambitious applied science projects to industry and the military. In fact, Bush spoke highly of the value of basic research, not only to be later applied to the material needs of the population but also as a useful tool to fight what was left of fascism in a devastated Europe, and to reinforce liberal, democratic values (Bush, 1945; Krige 2006). Obviously that framework did not apply to Spain, but the elusiveness of the pure-applied science debates were appropriated in Franco’s Spain for different purposes.<sup>14</sup>

In some of his papers at the end of the Second World War, even Emilio Jimeno, a fierce opponent of liberal capitalism, acknowledged that “pure” science was in the hands of a select minority in the country, which deserved in his view full admiration and respect (Jimeno, 1945: 561). This was probably not incompatible with a strong rhetoric in favour of applied science. Edited by the PJC, journals such as *Revista de Ciencia Aplicada* combined



papers about local applications, using national, raw materials, with exhaustive information on international research centres, conferences, books and journals from a wide variety of topics, which included pure, academic research. Even journals such as *Ión* (*Revista española de química aplicada*) strongly supported chemical industry, but established long-lasting links between academic research and industrial applications, with ample information on foreign chemistry journals and books. *Ión*'s fierce, totalitarian opposition to liberalism, as often appeared on the front cover as propaganda, did not exclude valuable data about foreign, "pure" research on the inside pages (Nieto-Galan, 2019). In a way, Ibáñez Martín's crusade and his rhetoric of a new "pure" science for the new regime inevitably opened the door to an applied science programme, which many saw as the ideal development for actually breaking with the pre-Civil War past.

### "APPLIED" CHEMISTRY AND PHYSICS

In 1955, Franco's inauguration of a new building for the *Patronato Juan de la Cierva* (PJC) in Madrid describes very well the "applied" science project of the dictatorship (Fig. 2 a, b) (Patronato Juan de la Cierva, 1955; López 1997, 1998, 1999). Manuel Lora-Tamayo (1904-2002)—at that time secretary of the PJC, and a key figure in the development of an applied chemistry to serve industry—, welcomed Franco to the new premises. José Antonio Suanzes joined Lora-Tamayo at the head of the reception committee. Suanzes was the president of the *Instituto Nacional de Industria* (INI), a state institution devoted to the promotion of Spanish industry in the framework of the autarchic ideas of the early decades of the regime. The select group also included Joaquín Planell, the minister of industry, Joaquín Ruiz Giménez, the minister of education, admiral Luis Carrero Blanco, one of Franco's right-hand men in the cabinet, and obviously Ibáñez Martín and Albareda as president and general secretary of the CSIC. The new building hosted around a thousand scientific journals in a new library for information and documentation applied to industry (*Biblioteca de información y documentación aplicada a la industria*). It also included a photo-documentation service; a new centre for experimental cold (*Centro Experimental del Frío*), the iron and steel institute (*Instituto del Hierro y del Acero*), the national institute for the rationalization of labour (*Instituto Nacional de Racionalización del Trabajo*), the electricity institute (*Instituto de Electricidad*) and the wind energy commission (*Comisión de Energía eólica*) (*Revista de Ciencia Aplicada*, 1955b). In his address, Franco himself stressed that: "These institutes are the result of a perfectly defined *industrial activity*. They respond to effective scientific and technical needs... to *national demands* and orientation... as well as to problems arising from the *optimal use of our natural resources*".<sup>15</sup> In fact, under the label of "technical research" (*investigación técnica*) the network of PJC institutes covered a huge range of areas of applied science and promoted new experts to the intellectual elite.<sup>16</sup> Moreover, the PJC led joint collaborations on physics, physical chemistry, entomology, edaphology,

pharmacognosia with other centres, institutes and university laboratories.<sup>17</sup>

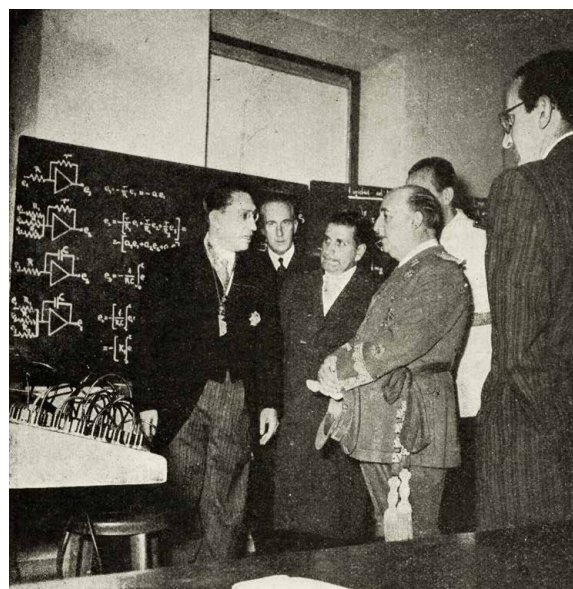


Figure 2: a. Franco on the new PJC premises, together with Suanzes (on his right) and Lora-Tamayo (on his left); b. Franco with the director of the PJC Institute of Electricity, José García Santesmases. *Revista de Ciencia Aplicada*, 1955, 43, p. 153 (a), p. 156 (b). Reproduced with permission of the Biblioteca de Catalunya (Barcelona).

Such applied science policies were reflected, for instance, by the 1953 invitation of the German chemist Walter Reppe (1892-1969), at that time director of the powerful chemical firm BASF (*Badische Anilin und Soda Fabrik*) in Ludwigshafen, to the *Ciudad Universitaria* and the CSIC (*Revista de Ciencia Aplicada*, 1953; Martín Guzmán and Rubio Alberola, 1950). At the BASF central laboratory, Reppe’s work with acetylene and metallic catalysers at high pressure with special glassware epitomized a good part of the German pattern of “science-based industry”, which had its roots in the late nineteenth century, and had certain continuity after the Second World War (Johnson, 2000). In fact, the Nazi collaboration with Francoist Spain during the War had strengthened the links between German industries and Spanish entrepreneurs (Presas, 2008). Acetylene,  $C_2H_2$ , became a polyvalent molecule, with a carbon-carbon triple bond, and a highly promising starting material for multiple reactions of applied chemistry in the laboratory and at industrial scale. Oxidation, addition of chlorine, water and hydrochloric acid, and several polymerizations led, for instance, to vinyl plastics and to artificial rubber, through butadiene, and provided new signs of modernity and progress (Morris, 1993). Reppe’s work at BASF from 1949 to 1957 was an ideal target for the Spanish applied science programme. The PJC “*Sección de Plásticos*” was keen to work on all the applications of acetylene. The *Real Sociedad Española de Física y Química* (RSEFQ) awarded Reppe an honorary membership.

At the intersection between physics and chemistry, the pure-applied divide and its tacit political weight also tinged other scientific disciplines. In 1948, Octavio R. Foz Gazulla—a Professor of Physical-Chemistry at the University of Madrid—was also deputy director of the *Instituto de Química Física Rocasolano* at the CSIC. The Institute was one of the jewels of the new national research setting built in Madrid after Franco’s victory in 1939, which bear the name of Rocasolano for his support to the coup d’état. Foz Gazulla dismissed the pure, theoretical nature of physical chemistry in the following terms:

This is a very young discipline, even more so in Spain. Not so long ago, physical chemistry used to be considered among us as a kind of *scientific curiosity without practical interest*... We shall achieve the widespread conviction that it is also basic for industrial growth.<sup>18</sup>

The “scientific curiosity without practical interest” subtly referred again to Moles’s prestigious research group on physical chemistry in the 1930s in the labs and walls of the old INFQ, which now sheltered his own research under new fascist values. The regime had ignored Moles’ international prestige in “pure” physical chemistry due to it being too close to the pure, supposedly useless, liberal science of the Republican years, which now seemed incompatible with the new “applied” science (Nieto-Galan, 2019). The target was, therefore, the invention of a new, “applied” physical chemistry, much more in tune with the new values of the dictatorship. Not by chance, in 1949, the

*Real Academia de Ciencias Físicas y Naturales* (RACFN) in Madrid sent an invitation to Theodor Svedberg (1884-1971), a Nobel Prize in Physics, and director of the physical chemistry institute at the University of Uppsala, to whom the CSIC also awarded an honorary medal (“Real Academia de Ciencias”, 1949). Svedberg was welcomed as an international expert on “applied” physical chemistry,<sup>19</sup> which could justify the turn towards a new science that was far removed from what Moles might represent.

The rhetoric of applied science also reached other domains that were often devoted to sophisticated, pure, academic science. In 1945, the Professor of theoretical and experimental physics, José Baltá Elias (1893-1973), was the director of the Electricity section at the *Instituto de Física Alonso de Santa Cruz* at the CSIC. Baltá wrote an obituary for Blas Cabrera, the director of the INFQ, and a crucial figure of the liberal science of the 1930s, who had passed away during exile in Mexico (Baltá, 1945a). After the Civil War, Baltá had comfortably placed himself in the new academic system, but had the courage to refer to one of his republican masters. Although in his obituary there was not one reference to Cabrera’s exile and the political reasons that forced him to leave Spain, Baltá rhetorically praised Cabrera’s “pure” research on magnetism in the 1930s. Baltá’s obituary was an “apolitical” account of one of the great luminaries of the 1930s, which appeared—without any portrait—in 1945 in the journal of the RSEFQ. Apart from that circumspect homage to Cabrera, Baltá was in practice very keen on promoting promising applications of physics such as fluorescent lighting (Baltá, 1945b) and solar energy (Baltá, 1957). But perhaps his defence of applied relativity was one of the most striking aspects of his scientific scheme. In Baltá’s words:

Despite its apparent lack of immediate utility, it [relativity] could be paradoxically qualified as a popular theory, since it called the attention of the general public, no matter their knowledge of the subject. The truth is that such a theory has achieved its maturity in science, to be currently applied as a tool by thousands of physical chemists around the world who are working on energy assessment and spectroscopy.<sup>20</sup>

In a similar vein, top, pure research on quantum chemistry at international level, once in Franco’s Spain, had its “applied science” rhetoric. This was the case of José Ignacio Fernández Alonso (1917-2012), who, after impressive training abroad with luminaries such as Raymond Daudel, Linus Pauling, and Charles Alfred Coulson, in 1955 lectured at the University of Valencia on the practical “application” of quantum chemistry for the treatment of cancer (Fernández Alonso, 1955; Tomás Vert, 1988). Fernández Alonso did his PhD under the supervision of Tomás Batuecas (1893-1972), a pupil of Moles, who would establish his career in the new regime, so the “pure”, liberal scientific school of Moles and the INFQ also had some tacit continuities after the War. Likewise, Carlos Nogareda (1900-1990), another of Moles’ pupils, who also survived the Civil War and the process of ideological cleansing,



ended up as professor of physical chemistry at the University of Salamanca. Nogareda's scientific production on "pure" chemistry was poor and almost negligible. In tune with the autarchic atmosphere of economic self-sufficiency of the early 1950s, he focused on teaching, science popularization and the promotion of applied chemistry to industry. Nevertheless, that profile was miles away from Nogareda's earlier top international research training in pure science at Cambridge, where he had worked as a "pensionado", close to several Noble prizes in physics like Joseph John Thomson (1856-1940), and Ernst Rutherford (1871-1937) (Nogareda, 1950; Nieto-Galan, 2019). In fact, the apparently useless training in pure science at the INFQ in Moles' research school had produced scientific talents such as Fernández Alonso and Nogareda, but their survival in the Francoist system inevitably required high doses of "applied" science rhetoric.

### **"APPLIED" SCIENCE: FROM WAR TO INDUSTRY**

The skills acquired in wartime left their mark on the regime's applied science project. As far as we know, scientific mobilization for the mass production of war weapons was relevant on both sides of the Civil War. Francisco Giral (1911-2002), a key figure of the Republican scientific elite who went into exile in Mexico, worked at such Republican war factories as La Marañosá. On the Francoist side, names like Luis Blas (1906-1967) and José María Fernández-Ladreda (1885-1954) played a key role in the production of weapons during the war, and their experience contributed to several applied science policies in the early decades of the dictatorship (Nieto-Galan, 2019). It was therefore not by chance that a member of the military, Otero Navascués, directed the *Comisión Técnica especializada* (CTE) on "Applied physics" at the PJC (López, 1998). Otero also worked on applied optics at the "Daza de Valdés" Institute, which he directed in 1950, when the institute had a Department of electronic optics, vision, technical optics and spectroscopy, all devoted to applications to other branches of physics and to industry (Otero Navascués, 1950). The institute was named in honour of Benito Daza de Valdés (1591-1634), a seventeenth-century natural philosopher—a la Menéndez Pelayo—and who was viewed as a kind of mythical founding father of optics, now a branch of physics in the twentieth century. Otero was also a prominent figure in the regime's plan to develop nuclear energy in Spain, and, from 1954, he was director of the *Junta de Energía Nuclear* (JEN). After the US-Spain agreement of 1953, the JEN became mainly dependent on American "applied science" nuclear technology (MacVeigh Alfós, 1957; Romero de Pablos and Sánchez Ron, 2001). Perhaps not by chance, in 1956, the US ambassador, David Lodge, offered the JEN a "technical" library as a donation from the American Commission of Atomic Power (*Revista de Ciencia Aplicada*, 1956; Romero de Pablos, 2018).

When appropriating the pure-applied dichotomy to industry, the voice of Fernández-Ladreda, a military hero

of the Civil War, expert on industrial chemistry, professor of technical chemistry, and Minister in Franco's cabinet, was particularly relevant (Fig. 3) (García-Conde, 1954).<sup>21</sup> Fernández-Ladreda played an active role against the Asturias socialist revolt of 1934, and later defended the city of Oviedo against Republican troops during the Civil War. After the War, he accumulated great experience in war chemicals – he managed a weapons factory in La Coruña-, and in 1940, he was promoted to General. After being Minister of Public Works in Franco's cabinet (1947-1951), in 1952 Fernández-Ladreda became general director of weapons (armament) in the Ministry of the Army, a position that was compatible with his collaboration with the PJC to promote applied chemistry for industry in the fields of explosives, steel, penicillin (Santesmases, 2018), copper, and war weapons (Instituto de Estudios Asturianos, 1955). In fact, Fernández-Ladreda became president of the Patronato's technical commission (*Comisión técnica especializada* – CTE) on metallurgy and, on a local level, he was also president of the "applied chemistry" section at the University of Oviedo (Rodríguez Pire, 1955).



Figure 3. José María Fernández Ladreda, as he appeared in *Ión*, 1945, 49(5), p. 415. Author's private collection.

Fernández-Ladreda led the "modernization" of technical chemistry in the new regime, which he considered to be composed of three pillars: 1. Chemical engineering (a young, fashionable discipline based on the American pat-





tillation to obtain synthetic gasoline. Carbon dioxide, submitted to industrial processes of hydrogenation, or treated with chlorine, ammoniac and caustic soda, could lead to very useful products like tanners, drugs, colorants, plastics, and perfumes. Acetylene also provided a huge range of useful products like solvents, rubber, plastics, drugs and vinegar. In some of his texts on chemical engineering, Fernández-Ladreda stressed that, given the urgent need for better training of experts in industry, “pure”, speculative chemistry was not the main target (Nieto-Galan, 2019).

The war logic, and the utilitarian mobilisation of scientific efforts for urgent application to the battlefield, made its mark on his biography, but also on the militarized, totalitarian atmosphere of the early decades of the regime. Other members of the military also helped to spread the applied science programme. For instance, Lieutenant Colonel Onrubia discussed how former experience in passive defence during the war could contribute to the chemistry of rubber, cellulose, activated carbon and fire extinguishers (Onrubia, 1942). Colonel Juan González Anelo became a relevant figure in the chemistry of combustibles and minerals.<sup>23</sup> Luis Blas also used his experience in the war to work on applications of bromine (Blas, 1942). As a whole, the immediate application of scientific knowledge for the sake of efficiency, productivity and factory discipline could easily be extrapolated for the sake of rigid control of society.

Nevertheless, the intimate relation of chemistry as a profession with industry opened other avenues for the appropriation of the “pure” and “applied” categories. In 1945, in a meeting of the RSEFQ, its president Antonio Rius Miró (1890-1973), at that time director of the CTE on “applied” chemistry at the PJC, closed the event with an optimistic vision of chemistry as a useful applied science with the following words:

Today we have a staff of chemists with enough research training to successfully contribute to the technical development of our country... [and to] the remarkable development of our industry, which has managed to create all the elements that were missing in *the hard years of the past*.<sup>24</sup>

Rius Miró stressed again the point of those “hard years of the past”, in which the useless “pure” science of the JAE and the INFQ supposedly did not promote industrial, applied chemistry. He called for new researchers to be trained in an “industrial spirit”, so they could adapt their work to the country’s raw materials, but at the same time praised Wilhelm Ostwald’s “pure” research on ammonia as a basic tool with further industrial applications.<sup>25</sup> Close to industrialist Juan Abelló (1895-1983), and very well connected with Albareda at the CSIC and the scientific elite of the regime, Rius Miró attempted to “modernize” the training of industrial chemists and move towards the new chemical engineering that had been so successfully developed in Britain, and particularly in the US. From the early autarchic years at the end of the Second World War to the 1950s with the US agreement with Franco’s

Spain, Rius Miró appropriated the “pure”, abstract concept of “unit operations”, a sort of theoretical framework for building a new academic field, for the needs of the Spanish chemical industry. What apparently was chemistry to be applied to industry became a sort of modern, “pure” knowledge, which tinged that academic culture with a layer of fashion and modernity (Nieto-Galan, 2019; Toca, 2006).

## CONCLUSION

In 1942, the editorial pages of the journal *Ión* were entitled “La Universidad y la Industria”, exactly the same name given to Moles’ famous address in 1929 (Moles, 1930). Now, in the totalitarian atmosphere of the recent victory in the Civil War and the close ties between the regime and Nazi Germany and Fascist Italy, the point was to praise the increasing number of “technical chemistry” university chairs in comparison to figures from the pre-war era and the courses on industrial matters to be held on university campuses. *Ión* also encouraged further “technical training” for undergraduates and increased the technical services offered by universities to industries. In tacit acknowledgment of the contributions of the JAE generation, the *Ión* editorial board considered that, in the early decades of the twentieth century, the scientific culture of the country had shifted “from the blackboard to the laboratory”. Now, after the War and the victory of Spanish fascism, it was time to move “from the laboratory to the factory”, technical chemistry being a useful complement to the emerging chemical engineering. Therefore, the high demand for applied science at universities left almost no room for pure science (Ión, 1942). In practical terms, Moles’ claims about the polyhedral potentialities of basic research seemed rather marginal on the agenda of the new intellectuals and scientists of the regime.

As discussed in the former sections, the pure-applied divide became a powerful tool for political propaganda, a weapon in ideological discourses and a subtle strategy for professional interests in early Francoism. As in other political regimes, even in liberal democracies, the pure-applied rhetoric transcended its supposedly restricted technical nature to inevitably invade the political realm. Nevertheless, applied science public campaigns, industrial discipline, rigid large scale methods in factories, obsession with the country’s raw materials –often linked to the autarchy of the first two decades of the dictatorship–, was never in practice isolated from academic research, laboratory experiments and some speculative research projects. Opposing the liberal context of the pre-war years, even enthusiastic defenders of the new regime, such as Ibáñez Martín, had to invent new meanings for “pure” science, which was now linked to spiritual, religious values, in order to distance it from the secular, pure science of the Second Republic.

In fact, the divide between pure, liberal, republican science on the one hand and applied, fascist, totalitarian science on the other was more elusive than expected. Despite the difficulty of practically implementing the so-

called “silver age of industry” -in reflection of the “silver age of science” of the early decades of the twentieth century-, Republican policies strengthened plans for industrial support, developed applied research projects, and created small-scale laboratories to test large scale methods (Nieto-Galan, 2019). Likewise, totalitarian, essentialist rhetoric of a new “pure” science of a spiritual nature to fit within the new logic of the CSIC, coexisted alongside strong arguments in favour of the radical utilitarianism of the PJC’s policies.

Emilio Jimeno, who was highly reputed for his project of chemistry “applied” to metallurgy, expressed in some of his writings the elusive nature of the pure-applied divide. In 1945, he described three groups of chemists that existed at the time: 1. Teachers and communicators (mainly chemistry teachers at secondary school level and some popularisers); 2. Industrial chemists (with technical skills to work in industry); 3. A minority working on “pure” research: “Those who use their efforts in original research to broaden our knowledge about facts and their fundamental principles... those who provide more relevance to a nation, despite being the smallest group”.<sup>26</sup> As discussed earlier, Jimeno, who, since the 1920s had led a public campaign in favour of applied science for industry, assumed in practice the value of pure research. Likewise *Ión*, the genuine journal for applied chemistry, could not avoid occasional remarks praising pure research as being extraordinarily important for the nation, whereas the CSIC annual reports stressed the value of pure science as an ideal complement of the technology developed at the PJC.

The examples presented in this paper endorse Robert Bud’s thesis of the ideological nature of the pure-applied divide in different historical contexts. In the early decades of Franco’s dictatorship, many scientists (mainly chemists, in our case) became agents of the co-construction of a new regime. They played their cards to gain professional prominence and social prestige in a totalitarian atmosphere, which seriously limited their individual freedom, but offered new career opportunities in academia and industry. It is therefore in that context that we should place the aggressive addresses against the JAE’s pure science, the uncritical declarations in favour of applied science as a handmaiden of the nation, or even more elusive appropriations of the pure-applied dichotomy. What a dramatic paradox for those repressed, exiled and even executed for their liberal, pure science of the 1930s.

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## NOTES

- 1 A recent attempt to discuss the utilitarian nature of Francoist science is: González Bueno and Baratas (2019).
- 2 “Aquel ‘dejar hacer’, aquel abandono del planteamiento y de la dirección, base de la vida de las sociedades políticas liberales, es ya incompatible con el progreso y la mejora de las naciones viejas”, “II Congreso Nacional de Ingeniería” (*Revista de Ciencia Aplicada*, 1950), p. 355.
- 3 In 1926, Rocasolano published a chapter in a collective international volume on colloids: Alexander (1926). See also: Nieto-Galan (2019).
- 4 Rocasolano described his colleagues at the JAE and the INFQ in the following terms: “These professionals of science... do not commit to study for their love of truth, but, because, at the service of low politics, they comfortably take positions, which, in recent years, were long-lasting and lucrative in Spain” (Artigas et al., 1940, p. 160).
- 5 “...cada profesor anuncia para un curso determinado un programa de trabajo, cuyo arranque suele ser el asunto químico con su técnica que aquel practicó en el período de su formación científica en el Extranjero, dándose casos de pertinaz repetición en las operaciones para buscar la novedad de los resultados en las lejanías de la parte decimal de una cifra cuya variación es intrascendente en los usos que ofende la ciencia especulativa o de aplicación...”, Luis Bermejo, “El Instituto Rockefeller”, in Artigas et al. (1940, pp. 197-202, p. 199).
- 6 Denuncia de José María Otero Navascués, *Archivo del Ministerio de Defensa*, Madrid, sumario 25.334, fols. 46-47. Quoted in Sales and Nieto-Galan (2019).
- 7 “Elementos indeseables de la Institución Libre de Enseñanza y con notorio atropello de otro opositor de más valía”, Denuncia de Francisco de Asís Navarro Borrás, *Archivo del Ministerio de Defensa*, Madrid, sumario 25.334, fols. 44-45. Quoted in Sales and Nieto-Galan (2019).
- 8 Menéndez Pelayo (1953) [edición de Enrique Sánchez Reyes] “La Sociedad Menéndez Pelayo, dueña del derecho de propiedad intelectual de las obras de Marcelino Menéndez Pelayo ha concedido la exclusiva para editarlas en el CSIC”.
- 9 “...sobre los pigmeos que lograron tan solo arañar la corteza centenaria de la nación”, (Ibáñez Martín (1940), p. 5.
- 10 “...nos enteramos del desprecio o del sectarismo inalicificable con que cajones enteros de publicaciones del Consejo, enviados como obsequio para establecer relaciones con instituciones científicas de otros países, habían sido sistemáticamente arrojadas al mar en ciertos puestos porque no se quería absolutamente nada con nosotros”, Romañá (1970), p. 26.
- 11 “...le fueron entregados al Jefe del Estado 1200 ejemplares de libros y revistas que constituyen la labor editorial del Consejo” (*Revista de Ciencia Aplicada*, 1955a, p. 160). See also Malet (2008).
- 12 “Ciencia una, rendida a la verdad y el bien concebido como servicio a Dios y a la Patria, exigida por el Estado para el bien común de sus necesidades materiales y espirituales, producida como aportación al progreso humano y para prestigio, engrandecimiento y prosperidad de España”, Ibáñez Martín (1942), p. 21.

- 13 (1970) *Arbor*, 289, pp. 9-50. See also Herf (1984).
- 14 In the early 1950s, Pascual had already used several British and American examples in a public address to discuss the nature of scientific research. Pascual (1953), p. 23.
- 15 “Surgen estos institutos como consecuencia de una *actividad industrial* perfectamente definida, y obedecen a una necesidad efectiva de orden científico y técnico...respondiendo a una *necesidad u orientación nacionales*, ... [al] mayor aprovechamiento de *nuestras reservas naturales*” (*Revista de Ciencia Aplicada*, 1955b, p. 13), my emphasis.
- 16 Instrumental científico (Armando Durán), construcción y cemento (Eduardo Torroja), combustible (Instituto del Carbón, Oviedo: Francisco Pintado, Sección de Zaragoza: Vicente Gómez Aranda), grasa (Sevilla: Juan Martínez Moreno), racionalización del trabajo (Madrid: Aureo Fernández Ávila), soldadura (Manuel de Miró), hierro y acero (Agustín Plana), electrónica (Manuel Espinosa), investigaciones pesqueras (Facultad de Ciencias, Barcelona: Francisco García del Cid) química (Lora-Tamayo), óptica (José María Otero Navascués), electricidad (José García Santemesas), Investigaciones técnicas de Barcelona (Antonio Cumella), ENCS (Eduardo Angulo), Piritas españolas (INI) (Ángel Vián), electroacústica (Alberto Laffon, Ezequiel Selgas), Asociación electrotécnica Española (Carlos Laffite). Departamentos: plásticos (Juan de la Infiesta), fermentaciones industriales (José Garrido), química vegetal (Eduardo Primo), silicatos (Vicente Aleixandre), Centros: experimental del frío (Rufino Beltrán), información y documentación (Juan Juretschke), Comisión: energía eólica (Luis de Azcárraga) (*Revista de Ciencia Aplicada*, 1955b).
- 17 In 1955, the Patronato opened a branch in Barcelona for the industrial needs of the “region”: tanning, textiles, metallurgy, cellulose, chemistry.
- 18 “Disciplina muy joven, más aún en España, la química-física solía considerarse entre nosotros, hasta hace no mucho tiempo, como *una especie de curiosidad científica sin interés práctico*... Falta lograr que se generalice el convencimiento de que también es básica para el desarrollo industrial”, Foz Gazulla (1948, p. 37), my emphasis.
- 19 To fuel, synthetic rubber, mineral acids, acetylene, plastics, fermentations, photography and electrical appliances, metallurgy, electronics (semiconductors), catalysis, colloids, electrochemistry, chemical engineering.
- 20 “... no obstante su aparente carencia de utilidad inmediata, podría calificarse paradójicamente de teoría de multitudes o de masas, por el interés y discusiones que provocó entre el gran público, con más a menos conocimiento de causa. Lo cierto es que tal teoría ha adquirido carta de naturaleza en la ciencia, para ser *aplicada* corrientemente como herramienta de trabajo por millares de físico-químicos de todo el mundo, ocupados lo mismo en evaluaciones energéticas que en desentrañar espectros” (*Revista de Ciencia Aplicada*, 1955a, p. 267), my emphasis.
- 21 In the 1920s, his military career at the Academia de Artillería de Segovia and his active role in the Rif War, in the Spanish Protectorate of Morocco, led to his expertise on chemical weapons, and he moved to Madrid to work in the Artillery chemical laboratory. After some international training, he settled down in Oviedo, the capital of coal mining, and entered into politics from a conservative position to become mayor of Oviedo (1924-1926), and later, in the 1930s, MP of the right wing party CEDA (Confederación Española de Derechas Autónomas).
- 22 “estudio de los procesos y circunstancias de aplicación de las especies o productos químicos”, Fernández-Ladreda (1951, pp. ix-x).
- 23 *Íón*, 8(2), 1942, p. 267.
- 24 “Tenemos hoy un plantel de químicos con formación investigadora suficiente para intervenir con éxito en el desarrollo técnico de nuestro país... [y] el notable desarrollo de nuestra industria, que ha sabido crear cuantos elementos han faltado durante *los difíciles años pasados*”, “Discurso del Presidente” *Anales de Física y Química* 41,(1945, p. 144), my emphasis.
- 25 *Idem*, p. 146.
- 26 “Los que emplean sus esfuerzos en investigaciones originales con el fin de ampliar nuestros conocimientos acerca de los hechos y sus principios fundamentales... los que dan más relieve a una nación, a pesar de ser el grupo menos numeroso”, Jimeno (1945, p. 562).

## REFERENCES

- Agar, J. (2012) *Science in the 20th Century and Beyond*. Cambridge: Polity Press.
- Alexander, J. ed., (1926) *Colloid chemistry: Theoretical and applied*. New York: The Chemical Catalog Co.
- Artigas, M., Martín-Sánchez Juliá, F., Gregorio Rocasolano, A. de, Allué Salvador, M., Sancho, M., Temprano, B., Riba, C., Miral, D., et al (1940) *Una poderosa fuerza secreta*. San Sebastián: Editorial Española.
- Baltá Elías, J. (1945a) “In Memoriam. Noticia biográfica del Excelentísimo Señor Don Blas Cabrera y Felipe”, *Anales de Física y Química*, 41, pp. 1261-1273.
- Baltá Elías, J. (1945b) “Fundamentos físico químicos y aplicaciones técnicas del alumbrado por fluorescencia”, *Anales de Física y Química*, 41(2), pp. 111-142.
- Baltá Elías, J. (1957) “Ingeniería solar”, *Revista de Ciencia Aplicada* 59, pp. 481-498.
- Blas, L. (1942) “La industria del bromo en España”, *Íón*, 7(2), 117-19.
- Box, Z. (2010) *Año Cero. La construcción simbólica del franquismo*. Madrid: Alianza.
- Bud, R. (2012) “‘Applied Science’: A Phrase in Search of a Meaning”. *Isis*, 103 (3), pp. 537-545. doi: <https://doi.org/10.1086/667977>
- Bush, V. (1945) *Science the Endless Frontier*. Washington: United States Government Printing Office.
- Camprubí, L. (2014) *Engineers and the Making of the Francoist Regime*. Cambridge Ma.: MIT Press.
- Camprubí, L. (2017) *Los ingenieros de Franco. Ciencia, catolicismo y Guerra fría en el Estado franquista*. Barcelona: Crítica, 2017.
- Camprubí, L. and Glick, T. (2020) “Spain”. In: H. R. Stolten, R. L. Numbers and D. N. Livingstone, eds., *The Cambridge History of Science. Vol. 8. Modern Science in National, Transnational and Global Contexts*. Cambridge: Cambridge University Press, pp. 361-375.
- Cazorla-Sánchez, A. (2005) “Beyond ‘They Shall Not Pass’. How the Experience of Violence Reshaped Political Values in Franco’s Spain”, *Journal of Contemporary History*, 40(3), pp. 503-520. doi: <https://doi.org/10.1177/0022009405054569>
- Consejo Superior de Investigaciones Científicas (1942) *Memoria de la Secretaria General 1940-1941*. Madrid: CSIC.
- Consejo Superior de Investigaciones Científicas (1946) *Memoria de la Secretaria General, año 1945*. Madrid: CSIC.
- Fernández Alonso, J. I. (1955) “Hacia una teoría cuántica de las sustancias que muestran actividad cancerígena. Lección inaugural del curso 1955-56”, *Anales de la Universidad de Valencia*, 29(I), pp. 1-106.
- Fernández-Ladreda, J. M. (1951) *Simposium de Temas de química aplicada*. Madrid: Aguilar.
- Foz Gazulla, O. R. (1948) “Química física y ciencia aplicada”, *Revista de Ciencia Aplicada*, 2(1), 37-41.
- Galison, P. (2008) “Ten Problems in History and Philosophy of Science”, *Isis* 99, pp. 111-124. doi: <https://doi.org/10.1086/587536>
- García-Conde, J. R. (1954) “Don José María Fernández-Ladreda. Una gran pérdida para la ciencia española”, *Revista de Ciencia Aplicada* 40, p. 463.
- Gibbons, R., ed. (1994) *The New Production of Knowledge. The Dynamics of Science and Research in Contemporary Societies*. London: Sage.
- Godin, B. (1998) “Writing Performative History: The New Atlantis”, *Social Studies of Science* 28, pp. 465-483. doi: <https://doi.org/10.1177/030631298028003004>
- González Bueno, A. and Baratas, A., eds. (2019) *Ciencia útil. Investigación básica y aplicada en Farmacia y Ciencias de la Vida*



- durante el Franquismo. Madrid: Universidad Complutense de Madrid.
- Gooday, G. (2012) “Vague and artificial. The historical elusive distinction between pure and applied science”, *Isis*, 103, pp. 546-554. doi: <https://doi.org/10.1086/667978>
- Gregorio Rocasolano, A. de (1937) *De la vida a la muerte. Trabajos del Laboratorio de Investigaciones Bioquímicas de la Facultad de Ciencias de Zaragoza*. Zaragoza: Editorial Gambón.
- Guirao, F. (1998) *Spain and the Reconstruction of Western Europe 1945-1957. Challenge and Response*. London: MacMillan.
- Gutiérrez Ríos, E. (1970) *José María Albareda. Una época de la cultura española*. Madrid: CSIC.
- Herf, J. (1984) *Reactionary Modernism. Technology, Culture and politics in Weimar and the Third Reich*. Cambridge: Cambridge University Press.
- Ibáñez Martín, J. (1940) *Hacia una nueva ciencia española. Discurso de José Ibáñez Martín en el acto inaugural del CSIC... 30 de octubre de 1940 en la Real Academia Española*. Madrid.
- Ibáñez Martín, J. (1942) *El sentido político de la cultura en la hora presente. Discurso de José Ibáñez Martín en el año académico 1942-43, en el Paraninfo de la Universidad Central de Madrid*. Madrid: Imprenta Samarán.
- Ibáñez Martín, J. (1950), *1939-1949. Diez años de Servicios a la cultura española*. Madrid: Hijos de Heraclio Fournier.
- Instituto de Estudios Asturianos (1955) *Velada-Homenaje a la Memoria del Excmo. Señor José María Fernández-Ladreda (celebrada el 16 de febrero de 1955)*. Oviedo: Diputación de Asturias. Instituto de Estudios Asturianos del Patronato José M.<sup>a</sup> Cuadrado (CSIC).
- Ión (1942) “Editorial. La Universidad y la Industria”, *Revista de Ciencia Aplicada*, 11(2), pp. 433-4
- Jimeno, E. (1945) “Valor de las teorías científicas y explicación del fenómeno de hidrólisis”, *Anales de Física y Química*, 41, pp. 561-572.
- Johnson, J. (2000) “The Academic-Industrial Symbiosis in German Chemical Research, 1905-1939”. In: Lesch, J. ed., *The German Chemical Industry in the Twentieth Century*. Dordrecht: Kluwer, pp. 15-56.
- Kaldewey, D. and Schauz, D., eds. (2018) *Basic and Applied Research: The Language of Science Policy in the Twentieth Century*. New York/Oxford: Berghahn Books.
- Kline, R. (1995) “Construing ‘Technology’ as ‘Applied Science’: Public Rhetoric of Scientists and Engineers in the United States, 1880-1945”, *Isis*, 86, pp. 194-221. doi: <https://doi.org/10.1086/357153>
- Krige, J. (2006) *American Hegemony and the Postwar Reconstruction of Science in Europe*. Cambridge Mass.: MIT Press.
- López García, S. (1997) “El Patronato Juan de la Cierva (1939-1960), I. Parte: Las Instituciones precedentes”, *Arbor*, 619, pp. 201-238. doi: <https://doi.org/10.3989/arbor.1997.i619.1828>
- López García, S. (1998) “El Patronato Juan de la Cierva (1939-1960), II. Parte: La organización y la financiación”, *Arbor*, 625, pp. 1-44. doi: <https://doi.org/10.3989/arbor.1998.i625.1787>
- López García, S. (1999) “El Patronato Juan de la Cierva (1939-1960), III. Parte: La investigación científica y tecnológica”, *Arbor*, 637, pp. 1-32. doi: <https://doi.org/10.3989/arbor.1999.i637.1679>
- Lora-Tamayo, M. (1970) “Ibáñez Martín y el CSIC”, *Arbor*, 289, pp. 7-10.
- MacVeigh Alfós, J. (1957) “La utilización en España de la energía nuclear. Ensayo de un programa”, *Revista de Ciencia Aplicada*, 57, pp. 357-358.
- Malet, A. (2008) “Las primeras décadas del CSIC: Investigación y ciencia para el franquismo”. In: A. Romero, M. J. Santesmases, eds., *Cien años de política científica en España*. Madrid: Fundación BBVA, pp. 211-256.
- Malet, A. (2009) “José María Albareda (1902-1966) and the Formation of the Spanish Consejo Superior de Investigaciones Científicas”, *Annals of Science*, 66, pp. 307-332. doi: <https://doi.org/10.1080/00033790902961819>
- Martín Guzmán, G. and Rubio Alberola, A. (1950) “Modernas orientaciones técnicas de la química del acetileno”, *Revista de Ciencia Aplicada*, 15, pp. 314-323; 16, pp. 417-427; 17, pp. 507-526.
- Menéndez Pelayo, M. (1953) *La Ciencia Española*. (3 vols.) Santander: Aldus.
- Moles, E. (1930), “La Universidad y la Industria”, *Química e Industria*, 7, pp. 148-153.
- Morris, P. (1993), “An Industrial pioneer: Walter Reppe was one of the pioneers of the German chemical industry”, *Chemistry in Britain*, 29(1), pp. 38-40.
- Nieto-Galan, A. (1998), “The images of science in modern Spain. Rethinking the ‘polémica’”. In K. Gavroglu, ed., *The Sciences in the European Periphery during the Enlightenment*. Dordrecht: Kluwer, pp. 65-86.
- Nieto-Galan, A. (2019) *The Politics of Chemistry. Science and Power in Twentieth-Century Spain*. Cambridge: Cambridge University Press.
- Nogareda, C. (1950) *Rayos cósmicos: Discurso inaugural del curso académico 1950-51*. Salamanca: Universidad de Salamanca.
- Onrubia, A. (1942) “La defensa pasiva propulsora de las industrias químicas”, *Ión*, 6(2), pp. 21-24.
- Otero Navascués, J. M. (1950) “El Instituto de Óptica Daza de Valdés”, *Revista de Ciencia Aplicada*, 16, pp. 385-93.
- Pascual, J. (1953) *La investigación científica y sus diferentes clases*. Barcelona: CSIC, Delegación de Barcelona.
- Patronato Juan de la Cierva (1947) *Hacia una nueva organización científica en los Estados Unidos*. CSIC. Madrid: Patronato Juan de la Cierva.
- Patronato Juan de la Cierva (1955) *Patronato Juan de la Cierva de Investigación Técnica, 1945-1955*. Madrid: Industrias Gráficas.
- Pestre, D. (2003) *Science, argent et politique: Un essai d'interprétation*. Paris: INRA.
- Presas, A. (2008) “La inmediata posguerra y la relación científica y técnica con Alemania”. In: A. Romero, M. J. Santesmases, eds., *Cien años de política científica en España*. Madrid: Fundación BBVA, pp. 173-209.
- Preston, P. (2012) *The Spanish Holocaust. Inquisition and Extermination in Twentieth-Century Spain*. London: Harper Press.
- Revista de Ciencia Aplicada* (1949) “Real Academia de Ciencias Exactas Físicas y Naturales. Primer Centenario de su Fundación”, 8, pp. 217-219.
- Revista de Ciencia Aplicada* (1950) “II Congreso Nacional de Ingeniería”, 15, pp. 353-359.
- Revista de Ciencia Aplicada* (1953) “La química del acetileno. Reacciones y procedimientos técnicos. Conferencias del Profesor Walter Reppe”, 32, pp. 261-62
- Revista de Ciencia Aplicada* (1955a) “Consejo Superior de Investigaciones Científicas. XIII Reunión Anual del Pleno”, 43, pp. 58-161.
- Revista de Ciencia Aplicada* (1955b) “Su Excelencia el Jefe del Estado inaugura el edificio del Patronato Juan de la Cierva”, 43, pp. 153-57.
- Revista de Ciencia Aplicada* (1956) “Entrega de una biblioteca técnica norteamericana a la Junta de Energía Nuclear”, 48, pp. 73-74
- Richards, M. (1998) *A Time of Silence (1936-45). Civil War and the Culture of Repression in Franco's Spain*. Cambridge: Cambridge University Press.
- Roberts, L., Schaffer, S. and Dear, P., eds. (2007) *The Mindful Hand: Inquiry and Invention from the Late Renaissance to Early Industrialisation*. Amsterdam: Koninklijke Nederlandse Akademie van Wetenschappen.
- Rodríguez Pire, L. (1955) “Ladreda, Catedrático y Químico”. In: *Velada-Homenaje a la Memoria del Excmo. Señor José María Fernández-Ladreda (celebrada el 16 de febrero de 1955)*. Oviedo: Diputación de Asturias. Instituto de Estudios Asturianos del Patronato José M.<sup>a</sup> Cuadrado (CSIC), pp. 13-19.
- Romaña, A. (1970) “Ibáñez Martín y la Ciencia Española”, *Arbor*, 289, pp. 25-29.

- Romero de Pablos, A. (2018) "Historia de una biblioteca atómica", In: L. Camprubí, X. Roqué and F. Sáez de Adana, eds., *De la Guerra Fría al calentamiento global Estados Unidos, España y el nuevo orden científico mundial*. Madrid: La Catarata, pp. 63-84.
- Romero de Pablos, A. and Sánchez Ron, J. M. (2001) *Energía nuclear en España: de la JEN al CIEMAT*. Madrid: CIEMAT.
- Sales, J. and Nieto-Galan, A. (2019) "Exilio y represión científica en el primer franquismo: el caso de Enrique Moles", *Ayer* 114 (2), pp. 279-311.
- Santesmases, M. J. (2018) *The Circulation of Penicillin in Spain. Health, Wealth and Authority*. London: Palgrave, MacMillan.
- Saz, I., Box, Z., Morant, T. and Sanz, J., eds. (2019) *Reactionary Nationalists. Fascists and Dictatorships in the Twentieth Century. Against Democracy*. Basingstoke: Palgrave/MacMillan.
- Schauz, D. (2014) "What is Basic Research? Insights for Historical Semantics", *Minerva*, 52, pp. 273-328. doi: <https://doi.org/10.1007/s11024-014-9255-0>
- Somsen, G. (2017) "Science, Fascism and Foreign Policy. The Exhibition 'Scienza Universale' at the 1942 Rome World's Fair", *Isis*, 108(4), pp. 769-791. doi: <https://doi.org/10.1086/695758>
- Toca, A. (2006) "'Dos profesiones para un solo cometido'. La introducción de la ingeniería química en España durante el primer franquismo", *Dynamis*, 26, pp. 253-285.
- Tomás Vert, F. (1988), *Laudatio. Investidura como "Honoris Causa" por la Universitat de València a José Ignacio Fernández Alonso*. Valencia: Universitat de València.
- Wizinger, R. (1942) *Carbón, Aire y Agua. Revisado, puesto al día y adaptado al caso español por el Dr. José María Fernández-Ladreda y Menéndez-Valdés, Coronel de Artillería, Catedrático de Química Técnica de la Universidad de Sevilla*. Madrid: Ediciones Afrodísio Aguado. Biblioteca Técnica y Profesional Afrodísio Aguado.