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Gender, names, and numbers: Recovering a national community of women scientists, 1975-2000

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ENG **Abstract: Introduction**. Databases of scientific publications are not only tools for researchers, but also become available sources for reconstructing scientific communities in the history of science and technology. A world of names of knowledgeable people in research and academia has been constructed from databases that rely on the association between authorship and authority. In this system of recognition, gender has been either absent or simply ignored, stabilizing male authority. **Objective and methodology**. With the aim of reconstructing a community of Spanish women microbiologists, we explore the presence of these women in the publication database Web of Science (WoS) and two specialised Spanish journals between 1975 and 2000. **Results**. A list of 33 women belonging to the scientific community of interest resulted from this endeavour. From this search process, we discuss the gender issues embodied in the sources available and analyse the related challenges and the methods and resources we employed. Our research highlights the concealed gender issues relating to the WoS, as well as the exclusion of many journals, particularly those published in languages other than English. We overcame these limitations by both utilising tools provided by the database and retrieving the scientific recognition given to women as authors in two Spanish journals. This experience of reconstructing collectives by focusing on women thus embodies a reflection on the sources used to identify women and the collectives in which they worked. A set of sources were identified, and the relationships developed between these sources enabled us to unveil the geopolitics of scientific authority through authorship and to reconstruct a gendered scientific community. **Conclusions**. This essay proposes a methodological approach in which limitations, such as the quantification of productivity and the association between authorship and authority, have been problematised yet sufficiently overcome to accomplish our objective. Instead of avoiding their use, a critical look at the construction of these sources has allowed us to recommend a useful methodology that challenges these limitations from within.
Keywords: History of antibiotics, women microbiologists, scientific authority, authorship, scientific databases, Web of Science, Spain.

ES Género, nombres y números: Recuperar una comunidad nacional de científicas, 1975-2000

Resumen: Introducción. Las bases de datos de publicaciones científicas no son solo herramientas con las que investigar, sino fuentes para reconstruir comunidades científicas en historia de la ciencia y la tecnología. Con esta base de datos se ha construido un mundo que se apoya en la relación entre autoría y autoridad. En ese sistema de reconocimiento, el género ha estado ausente o ha sido simplemente ignorado, lo que ha reforzado la autoridad masculina. **Objetivo y metodología**. Con el fin de reconstruir una comunidad de microbiólogas españolas, hemos explorado su presencia en la base de datos de publicaciones Web of Science (WoS) y en dos revistas españolas especializadas, entre 1975 y 2000. **Resultados**. Hemos obtenido una lista de 33 mujeres pertenecientes a esa comunidad científica. En el proceso de búsqueda, el género surge incorporado a las fuentes; con el género como categoría hemos analizado los retos, los métodos y los recursos empleados. Nuestra investigación muestra el género de la WoS, así como la exclusión en esa base de datos de muchas revistas, en particular las publicadas en idiomas distintos del inglés. Para superar esas limitaciones de la WoS hemos usado herramientas que esta proporciona, además de recuperar el reconocimiento científico otorgado a mujeres autoras en dos revistas españolas. Esta experiencia de reconstrucción de una comunidad de mujeres conduce a una reflexión sobre las fuentes. El conjunto de fuentes identificadas y las relaciones entre ellas nos permite tanto desvelar la geopolítica de la autoridad científica que opera a través de la autoría como reconstruir una comunidad de género. **Conclusiones**. Este

artículo propone una aproximación metodológica por la que limitaciones como la cuantificación de la productividad y la asociación entre autoría y autoridad, se problematizan para lograr nuestro objetivo. En lugar de evitar su uso, una mirada crítica a la construcción de estas fuentes nos ha permitido recomendar una metodología útil que desafía esas limitaciones desde dentro.
Palabras clave: Historia de los antibióticos, microbiólogas, autoridad científica, autoría, bases de datos científicas, Web of Science, España.

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1. Introduction

In the contemporary era, scientific authority is associated with authorship. Published authors are recognised as knowledgeable and expert scholars, while those who are not signatories to a publication or unpublished manuscript have no recognised authority. Among scientific authors, the gendered hierarchies of the laboratory – the space in which experiments are performed – manifest the social epistemology of authority (Rossiter, 1982, Chapter 10). The styles and codes of representing authority are transferred from the lab to lists of authors, as well as academic power and leadership, in a feedback loop that stabilises male authority.[1] In such a coherent circular system of recognition, gender has been either absent or simply ignored. A world of names of knowledgeable people in research and academia has been constructed from databases, in which each publication corresponds to a certain level of prestige and recognition.[2]

With the aim of reconstructing a community of Spanish women microbiologists, we have selected a set of sources to identify a group of women's names. They had contributed to this biological and biomedical discipline in a period between 1975 and 1999. In this paper, we describe and analyse each of the steps we have taken to afford this objective. All along the research, the gender issues embodied within these sources emerged. This has led us to show, in all this epistemic complexity, how a gendered community is reconstructed, while we present the methods and resources available for locating Spanish women microbiologists among authors in journal and publication databases.

Journal indexes and the Web of Science as authorship sources enable us to discuss the absence of both gender and many national journals from this purportedly global database. These constraints can be overcome by taking advantage, first, of the tools provided by the WoS database. Secondly, this is complemented by retrieving the scientific recognition that women authors have been afforded by the Spanish journals we have reviewed. The geopolitics of the WoS, understood from a historical perspective, are confronted here by the gender anonymity of authorship. This means that Spanish journals were not included in the WoS, as the original database was not created for this purpose of retrieving Spanish women scientists. Thus, while overcoming this absence in the WoS we are allowed to discuss the geopolitics of the database itself: its geographical dimension and the role of this geographical dimension in the construction of a gendered scientific authority.

An awareness of the constant participation of women in the production of knowledge and experimental practices, through authorship, writing, and performing experiments, has emerged from the feminist historiography on sources for reconstructing expert communities of women.[3] This paper is situated within the area of gender studies that explores how women experience the production of knowledge and the practices of research in a gendered social order.[4] Being an author, a signatory, does not necessarily reflect academic authority. Our focus here is the tangible contributions made by women. The techniques we employed to find and identify women authors emerged as part of our research into Spanish women microbiologists involved in antibiotics research. Whether searching for new drugs or using existing ones for biological research, as an object or a tool.

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1 On the meaning of 'sex roles ... and how they function to maintain social order or promote its change', see the classic reference Scott (1986, p. 1054). On the study of knowledge production and authority from the sociology, history, and anthropology of science, see Cronin (2005), and Latour and Woolgar (1979).

2 A review on bibliometric analysis for addressing gender differences in research is in Mählck (2001).

3 On searching for women, see Green (1999). On women microbiologists researching antibiotics, see Eveleigh and Bennett (2018). For a discussion on women's authorship and authority, see Cabré i Pairet (2003). The scholarship on this is vast, but the most influential works from scientific disciplines and the humanities include Abir-Am and Outram (1987), Cabré i Pairet and Ortiz-Gómez (2001), Miqueo et al. (2003), More et al. (2009), Ogilvie et al. (2000), Rossiter (1982, 1998, 2012), Santesmases (2000, 2020), Schiebinger (1991), and Pérez Sedeo and Kiczkowski. (2010).

4 On the historiography of women scientists in Spain, see Álvarez Ricart (1988), Ballarín Domingo (2001), Cabré i Pairet and Ortiz Gómez (1999), Flecha García (1996), Magallón Portolés (2004), and Santesmases (2000).

This paper presents the result of this process, a significant list of women's names, as well as the methodological reflections and choices that proved useful for reconstructing the scientific community of interest. It also identifies women belonging to it and contributing to the field of antibiotics and its resistances. This text provides an account of our search for these women, and the efficacy for this purpose of the tools and databases available. This set of sources has become a methodological space in itself, in which we initially confirm the constant historical presence of women in the microbiological space of production. Then, we demonstrate the extent to which women microbiologists have not only contributed to the history of knowledge about microbes but also that of antibiotics and antibiotic resistance.

Although women scientists have often been either concealed or kept in the margins due to the limitations of historiography and its sources, as we show in this paper, the tools required to unveil their names are available. As Jane Scott (1986) has argued, every word has a history and, as we historicise a gendered social order in the sciences, particularly in microbiology, gender, and women are both the subjects and objects of our analysis.

2. Gender, authorship, and publication databases

By confining our study of women microbiologists to those who conducted research on or with antibiotics, we can use the term antibiotic as a research tool to reconstruct a gendered history of both our own investigation. We can also examine the sources and contents of the relevant research. Thus, we situate our object of enquiry – antibiotics – as a tool in our search for women's authorship and the research performed by these women. This has led us to genderise both antibiotics and the practices involved in researching on and with these drugs. It is the genderising of our project that has enabled us to locate women and gender in the construction of authority, authorship, and research on antibiotics (Santesmases, 2014).[5]

As a first step in our search for the names of women in the vast and high-profile WoS database, we used the names of antibiotics as search terms. We also considered using the vast scientific database MEDLINE for this research. However, MEDLINE would not allow us to apply our search terms to keywords, and no field tags are available for countries, only addresses, which can produce indistinct results. As it is well known, WoS database does not currently include the first names that would go at least some way towards determining the gender of authors. Another obvious embodied constraint is the non-inclusion of many journals.

It is worth noting that the WoS originated from the Welch Medical Library Indexing Project, initiated in the late 1940s and funded by the US Armed Forces Medical Library to develop an indexing and information retrieval system for medical publications (Garfield, 2007; Small, 2018). The initial Science Citation Index (SCI), invented by Eugene Garfield, circulated widely from the 1970s onwards and became a dominant source of recognition in most countries through the 1980s and 1990s.[6] The influence of this original setting became international, determining how journals in the English language were published and prompting unparalleled funding schemes at the roots of science policy as performed today.[7]

Academic and scientific authority has since been constructed on the citation indexing scheme elaborated at that time. Due to this geopolitical selection bias, very few Spanish journals are included (Bordons, Morillo, Fernández, & Gómez, 2003). However, the value attributed to the journals that are selected by WoS makes the publication in non-native and foreign language journals necessary for many researchers aspiring to an academic career. To address this constraint, we also reviewed two Spanish journals over the same period, from which we identified a set of women microbiologists involved in antibiotic research.[8]

Searching for women's names in archives and journals remains a difficult task.[9] However, it is less difficult to identify the names of Spanish women: not only do they retain their surnames on marriage, but there are substantially less gender-neutral names than in English-speaking countries. It is sometimes possible to identify women's names in Central and Eastern European languages, particularly those that employ the Slavic name suffixes, but this depends on whether a woman is married and with whom.[10]

Large bibliographic databases based on surnames are of little help when reconstructing a gendered research community, as these names belong to cultures that deem a distinction between women and men to be unnecessary. Such a lack of differentiation in authorship has reinforced men's authority. As the historiography of women has demonstrated, it is a laborious challenge to discover names and recreate the communities of active women professionals that enable a gendered biographical account of collectives.[11] Yet our certainty of their participation in all areas of research and science – or almost all, as some have been, and a few

5 On women engineers, see Tobies et al. (2014) and Zachmann (2004).

6 On uses and evaluation within the Spanish biomedical community, see Camí Morell et al. (1997).

7 On US funding policy for biology and biomedicine, see Appel (2000).

8 On the manual work needed when searching for women, see the case of Spanish women editors of scientific journals in Miqueo et al. (2011).

9 On women hidden behind the names of their male colleagues in archives, see Romero de Pablos (2016) and Velasco Martín (2016, 2020).

10 'Global talk on Women at Universities in East-Central Europe', held virtually on the 27 of January 2022, was a highly inspiring presentation and short discussion on this topic, in which a group of colleagues presented books by Bečvářová (2019) and Derra et al. (2020). Languages and the challenges they pose for the practices of identifying women's names in research were addressed. https://www.eventbrite.de/e/global-book-talk-women-at-universities-in-east-central-europe-tickets-239494112337#.

11 For a gender study on Spanish patents that addresses the difficulties of identifying women's names, see Mauleón et al. (2014). See also Romero de Pablos (2020) on a case of a woman scientist' patent.

remain, particularly impermeable or discouraging to women – motivated our reconstruction of this gendered community.

3. Gender and microbiology in WoS

As explained above, WoS was our initial source for identifying Spanish women scientists who worked on antibiotics or antibiotic resistance, or who used antibiotics as tools in their research. Following considerable debate and advice on search term selection (see below), we secured a list of authors, all with surnames and initials. This non-gendered list is the standard introduction to database searches for a yet unknown scientific community.

In order to construct a corpus of scientific publications on antibiotics from WoS, we relied on bibliometric analysis experts led by María Bordons. Through continuous discussion with and advice from two members of this group, Borja Manglano and Luz María Moreno Solano, we constructed the six sets analysed below. We used the three main databases – Science Citation Index (SCI), Social Sciences Citation Index (SSCI) and Arts and Humanities Citation Index (AHCI) – on the Web of Science Core Collection (WoSCC). With historical intent, we followed bibliometric instructions to ask WoSCC a number of questions, as if it was an archive. The questions formulated our initial path by including a date range, 1975–1999, and Spain as the country of affiliation of the authors.

We posed four independent questions based on selected search terms that were sought for in the title and keywords of articles and reviews.[12] These terms were: (1) *antibiotic/s* as a general term; (2) names of groups of antibiotics with no additional pharmacological action, such as *penicillin/s*, *tetracycline/s* and *cephalosporin/s*; (3) names of groups of antibiotics with additional non-antimicrobial activities, such as *quinolone/s, sulfonamide/s* and *glycopeptide/s*; and (4) specific names of generic antibiotics, including *amoxicillin*, *ampicillin*, *gramicidin*, *fosfomycin* and *rifampicin*. Those groups of terms were also combined and asked altogether in a single query (5). In order to construct a set of antimicrobial-only research papers and authors, a final query (6) was posed in which only the questions 1, 2 and 4 were combined. Each query produced a different set of publications and, therefore, of author's names, displayed in a ranking sorted by productivity —understood as the number of signed indexed publications. As a result, for each set, we secured two connected lists, one of documents and a non-gendered one of signatories, the total results of which are compiled in Table 1.

Table 1. Sets, Terms and Resulting Quantities of Documents and Authors involved in research on antibiotics in Spain, 1976–1999 in WoS

	Terms searched for in title and keywords	Number of documents	Number of authors
Set 1	Antibiotic/s	656	1492
Set 2	Names of antibiotics with no other pharmacological action	697	1670
Set 3	Names of antibiotics with other non-antimicrobial action	376	1113
Set 4	Specific names of generic antibiotics	1745	4966
Set 5	Combination query: 1 OR 2 OR 3 OR 4	2960	7017
Set 6	Combination query: 1 OR 2 OR 4	2728	6662

Authors' elaboration of data from WoS.

As shown in Table 1, there are many publications in each set, the highest amounts corresponding to combinations, followed by papers referring to specific antibiotics. This reflects the substantial amount of research that has been conducted on isolated antimicrobials by specialised research groups prior to commercialisation, including clinical trials, pilot plants and experimental manufacturing.[13] Once the total of authors has been obtained, identifying the women belonging to it becomes the next step.[14] The quantity of these results

12 In order to assemble a manageable number of publications for our research, we simplified the search by not including abstracts among the paper elements to be surveyed. As antibiotics have several purposes within experimental research, publications in which an antibiotic has not been a research object itself – for instance, when it has been used as a control mechanism for the selection of a certain bacterial strain – could include the relevant terms in the abstract. Therefore, they could be selected. In a further attempt to simplify the study, the resulting publications were then refined by document type, and conference proceedings, meeting abstracts, editorial material, letters, etc., then discarded.

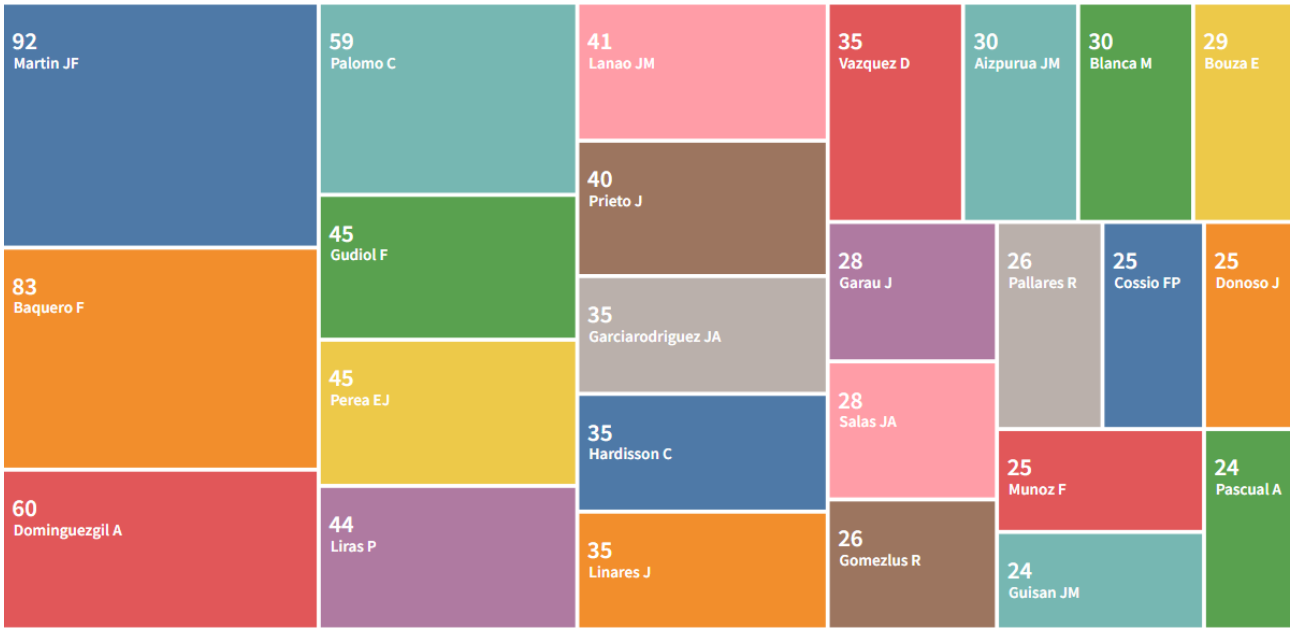
13 The early history of penicillin reveals the extensive studies conducted before any antibiotic is finally made available for clinical trials and on the market, see Bud (2009), Hobby (1985), Lesch (2006), Marks (2000), Santesmases (2018) and Santesmases & Gradmann (2011).

14 Due to the signatory variants of an author throughout their academic career and the possibility of authors with the same surname and initial being collected into a single author record, these numbers are not an entirely reliable representation.

was too vast for our purposes of gender inference, but at the same time emphasises the value of gendering such a significant community. The lists also demonstrate the usefulness of WoS, despite its limitations.

As WoS lists the authors by number of signed publications, we surveyed the 25 most productive authors provided by each set. This reduced our results to manageable amounts, from which we could proceed to identify the names of women. It might seem redundant to go through all the sets. However, as this process requires a selection, the order within the ranking becomes relevant, and the combination sets provide additional sources of information in terms of gender. This order is displayed in the WoS through a diagram presenting the 25 most prolific names for each query. Figure 1 shows the diagram obtained for combination Set 5. This visual representation of authority in a bright-coloured diagram, with the number of publications decreasing from top left to bottom right, embodies the extent to which counting has become an exercise associated with recognition.

Figure 1. Tree Map chart visualization automatically displayed by WoS for 25 most prolific authors of indexed publications on a combination of antibiotic-related terms (Set 5).



Source: Web of Science, accessed September 2023.

From these reduced lists, gender could be inferred. By locating forenames from initials and surnames in scientific publications, news reports and institutional profiles on the internet, we identified a total of twenty women among the six top 25 results. Table 2 shows the number of women found for each set, and their percentage and position in the 25 most prolific author lists. As shown, the third set produced nine women (36% of the 25 total), the first revealed six (24%), the fourth produced five (20%), the second revealed four (16%), and sets five and six both generated three women (12%). The identities of the women in this Spanish gendered microbiology collective are shown in Table 3.

Table 2. Women found among the 25 most prolific authors for each query in WoS: number of women, gender percentage of authorship, and position of women in the list

	Terms searched for in title and keywords	Number	Percentage	Position
Set 1	General terms	6	24%	5, 8, 9, 11, 14, 16
Set 2	Names of antibiotics with no other pharmacological action	4	16%	9, 15, 16, 24
Set 3	Names of antibiotics with other non-antimicrobial action	9	36%	8, 11, 14, 15, 16, 19, 20, 23, 25
Set 4	Specific names of generic antibiotics	5	20%	5, 15, 19, 20, 25
Set 5	Combination: 1 OR 2 OR 3 OR 4	3	12%	7, 12, 22
Set 6	Combination: 1 OR 2 OR 4	3	12%	6, 10, 20

Source: authors' elaboration of data from WoS.

Table 3. Women found in the 25 most prolific authors from all sets: forename (traced outside WoS), surname, set, quantity of publications and position in list.

First name	Surname	Number of publications (and position) in the most prolific author list for each set					
		Set 1	Set 2	Set 3	Set 4	Set 5	Set 6
Carmen	Méndez	16 (5)					
Josefina	Liñares	11 (8)	18 (15)			35 (12)	34 (10)
Mercedes	Maqueda	11 (9)					
Eva	Valdivia	11 (11)					
Paloma	Liras	10 (14)	13 (24)		34 (5)	44 (7)	44 (6)
Josefa	Donoso	9 (16)	22 (9)			25 (22)	25 (20)
Cristina M.	Rosell		18 (16)				
Mercedes	Álvarez			9 (8)			
Sacramento	Ferrer			7 (11)			
Victoria	Sanznebot			7 (14)			
Carmen	Torres			7 (15)			
Rosa	Berges			6 (16)			
María Carmen	Mendoza			6 (19)			
María Teresa	Montero			6 (20)			
María Ángeles	Xicota			6 (23)			
Emilia	Cantón			5 (25)			
Concepción	Abad				17 (15)		
María Luisa	Gómez-Lus				16 (19)		
Tránsito	Olay				16 (20)		
Amparo	Sánchez				15 (25)		

Women have been ordered by first appearance in the 25 most prolific authors in the order of queries, and by their position within that list. When publication quantity is the same, WoS ranks names alphabetically.
It is worth clarifying that the number of publications found in the combined questions may be higher than the sum of the individual questions because the number of publications is only shown for the 25 most prolific authors. They are always included in combinations. Source: authors' elaboration of data from WoS.

Although men appear more prolific or at least more visible in such databases, due to generally holding higher academic positions, this does not necessarily mean that women have been less involved or less productive in research.[15] These results do not correlate with the proportion of women in science, which has been determined to be around 30% since at least the 1980s.[16] The low percentage of women resulting from each query demonstrates that men are more often signatories in general and probably over a wider range of terms than women. The gendered hierarchy of laboratories may well be a factor in this, as more directors of departments and research units are men and sign publications alongside researchers in the groups they lead.[17] Although women feature throughout the most prolific 25 researchers in each query result, they are never placed above the fifth position.

As expected, combination sets don't provide additional names (see Table 3). However, it is informative how they report the lowest percentages of women. In this case, adding names and research areas results in the displacement of mostly women, who become less present in the diagram and harder to find and recognize. Only three women publish in quantities large enough and range of terms wide enough to appear in both

15 As Bordons et al. (2003) have shown, productivity is directly related to professional status in a feedback loop. Not only is productivity needed to gain promotion, higher positions with their greater opportunities for collaboration and securing funding facilitate an increase in productivity. The lower productivity of women researchers can be explained by the vertical segregation generally depicted in the scissors diagram. When scientists with the same professional status are compared, no significant difference is found.

16 On the evolution of women scientists in Spain, see Alcalá Cortijo et al. (2005). The situation has changed little: *She Figures* 2021 claim that 32.8 per cent of the total population of researchers in the European Union are women (European Commission & Directorate-General for Research and Innovation, 2021). According to the same report, the figure in Spain is nearer to 40. https://ec.europa.eu/assets/rtd/shefigures2021/index.html#chapter4

17 On the situation in the fields of Chemistry and Natural Resources, see Bordons et al. (2003).

combination sets. Avoiding repetitions, a total of twenty women was obtained from these sets. This list of names is too biased, too constrained by WoS calibrations, to constitute the sole source for reconstructing a national gendered community in microbiology from a historical perspective to represent the community of women involved in antibiotic research. To overcome the limitations of WoS, we also reviewed Spanish journals of microbiology not included in this database.

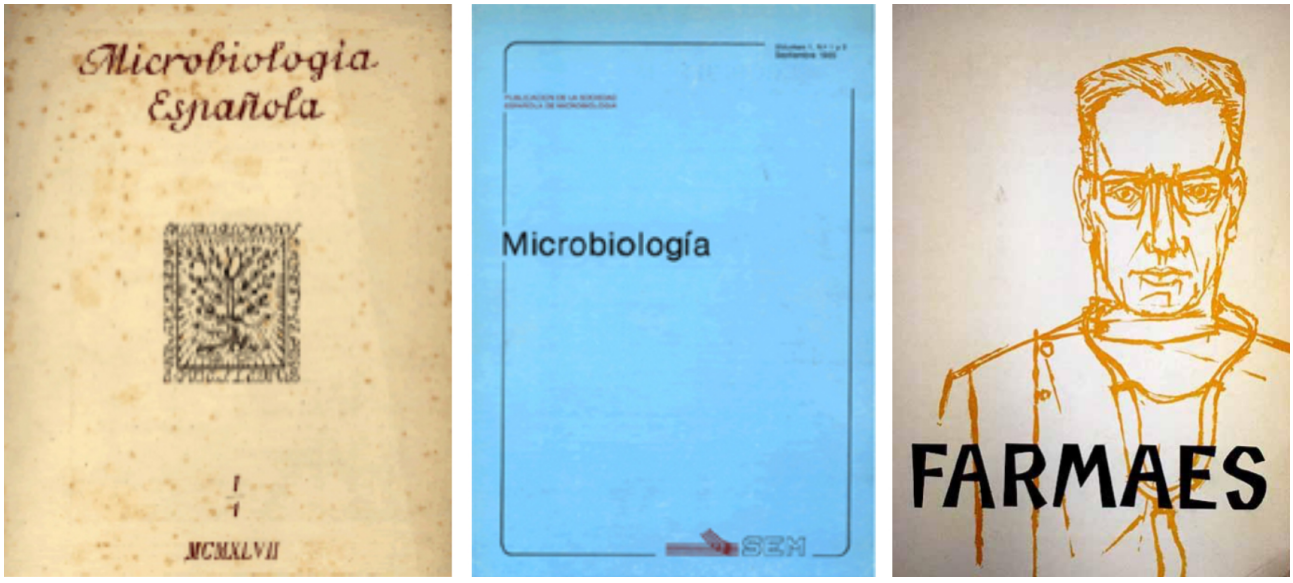
4. Spanish microbiological journals

The first journal we selected was the Spanish, peer-reviewed *Microbiología Española*, edited by the Spanish Society of Microbiology and renamed *Microbiología SEM* in 1985. Since its launch in 1947, between one and four issues have been published each year.[18] This journal has a national character and scope, and thus is a useful source for analysing the Spanish arena of microbiological research in the period under study. This selection is based on the growing articulation and leadership of the Spanish community of microbiology around the Spanish Society of Microbiology and its Spanish-language journal.[19]

We also surveyed the journal *Farmaes*, published by the 'scientific section' of Compañía Española de Penicilinas y Antibióticos (CEPA), one of the Spanish firms authorised by the Franco dictatorship during the late 1940s (Santesmases, 1999, 2018). Between 1956 and 1982, *Farmaes* was an agent in CEPA's strategic marketing of antibiotics to physicians and clinicians. The scientific and medical content of articles uses the same styles and strategies as publications designed to sell antibiotics at that time (Gaudillière & Thoms, 2013).[20] In between advertisements for CEPA products, contents include contributions from clinicians and academics on medical issues such as diseases, medicines and recent therapies.

A network of interactions between clinical, academic and industrial fields is revealed through *Farmaes*'pages, providing a picture of the socio-medical network of experts whose practices and knowledge participated in the promotion of CEPA antibiotics as reliable scientific drugs. It was following the publication of experiments relating to the isolation and commercialisation of the new antibiotic fosfonomycin, later named fosfomycin and marketed by CEPA as Fosfocina from 1973 (Santesmases, 2018). Farmaes began to publish articles on this antimicrobial by Spanish clinicians and researchers. The journal features the proceedings of conferences celebrating fosfomycin and articles with CEPA research staff and other clinicians as signatories. *Farmaes* enables us to explore the industrial connections of those involved, who generally have influential expertise and a strong voice in professional communities. By including the periodical and propaganda strategy of a private firm, we expand our analysis of gendered authority in microbiological networks beyond research and clinical laboratories to include antibiotic manufacturing.

Figure 2. Covers of the Spanish scientific journals reviewed identify Spanish women conducting antibiotic research



From left to right: *Microbiología Española*, *Microbiología SEM*, and *Farmaes*. Source: webpage of the Spanish Microbiology Society and scan of *Farmaes*' cover made by the authors.

18 The journal was renamed again in 1998. With international aspirations, *International Microbiology* is currently the official journal of the Society. Published entirely in English, the journal aims to promote the use of English in papers and the discipline in Spain. By 2005, it had been incorporated into the Science Citation Index (SCI). See SEM's website.

19 For a historical reconstruction of the Spanish Society of Microbiology, its scope and journals, see Vázquez Valero and Ronda Laín (2002) and García Mendoza and Martínez (2008). On Spanish microbiologists of the 1950s and the 1960s, as founders of the Spanish Society of Microbiology, see Santesmases and Muñoz (1997).

20 On pharmaceutical marketing, see Gaudillière and Thoms (2013). On CEPA as one of the two factories permitted to manufacture penicillin in Franco's Spain during the late 1940s, see Santesmases (2018).

The publications and contents of these two journals were explored – and in the case of the first journal, only those related to antibiotics or their resistances were selected – as means for women authors. We secured a list of women from these two journals, which in some cases provide the full names of authors. When these were not included, forenames were again ascertained from institutional websites and internet archives. Our main aim was not to count the number of publications by each woman, but rather their appearance on indexes as authors. As can be seen in Table 4, a total of 33 women researchers were found among the signatories of papers published in these journals between 1975 and 1997. Although six of these had featured among the 25 most prolific author results for the sets we conducted in WoS, the Spanish journals provided a significant number of previously undiscovered names. Women microbiologists appear and disappear in WoS, depending on assumptions made, and the gender invisibility of scientific publication databases provides a landscape that requires careful and repeated examination.

This list of women microbiologists and the actions taken to construct it constitute both a method and an epistemology, a way of knowing and a practice for gaining knowledge. An assumption about gender was instrumental for constructing this gender knowledge: we knew we would find a group of women microbiologists but did not know their names. Names count; they create gendered identities in our study. Numbers became a classification category on the basis of publication productivity, obtained from the vast WoS database, which only enables part of the community of women microbiologists to be taken into account.

Our sources proved to be a combination of assumptions, practices, and sets of publications and journals. This not only reveals the limitations of WoS for a study in search of a gendered community, but also the agency of the absence of many journals from such databases. The fact that instrumental Spanish journals – instrumental for our study – were not included has its historical roots in the origins of WoS as a tool created for a particular national scientific community. The manufacture of the concept of "international publications" merits further investigation. This study has prompted such a reflection on WoS by focusing on gender, an invisible factor for this database. Through our attempts to overcome this gender invisibility, we found an additional absence: that of articles published in journals not included in WoS. These Spanish journals belong to an expert community whose capacity to create authority from publishing was challenged by the WoS database. As our findings show, this feedback loop has become a silent, concealed factor that participates in the manufacturing of scientific authority. Only collecting the names of women microbiologists from Spanish journals, rather than counting publications, reveals this feedback loop.

Table 4. Women found in the Spanish Scientific Journals Microbiología Española/Microbiología SEM and Farmaes (1975–1997) and their non/inclusion in WoS queries

First name/s	Surname/s	Comparison with WoS results
Emilia	Cantón Lacasa	In at least one of the 25 most prolific authors lists
María Luisa	Gómez-Lus	
Paloma	Liras Padín	
Carmen	Méndez Fernández	
María del Carmen	Mendoza Fernández	
Tránsito	Olay	
Ángeles	Arias	Among resulting authors for at least one of the six queries, but not in any of the 25 most prolific author lists
Rosa	Cardoza	
Helen M.	Dodd	
Ana	Felipe	
María Luisa	García López	
Concepción	García Mendoza	
Carmen	Guerrero	
Amelia M.	Hernández García	
Inmaculada	Meseguer	
Monique	Novaes-Ledieu	
(María) Isabel	Otal Gil	
Concepción	Pintado	
María José	Rivera	
Loreto	Robledano	

First name/s	Surname/s	Comparison with WoS results
Ana María Joaquina	Rodríguez Alonso	Among resulting authors for at least one of the six queries, but not in any of the 25 most prolific author lists
Ana	Rodríguez González	
Concepción	Ronda	
María	Santos Durántez	
María V.	Vicente	
Carmen	Vilches Cañizares	
Rosa	Cenamor Jerez	Not in resulting authors for any of the six queries
María Ángeles	Díaz	
María Francisca	Fillat Castejón	
Begoña	Gómez-Miranda	
María Dolores	Montoya	
Ángeles	Moya	
Alicia	Muela	

Women within each of the three categories in the comparison column are alphabetically ordered by surnames. Source: authors' elaboration of data from WoS.

5. A national approach and a large database: a reflection on gender and bias

Until very recently, the gender of authors has not been regarded as relevant in the social order in which WoS was manufactured. This lack of interest in whether an author is a woman suggests that male authorship has not only been taken for granted, but is also the basis upon which such publication databases, constructed to produce authority and academic distinction, have been created.[21] This gender invisibility is also found in other platforms of authority, including publications and styles of referencing that exclude the forenames of authors.

We selected WoS for our analysis as it is one of the most highly regarded databases among scholars and science policy-makers. However, the practice of quantifying publications does not reveal the scientific community we wish to investigate. Both the scientific community and the bibliometric statistics that databases provide are governed by the gendered politics of science. Jeremy Greene (2007), Aryn Martin and Michael Lynch (2009), and Theodor Porter (1996), are among authors who have discussed number creation and the complexity of their production from, respectively, metabolic studies, images, and social events. Databases are governed by the geopolitics of the sciences and technologies, in which journals from some nations are not included or are required to meet particular requirements to be considered (Bordons et al., 2003; Cronin, 2005). Such a mainstream scientific database as WoS is of little use when reconstructing a gendered scientific community, but remains a useful tool for finding publications by a given author when her/his name is known. We have therefore used Spanish journals to explore the academic, clinical, and industrial spaces relevant to our research. By prioritising names over productivity and using these journals as sources, we then followed the names to determine the authority commanded by these women through WoS.

Our approach was not only designed to identify those women scientists within the list of the most productive 25 authors, but any woman contributor that available sources could provide. Those few women who did appear in the WoS 25 most productive lists were not a representation of the 30 percent of women active within the research community. Our review of the papers in every issue of the Spanish journal provided us with women's names, enabling us to recreate a community of expert women researchers whose academic authority we then verified through WoS. Our methodology and the research pathways analysed in this essay contribute to discussions on the meaning and usefulness of scientific production as presented by WoS; the recognition afforded to the most prolific authors; the symbolic capital attributed to journals excluded from this database; and the gendered meaning of authority, authorship, and recognition[22]. The resulting list of women microbiologists challenges the authority held by publications and journals included in WoS and recognised by expert communities.

In this paper, we have discussed our approach to reconstructing a relatively unknown community. We have used authorship as authority in order to discuss and in part challenge the taken-for-granted relationship between these two factors: that is, that authority is constructed through publication, and recognition is created through the inclusion of an author's name in WoS. Those who are not signatories are absent from both the

21 Searching for publications and citations is an easy task when surnames and names are known. For a critical review of publication databases, see Cronin (2005) and references therein. On the limitations for Spanish names, in this case regarding funding agencies, see Álvarez-Bornstein et al. (2017).

22 On authority and authorship from a gender point of view, see Cabré i Pairet (1995).

database and our selection. Signatures and publications are our first contact with the Spanish women microbiologists we wish to study, and we cannot bypass the authority mechanisms of science policy embodied in publication strategies.

By combining women and antibiotics in our historical reconstruction, a selected set of objects – antibiotics and journals – has allowed us to articulate the agents at play in this history. By focusing on such a set, we have been able to identify a group: a collective of Spanish women microbiologists. In this research, both our analysis and ourselves have conducted a relationship with antibiotics and their associated microbes (Brives, Rest, & Sariola, 2021; Landecker, 2016; Núñez-Casal, 2015), objects acting as articulators not only of a historical reconstruction, but the research we have conducted. A set of sources were identified through these objects, and relationships developed between these sources enabled us to unveil the geopolitics of scientific authority through authorship and reconstruct a gendered scientific community.

6. Conclusion

The concepts and results discussed here speak not only about our methodology but the community under study. We have identified women researchers belonging to an expert community: that is, a set that represents gendered microbiology expertise on antibiotics. The historical focus of the project is contemporary – from the mid-1970s to the end of the 1990s – and the community of interest is a recent one. Scientific databases and specifically WoS are not only current tools for researchers, but also become available sources for reconstructing scientific communities in the history of science and technology. In our experience, WoS was a useful source, providing us with many scientific articles and authors, and verifying authority as defined by publication quantity.

However, it is also geographically biased and gender-blind. Its wide scope implies a selection in the data presented. The selection criteria have geopolitical and gendered implications that reproduce and reinforce the invisibility of women scientists and the gendered hierarchies of the laboratory. Both the absence of any gender mark in the authors indexed and the use of productivity as a sorting criterion have made the process of looking for women an active one. The realization of the gendered construction of the database was only possible due to our awareness of both the gender politics of science and the participation of women in scientific activity. Statistics, indexes and quantitative indicators are of no help for the identities required in the situating intent of feminist historiography. Our search for these women scientists has therefore required a critical and analytic use of sources to overcome various challenges.

We therefore conducted a subsequent, qualitative search, by methodically examining Spanish journals that do not appear in WoS. As a complementary approach, the scope was dramatically reduced, yet it was our critical conscience the one that guided the selection. These provided additional names of women microbiologists, enabling us to reconstruct a gendered research community without any consideration of the social status of their research settings. This has been an inclusive choice: the strategic combination of these sources contributes to debates about the reproduction and reinforcement of gender hierarchies in science policy. The outcome of names has been very different, not only between the parallel strategies followed in different sources, but also among the different sets in WoS. This just goes to show how crucial the selection of a critical search criteria is, yet how complex the process is.

This paper gives an account of a successful search process. A list of names of women's names – and two surnames – has resulted from this experience. A total of 33 women belonging to the scientific community of interest and who have contributed to the research field of antibiotics have been identified. Besides this list, a satisfactory methodological strategy is presented. Our experience of reconstructing collectives by focusing on women thus embodies a reflection on the sources used to identify women and the collectives in which they worked. Much has been written on the relationships between women, scientific production, citations, and recognition.

In the research presented in this paper, we have explored these issues by reflecting on how databases and publications as historiographic sources relate to gender. Limitations such as the quantification of productivity and the association between authorship and authority have been problematised yet sufficiently overcome to accomplish our objective. Instead of avoiding their use, a critical look at the construction of these sources has allowed us to propose a useful methodology that challenges these limitations from within.

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