

## Gabriella Morreale, The Italian-Spanish Chemist who Introduced the Heel Prick Test in Newborns



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**ABSTRACT:** This article shows the biography of a woman, Gabriella Morreale, born in Italy but nationalized Spanish for having lived since she was eleven years old and having developed her brilliant work in that country, to whom many merits are owed because of the important discoveries that she did in her professional activity as a graduate and doctorate in Chemistry. Among its milestones are the introduction of the heel prick test, a clinical test for the early detection of congenital metabolic diseases, and her studies on iodine deficiency, especially serious among the youngest, because it can cause brain damage. The main objective is to remember her figure and put her as a reference to society. The methodology followed has been the usual one in this type of works, the search in mainly primary sources of data about her life and the importance of her scientific research.

**KEYWORDS:** Italian Spanish chemist women, Gabriella Morreale, the heel prick test in newborns, iodine deficiency, history of sciences.

### 1. INTRODUCTION

Although there are some very good biographies in the literature, albeit scarce, about Gabriella Morreale, an Italian-Spanish woman, born in Milan at the beginning of the 30s of the last century and who later obtained Spanish nationality in 1953, her figure goes almost unnoticed for society in general, which ignores her transcendental scientific milestones. And all this despite her scientific work makes her worthy of being recognized as one of the best chemists of the second half of the 20th century, thanks to the important discoveries she obtained throughout her career, both nationally and internationally,

This article is written with the intention of highlighting that woman in society, showing a biography of hers that completes those already existing in the literature with novel data. Its main objective is to put this woman as a referent to society and show her as a model and example for the rest of the women who have the same aspirations.

The methodology followed in the article has consisted of searching for information on her in all types of sources, basically primary, in archives and records, both bibliographic and digital, with the aim of highlighting all the relevant aspects of her life that are not contemplated in the scarce previous biographies existing about her.

The acronyms used in this article are as follows: CSIC represents the Spanish "Consejo Superior de Investigaciones Científicas" (see Note 1); CIB-CSIC the Spanish "Centro de Investigaciones Biológicas del CSIC" and UAM the Spanish "Universidad Autónoma de Madrid".

### 2. RESULTS: GABRIELLA MORREALE: HER BIOGRAPHY

In this section we present the biography of Gabriella Morreale, emphasizing the most important aspects of her professional activity and completing some of the existing biographies of her in the literature with new data.

The woman who has become the forerunner of modern endocrinology in Spain, for having been a pioneer researcher of thyroid hormones and responsible for the implementation of early detection of congenital hypothyroidism in Spanish healthcare, reducing the cases of cretinism by thousands, Italian-born and later naturalized Spanish Gabriella Morreale de Castro, was born on April 7, 1930 in Milan.

She grew up in a family with a high academic background. Her parents, Eugenio Morreale and Emilia de Castro, a native of Milan, were both biologists. Both her maternal grandfather and great-grandfather (Italian) were university professors and her mother was responsible for the classification and conservation of boa snakes saved from the bombing of World War II in Milan [1].

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As her father was a Sicilian diplomat, the family lived in different places in the years following Gabriella's birth, so she lived in Milan, Vienna and Baltimore, where her father was appointed as Italian consul, before the family was repatriated to Europe due to imminent danger of war, when she was 11 years old. The new father's destination as Italian consul was Malaga where she was enrolled in the German School, then in the Institute Vicente Espinel (where Severo Ochoa (1905-1993), Nobel Prize in Physiology or Medicine in 1959 together with the American Arthur Kornberg, also studied) and finished high school at the Colegio de El Monte in Malaga. Figure 1 shows her when she was 14 years old.



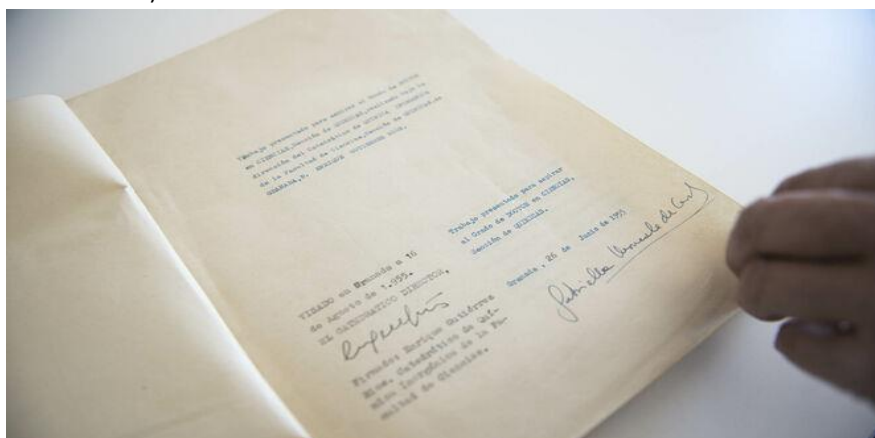
**Figure 1. Gabriella Morreale, when young.**  
Source: Diario Sur, Málaga, 3 Aug, 2021

Her vocation for science awoke as a child, playing with her mother's microscope. Therefore, after finishing secondary studies, she moved to Granada, to start an scientific university career. In this way, Gabriella Morreale studied Chemical Sciences, a degree that she finished in 1951 in just four years, instead of the usual five, thanks to a permission she requested and obtained from the Rector, obtaining honors in thirteen of the seventeen subjects and also the extraordinary career prize, at the University of Granada [1].

After graduating in Chemistry, she was awarded a CSIC scholarship to work on Physiopathology of Nutrition that same year with Professor Enrique Ortiz de Landázuri (see Note 2). She continued her activity receiving a scholarship from the Rectorate of the University of Granada (1953) to carry out her doctorate.

In 1954, she served as head of the Physiopathology of Nutrition Section of the CSIC, also in Granada (1954-1957) and finally, and with the highest qualification, she received the title of Doctor of Science from the same University in 1955 (almost 50 years later, in 2001, she would receive another doctorate, the Doctor of Medicine, honoris causa, from the University of Alcalá de Henares (Spain)) [1]. As a curiosity, indicate that 1951 was the first year in which doctoral theses could be defended at another University different from the Central University of Madrid.

Her doctoral thesis in Chemist (Figure 2) was directed by Professor Enrique Gutiérrez Ríos (see Note 3). In it, she showed that the high incidence of goiter (a swelling of the thyroid gland that causes a swelling in the neck) in the Alpujarras (a poor region of the province of Granada) was due to the lack of iodine in the área (later, she would carry out this same study in the region of Las Hurdes, in Extremadura).



**Figure 2. Gabriella Morreale's Ph.D. Thesis. Source: CSIC**

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Between her bachelor's degree and her doctorate, Gabriella Morreale married the Spanish doctor and surgeon Francisco Escobar del Rey in 1953 (see Note 4), whom she had met in the Alpujarras [1]. That same year, she became a Spanish citizen.

Once both had completed their doctoral thesis (her husband's doctoral thesis had been advised by Eduardo Ortiz de Landázuri and was focused on the administration of iodized salt in the Alpujarras) and both being convinced that in order to carry out research of a certain quality they needed to broaden their training, they moved to Madrid and, there, guided by Professor José María Albareda, general secretary of the CSIC (see Note 5), requested and obtained scholarships to work together at the Department of Endocrinology at the University of Leiden (Holland), invited by Professor Andreas Querido (see Note 6), where they specialized in the study of the thyroid from a bidisciplinary approach, each with their knowledge [1 and 2].

After that stay, the couple returned to Spain in 1957-1958, since, apart from being the country of the husband and the country of adoption of the wife, it was in Spain where the iodine levels were especially low and, therefore, where they could take better advantage of their knowledge and at the same time help improve people's lives. In Madrid, thanks again to profesor Albareda, they stayed at the CSIC Residence, where they wrote their first publications.

In that time and again with the generous intervention of profesor Albareda, they obtained the help of Jesús García Orcoyen (see Note 7), who provided them with the means to develop a method to assess iodine in urine and water, and to carry out a study in the Community of Madrid, which revealed a high incidence of goiter and iodine deficiency in each of the six zones into which it had been subdivided [1].

She joined the CSIC as a scientific collaborator, joining CIB-CSIC, and as a scientific researcher, she founded and was Head of the Thyroid Studies Section of the Institute Gregorio Marañón between 1963 and 1975

Immediately afterwards, she was director of the Gregorio Marañón Institute of Endocrinology and Metabolism between 1975 and 1980. During that interval, in 1975, while she was a research professor, she moved with her group to the Faculty of Medicine of the UAM, turning her laboratory into one of the pillars of the current "Alberto Sols" Biomedical Research Institute (IIB-CSIC-UAM), of which she was deputy director from 1984 to 1990. She was also part of and chaired the Spanish Society of Endocrinology, from 1975 to 1979 and was a founding member of the European Thyroid Association, which he chaired in 1977 (a very brief biography on Alberto Sols can be checked in Note 8).

During all those years, her scientific and research career was bright and extensive. She and her collaborators provided what is now known about the functioning and diseases that affect the thyroid and its functions. Among others, in 1976 she began the pilot study to detect congenital hypothyroidism in newborn children, which gradually spread throughout the country, which today allows early diagnosis and treatment with thyroid hormone, which prevents mental retardation of approximately 150 children a year.

In addition, Gabriella Morreale analyzed and demonstrated that the mother's thyroid hormone crosses the placenta during pregnancy and influences the brain development of the fetus, which led to the administration of iodine supplements to pregnant women becoming a common practice to avoid problems in that development.

She always wanted, and tried, that her work would not stay in the laboratory, but would move into people's lives and change their lives for the better. Apart from the two issues mentioned above, the heel prick test to detect metabolic problems in newborns and iodine supplementation for pregnant women to prevent problems in the fetal brain development, we must add another measure that managed to transfer it to the health authorities: the need to iodize common salt to ensure that the population consumed enough iodine to avoid the problems that a deficit of this element could cause. Let us recall that the heel prick test is a clinical test for the early detection of congenital metabolic diseases. It consists of punctures in the heel that are performed on neonates to obtain a blood sample. It is used to detect pathologies such as congenital hypothyroidism, congenital adrenal hyperplasia, hyperphenylalaninemia or phenylketonuria, congenital hemoglobinopathies, biotinidase deficiency or galactosemia. Through this test, serious brain and neurological disorders, growth disorders, respiratory problems and other serious developmental complications can be detected. This detection through clinical analysis is important because children may not present an apparent sign after birth, but its existence causes serious health problems in the first months of life.

Likewise, together with her husband (Figure 3), she directed numerous epidemiological studies in all the regions of Spain that have allowed to gain an in-depth understanding of the problem of iodine deficiency and its psychosocial consequences, and its correction through the introduction of iodized salt in the 1990s. of the last century. According to Juan Bernal and M.<sup>a</sup> Jesús Obregón, from IIB-CSIC-UAM "Alberto Sols" in Madrid, *"Her work has had a great impact on public health actions that have prevented thousands of cases of mental retardation"* [3].



**Figure 3. Gabriella Morreone and her husband working in the lab. Source: Diario “El Mundo”, 28 Jun, 2018**

In addition to publishing more than 200 highly relevant scientific papers, her research on thyroid hormones allowed the practical eradication of goiter due to iodine deficiency in Spain, when iodized salt was commercially incorporated, and she contributed decisively to the decision to provide iodine supplements pregnant mothers to ensure proper brain development of the fetus. Among her numerous publications, the following may be cited [1]

1. With J. R. Mora Lara y F. Escobar del Rey, “Sobre la dosificación de sodio en suero”, en *Laboratorio*, 9 (1951), págs. 1-10.
2. With F. Escobar del Rey et al., “Bases científicas que aconsejan el uso de la sal yodada en la profilaxis del bocio endémico”, en *Revista Clínica Española*, 54 (1953), págs. 285-289.
3. With F. Escobar del Rey, “Studies on the peripheral disappearance of thyroid hormones-ii-the effect of swimming for two hours on the <sup>131</sup>i distribution in thyroidectomized l-thyroxine maintained rats after the injection of <sup>131</sup>i labeled l-thyroxine”, en *Acta Endocrinológica*, 23 (1956), págs. 393-399.
4. With F. Escobar del Rey, “The effect of thiouracil, methylthiouracil and propylthiouracil on the metabolism of thyroid hormones in thyroidectomized lthyroxine maintained rats”, en VV. AA., *Advances in thyroid research*, London, Pergamon Press, 1960, págs. 80-87.
5. With F. Escobar del Rey et al., “Increase of the rate of release of thyroidal <sup>131</sup>i and of circulating thyrotropic activity at early stages of propylthiouracil treatment in the rat”, en *Nature*, 191 (1961), págs. 1171-1174.
6. With S. Ares, “Alteraciones tiroideas en el recién nacido”, en VV. AA., *Tiroides*, Madrid, Mc Graw Hill, 2007, cap. 7.
7. With M. J. Obregón y F. Escobar del Rey, “Iodine deficiency and brain development in the first half of pregnancy”, en *Public Health Nutrition*, 10 (2007), págs. 1554- 1570.
8. With J. Sánchez-Vera et al., “Inadequate iodine nutrition of pregnant women from Extremadura (spain)”, en *European Journal of Endocrinology*, 159 (2008), págs. 439-445.
9. With M. J. Obregón, “Consecuencias de la privación de iodo y hormonas tiroideas en el desarrollo cerebral”, en A. M. Pascual- Leone y J. M. Medina (eds.), *Desarrollo perinatal: origen de las patologías adultas*, Madrid, Instituto de España, Real Academia Nacional de Farmacia, 2008, págs. 107-130.
10. With M. Rivas et al., “The dream protein is associated with thyroid enlargement and nodular development”, en *Molecular Endocrinology*, 23 (2009), págs. 862-870.
11. With M. J. Costeira et al., “Parameters of thyroid function throughout and after pregnancy in an iodine-deficient population”, en *Thyroid*, 20 (2010), págs. 995-1001.
12. With C. Grijota-Martínez et al., “Lack of action of exogenously administered t3 on the fetal rat brain despite expression of the monocarboxylate transporter 8”, en *Endocrinology*, 152 (2011), págs. 1713-1721.

Gabriella Morreale received numerous distinctions and awards for her bright and extend work, both in life and after her death. Among the awards received in life can be cited the following: Francisco Franco Award from the Science Division of the CSIC, 1968 (shared with her husband); National Prize for Research in Medicine, from the Presidency of the Government, 1977 (shared with her husband); Reina Sofía Research Award for the Prevention of Subnormality, 1983 (shared with her husband and A. Ruiz-Marcos); European Thyroid Association Research Award (1985); Order of Merit of the Italian Republic (1987); Severo Ochoa Award for Biomedical Research, Ferrer Foundation, 1989 (shared with her husband); First Prize for Research in Endocrinology and Nutrition, Spanish Society of Endocrinology, 1991 (shared with Her husband); Pitt-Rivers Lecture Award, granted by the British Societies of Endocrinology (1994); honorary academician of the Royal Academy of Medicine (1994-); the Ramón Areces Foundation

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organized an international symposium on thyroid hormones, in her honor and that of her husband (1995); José Gómez-Acebo National Biology Award, VII National Living Culture Awards (shared with Her husband), 1996; National Award for Medical Research Gregorio Marañón (1997); Rey Jaime I Prize for Clinical Medicine (1998); Doctorate in Medicine, honoris causa, from the University of Alcalá (2001); Serge Lissitzky Award from the European Thyroid Association (2009) [1].

And as regards the awards obtained posthumously, the CSIC paid tribute to her in 2018 [4], and the University of Granada paid also tribute to her on 3 Jun [5], 2022. Moreover, in 2020, the book entitled "*Gabriella Morreale, her life and her time*", was awarded in October 2020 with the XXIII National Award for University Publishing in the category of Best Outreach Work scientific. The authors are the researchers women of the CSIC María Jesús Obregón, disciple of Gabriella Morreale and researcher at the IIB-CSIC-UAM until her retirement; Flora de Pablo, belonging until her retirement to the CIB-CSIC, and Francisca Puertas, from the Eduardo Torroja Institute of Construction Sciences (IETcc-CSIC), and the mathematician José Pedro Moreno, from the UAM. This award, granted by the Union of Spanish University Publishers (UNE), recognized the best works published by Spanish universities and research centers during 2019. On behalf on all the authors, Moreno affirmed that [6]:

*Writing about Gabriella was something totally necessary to value and make her figure visible as a woman, wife, mother and magnificent scientist at a time when it was very difficult for women to have an important scientific career. She got it, and with a vengeance. In addition, she created a school in Spain and abroad.*



**Figure 4. Gabriella Morreale. Source: [2]**

Also, Gabriella Morreale (Figure 4) was a great teacher of scientists. She trained several generations of students (women and men) at the Faculty of Medicine of the Autonomous University of Madrid, at the Gregorio Marañón Institute of Endocrinology and Metabolism and at the "Alberto Sols" Biomedical Research Institute, training them in the field of endocrinology of thyroid hormones, both from the basic and applied point of view, all of them contributing to the birth of experimental and molecular endocrinology in Spain. She conveyed to all of them her passion for knowledge, scientific rigor and the need to help populations at risk. According to Juan Bernal and M<sup>a</sup> Jesús Obregón, researchers from "Alberto Sols" [7]: "*Those of us who have been their disciples recognize her passion for science and scientific rigor, as well as her kindness and the sweetness of her carácter*".

Also, according Susana Ares, Coordinator of the Thyroid Group of the Spanish Society of Pediatric Endocrinology [8]:

*As a person, her cheerful and familiar treatment, ability to work and her wonderful intelligence adorned with great simplicity were to be highlighted. I have sincerely admired her, for her integrity, her rigor, perseverance and professionalism. Every day I learned something, but above all what he taught me was the enthusiasm, the passion for knowledge, the generosity and intellectual modesty. I support myself directly, unconditionally and with her continuous example, for her deep kindness and sweetness and until her death, because Gabriela always considered me like a daughter.*

Gabriella Morreale (Figure 5) was retired (compulsory) in 1995, upon reaching the age of sixty-five, but she continued researching as a doctor linked ad honorem to the CSIC. From May 1997 until she was seventy years old, she was hired by the CSIC. She passed away in Madrid, on 4 Dec. 2017. The fruit of her marriage were her son, Héctor, and a granddaughter, all of whom survived her husband Francisco Escobar.





Figure 5. Gabriella Morreale and her husband together with the then Kings of Spain, Don Juan Carlos I and Doña Sofía. Source: [9]

### 3. CONCLUSIONS

During the first hours of a baby's life, doctors perform various clinical tests to check their health. One of the most frequent diagnostic tests in several countries around the world, including Spain, is the heel test, a blood draw in this area of the foot that is performed 48 hours after birth. The objective of this analysis is to rule out that the child suffers from congenital metabolic diseases, brain or neurological disorders, respiratory problems or growth disorders. If the results are positive, doctors can take action early and treat children before the first symptoms appear. Also, do not forget that years after Spain adopted the heel prick test, UNICEF decided to imitate the measure and apply the blood test to newborns around the world. On the other hand, since 1990 the World Health Organization has recognized the right to consume iodine during pregnancy and early childhood. Therefore, diagnosing this condition at time is fundamental, and this was an achievement achieved by the Italian-Spanish chemist Gabriela Morreale, unknown by society despite her extremely important research.

A vision of the life of Gabriela Morreale justifies without any doubt that she should be considered one of the most important Spanish chemical women of the second half of the 20th century. She was one of the founders of modern Endocrinology in that country, dedicating her efforts and her work to the study of the role of iodine and thyroid hormones in brain development. As the most important milestones, in the 1970s she introduced the study for the detection of congenital hypothyroidism in newborn children, which gradually spread throughout the country, allowing early diagnosis and treatment with thyroid hormone, which prevents mental retardation of approximately 150 children a year. To do this, she initiated the routine measurement of TSH and thyroid hormones in the heel blood of newborns to prevent hypothyroidism and congenital cretinism and later demonstrated the importance of maternal thyroid hormones in the development of the fetal brain, contributing to define the nutritional requirements of iodine of pregnant women. Her work has had a great impact on public health actions that have prevented thousands of cases of mental retardation.

However, as it has been already indicated, except in the scientific world and not excessively, she is a figure quite unknown by society, which has not recognized her what her work has undoubtedly deserved.

For all these reasons, the author considers that this woman should be taken as a reference by society, which should recognize her and grant her the merits all of her meritorious work.

### NOTES

These notes explain some aspects and show some very brief biographies of people appearing in this work.

1. El Consejo Superior de Investigaciones científicas (CSIC) is a Spanish state agency attached to the Ministry of Science and Innovation with the consideration of a public research organism. Its fundamental objective is to develop and promote research for the benefit of scientific and technological progress, for which it is open to collaboration with Spanish and foreign entities. According to the SIR World Report 2012 classification, it is the largest public institution dedicated to research in Spain, having

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become ninth in the world in 2012. It is multidisciplinary in nature and carries out advanced research in all scientific areas thanks to its 121 institutes and three national centers distributed in all the autonomous communities of Spain, similar to the French CNRS. It was created after the Civil War by the founding law of November 24, 1939. In <https://www.csic.es/es/el-csic>

**2.** Eduardo Ortiz de Landázuri Fernández de Heredia (1910 - 1985) finished his degree in Medicine at the Central University of Madrid in 1933. In 1935 he was awarded a scholarship by the Junta de Ampliación de Estudios to carry out a stay at the German University of Frankfurt am Main. After the Spanish Civil War, in which he served as medical lieutenant in the republican army, he was subjected to a purification process from which he was acquitted. In 1946 he obtained the chair of General Pathology at the Faculty of Medicine of Cadiz, dependent on the University of Seville, and that same year he acceded to the same chair at the University of Granada. In 1951 he was dean of the Faculty of Medicine of Granada and the following year he obtained the chair of Clinical and Medical Pathology of that Faculty. In 1958 he was vice-rector of the University of Granada and in October of that year he moved to Pamplona to work at the Medicine School of the General Study of Navarra. He was dean of the Faculty of Medicine of that University on two occasions and between 1966 and 1969 he was vice-rector of the University. His canonization is currently under study. In <https://dbe.rah.es/biografias/21542/eduardo-ortiz-de-landazuri-y-fernandez-de-heredia>

**3.** Enrique Gutiérrez Ríos (Madrid, 1915-1990), graduated in Pharmacy and doctor in Chemical Sciences, held the chairs of Inorganic Chemistry at the universities of Granada and Madrid, becoming rector of the latter between 1964 and 1967. Among other positions he was Member of the Council of State of Spain, of the Council of the Kingdom, president of: CSIC between (1973-1974), of the National Council of Education, of the Advisory Commission for Scientific and Technical Research, of the Royal Spanish Society of Physics and Chemistry and director of the Department of Inorganic Chemistry at the Complutense University of Madrid. He received, among others, the Francisco Franco Science Prize (1966) and José María Albareda (1970), as well as the Grand Cross of the Civil Order of Alfonso X el Sabio (1964). In <https://dbe.rah.es/biografias/11421/enrique-gutierrez-rios>

**4.** Francisco Escobar del Rey (Villaviciosa de Córdoba, 1923-Madrid, December 16, 2015) graduated from the Faculty of Medicine of the University of Granada in the 1950s and presented his doctoral thesis on the administration of iodized salt in the region of Las Alpujarras, directed by Professor Ortiz de Landazuri. Since then, his scientific career cannot be separated from that of his wife, Professor Gabriela Morreale. Both worked for years at the University of Leiden together with Professor Andreas Querido. In 1958, they returned to Spain and founded the Thyroid Study Unit at the Higher Council for Scientific Research. In 1974, they became part of the Autonomous University of Madrid and co-founded the Biomedical Research Institute. He participated in numerous studies on the physiology of the thyroid gland and on the metabolism of thyroid hormone. Both he and Morreale made important contributions in this field, including the conversion of peripheral tissues T4 to T3. They also stood out for their work with maternal hormones in the development of the fetus. In addition, they conducted studies on iodine in Spanish areas where salt was lacking and they made iodized salt known. They also developed the screening program for congenital hypothyroidism in newborns. His research related iodine deficiency in pregnant women with important neuronal disorders in children, such as cretinism, and in direct relation to school failure, lower than average mental quotients or hyperactivity. Remained active until 2007, when he retired at the age of 84. At the end of his career he was named favorite son of his hometown. In [https://www.eurothyroid.com/files/download/obituaries/obituary\\_escobar-del-rey.pdf](https://www.eurothyroid.com/files/download/obituaries/obituary_escobar-del-rey.pdf)

**5.** José María Albareda Herrera (1902 - 1966), born in Caspe (Zaragoza), prominent member of Opus Dei, studied Pharmacy at the University of Madrid and Chemical Sciences at the University of Zaragoza, where he began scientific research. He obtained a doctorate in Pharmacy. He was Professor of Agriculture at the Institute of Secondary Education of Huesca and, in 1940, he obtained the chair of Applied Geology at the Faculty of Pharmacy of the University of Madrid. When the CSIC was created by the Franco government in 1939, he was appointed general secretary, a position he held until his death. He was rector of the University of Navarra (1960-1966) and founded and directed the Institute of Edaphology in Spain. In <https://dbe.rah.es/biografias/5972/jose-maria-albareda-herrera>

**6.** Andries Querido (Amsterdam, September 15, 1912 - Oegstgeest, January 30, 2001) graduated in Medicine from the University of Amsterdam, where he received its gold medal for research he carried out as a student assistant, on the need for vitamin D in relation to the calcium and phosphorus composition of the diet. That work was the germ of his doctoral thesis, which he obtained at the age of 23 and that gold medal also earned him a travel scholarship to carry out pathophysiological research in American scientific institutes. He was Professor of Internal Medicine at the University of Leiden and founder of the Faculty of Medicine of Rotterdam. In <http://www.biografischportaal.nl/persoon/90086187>

**7.** Jesús García Orcoyen (1903 – 1988), born in Estenoz (Navarra), studied Medicine at the University of Madrid, where in 1924 he was appointed assistant for practical classes of the chair run by Sebastián Recasens y Girols. He received his doctorate in 1931

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with an Extraordinary Prize and that same year he was appointed assistant professor of the chair of Obstetrics and Gynecology at the Faculty of Medicine in Madrid, which he won by opposition in 1943. He was General Director of Health in 1960 and 1965. He received innumerable distinctions and honors and in 1974 he joined the Royal National Academy of Medicine as a full academician. In <https://dbe.rah.es/biografias/10407/jesus-garcia-orcoyen>

8. Alberto Sols García (Alicante, 1917- Denia, 1989) is considered in the field of Science as the pioneer of Biochemistry in Spain. He studied Medicine at the University of Valencia and received his doctorate at the Complutense University of Madrid, subsequently moving to Barcelona to carry out his research work. In 1951, through a scholarship from the Junta de Ampliación de Estudios, he moved to the United States where he worked for three years at Washington University in St. Louis, Missouri, together with the marriage of researchers, both Nobel Prize winners in Medicine, Carl Cori and Gerty Cory. There he conducted various studies on hexokinase, the enzyme that determines the energy metabolism of the brain. He returned to Spain in 1954 and continued his research work at the CSIC, at the Center for Biological Research. In 1957 he received the Francisco Franco Prize for Science for his work on enzymatic phosphorylation and active transport of sugars. In 1976 he was appointed Professor of Biochemistry at the Autonomous University of Madrid. He has published nearly 200 papers in specialized journals, most of them in the United States. In 1963 he was President-Founder of the Spanish Society of Biochemistry and in 1981 he received the first Prince of Asturias Award for Scientific and Technical Research. In 1987 he received the Santiago Ramón y Cajal National Research Award from the Ministry of Education and Science. In <https://dbe.rah.es/biografias/17434/alberto-sols-garcia>

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