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Abstract

This paper¹ outlines the activity as a mathematician, historian, and compromised person of the Spanish mathematician Norberto Cuesta Dutari (1907-1989) and its relationship with the social and political situation in Spain under General Franco's regime between 1939 and 1977 and the first years of the democratic restoration. It is shown that he was able to achieve a good mathematical production, though he never was close to the establishment and therefore could not profit from a number of opportunities for personal and institutional promotion. This article is the result of an elaboration of information directly gathered from its main protagonist, a number of secondary sources, and the primary sources: his papers and books, from which a hopefully complete list can be found in Appendix I.

AMS 2000 Mathematics Subject Classifications: 01A60, 01A70, 01A73, 01A80

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A General Introduction: Continuity, or not?

The Spanish Civil War ravaged Spain during three years between 1936 and 1939, during which the country was divided in two zones, the so-called *Zona Nacional* under the rule of the rebel General Franco, and the *Zona Roja* that remained more or less loyal to the established republican Government. Well before the end of the war, with Franco's victory in perspective, the various political groups gathered around his autocratic regime had already started to shape an organisation of entities in charge of future scientific, technological and higher education policies according with the regime ideology –or rather, lack thereof (see *e.g.* Malet 2008).

A first step was the creation of the *Instituto de España* –a concentration of all academicians available in the *Zona Nacional*–, and the abolition of the *Junta de Ampliación de Estudios* (JAE), active since 1907. The JAE had been the official though largely autonomous structure in charge of scientific policy for over thirty years, and it had survived World War I, the dictatorship (1923-1930) under General Primo de Rivera (1930-1931), and the republican years from 1931 onwards. It had been ideologically inspired by the Krausean ideas developed by Francisco Giner (1819-1915) and until the early thirties its policy was to consider scientific development as the engine of national progress. This viewpoint implied involvement of both research and university life, as shown by the many scientists formed within the JAE structure that obtained university chairs, though it was customary for them to resign these posts almost automatically (see *e.g.* Corral 2008). Nevertheless, in 1931 the relevant Spanish philosopher, writer, and officer of the JAE José Ortega y Gasset (1883-1955) pointed out to a separation of research and educational activities, leaving these as the main aim of universities (Ortega 1931). Ortega's idea was carried into practice by the Franco regime when the war ended and a comprehensive organisational structure for scientific policy was created in 1939:

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The *Consejo Superior de Investigaciones Científicas* (CSIC). It took over all facilities of the JAE and was organised as a complicated and ever changing network of institutes, laboratories, libraries, museums, etc. Universities did not appear in this scheme, but during the first four or five years, as the CSIC had no fixed position scientists, many of its areas were mainly covered by university Professors whose links with the CSIC were a mixture of honorific and lobbying activities. For an interesting though rather informal overview of the joint history of the JAE and the CSIC see the commemoration book of the first centennial of the JAE (Puig-Samper 2007).

To a large extent, the political history of the CSIC between 1941 and 1966 is that of its Secretary General José María Albareda (1902-1966), who exerted a strict control on funding and university chair appointments. A number of chairs whose tenants had either fled into exile or been punished by the new regime were awarded to younger people whose fidelity to the new rulers was out of question. Political loyalty was assessed from a number of circumstances: For those who had lived and worked in the *Zona Nacional* during the war, or had been enrolled in Franco's army, it was more or less an automatic matter. On the other hand, having been imprisoned or prosecuted in the *Zona Republicana* could be a positive added value, but in any case all civil servants trying to recover their posts once the war was over were scrutinised in a deputation process whose final result was to a large extent determined by a delicate network of friendships and affinities. Ideology was a rather foggy conception in the early 1940's in Spain, but being in good relations with the Army or with certain social sectors close to the Catholic Church, like the then recently founded *Opus Dei* organisation, or the older and influent *Asociación Católica de Propagandistas*, was a necessary condition –and sometimes a sufficient one- for success in many academic and scientific affairs. A well studied case is that of Julio Rey Pastor (1888-1962), the acknowledged founder of the 20th Century Spanish Mathematics school, who spent the war years in Argentina. The struggle between the various groups over the control of the educational and scientific policy systems was a marked feature of post-war Spanish politics (González-Redondo 2002a and 2002b, López-Sánchez 2006, Morente 2005, Peralta 2006). Albareda, one of the earliest affiliates of the *Opus Dei*, controlled *oposiciones* (public contests) for chairs and other appointments imposing the presence of the adequate persons in examination boards.

Therefore, there was a sort of continuity between some ideas which came to light during the republican years and post-war policies: Research and education at the higher level were considered separate fields, in the line promoted by Ortega. But continuity with the pre-republican state of affairs was broken. Moreover, intermediate education was largely put in the hands of the Catholic Church through several religious orders, as an overreaction to the laicity of the republican years. In this way, one of the conflicts between Catholic factions was solved when members of the *Opus Dei* obtained control of higher education and research.

The Mathematical Sciences were no exception to this rule. The *Laboratorio-Seminario Matemático* of the JAE and the Mathematics section of the *Institut d'Estudis Catalans* that had acquired an independent status in 1933 were overrun by the *Instituto 'Jorge Juan' de Matemáticas*, a section of the CSIC which was active until 1982, and for years after the war the small *élite* concentrated around this Institute tightly governed the official Spanish mathematical activity: The few University chairs were unattainable for candidates from outside the kernel gathered in the '*Jorge Juan*'. Francisco Navarro

Borrás (1905-1970), an architect and academician who held the chair of Rational Mechanics at Madrid, was Albareda's man in the many contests for Mathematics chairs he presided from the early forties until the 1960 decade, as a search in the *Boletín Oficial del Estado* (Spanish Official Gazette) easily shows.



Figure 1: Francoism and Mathematics: Dedication² page in the first after-war volume of the Journal *Matemática Elemental*, 1941.

Sixto Ríos García (1913-2008), a student of Rey Pastor, was a former mathematical analyst who after the war switched to Statistics, where he eventually became the father of the prevailing modern school of Spanish statisticians, and a prominent character in the Spanish scientific arena. See a recent biography in (Escribano and Busto 2009). In some articles of his (see *e.g.* Ríos 1994, Ríos 1997) on the history of the Spanish mathematical activity he proudly describes the pre-war years –much in the JAE spirit– as *los años de los investigadores*, *i.e.* the epoch of researchers, among which he obviously includes himself. After the war some Spanish mathematicians, like Ríos himself, could continue their work on previous research in the orbit of the new CSIC, or even start new ones when some funding was available and candidates were not objected by the establishment. But on the political landscape of those years, the importance of Mathematics at the official level was greatly reduced: Autarchy favoured other Sciences of a more practical or applied nature, *e.g.* some branches of Chemistry, of Physics, Pharmacy and applied Physiology (Sanz and López 1997), so again some continuity

² The grandiloquent rhetoric of these words is difficult to render into English. Most probably they were written by the regime poet and playwright José María Pemán (1897-1981).

with the pre-war situation can be observed in these fields: A switch towards these more applied branches, as opposed to the mainly theoretical aims fostered by the JAE, had already been undertaken by the Republic with the *Fundación Nacional de Investigaciones Científicas y Ensayos de Reformas* which was active between 1931 and 1939, when it disappeared into the CSIC. To present but an example, Chemistry degrees were offered by all twelve Spanish Universities, while Mathematics degrees could be obtained only at three, namely Madrid, Barcelona and Saragossa. For some time Doctorates were awarded solely by the University of Madrid, showing that the totalitarian regime had recovered a strong centralistic component.

Fortunately enough, in the 1940's and 1950's Mathematics was still largely considered an individual affair, so some Professors and researchers were able to make their livings outside the official mainstream as secondary school teachers or through private lessons, and embarking in research on topics where direct interaction with other mathematicians was not an urgent matter. In 1953 the Franco regime signed a cooperation treaty with the USA, Spain entered the UNO, and the political landscape slowly evolved into a more tolerable dictatorship. Over the years, in addition to population increase and ageing of faculty, this fact did contribute to some of these outlier mathematicians being eventually appointed to university chairs and to become members of the established mathematical community.

Publication of original mathematical results in Spain in the immediate post-war years was largely centralised in the *Revista Matemática Hispano Americana* (RMHA, series IV), the continuation of the previous journal of the *Sociedad Matemática Española* (series I and II) with the same name which some enthusiasts had managed to keep alive even during the war (series III) in the *Zona Republicana*. Results on elementary Mathematics appeared in *Matemática Elemental* (also series IV), which had been refounded as well in 1941 after being discontinued by the war. It disappeared in 1949, when *Gaceta Matemática* took its place. All these journals were published by the CSIC. The *Revista de la Academia de Ciencias* was also a vehicle for mathematical papers, both before and after the war. Nevertheless, the higher divulgation journal *Euclides*, mostly dedicated to students preparing entrance examinations for the Engineering Schools, appeared in 1941 with a large amount of Mathematics in its contents: It had been founded by José Barinaga Mata (1890-1958), expelled from his chair at the Madrid University, and José Gallego-Díaz Moreno (1913-1965), an engineer and also a disciple of Rey Pastor. *Euclides* survived until 1960, and it is an interesting example showing the existence of something close to a Spanish mathematical community in the dark post-war years. The University of Madrid started as well in 1941 its journal *Revista de la Universidad de Madrid*, whose section *Ciencias* also accepted Mathematics papers. There has been some arguing about the quality of materials in these journals, focusing on the lack of peer-review previous to publication, but to a large extent the objection can be easily overcome. Even in the early forties some Spanish mathematicians managed to publish in first rank international journals: e.g. Germán Ancochea Quevedo (1908-1981) published in *Annals of Mathematics* and *Journal für die reine und angewandte Mathematik*, and Ricardo San Juan Llosá (1909-1969) was also a current author of other international journals, and in many cases they were responsible of recommending papers for publication in the RMHA. Moreover, a-posteriori abstracts and critiques used to appear in *Zentralblatt für Mathematik* and *Mathematical Reviews*, the respected reviewing journals of the time. During World War II, the *Zentralblatt* was published until 1943, then discontinued and reappeared in 1947.

The last volume of its forerunner, the *Jahrbuch über die Fortschritte der Mathematik*, appeared in 1942. *Mathematical Reviews* was started in 1940, and both covered the Spanish production on those years. See also (Ausejo and Hormigón 1999 and 2002). In the following table a classification scheme according to the *Jahrbuch* is offered:

Mathematician	Born	Math Group	JFM ³ revs.	Production years	Publication comments	Post-war situation
E. Terradas	1883	I	9	1904-18	Local journals, Engineering Reports	Argentina, then back to chair and many other official positions
J. Rey Pastor	1888	I	79	1911-37	International	Argentina, then back to chair
J. Barinaga	1890	I	25	1912-42	RMHA	Expelled from chair
T. R. Bachiller	1899	I/II	8	1925-42	RMHA	Puerto Rico, then back to chair
P. Puig	1900	I/II	11	1925-41	RMHA	High School, later chair
F. Navarro	1905	I/II	5	1929-42	Local journals, Textbooks	Chair, CSIC and political involvement
N. Cuesta	1907	III⁴	1	1942	RMHA	High School
G. Ancochea	1908	II	5	1933-42	International	Chair maintained
R. San Juan	1909	II	15	1929-41	International	Chair maintained
S. Ríos	1913	II/III	26	1933-42	International ⁵	Chair (new)
P. Abellanas	1914	III	2	1942	RMHA	Chair (new) CSIC
F. Botella	1915	III	3	1941-42	RMHA	Chair (new) CSIC

Table I: A classification (with respect to the Civil War time) of some Spanish Mathematicians –in the Madrid area– according to age and number of reviews in the *Jahrbuch über die Fortschritte der Mathematik*

Personal and academic data of Professor Cuesta.

Professor Norberto Cuesta Dutari (1907-1989) [Cuesta, from now on], whose academic career spanned the whole duration of the Franco regime, provides a most remarkable and interesting example of one such ‘outlier mathematician’. Most data on his life can be found in his autobiographic last academic lecture (Cuesta 1978). A son of a Basque-Argentinian family, born in the oldest university city in Spain, he lived and worked at his native Salamanca from 1947 until he passed away in February 1989. His education was deeply marked by his father’s early death, a few childhood years in Argentina, and secondary school at a Jesuit institution. After reading for a degree in Chemistry at his hometown in the period 1925-1929, he studied *Ciencias Exactas* (this was the name then given to Mathematics in Spain) at Saragossa, obtaining his degree the year 1932. He worked at Granada between 1933 and 1937 as an assistant in the university, but in 1936-1937 he became a secondary school teacher because the government of the *Zona Nacional* –where Granada was- had ordered Universities to stop their activity. Late in 1937 Cuesta was sent to a secondary school in Teruel, quite close to the war front, but only a few days after his arrival a massive republican offensive hit the town, which was subsequently occupied by the *Ejército Rojo*. Cuesta, considered a representative of the rebel government, was captured and spent forty days in prison, then set free in Valencia,

³ *Jahrbuch über die Fortschritte der Mathematik* (1868-1942)

⁴ By age, Cuesta should belong to group II, but mathematically, and in official terms, he is better classified into group III.

⁵ In Spain, Ríos used to publish in the *Revista de la Academia*, rather than in the RMHA.

but while trying to travel to Barcelona he was again imprisoned and was in jail until November 1938.



Figure 2: Professor Cuesta in academic dress (around 1970)

Once released, he was enrolled by the republicans and served as a soldier in administrative tasks until the end of the war in April 1939. We find him again at Granada for the academic year 1939-1940, and that same year, in a round of contests promoted by the new authorities where he could take profit of his having been imprisoned in the *Zona Roja*, he obtained a fixed secondary school position (*catedrático*) at Ávila, a mere 100 km away from Salamanca. The board for the contest was chaired by Navarro. In Ávila he managed to write a memoir on order properties of the real numbers and some generalisations thereof inspired on his previous readings of Sierpinski and Hausdorff, and with the help of Ancochea, who acknowledged the quality of the work and agreed to act as adviser, he obtained his Doctorate in Madrid on February 5th, 1943.

Traditionally, university chairs in Spain had been awarded to very young people shortly after obtaining a Doctorate, if they happened to belong to the right group. The JAE had also practised this custom, as shown in the preceding pages, and the Franco regime considered this tradition an acceptable one as well. Therefore Cuesta made several attempts to obtain a university chair in various contests presided by Navarro, all of them unsuccessfully. The main reason for not obtaining an appointment can be found in his relative isolation from the '*Jorge Juan*' nucleus and his basically autodidact formation. Moreover, in the mid-forties he was already in his thirties and this did not help. He finally settled in Salamanca in a provisory way during 1947, for his former mentor Ancochea was moving to Madrid and had recommended him as an adequate successor. Anyway, tenure was by no means automatic, as Cuesta himself knew from his recent experience, so in order to duly install himself, he participated once more in a contest (1950) to definitely occupy a secondary school Professorate in his native city. An opportunity appeared when a chair in Mechanics (with teaching duties in Mathematics) was offered for public contest the year 1949. The examination board –once more with Navarro as president- was published by the official gazette in 1953, and exams took place in early 1955. Cuesta concurred to the contest, but the appointee was the physicist Jesús Tharrats Vidal, a brother of the world-known artist Joan Tharrats, who only spent one academic year (1955-1956) in Salamanca before moving to Barcelona, and afterwards to Puerto Rico. As a result, Cuesta abandoned the university and also considered an offer from Rey Pastor about moving to Argentina, where his direct relatives lived (this information is available in the web page www.elgranerocomun.net)

maintained by Ernesto García Camarero). He decided not to go, and soon he was again lecturing in the university, where once more an opportunity appeared for him to access a chair. He finally obtained it the year 1958 –with Navarro as chairman of the examination board once more- at the age of fifty, by far much older than it was the rule in those years, and he proudly read his *Antrittsvorlesung* on May 12th 1958, though he did not resign his secondary school duties until 1964. An abridged version of the memoir on the teaching of Mathematical Analysis he had prepared for the contest was published (Cuesta 1958c) shortly afterwards at the instance of one of the most distinguished Spanish mathematicians of his time, Pedro Puig Adam (1900-1960), who happened to be a member of the board. Cuesta retired in 1977 and he was subsequently emerited, so his actual retirement took place in 1983. He died on February 5th, 1989, exactly forty-six years after reading his thesis.


 A handwritten signature in cursive script, reading "Nortón Cuesta de Abari". The signature is written in black ink on a light-colored background. Below the main text of the signature, there is a large, stylized flourish that loops back under the main text.

Figure 3: An 'official' signature of Professor Cuesta, 1971

On the personal side, Cuesta was a cultivated person, with a solid classical background he attributed to his having studied with the Jesuits, and broad interests outside Mathematics. One example was his study and edition of *El Criticón* (Cuesta 1955b), the masterpiece by the Jesuit writer Baltasar Gracián (1601-1658) of the baroque epoch: It is still considered a fundamental reference on the topic. He could read in several languages, including Latin and some classical Greek, but always wrote in a very personal Spanish (Pacheco 2007) where he insisted in keeping track of etymology disdaining the current orthographical rules and with many, very precise, quotations in the original languages both in footnotes and within the text. His idea of Justice was an extremely strict one –even to the point of rigidity- and his personal behaviour was guided by a few solid principles: Hard work, an ordered life, personal effort, a good culture, a deep mistrust of official organisations, and an amusing curiosity. He was also a deeply religious person who trusted very little the Catholic Church and its satellite organisations. In his university life he was never in charge of management duties, but in a sense his promoting Mathematics curricula for first-year students was something like that: In those days funding was proportional to the number of enrolled students and the first general-purpose year –the so called *Selectivo de Ciencias*- was the source from which books were bought and journal subscriptions paid. Nevertheless, although he was a political skeptic, between 1961 and 1966 he served in the City Council, where he took over the Educational area, and contributed to plan a city school map and to implement some hygienic measures in educational establishments.

He more than once crashed with the establishment: He firmly opposed the Honorary Doctorate awarded by the university to the dictator Franco in 1954 (see *e.g.* Claret 2004), a fact that undoubtedly had something to do with his not obtaining the Mechanics chair in 1955, and later on, while still serving in the City Council he quarrelled (1965-1966) with the Bishop Mauro Rubio (1919-2000) when he realised that the projected demolition of an old church in the city centre could be a cover for some speculative moves. He went on trial in 1967 and was condemned to a symbolic fine, but the church is still there. His personal, moody behaviour acquired him a name

as a polemic person, incurring in ‘political incorrectness’ when he was convinced of his being right on anything. As a member of examination boards for theses he always read the memoirs very carefully, annotated them, and formulated many questions: Such behaviour was considered a rather unpolite one in those days. Its apex came in 1969, when he even managed a thesis to be rejected in Madrid by showing that part of it was a strict copy of a certain book: He produced the book and proceeded to a comparison: Most possibly the copied pages were there as supplementary or introductory material, but his rigid viewpoint led him to this extreme attitude that earned him the serious enmity of a sector of mathematicians in Madrid, with some bitter results in the years to come.

Partly as a consequence of his frontal crash with the Church, Cuesta was elected a corresponding member of the *Academia de Bellas Artes*, and the *Academia de Ciencias Exactas, Físicas y Naturales* also elected him as a corresponding member. It is unclear why he was not appointed as a full member of this second Academy. He read his inaugural dissertation in this one in 1971 (Cuesta 1971).

A lecture room in the Mathematics building at Salamanca wears his name, and a street near the new university campus has been named after him as well. His personal library with more than five thousand books and a presumably most interesting *Nachlass* of diaries, notebooks and letters are preserved in the university library of Salamanca. The books are already accessible, but personal papers are not yet available for consultation.

Cuesta as a mathematician.

Mathematically, Cuesta acknowledged the formation he acquired in his student years at Saragossa, but otherwise he considered himself a sort of autodidact. Among his books there is a dearth of carefully studied and annotated Mathematics texts, all of them with his signature and date of purchase: Many had been bought and read between 1925 and 1930, before he officially studied Mathematics.

The starting point of Cuesta’s life as a mathematician was his doctoral thesis, which he published as a series of articles in the first numbers of the refounded RMHA (Cuesta 1942, 1943a, 1943b). The thesis itself is the third reference, the other two being complementary materials. This suite was later completed with a number of further results obtained until 1955, and the whole set was reworked and published (1958-1959) in a four-article format (Cuesta 1958e, 1958f, 1959a) by the *Revista de la Academia de Ciencias*. Shortly afterwards, at the suggestion of Ríos, the complete saga was edited in book form under the title *Matemática del Orden* (Cuesta 1959c) by the *Academia de Ciencias*.

It is interesting to remark that Cuesta always worked with a typical pattern or epistemic method, a combination of several years of work-in-progress and a final recopilation or ‘closure step’, clearly inspired on the construction method of transfinite ordinal numbers by Cantor so beautifully explained in Hausdorff’s *Grundzüge* (Hausdorff 1914), a book he often read and consulted, and which provided one of the threads of Cuesta’s original research interests. *Matemática del Orden* was the first of these closure episodes. The book was translated into French (Cuesta 196X) by Cuesta himself and two French-speaking persons, but the translation was never published. The handwritten manuscript is preserved by the university library at Salamanca. There was also a further

attempt to write an English translation, but with no success. This contribution to pure Mathematics was and still is a really outstanding one, as the German mathematician Egbert Harzheim, who corresponded with Cuesta in the sixties, duly acknowledged in his encyclopedic book *Ordered Sets* (Harzheim 2005). The postal exchange began when Cuesta pointed to Harzheim that some results appeared in (Harzheim 1965) had already been published by him years before.

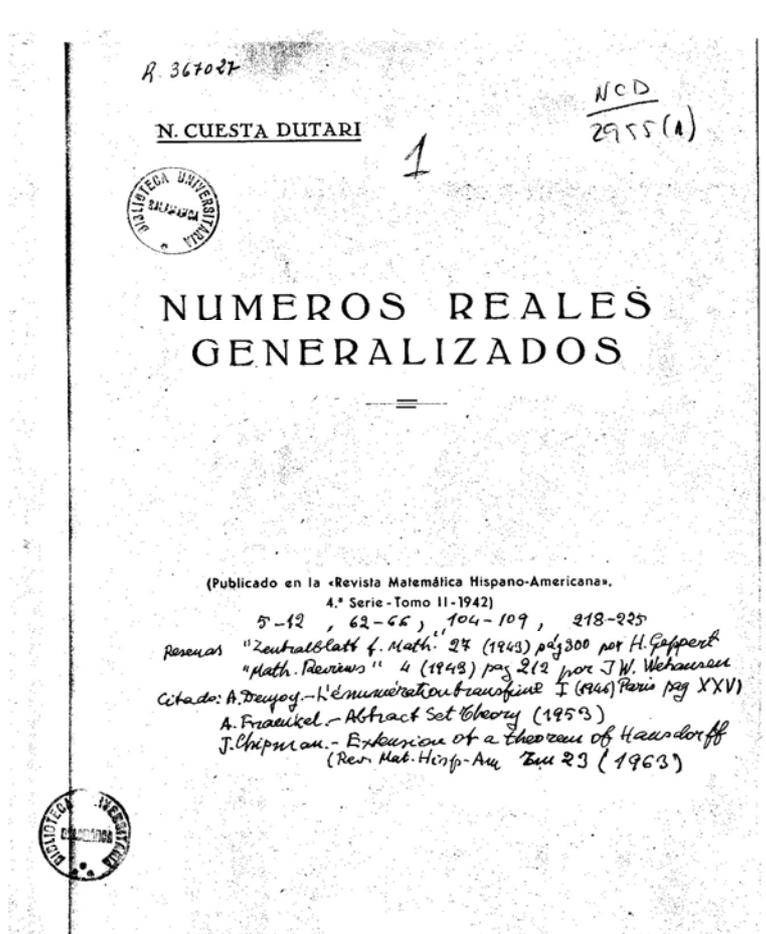


Figure 4: Cuesta's personal copy of his first publication, with his own record of citations and reviews.

There were two more closure episodes in Cuesta's production. The last one is his long (Cuesta 1982b) plenary address intitled "*Matemáticas finitas, matemáticas asintóticas, matemáticas infinitas*", at the IX *Jornadas Hispano-lusas de Matemáticas* that took place in Salamanca: It is a sort of uninhibited mathematical last will with very deep ideas on the general evolution of Mathematics and some particular areas thereof. The other one will be considered in the next section.

He obtained very elegant results on how to construct all total order types on any set –in particular on the real line- by diadic constructions, and later, triadic constructions for partial orderings, adding elements one at a time and comparing its performance with lexicographic orders: This research was in the mainstream of Order Theory (see Denjoy 1946, 1952, 1954a, 1954b, Cuesta 1954c and 1956b), and is still cited today as fundamental work on the topic. The problem of finding a mathematically sound rule for naming ordinal numbers was also addressed by Cuesta in several papers between 1949 and 1981, but he could not find a solution. In 1982 he presented to the *Academia de*

Ciencias a communication by the Seville mathematician Juan Arias de Reyna (Arias de Reyna 1984) with some interesting considerations of impossibility under certain conditions. The interest accorded by the Professor to this problem can be read in his encyclopedia entry (Cuesta 1991).

In 1974, the American mathematician John Conway (Conway 1976) described a number domain generalising the real numbers, which had been popularised by the mathematician and computer scientist Donald Knuth under the name ‘surreal numbers’ in his 1974 mathematical novel (Spanish translation, Knuth 1979): They are equivalent to one of the constructions by Cuesta. He always published in Spanish (see Appendix I, Malet 1998) and his only attempt to publish in English (Cuesta 1955d) had a disastrous outcome: Such high quality Mathematics surely deserved a better fate than that precarious attempt into English language, as Friedrich Bagemihl duly observed in the *Mathematical Reviews*. At the suggestion of the author of this paper, an improved English translation was attempted in 1982, but it was not completed.

While doing research on foundational questions, Cuesta became interested in Metamathematics, a field which occupied him for some time: In the seminar he conducted on Mondays the book *The Mathematics of Metamathematics* (Rasiowa and Sikorski 1970) was read during one year. Several papers (Cuesta 1951a, 1954b, 1961, 1962a, 1962c) show the evolution of his ideas on the topic. In the mid-sixties, he started turning his attention to some chapters in the History of Mathematics and to the writing of a series of very original books, as well as some incursions on didactical questions and the practical teaching of Mathematics at an intermediate level. 1969 marks the end of his prolific writing in the RMHA –to which he had contributed thirty-nine papers since 1943- and his subsequent production was disseminated mainly in *Gaceta Matemática* (twelve papers), in talks at the annual meetings of Iberian mathematicians, and other small publications of more reduced circulation, but above all in his books. His last article in a broad diffusion mathematical journal was published in *Collectanea Mathematica*: It dealt with the arithmetic of twin primes (Cuesta 1986a). He had also contributed to this journal with two more papers during his years of interest in Metamathematics in 1957 and 1962.

The last original mathematical contributions by Cuesta (Cuesta 1986, 1987, 1988) on arithmetical problems were three articles published in the ephemeral journal *Matemas* a group of Mathematics students at Salamanca kept active between 1986 and 1988.

A few articles were published in Philosophy journals, like his reflection (Cuesta 1958a) on the infinite in the CSIC journal *Revista de Filosofía*, and two papers (Cuesta 1980a, 1980b) in the heterodox journal *El Basilisco* edited in Oviedo by the philosopher Gustavo Bueno. In whole, Cuesta’s production comprises more than ninety papers and presentations in Mathematics meetings, and five books. He never co-authored any of them –that was the rule during his creative life- and his sense of rigour in the mathematical enterprise prevented him from advising many theses: Only two students, Pablo Carpintero (Carpintero 1970), and María A. Isidro (Isidro 1977) read theirs under his guidance. The thesis by Carpintero on infinite Boolean Algebras was an output of the Monday seminars, and that of Isidro was inspired by the interest on the work of Euler Cuesta had developed in the early seventies. A third student, Jesús Gómez (Gómez 1980), wrote a memoir inspired by some ideas of Cuesta on infinite polyhedra, but he was formally supervised by Pedro Abellanas (1914-1999), an old friend of

Cuesta from the Saragossa years who was an influential figure in the Spanish mathematical landscape for many years: The 1969 thesis affair was still alive. Two *tesinas* –an old rough equivalent of a Master’s thesis- of mathematical content were also advised by Cuesta: *Influencia en la primitivación de las integrales racionales de la inexactitud de las raíces del denominador* by Emiliano Hernández (Salamanca, 1968), and *Estudio crítico sobre ordenaciones* by Purificación Galindo (Universidad Nacional de Educación a Distancia, 1981).

On the teaching side, Cuesta always prepared his lectures very carefully: After one of them, by studying the blackboard the whole lecture and its leading thread could be easily followed. He used to write a lot, not only formulas, but also many drawings, historical data, and even those little comments which usually appear as spoken remarks deserved a bit of chalk. His books were in some sense the output of many lectures and reflections on them: A very fine book is the *Geometría Vectorial* (Cuesta 1968b), intended as an ‘intuitive’ introduction to Linear Algebra and some of its applications up to Stokes’ theorem for multiple integrals. It was very popular in Latin America for many years, and the author inaugurated with it the custom of inserting long and polemic forewords, where he expounded unorthodox ideas not only on mathematical matters, but also on Philosophy, Logic, History, university policy, general Politics and many more.

Cuesta as a historian of Mathematics.

The interest on historical questions was a constant in the mathematical endeavour of Cuesta. He was well aware of the techniques historians employ in their work, and thoroughly applied them by using only primary sources whenever it was possible. His first strictly historical paper –where his mastery of the technique is clear- was the obituary of Barinaga (Cuesta 1966c), containing a most interesting chapter with a detailed analysis of the polemic 1932 contest for a chair on Differential Equations in Madrid, where Barinaga acted as Secretary of the board that did not appoint the already influential scientist Esteban Terradas Illa (1883-1950). The story of Terradas and Rey Pastor in the Spanish mathematical panorama during the 1940’s has been studied in depth by several authors (see *e.g.* González-Redondo 2002b, Malet 2008 and references therein).

In the History of Mathematics, Cuesta basically dealt with two problems: The invention of Infinitesimal Calculus and its introduction in Spain, and a thorough study of the methods and ideas of Euler on series.

In the book *Historia de la Invención del Análisis Infinitesimal y de su Introducción en España* (Cuesta 1976) he clearly established that the main tools of the Newtonian approach to infinitesimal Analysis were the ‘first and ultimate ratios’ method and a skilfull use of series expansions starting with the binomial formula. The same ideas have been described by Niccolò Guicciardini in his books on the history of Analysis in Britain (Guicciardini 1989, 1999). On the Leibnizian approach, he wrote at length on the idea of actual infinitesimals, and established that the true merit of the *Nova Methodus* was the obtention and integration of a differential equation for the first time in history. We also find in the *Historia de la Invención* that Infinitesimal Analysis was brought into Spain by the Jesuits and first taught at the University of Salamanca by the *ilustrado* (enlightened), later an *idéologue* and liberal politician, Juan Justo García (1852-1830), to whom he had devoted an exhaustive two-volume biography (Cuesta

1974b). This second part of the *Historia de la Invención* had its origin on a projected thesis by Eulogio Hernández (1922-1997) on the History of Mathematical Analysis in Spain that did not succeed. Hernández had found in Toulouse archival evidence of the first Spanish incursions into Infinitesimal Analysis, but his findings were not enough for him to deserve a Doctorate. When he tried to present his work in Madrid with Cuesta's approval in 1971-72, the 1969 thesis affair showed its consequences: Anything fathered by Cuesta was put on a serious quarantine, and the 'scientific' excuse was the short sighted argument that History of Mathematics could not be paramount to 'real' Mathematics. The reader of the *Historia de la Invención* can find the acknowledgement to Hernández for his contribution. This book was reprinted twice, in 1985 and 1994. The 1985 printing was reviewed by Eberhard Knobloch (Knobloch 1986) for *Studia Leibnitiana*, and the review by Ubiratan D'Ambrosio in *Mathematical Reviews* deserved some *scholia* by Cuesta which were included in the 1994 posthumous reprint, in addition to some handwritten corrections of his own in the original manuscript.

On series in the work of Euler, he tried to establish that Euler's approach was as rigorous as any other ulterior development. This had been a recurrent topic in his lectures, where he insisted on the ontological status of infinitesimals and infinites and on how to use them in computations on a sound basis: He was very familiar with the works of Leibniz –or *Leibnitz*, as he always thought was the right spelling– of Du Bois-Reymond on the frontiers of convergence (Du Bois-Reymond 1871, 1876, 1877a, 1877b, 1882, Fisher 1981) especially *Die Allgemeine Functionentheorie*, and other classical studies on series convergence and summability. He acknowledged (Cuesta 1978) an early interest on these topics to Ríos, who as an analyst had studied series summation, a field to which Rey Pastor had made some valuable contributions.

The main results establishing that some methods of Euler are actually rigorous ones were published as an excerpt of the thesis of María Angeles Isidro, included as the long 16th Chapter in the third and definitive version of the surprising saga of reelaborations that led to a magnificent treatise on Mathematical Analysis –or rather, a true and very personal history of Analysis- finally intitled *La Sinfonía del Infinito, y ya en el paraíso de Euler* (Cuesta 1981a), a clear allusion to the deep importance he accorded to Euler in the development of modern Mathematics. A recent reference showing that the topic is still interesting and alive is (Ferraro 2008). Although the *Sinfonía* had had its origin in his classroom notes –the first version (Cuesta 1974a) presented the modest title *40 Lecciones de Análisis Matemático*- the 1975 enlarged version already had the new title *La Sinfonía del Infinito: 67 Lecciones de Análisis Matemático* (Cuesta 1975), and presented a decidedly historical flavour, not only for its many footnotes and quotations, but for the presentation of most materials in a sequential manner. The complete title of the third version was *La Sinfonía del Infinito, y ya en el paraíso de Euler: 99 Lecciones de Análisis Matemático*, and its writing was a real *tour-de-force*, where many new parts and comments already published elsewhere, e.g. his short autobiographical *Lección Académica Final* from 1977 were included, as well as some ideas of 1968 on Von Neumann's construction of ordinal numbers, and several others. The final result is a wonderful example (the second one) of his working pattern culminating with a closure step.

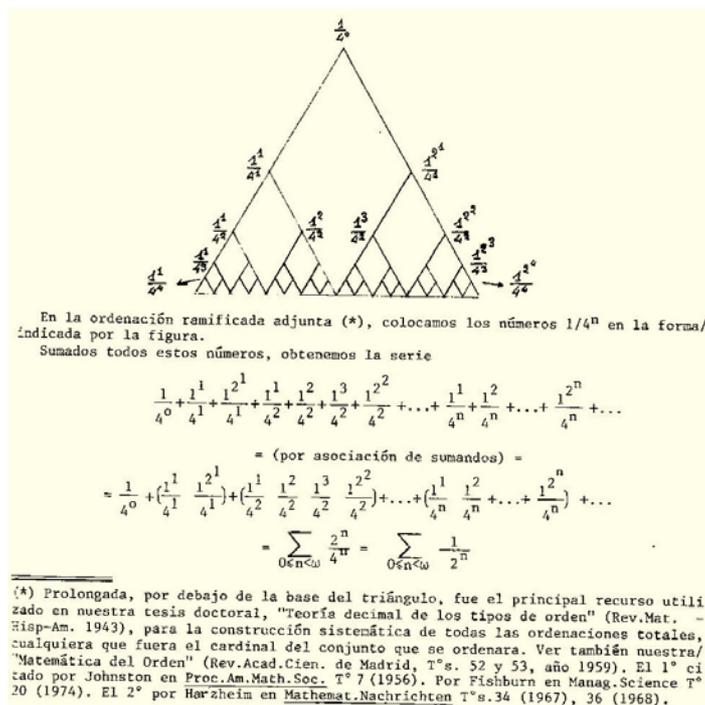


Figure 5: A page of *La Sinfonía del Infinito* (1981), with an example of Cuesta's mathematical work: Remark the long footnote explaining the particular history of his method for constructing total orderings on any set and showing citations of some of his papers.

Cuesta's contributions to journals on the History of Science were four short papers in the Spanish journal *Llull*, where his obituary was published after his death (Hormigón 1989). The most interesting article (Cuesta 1981b) deals on some topics of Euclid and is a vindication of Euclid as a reaction to the publication of a book (Piaget 1981) on the teaching of 'modern mathematics'. A number of articles on historical questions and mathematical curiosities, as well as a small clashing debate with the science theorist Mario Bunge, were also published in newspapers from 1982 onwards.

Cuesta's dream.

Of foremost importance in Cuesta's academic life was his interest in establishing a study track in Mathematics at Salamanca, to which he devoted plenty of time and personal involvement. Indeed he wanted a mathematically sound centre, but in his personal view (Cuesta 1966b) –already commented upon in the above pages- it should be a bright academia where Mathematics and Mathematics teaching would reign over any other consideration, in an idealised picture of the Göttingen golden age which he very much admired and tried to imitate in the seminars he conducted on Monday evening. As he used to work on his own with no funding other than the amount the chair obtained proportional to the number of undergraduate students and his ordinary wages, he expected this behaviour to be the rule, rather than the exception. When gathering research materials in places other than Salamanca he travelled there at his own expenses, installed himself in a cheap hotel, and a notebook and a few pencils was everything he needed: For him, scientific policy as an everyday affair meant little. This spartan lifestyle –indeed his being single did help- could not be easily imposed on other people.

Historically, the university had had up to three chairs in Mathematics, but had never offered a degree in Mathematics. Just before the Civil War two chairs were awarded to two young and promising mathematicians belonging to the school around Rey Pastor: San Juan in 1935 and Ancochea in 1936. San Juan was at Salamanca only for one year, and had moved to Madrid just before the war, which he spent in the *Zona Republicana*, where he managed to keep the *Sociedad Matemática Española* alive. After the war he was again in Madrid, where he had an active though mostly unofficial role in the *Instituto 'Jorge Juan'*. Ancochea remained at Salamanca and eventually moved to Madrid the year 1947, leaving behind him the first shelves of a very select mathematical library, a number of subscriptions to journals, and the first mathematical numbers of the *Acta Salmanticensia* series, a non-periodic journal to which several internationally distinguished mathematicians contributed. The *Acta* provided a sound basis for library interchange for many years, and quite a number of journals were collected through it.

In late 1947 all Mathematics chairs remained vacant until 1958 –with the exception of the year Tharrats spent in Salamanca- when Cuesta was appointed to one of them with the specific mention of ‘Mathematical Analysis, with teaching duties for Chemistry students’. This cautionary language was, and still is, common in the Spanish university jargon: It was and is employed both as a deterrent and as a pointer to some specific candidates. He was the only full professor until 1966, and never stopped thinking of establishing a Mathematics School at Salamanca.



Figure 6: The group of mathematicians at Salamanca gathered on the occasion of a farewell party in honor of Rafael Mallol, who was moving back to Barcelona (1969). From left to right: Teresa Cañadas, Pablo Carpintero, Leandro Guevara, Eulogio Hernández, Professor Cuesta, Rafael Mallol with his wife and son, unidentified lady, José Manso and Jesús Gómez. The picture was taken by Carlos Durán, whose shadow appears in the foreground.

On the wake of the evolution of the Franco regime favoured by a series of the so-called *technocratic* Governments –in opposition to the previous ones with many military- whose Ministers were chosen among economists, lawyers and engineers, Spanish Universities had already entered a growing stage, and in 1965 a new degree in Biology was offered at Salamanca by the *Facultad de Ciencias*, where only Chemistry and the general-purpose first year in Science had been traditionally taught. Cuesta could have introduced the Mathematics degree that same year as well, but being on his own, it seemed a difficult task (see Figure 7, taken from (Cuesta 1966b)). Thus, when Rafael Mallol Balmanyà (1925-1988) was appointed to a second chair of Algebra in 1966, and the statistician José Pérez Vilaplana, a student of Ríos, was also hired, there was a time during which the three classical chairs were back and Cuesta’s dream of a degree in Mathematics in Salamanca seemed quite close to materialise, but things were not so easy: Vilaplana, who was not a tenured Professor, left Salamanca and Mallol returned to

Barcelona in 1969. Nevertheless, Cuesta did not give up, and eventually, during the Rectorate (1968-1972) of Felipe Lucena Conde (1923-1976) the university opened its doors to 34 Mathematics students in October 1971. A detailed account containing many informations of interest on dates, names, meeting minutes and student numbers can be found in the book (Cabezas 2001).

It is worth pointing out that the generalised creation of Faculties, Polytechnics, and Universities, though started a few years before, was boosted by the *Ley General de Educación* (LGE) of 1970 promoted by the Education Minister José Luis Villar Palasí, a law that catered to a general modernisation of the educational system in Spain when it was clear that the Franco regime was close to an end. Without these general environmental conditions the isolation of Cuesta and the difficulties for the study track in Mathematics would not have been overcome, and he was aware of it. Indeed there were more people in other Universities with interests similar to Cuesta's in various areas, but this general picture seems a very reasonable one. The new faculty, a group of mathematicians led by the very gifted mathematician Juan Bautista Sancho Guimerá, arrived in Salamanca from Barcelona in two steps during 1971 and 1972. To a very large extent, the shape and performance of today's Salamanca mathematical school is a result of the activity of this group.

Y si la atención debida al alumnado, aboga por ese incremento de cátedras y por la extensión de las enseñanzas, que propongo al estudio de ustedes, también lo aconseja la organización de una investigación matemática continua y duradera. Uno se asfixia en esta soledad. Son necesario ambiente para la investigación, compañeros con quienes cambiar ideas, y discípulos que, son su interés, renueven la atmósfera, y sirvan de acicate a la curiosidad.

Figure 7: Final words of the inaugural address to the IV *Reunión Anual de Matemáticos Españoles*, Salamanca, 1963 (Cuesta 1966b). The first sentence acknowledges the need of more faculty due to population growth and the needs of research, and the second one is a desperate call to put an end to the (his) loneliness in the isolation of provincial Universities.

Cuesta had developed his own idealised picture of actual scientific activity with a certain disdain of its mundane servitudes, like struggles for funding, fierce battles around tenures, probably as a result of past experiences with his old acquaintance Navarro, and other everyday questions. Even his sometimes peculiar behaviour and ideas on how to do Mathematics on a personal basis did not match the paradigm introduced by the sudden expansion of the higher educational system fostered by the LGE. His only doctoral student to obtain a tenured position was Carpintero (1973), who soon moved from Salamanca to Santiago de Compostela, so Cuesta's initial impulse was not followed by a school of academic descendants. He taught Multivariate Calculus and Mathematical Analysis courses until his retirement in 1983.

Conclusions.

Several conclusions can be drawn from this study:

- First, there was not a large *scientific* gap between pre- and post-war Mathematics in Spain: Somehow, mathematical journals survived, and as shown by the journal *Euclides*, even a sense of mathematical community was present.
- Second, university chair appointments and other promotion opportunities were strictly controlled by a few people close to the regime establishment.

- Third, the possibility existed of doing mathematical research in peripheral places for people who dared to embark in it, though it was much harder than outside the centralised CSIC framework.
- Fourth, Cuesta produced very high quality Mathematics whose spread, though not straightforward, was not restricted to the Spanish environment.
- Fifth, the slightly melancholic realisation that the creation Mathematics degrees in Spain –Salamanca and other places- was to a large extent a contingent result of the regime evolution started in the mid-sixties.

A personal remark.

In the period 1970-1976, while an assistant in the environment of Cuesta at the *Facultad de Ciencias* in Salamanca, the author had the occasion to witness many events and facts described in this paper. The 1969 thesis case (the name of the candidate must remain undisclosed) was also personally observed by the author, then in his last student year in Madrid. From 1980 onwards, Cuesta and the author developed a more friendly relationship, where book interchange and many lengthy talks took place on Sunday mornings at the Professor's home, it came to its end only when the old Professor passed away. The author had some role in the letter exchange with Bunge, triggered both by the review of (Cuesta 1982a) published by Bunge in the newspaper *El País*, and a letter to the director by the author and two more friends.

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In a more personal way, many thanks go to Carlos Durán, Prof. Dr. Egbert Harzheim, Emiliano Hernández, Asun Herranz, Manuel López –who beautifully typed most writings by the Professor between 1972 and 1988-, Albert Presas, Jürgen Renn, Juan-Luis Romero, and Carlos Suárez.

References.

Citations of Cuesta may be found in references where an asterisk (*) is present. Not all of them are cited in the main text of the paper. Items cited are underlined.

Acharyya S (2004)* A generic method to construct P -spaces through ordered fields, Southeast Asian Bull. Math. 28, 783-790.

Alling N (1987)* *Foundations of analysis over surreal number fields*, North-Holland, Amsterdam.

Alling N, Ehrlich P (1986)* An abstract characterization of a full class of surreal numbers, Compt. R. Acad. Sci. Soc. R. Can. 8, 303-308.

Alling N, Swartz, T (1990)* Monomorphisms of inductive number systems, Portugaliae Mathematica 47(3), 293-308.

Arias de Reyna J (1984)* El problema onomástico para los ordinales numerables, Rev. Acad. Ci. Madrid 78, 201-203.

- Ausejo E, Hormigón M (1999) The history of Mathematics in Spain, *NTM Zeitschrift für Geschichte der Wissenschaften, Technik und Medizin* 7(1), 13-20.
- Ausejo E, Hormigón M (2002) Spanish initiatives to bring Mathematics in Spain into the international mainstream, en Parshall K & Rice A (eds) *Mathematics unbound: The evolution of an International Mathematical Research Community 1800-1945*, American Mathematical Society.
- Bourdeau M (2003)* La critique de la Théorie des Ensembles dans la *Dissertation* de Brouwer, *Math. & Sci. Humaines*, 164, 29-43.
- Cabezas J (2001)* *Antecedentes históricos de las Facultades de Ciencias, Química, Biología y Farmacia de la Universidad de Salamanca*. Instituto de España y Real Academia de Farmacia, Madrid.
- Carpintero P (1970)* *Número de tipos diferentes de álgebras de Boole de cardinal m infinito*, Thesis, Universidad de Salamanca.
- Carpintero P (1971)* *Cuatro trabajos sobre Topología, Álgebras de Boole, Hipótesis general del Continuo y Espacios Funcionales*, Ediciones de la Universidad de Salamanca.
- Carpintero P (1972)* *Algunos resultados sobre medida e integración*, Acta Salmanticensia (Ciencias) 42, Universidad de Salamanca,
- Claret J (2004)* *La repressió franquista a la Universitat Espanyola*, Thesis, Universitat Pompeu Fabra, Barcelona.
- Conway J (1976) *On numbers and games*, Academic Press, New York.
- Corral C (2008) *El Doctor Juan Negrín y el Laboratorio de Fisiología de la JAE (1916-1936)*, Fundación 'Juan Negrín', Las Palmas de Gran Canaria.
- Denjoy A (1946)* *L'Énumération transfinie I: La notion de rang*, Gauthier-Villars, Paris.
- Denjoy A (1952) *L'Énumération transfinie II: L'Arithmétisation du transfini*, Gauthier-Villars, Paris.
- Denjoy A (1954a) *L'Énumération transfinie III: Études complémentaires sur l'Ordination*, Gauthier-Villars, Paris.
- Denjoy A (1954b) *L'Énumération transfinie IV: Notes sur les sujets controversés*, Gauthier-Villars, Paris.
- DuBois-Reymond P (1871) Notiz über einen Cauchy'schen Satz, die Stetigkeit von Summen unendlicher Reihen betreffend, *Math. Annalen* 4(1), 135-138.
- DuBois-Reymond P (1876) Notiz über infinitäre Gleichheiten, *Math. Annalen* 10, 36-38.
- DuBois-Reymond P (1877a) Über die Paradoxen des Infinitärcalculs, *Math. Annalen* 11, 149-167.
- DuBois-Reymond P (1877b) Über Integration und Differentiation infinitärer Relationen, *Math. Annalen* 14, 498-507.
- DuBois-Reymond P (1882) Die allgemeine Funktionentheorie (Ed. 1968 de D. Laugwitz), Wiss. Buchgesellschaft, Darmstadt.
- Escribano M, Busto A (2009) Sixto Ríos García: El matemático que impulsó la Estadística española en el siglo XX, *Gaceta de la RSME*, 12 (2), 380-401.
- Ferraro G (2008) *The rise and development of the theory of series up to the early 1820's*. Springer, Berlin.
- Fishburn P (1974)* Lexicographic orders, utilities and decision rules: A survey, *Management Science* 20(11) Theor. Ser. 1442-1471.
- Fisher G (1981) The infinite and infinitesimal quantities of DuBois-Reymond and their reception, *Archive for Hist. Exact. Sci.* 24(2), 101-163.

- Gómez J (1981)* *Figuras poligonales y poliédricas convexas en espacios normados*, Thesis, Universidad Complutense de Madrid.
- Guicciardini N (1989) *The development of Newtonian calculus in Britain*, Cambridge University Press.
- Guicciardini N (1999) *Reading the Principia*, Cambridge University Press.
- González-Redondo F (2002a) La vida institucional de la Sociedad Matemática Española, *Gaceta de la RSME*, 5(1), 229-244.
- González-Redondo F (2002b) La reorganización de la Matemática en España tras la Guerra Civil, *Gaceta de la RSME* 5(2), 463-490.
- González-Redondo F (2003)* *Un modelo para la delimitación teórica, estructuración histórica y organización docente de las disciplinas científicas: El caso de la Matemática*. Academia de Ciencias e Ingenierías de Lanzarote, Arrecife de Lanzarote.
- Harzheim E (1965) Einbettungssätze für totalgeordnete Menge, *Math. Annalen* 158, 90-108.
- Harzheim E (1967)* Kombinatorische Betrachtungen über die Struktur der Potenzmenge, *Math. Nachrichten* 34, 123-141.
- Harzheim E (1970)* Ein Endlichkeitssatz über die Dimension teilweise geordnete Menge, *Math. Nachrichten* 46, 183-188.
- Harzheim E (1968)* Über universalgeordnete Menge, *Math. Nachrichten* 36(3-4), 195-213.
- Harzheim E (2005)* *Ordered Sets*, Springer-Verlag, Heidelberg.
- Hausdorff F (1914) *Grundzüge der Mengenlehre*. Reprinted by Chelsea 1949.
- Herden G, Pallack A (2001)* Interrelations between the length, the structure and the cardinality of a chain, *Order* 18, 191-200.
- Hormigón M (1989)* Norberto Cuesta Dutari *in memoriam*, *Lull* 12(22), 186-190.
- Indurain E (2002)* *Matemática del Orden*, Discurso inaugural del curso 2002-2003 en la UNED de Pamplona.
- Isidro M (1977)* *Reposición crítica de algunos métodos de Euler*, Thesis, Universidad de Salamanca.
- Johnston J (1956)* Universal infinite partially ordered sets, *Proc. Amer. Math. Soc.* 3, 507-514.
- Knobloch E (1986)* Review: N. Cuesta's *Historia de la invención del análisis infinitesimal y su introducción en España*, *Studia Leibnitiana* XVIII(1), 113.
- Knuth D (1979) *Números surreales*, Ed. Reverté, Barcelona.
- López-Sánchez J (2006) La destrucción de la Ciencia en España: Consecuencias de la depuración franquista, in Otero L *et al* (eds) *La destrucción de la Ciencia en España: Depuración universitaria en el franquismo*, Universidad Complutense de Madrid.
- Malet A (1998)* Ferran Sunyer i Balaguer (1912-1967) and Spanish Mathematics after the Civil War, *The Mathematical Intelligencer* 20, 23-30.
- Malet A (2008) Las primeras décadas del CSIC: Investigación y Ciencia para el franquismo, in Romero A & Santesmases MJ (eds) *Un siglo de política científica en España*, Fundación BBVA, Madrid.
- Maz A (2005)* *Los números negativos en España en los siglos XVIII y XIX*, Thesis, Universidad de Granada.
- Morente F (2005) La Universidad fascista y la Universidad franquista en perspectiva comparada, *Cuadernos del Instituto Antonio de Nebrija* 8, 179-214.
- Neumer W (1953)* Bemerkungen zur allgemeinen Hypothese $2^{N_\alpha} = N_{\alpha+1}$ im Anschluss an einige Bemerkungen von E. Eyraud, *Math. Nachrichten* 9(6), 321-342.

- Ortega J (1931) *La misión de la Universidad*. Boletín de la Institución Libre de Enseñanza, LV, 84-91, 109-117, 143-147. Also in book form: Ed. Revista de Occidente, 1960.
- Pacheco J (2007)* El Profesor Cuesta y las palabras, words of November 9th 2007, www.dma.ulpgc.es/profesores/personal/jmpc .
- Pacheco J, Pérez-Fernández J, Suárez C (2007)* On the Reception and Spread of Metaphysical Explanations of Imaginary Numbers in Spain, *Folia Canariensis Academiae Scientiarum XVIII* (1-2), 101-132.
- Pacheco J, Pérez-Fernández J, Suárez C (2008)* Infinitesimals in Spain: Portuondo's 'Ensayo', *Submitted to Archives for History of Exact Sciences*.
- Peralta J (2006) Sobre el exilio matemático de la Guerra Civil Española, *Hispania Nova* (electrónica) 6. <http://hispanianova.rediris.es/>
- Piaget J, Choquet G, Dieudonné J, Thom R (1981) *La enseñanza de las Matemáticas modernas*, Alianza Editorial, Madrid.
- Poveda R, Morales Y (1999)* El uso del software 'scheme' como modelo de lenguaje matemático, *Actas IV CIEMAC*, San José de Costa Rica.
- Puig-Samper M (ed.) (2007) *Tiempos de investigación: JAE-CSIC, cien años de ciencia en España*, Consejo Superior de Investigaciones Científicas, Madrid.
- Rasiowa H, Sikorski R (1970) *The Mathematics of Metamathematics*, PWN Publishers, Warszawa.
- Ríos S (1994) Matemáticas y Astronomía, in Laín P (coord) "La edad de Plata de la Cultura Española", in *Historia de España*, Vol. XXXIX, Ed. Espasa-Calpe, Madrid.
- Ríos S (1997) Actividades matemáticas de D.Olegario Fernández Baños, *Zubía* 15, 143-154.
- Sanz L, López S (1997) *Política tecnológica versus política científica durante el franquismo*, working document 97-01, Instituto de Estudios Sociales Avanzados del CSIC, Madrid.
- Suárez C (2007)* *La introducción del rigor en las Matemáticas en España en el siglo XIX*, Thesis, Universidad de Cádiz.

Appendix I: Publications by Norberto Cuesta.

- Cuesta N (1942) Números reales generalizados, RMHA⁶ (Ser. IV) 2, 5-12, 62-66, 104-109, 218-225.
- Cuesta N (1943a) Construcción de un conjunto ordenado denso y no continuo cuyo número cardinal es ω_α , RMHA (Ser. IV) 3, 38-40.
- Cuesta N (1943b) Teoría decimal de los tipos de orden, RMHA (Ser. IV) 3, 186-205, 242-268.
- Cuesta N (1944a) Continuos asimétricos, RMHA (Ser. IV) 4, 16-23.
- Cuesta N (1944b) Disimilitud de conjuntos decimales, RMHA (Ser. IV) 4, 45-47.
- Cuesta N (1944c) Continuos de Suslin, RMHA (Ser. IV) 4, 175-187, 215-233.
- Cuesta N (1945) Permutaciones continuas con los números reales, RMHA (Ser. IV) 5, 191-203.
- Cuesta N (1946a) Número de tipos de orden, RMHA (Ser. IV) 6, 59-65.
- Cuesta N (1946b) Número de tipos de ordenación, RMHA (Ser. IV) 7, 3-9.
- Cuesta N (1947a) Notas sobre unos trabajos de Sierpinski, RMHA (Ser. IV) 7, 128-131.
- Cuesta N (1947b) Sobre el concepto de línea, RMHA (Ser. IV) 7, 249-254.
- Cuesta N (1948a) Estructuras y sus automorfismos, RMHA (Ser. IV) 8, 277-282.
- Cuesta N (1948b) Ordenación densa perfectamente escalonada, RMHA (Ser. IV) 8, 57-71
- Cuesta N (1949a) Ordenación de infinitésimos, RMHA (Ser. IV) 9, 131-140.
- Cuesta N (1949b) Sucesiones ascendentes de números ordinales, RMHA (Ser. IV) 9, 83-96.
- Cuesta N (1950) Complementos al artículo “Ordenación de Infinitésimos”, RMHA (Ser. IV) 10, 2-4.
- Cuesta N (1951a) Estructuras y Programa de Erlangen, RMHA (Ser. IV) 11, 17-51.
- Cuesta N (1951b) Problema equivalente al del continuo, RMHA (Ser. IV) 11, 240-242.
- Cuesta N (1952a) Estructuras proyectivas, RMHA (Ser. IV) 12, 107-128.
- Cuesta N (1952b) Correlación involutiva compleja, RMHA (Ser. IV) 12, 330-339.
- Cuesta N (1953) Modelos deductivos ordinales, RMHA (Ser. IV) 13, 211-223.
- Cuesta N (1954a) Álgebra ordinal, Revista Acad. Ci. Madrid 48, 103-145.
- Cuesta N (1954b) Estructuras deductivas, RMHA (Ser. IV) 14, 104-117.
- Cuesta N (1954c) Escalonamiento ordinal, RMHA (Ser. IV) 14, 237-268.
- Cuesta N (1954c) “L’enumération transfinitie” de Arnaud Denjoy, RMHA (Ser. IV) 14, 287-290.
- Cuesta N (1955a) Injusta atribución a Zorn del principio maximal, Gaceta Matemática 7, 174-176.
- Cuesta N (1955b) Para un texto más correcto del *Criticón*, Boletín de la Biblioteca. Menéndez y Pelayo XXXI, 19-50.
- Cuesta N (1955c) *Sobre la aritmetización del transfinito*, Acta Salmanticensia, Ser. Ciencias, Nueva Serie, Vol. 1(2), Universidad de Salamanca.
- Cuesta N (1955d) *Triadic construction of partially ordered sets*, Acta Salmanticensia, Ser. Ciencias, Nueva Serie, Vol. I(4), Universidad de Salamanca.
- Cuesta N (1956a) Una consecuencia de la hipótesis $\aleph_1 < 2^{\aleph_0}$, RMHA (Ser. IV) 16, 11-14.
- Cuesta N (1956b) Ordenatrices de Denjoy, RMHA (Ser. IV) 18, 179-192.

⁶ RMHA: Revista Matemática Hispano Americana.

- Cuesta N (1957a) Ciencia deductiva con bases irreducibles separables, *Collectanea Math.* 8, 73-83.
- Cuesta N (1957b) Nota sobre el producto de números complejos, *Gaceta Matemática* 8.
- Cuesta N (1958a) El infinito aritmético desde Zenón y Eudoxio, hasta Galileo y Cantor, *Revista de Filosofía A* 17(65-66), 181-194.
- Cuesta N (1958b) *El saber matemático: Lección de incorporación al Claustro de la Universidad de Salamanca*, Imprenta Calatrava, Salamanca.
- Cuesta N (1958c) Sobre concepto, método, enseñanza y fuentes del análisis matemático, *RMHA (Ser. IV)* 18, 87-98, 201-213.
- Cuesta N (1958d) Sobre un artículo de Mac Neille, *RMHA (Ser. IV)* 18, 3-9.
- Cuesta N (1958e) *Matemática del Orden I, II*, *Rev. Acad. Ci. Madrid*, 147-321.
- Cuesta N (1958f) *Matemática del Orden III*, *Rev. Acad. Ci. Madrid*, 609-770.
- Cuesta N (1959a) *Matemática del Orden IV*, *Rev. Acad. Ci. Madrid*, 33-19.
- Cuesta N (1959b) La estructura topológico-deductiva de medición, *RMHA (Ser. IV)* 19, 213-221.
- Cuesta N (1959c) *Matemática del orden*, Real Academia de Ciencias Exactas, Físicas y Naturales, Madrid.
- Cuesta N (1960a) Un enredo semántico-probabilístico, *Gaceta Matemática* 12(1-2).
- Cuesta N (1960b) Un enredo semántico-probabilístico 2º, *Gaceta Matemática* 12(7-8).
- Cuesta N (1961) Generadores matemáticos *Actas de la I reunión anual de matemáticos españoles* (Madrid), 183-198.
- Cuesta N (1962a) ¿Postulado = Axioma?, *Collectanea Mathematica* 14, 81-94.
- Cuesta N (1962b) Diario de las lecciones, *Gaceta Matemática* 14(7-8).
- Cuesta N (1962c) *Estructuras de implicación*, *Acta Salmanticensia*, Ser. Ciencias, Nueva Serie, Vol. 6(1), Universidad de Salamanca.
- Cuesta N (1963) Estructuras algebraicas de las fracciones (lección para Bachillerato), *Gaceta Matemática* 15 (3-4).
- Cuesta N (1964) Lógica de las cuestiones dialécticas, *Actas de la V reunión anual de matemáticos españoles* (Valencia).
- Cuesta N (1965a) Estructuración lineal de conjuntos *Actas de la IV reunión anual de matemáticos españoles*, *Acta Salmanticensia* 6(4),27-40.
- Cuesta N (1965b) Los números reales como triparticiones eudoxo-euclídeas del conjunto de fracciones, *Gaceta Matemática* 22 (5-6).
- Cuesta N (1965c) Nota crítica sobre un teorema de series funcionales, *Gaceta Matemática* 17, (1-2).
- Cuesta N (1966a) *Algunos aspectos del pensamiento matemático*, Discurso de apertura del año académico 1966-1967, Ed. Universidad de Salamanca.
- Cuesta N (1966b) Clima humano necesario para crear una escuela española de matemáticos, *Actas de la IV reunión anual de matemáticos españoles*, *Acta Salmanticensia* 6(4), 164-168.
- Cuesta N (1966c) Don José Barinaga: In memoriam (1958), *Gaceta Matemática* 18(3-4), 63-86.
- Cuesta N (1966d) Estudio vectorial de las homotecias *Actas de la IV reunión anual de matemáticos españoles*, *Acta Salmanticensia* 6(4).
- Cuesta N (1966e) *Integración conjuntista*, *Acta Salmanticensia*, Ser. Ciencias, Nueva Serie, Vol. 28, Universidad de Salamanca.
- Cuesta N (1966f) Una lección sobre el teorema de Rouché, *Gaceta Matemática* 18, 28-43
- Cuesta N (1967a) Probabilidades en conjuntos amorfos, *Actas de la VIII reunión anual de matemáticos españoles* (Santiago), 112-115.

- Cuesta N (1967b) Promoción positiva y negativa de vocaciones docentes, *Actas VI reunión anual de matemáticos españoles* (Sevilla), 183-190.
- Cuesta N (1968a) ¿La Aritmética ciencia física? *Gaceta Matemática* 19, 36-47.
- Cuesta N (1968b) *Geometría vectorial: Introducción intuitiva al Álgebra Lineal*, Ed. Alhambra, Madrid.
- Cuesta N (1968c) La numeración ordinal de Von Neumann, *Actas de la IX reunión anual de matemáticos españoles* (Granada), 41-49.
- Cuesta N (1969a) Escolios a un artículo de Uuno Saarnio, *RMHA* (Ser. IV) 29, 8-12.
- Cuesta N (1969b) La creación matemática del Profesor San Juan, *Gaceta Matemática* (Ser. 1) 21(5-6), 115-121.
- Cuesta N (196X) *Mathématique de l'ordre* (handwritten, unpublished) Translated by Norberto Cuesta, Antoine Pinède and Odile-Joseph Broucke. (569+15 p.)
- Cuesta N (1971) *Filosofía natural y pugna de facultades en la Universidad de Salamanca* (1779-1796) (Lección de incorporación como académico correspondiente a la Real Academia de Ciencias de Madrid), Imprenta Comercial Salmantina, Salamanca.
- Cuesta N (1972) Representación gráfica de la tripartición eudoxo-euclídea, *Gaceta Matemática* 24 (5-6).
- Cuesta N (1973) El postulado asintótico, fundamento esencial del Análisis, *Actas de la XI reunión anual de matemáticos españoles* (Murcia, 1970), 37-47.
- Cuesta N (1974a) *40 lecciones de Análisis Matemático*, Author's edition, Salamanca.
- Cuesta N (1974b) *El Maestro Juan Justo García: presbítero natural de Zafra* (1752-1830), *segundo catedrático de álgebra de la Universidad de Salamanca desde 1774 y creador de su Colegio de Filosofía en 1792*, Ediciones Universidad de Salamanca.
- Cuesta N (1975) Conceptuación matemática, *Actas de las IV Jornadas matemáticas Luso-españolas*, 15-38.
- Cuesta N (1975) *La Sinfonía del Infinito* (67 lecciones de Análisis Matemático), Ediciones de la Universidad de Salamanca.
- Cuesta N (1976) *Historia de la invención del Análisis Infinitesimal y de su introducción en España*, Ediciones de la Universidad de Salamanca.
- Cuesta N (1977a) Conjuntos de oscilación de $\sum_{0 < j < \omega} z^j$ y $\prod_{0 < j < \omega} \frac{1}{1+z^2}$, *Actas de las I Jornadas Matemáticas Hispano-lusitanas* (Madrid, 1973), 95-112.
- Cuesta N (1977b) Sobre ordenaciones continuas, *Actas de las IV Jornadas matemáticas Luso-españolas* (1), 81-85.
- Cuesta N (1978) *Lección académica final*, Universidad de Salamanca.
- Cuesta N (1979) Introducción en España del Análisis Infinitesimal, *Llull* 2(3), 47-49.
- Cuesta N (1980a) Análisis metamatemático de los números reales, *El Basilisco* 10, 4-7.
- Cuesta N (1980b) Análisis metamatemático de la axiomática de los números naturales, *El Basilisco* 11, 24-26.
- Cuesta N (1981a) *La Sinfonía del Infinito: y ya en el paraíso de Euler* (99 lecciones de Análisis Matemático), Ediciones de la Universidad de Salamanca.
- Cuesta N (1981b) Tres notabilísimos pasajes de Euclides, *Llull* 4(6-7), 35-42.
- Cuesta N (1982a) Las Matemáticas y el conocimiento científico factual, in M. Quintanilla (comp.) *Seminario de Teoría de la Ciencia* (1978-1979), Ediciones Universidad de Salamanca.
- Cuesta N (1982b) Matemáticas finitas, matemáticas asintóticas, matemáticas infinitas, *Actas IX Jornadas Hispano-lusas de Matemáticas 1*, 31-71.
- Cuesta N (1984a) *Las Matemáticas en Europa y en España en tiempos de Torres Villarreal*, Universidad de Salamanca.

- Cuesta N (1984b) En el tricentenario de las ecuaciones diferenciales de Leibnitz, *Llull* 7(12), 91-92.
- Cuesta N (1985a) Número de primos entre an y $a(n+1)$ y desde 1 hasta $n+1$. *Actas X Jornadas Hispano-lusas de Matemáticas*, 300-305.
- Cuesta N (1985b) Poliedros regulares infinitos, *Actas X Jornadas Hispano-lusas de Matemáticas*, 296-299.
- Cuesta N (1985c) Primos gemelos cribando las sucesiones de Cataldi, *Homenaje al Prof. Rodríguez Vidal*, 117-134, Zaragoza.
- Cuesta N (1985d) Escolios a unos comentarios de Pascual Llorente, *Llull* 6(10-11), 191-192.
- Cuesta N (1986a) Aritmética de las sucesiones $6n-1$, $6n+1$ y de los primos gemelos, *Collectanea Mathematica*, 37, 211-227.
- Cuesta N (1986b) Los primos desde an hasta $a(n+1)$, *Matemas* 1, 71-76.
- Cuesta N (1987) Los primos gemelos, *Matemas* 2, 51-67.
- Cuesta N (1988) Tabla de divisores de los números naturales, *Matemas* 3, 6-13.
- Cuesta N (1991) "Aritmética", entry in the *Gran Enciclopedia Rialp*, Ed. Rialp, Madrid.

Appendix III. Mathematics Meetings in Spain and in the Iberian Peninsula 1961-1990.

Reuniones Anuales de Matemáticos Españoles		
I	1961	Madrid
II	1962	Zaragoza
III	¿?	¿?
IV	1963	Salamanca
V	1964	Valencia
VI	1965	Sevilla
VII	1966	Valladolid
VIII	1967	Santiago
IX	1968	Granada
X	1969	La Laguna
XI	1970	Murcia
XII	1971	Málaga
Jornadas Hispano-Lusas de Matemáticas		
Portuguese cities in <i>italics</i>		
I	1972	Madrid
II	1973	Madrid
III	1974	Sevilla
IV	1977	Jaca
V	1978	<i>Aveiro</i>
VI	1979	Santander
VII	1980	Sant Feliu
VIII	1981	<i>Coimbra</i>
IX	1982	Salamanca
X	1985	Murcia
XI	1986	Badajoz
XII	1987	<i>Braga</i>
XIII	1988	Valladolid
XIV	1989	Puerto de la Cruz
XV	1990	<i>Évora</i>

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- 341** Silvio R. Dahmen **Boltzmann and the art of flying**
- 342** Gerhard Herrgott **Wanderer-Fantasien. Franz Liszt und die Figuren des Begehrens**
- 343** Conference **A Cultural History of Heredity IV: Heredity in the Century of the Gene**
- 344** Karine Chemla **Canon and commentary in ancient China: An outlook based on mathematical sources**
- 345** Omar W. Nasim **Observations, Descriptions and Drawings of Nebulae: A Sketch.**
- 346** Julia Kursell (ed.) **Sounds of Science – Schall im Labor (1800–1930)**
- 347** Sophia Vackimes **The Genetically Engineered Body: A Cinematic Context**
- 348** Luigi Guerrini **The ‘Accademia dei Lincei’ and the New World.**
- 349** Jens Høyrup **Über den italienischen Hintergrund der Rechenmeister-Mathematik**
- 350** Christian Joas, Christoph Lehner, and Jürgen Renn (eds.) **HQ-1: Conference on the History of Quantum Physics (Vols. I & II)**
- 351** José M. Pacheco **Does more abstraction imply better understanding?**
("Apuntes de Mecánica Social", by Antonio Portuondo)
- 352** José Miguel Pacheco Castela, F. Javier Pérez-Fernández, Carlos O. Suárez Alemán **Following the steps of Spanish Mathematical Analysis: From Cauchy to Weierstrass between 1880 and 1914**
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- 354** Albert Presas i Puig **Reflections on a peripheral Paperclip Project: A technological innovation system in Spain based on the transfer of German technology**
- 355** Albert Presas i Puig **The Contribution of the History of Science and Social Studies to the Understanding of Scientific Dynamics: the Case of the Spanish Nuclear Energy Program**
- 356** Viola Balz, Alexander v. Schwerin, Heiko Stoff, Bettina Wahrig (eds.) **Precarious Matters / Prekäre Stoffe.** The History of Dangerous and Endangered Substances in the 19th and 20th Centuries
- 357** Florentina Badalanova Geller ***Qur'ān in vernacular.*** Folk Islam in the Balkans
- 358** Renate Wahsner & Horst-Heino v. Borzeszkowski **Die Naturwissenschaft und der philosophische Begriff des Geistes**
- 359** Jens Høyrup **Baroque Mind-set and New Science.** A Dialectic of Seventeenth-Century High Culture
- 360** Dieter Fick & Horst Kant **Walther Bothe's contributions to the particle-wave dualism of light**
- 361** Albert Presas i Puig (ed.) **Who is Making Science? Scientists as Makers of Technical-Scientific Structures and Administrators of Science Policy**
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- 365** Viola van Beek „Man lasse doch diese Dinge selber einmal sprechen“ – Experimentierkästen, Experimentalanleitungen und Erzählungen um 1900
- 366** Julia Kursell (Hrsg.) **Physiologie des Klaviers.** Vorträge und Konzerte zur Wissenschaftsgeschichte der Musik
- 367** Hubert Laitko **Strategen, Organisatoren, Kritiker, Dissidenten – Verhaltensmuster prominenter Naturwissenschaftler der DDR in den 50er und 60er Jahren des 20. Jahrhunderts**
- 368** Renate Wahsner & Horst-Heino v. Borzeszkowski **Naturwissenschaft und Weltbild**
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- 375** Ludmila Hyman **Vygotsky on Scientific Observation**
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- 377** Fabian Krämer **The Persistent Image of an Unusual Centaur.** A Biography of Aldrovandi's Two-Legged Centaur Woodcut