

1 **CONTEMPORARY PUBLICATIONS IN EUROPE ON THE SPANISH**  
2 **EARTHQUAKE OF 1884.**

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## CONTEMPORARY PUBLICATIONS IN EUROPE ON THE SPANISH EARTHQUAKE OF 1884.

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### 19 **Abstract**

20 After the occurrence of the main shock on the 25th of December 1884, a considerable  
21 number of reports on the damage caused by the catastrophic Andalusian earthquake  
22 were published mainly during the following year (1885) in several European journals,  
23 as well as in bulletins of scientific societies and books. A few of them were anonymous  
24 notes while others were signed by most important geologists and seismologists from  
25 different European countries. Special cases are the publications from the members of  
26 the three commissions that were specifically appointed to study this Andalusian  
27 earthquake. In this article, we present detailed information about the publications that  
28 appeared mainly during the following year (1885) of the occurrence of this earthquake.  
29 The prompt study of the Andalusian earthquake provided an opportunity for the  
30 scientific community at that time to present and disseminate new modern ideas about  
31 the nature of earthquakes and their relationship with the geodynamic processes and  
32 geology of the region.

33

### 34 **Introduction**

35 On December 25th, 1884, a large destructive earthquake took place in southern Spain,  
36 south of Granada, with a maximum intensity of IX-X and an estimated magnitude of  
37 6.7-7. Felt aftershocks lasted for a year, and about forty of them were felt during the  
38 first ten days after the mainshock. In the provinces of Granada and Malaga (Figures 1a  
39 and 1b), the earthquake caused a total of 745 dead, 1475 injured and great damage to  
40 several towns and villages, with 4400 houses totally destroyed and 6300 partially  
41 damaged (Udías and Muñoz, 1979, Vidal Sánchez, 2011). The 1884 Andalusian

42 earthquake was the first large earthquake to have caused great damage and a  
43 considerable number of casualties in Spain after the great Lisbon earthquake of 1755.  
44 Large earthquakes in the Iberian Peninsula are separated by long periods of time, and so  
45 the detailed study of historical events is very important in order to carry out a correct  
46 evaluation of seismic risk. Shortly after the occurrence of the mainshock, mainly during  
47 the year 1885, a considerable number of reports and papers on the earthquake were  
48 published in science journals in Spain and in different European countries, including the  
49 journals *Revista Contemporánea* (Spain), *La Nature* (France), *Globus* (Germany),  
50 *Nature* (United Kingdom), and *Bullettino del Vulcanismo Italiano* (Italy). Scientific  
51 papers were also published in bulletins of scientific and cultural societies, such as  
52 *Anales de la Sociedad Española de Historia Natural* (Spain), *Comptes Rendus de la*  
53 *Académie des Science de Paris* (France), and *Real Accademia dei Lincei* (Italy). This  
54 was the first destructive earthquake in Europe after the Naples earthquake of 1857 and  
55 was the first earthquake that for its study, for the first time, that three European  
56 commissions were established in Spain, France, and Italy for detailed studies of the  
57 earthquake and its effects. Important contributions to its study were the publications by  
58 these commissions. Finally, books and chapters of books were soon also published on  
59 different aspects of the earthquake. In total, we have found 58 publications mostly  
60 published during 1885, 23 of them in France, 20 in Spain, 7 in the United Kingdom, 5 in  
61 Italy, 2 in Germany and 1 in Portugal. To the best of our knowledge, no other  
62 earthquake at that time in Europe was the subject of so many contemporary  
63 publications. This was a very early response to the natural disaster in Spain by scientists  
64 of different countries, and it provided an opportunity for the first ideas of modern  
65 seismology to be discussed.

66 These publications, besides reporting the damage and casualties produced by the  
67 earthquake and to review the seismicity of southern Spain, gave considerable attention  
68 to the relationship between earthquakes and the geology of the region. Geology was  
69 then experiencing important progress after the publication in 1830 of Charles Lyell's  
70 *Principles of Geology*. The relationship between earthquakes and geology was at that  
71 time an important new subject, and it was especially present in the publications of the  
72 members of the French commission. Another subject present in many of the  
73 publications derived from the 1884 earthquake was the presentation of the new ideas  
74 about the nature of earthquakes, abandoning the traditional explosive origin of

75 earthquakes proposed in the late seventeenth century by Martin Lister in England and  
76 Nicolás Lémery in France and spread by Isaac Newton in his *Optics* and George de  
77 Buffon in *Histoire et théorie de la Terre*. From the middle of the nineteenth century  
78 onward earthquakes began to be related to the geodynamic processes of the Earth's  
79 crust and specifically to the fractures or faults of the layers of the crust proposed by  
80 authors like as Eduard Suess and Ferdinand Montessus de Ballore. As we will see this  
81 new interpretation of the association of earthquakes and geological features is present in  
82 some of the publications about the 1884 earthquake.

83 We have classified the published information as:

- 84 - Anonymous reports
- 85 - Articles in scientific and cultural journals
- 86 - Reports in bulletins of scientific societies
- 87 - Publications of the three commissions
- 88 - Published books

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### 91 **Anonymous reports**

92 An anonymous note was the first published on January 8th in *Nature*, a well-known  
93 British science journal (Anonymous, 1885a), two weeks after the occurrence of the  
94 mainshock when strong aftershocks were still happening. The note focuses on the  
95 damage in towns and villages, the number of casualties and the number of houses  
96 destroyed. *Nature's* note says that: “in the province of Granada 673 bodies were  
97 recovered from the ruins of towns alone”, and that in the town of Alhama (Figure 1b):  
98 “over 1500 houses were destroyed and more than 300 dead were recovered up to the 4<sup>th</sup>  
99 of January” (Anonymous, 1885a). Another anonymous note was published in *Nature* on  
100 January 15th which relates the earthquake to the geological structure of the region of the  
101 Sierras Tejeda and Alhama (Figure 1b), where the focus of the disturbance was thought  
102 to lie (Anonymous, 1885b).

103

### 104 **Articles in scientific and cultural journals**

105 The first report about the earthquake to appear in a scientific journal with a known  
106 author was published on January 10th in *La Nature*, a Paris journal of popularization of  
107 science, reproducing a letter by Antoine F. Nogués, a French mining engineer working  
108 at Seville, written on 31st December, six days after the main shock (Nogués, 1885a).  
109 The report begins by describing how the earthquake was felt in Seville and gives a list  
110 of towns and villages of the provinces of Granada and Malaga with the largest damage  
111 and number of casualties, a first estimate of 383 dead, and proposed relationship of the  
112 earthquakes to faults and lines of fractures in the region. Nogués distinguishes three  
113 phases in the sequence of earthquakes: (i) earthquakes occurred in early December in  
114 Galicia (NW Spain) and Portugal (Figure 1a), (ii) the main earthquake of December  
115 25th, and (iii) the following aftershocks in the provinces of Granada and Malaga. He  
116 relates how the earthquake was felt in the cities of Granada, Malaga, Cordoba, and  
117 Cadiz (Figures 1a and 1b). A longer report written by Nogués on December 31th  
118 (Nogués, 1885b) was published later with two figures, one of them specifying the  
119 region of greatest damage (Figure 2). Nogués' first note (Nogués, 1885a) in *La Nature*  
120 was reproduced in *Nature*, which considered this to be “the first scientific investigation  
121 of the catastrophe” (Nogués, 1885d). A long note by Nogués, written in Granada on  
122 January 24th, with drawings of the damage in Albuñuelas and Alhama (Figure 1b) was  
123 published in *La Nature* on February 17th (Nogués, 1885c). A further report was  
124 published in *La Nature* by Gaston Tissandier (1843-1899), its founding editor and a  
125 science popularizer, about the large ground cracks produced by the earthquake in  
126 Periana and Guevejar (Tissandier, 1885) (Figure 1b). Camille Flammarion (1842-1925),  
127 an astronomer and popularizer of astronomy, published three notes about the earthquake  
128 in his journal *Revue d'Astronomie Populaire* (Flammarion, 1885).

129 On January 7th José Macpherson (1839-1902), a geologist of Cadiz from a Scottish  
130 family and an important introducer of modern geological ideas in Spain, gave a talk at  
131 the meeting in Madrid of the Spanish Royal Society of Natural History (*Real Sociedad*  
132 *Española de Historia Natural*). He sent a short report to *Nature*, which was published  
133 on January 22nd (Macpherson, 1885b). The main point of Macpherson's report is the  
134 relationship between the earthquakes and the geological structure of the region and the  
135 origin of the earthquakes as displacements on one or more of the faults that exist  
136 between the Sierra Nevada and the Serranía de Ronda. These were, at the time, new  
137 ideas about the origin of earthquakes (Figure 1b). For him an interest in this

138 phenomenon arose also from the correlations found between various observations, such  
139 as the orientation of ground fractures and cracks produced by the earthquake and the  
140 geological features present in the region. In Macpherson's opinion, the earthquakes  
141 indicate the fragility of those faults, which, though dating back to the Silurian period,  
142 for him are still apparently not completely welded. Enrique María Repullés y Vargas  
143 (1845-1922), an architect from Madrid, published an article with a summary of damage  
144 produced in buildings by the earthquakes in the journal *Revista Contemporánea*, a  
145 Madrid cultural publication (Repullés y Vargas, 1885a).

146 Two reports about the earthquakes were published by Heinrich Moritz Willkomm  
147 (1821-1895) a professor of Leipzig University, in the German journal *Globus*  
148 (Willkomm, 1885a). He was familiar with Spain because he had visited there previously  
149 and published a book on his journeys through the peninsula (Willkomm, 1847). In  
150 reports about the earthquakes, Willkomm gave a detailed accounting of the damage at  
151 the different places in the Granada-Malaga region, and gave a list of previous  
152 earthquakes, especially during the 19th century in the south and southwest of Spain,  
153 concluding: “Next to Italy, no other part of Europe is so frequently visited by  
154 earthquakes as the south and west of the Iberian Peninsula”. On April 30th a summary  
155 of Willkomm’s reports was published in *Nature* (Willkomm, 1885b). A report about the  
156 Andalusian earthquakes was published in Germany by Arnold von Lasaulx (1839-  
157 1886), a professor of mineralogy and petrology of the universities of Breslau and Bonn,  
158 in the journal *Humboldt, Monats Zeitschrift für die gesamten Naturwissenschaften* (Von  
159 Lasaulx, 1885).

160 In Italy Michele Stefano de Rossi (1834-1898), founding editor of *Bullettino del*  
161 *Vulcanismo Italiano*, published on March 1885 a general report of the earthquake  
162 (Rossi, 1885). Another Italian, Luigi Gatta, author of the book *Sismologia terrestre*  
163 (Manuali Hoepli XLIV, 1884), published in February 15th a report on the Spanish  
164 earthquakes in *Nuova Antologia*, a Florence journal of arts and sciences (Gatta, 1885).

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## 166 **Reports in bulletins of scientific societies**

167 Reports and notes on the earthquakes were also published very early in 1885 in  
168 bulletins of scientific societies in Spain, France, Italy and the United Kingdom.

169 Macpherson published a short note of his previously-mentioned talk in the acts of the  
170 Spanish Society of Natural History (*Anales de la Sociedad Española de Historia*  
171 *Natural*) (Macpherson, 1885a). In the same annals Salvador Calderón y Arana (1851-  
172 1911), a professor of mineralogy and botany at the University of Madrid, published a  
173 discussion about the different theories proposed to explain the earthquakes (Calderón y  
174 Arana, 1885a). Domingo de Orueta y Duarte (1862-1926), at that time a student at the  
175 Madrid Mining School (*Escuela de Minas*), gave a presentation in March 10<sup>th</sup> at the  
176 Spanish Society of Natural History and published two reports in the *Anales* of the same  
177 Society (Orueta y Duarte, 1885a) and in *Revista de la Real Sociedad Geológica* (Orueta  
178 y Duarte, 1885b). Federico Botella y de Hornos (1822-1899), a mining engineer from  
179 Alicante and author of a geological map of Spain, published a report on the earthquake  
180 in the Bulletin of the Royal Geographical Society of Madrid (*Boletín de la Real*  
181 *Sociedad Geográfica de Madrid*) (Botella y de Hornos, 1885a).

182 A fairly large number of reports were presented during 1885 at the weekly meetings  
183 of the Paris Academy of Sciences (*Académie des Sciences de Paris*) and published in  
184 the Reports of the Academy (*Comptes Rendus de l'Académie des Sciences de Paris*,  
185 CRASP). The first report about the Spanish earthquake was published on January 1st by  
186 Edmond Hébert (1812-1890), a professor of geology at the University Sorbonne (Paris),  
187 reproducing a letter written by Nogués on December 26th from Seville, a day after the  
188 occurrence of the mainshock, giving a list of villages with damage, the greatest at  
189 Alhama and Albuñuelas (Figure 1b) together with a large number of casualties, and  
190 giving also a short commentary on the geology of the region (Hébert, 1885). A second  
191 report reproduces a letter by Macpherson to Gabriel August Daubrée (1814-1896), a  
192 professor of the Mining School of Paris (*École des Mines de Paris*) (Macpherson,  
193 1885d). In the letter, Macpherson gives the area of maximum intensity of the earthquake  
194 located between the Serranía de Ronda and the Sierra Nevada (Figure 1b). A short  
195 description is then given of the geology of the region. Daubrée adds to Macpherson's  
196 note a list of earthquakes in the southern part of the Iberian Peninsula and northern  
197 Africa, beginning with the Lisbon earthquake of 1755 and ending with the latest in 1829  
198 (Torrevieja, Alicante) and 1841 (Seville and Malaga), taken from the Alexis Perrey's  
199 (1807-1882) catalog (Perrey, 1847) and concluded that the present earthquakes are a  
200 continuation of a numerous series of similar phenomena which have affected the region  
201 in the past (Daubrée, 1885).

202 A report also published in CRASP is a letter from the French geologist August  
203 Germain, centered on how the earthquakes were felt in the town of Torre del Mar  
204 (Malaga) (Figure 1b), the damage they produced, and the direction of the ground motion  
205 (Germain, 1885). Another report is the reproduction of a letter of Botella y de Hornos to  
206 Daubr e (Botella y de Hornos, 1885b). In his report, Botella y de Hornos adjoined a  
207 map of the region and focuses on the damage to the villages of Granada and Malaga  
208 provinces and mentions that the earthquake was felt as far as Madrid and Lisbon (Figure  
209 1a).

210 A second report by Macpherson was presented by H bert and published in CRASP  
211 (Macpherson, 1885e). Macpherson insists on the strong relationship between the  
212 earthquake and the geological structure of the region. He notes that the earthquakes are  
213 related to the north-south faults present in the Betic cordillera. He separates the region  
214 where the motion of the earthquakes was felt into three zones of largest to least  
215 intensity. A note by Ernest Deligny (1820-1898), a mining engineer working at mines in  
216 Huelva, was presented by Daubr e about a probable cause of the earthquake, but only  
217 the title of the presentation was published in CRASP (Deligny, 1885).

218 A short note about the earthquake from the point of view of a civil engineer was  
219 published in the London *Minutes of the Proceedings of the Institution of Civil Engineers*  
220 by Edward J.T. Manby, where he considers it to be the earthquake “most violent and  
221 destructive of modern times” (Manby, 1886). Raphael Meldola (1849-1915), a naturalist  
222 and chemistry professor at Finsbury Technical College, in a paper about the East  
223 Anglian Earthquake of April 22<sup>nd</sup>, 1884 published in the *Proceedings of the Geologists’*  
224 *Association*, added a note about the occurrence and large damage of the Spanish  
225 earthquake (Meldola, 1885).

226

## 227 **Publications of the three commissions**

228 This earthquake is the first in Spain and one of the first in Europe that was the  
229 subject of a true modern scientific study with a detailed assessment of the damage, the  
230 effects on the ground, the nature of ground motion, and the relationship with the  
231 geology. Three commissions were established for its study: an official Spanish  
232 commission, a French commission of the *Acad mie des Sciences* and an Italian

233 commission of the *Real Accademia dei Lincei*. These commissions published extended  
234 reports and other publications.

235 A Royal Order established the Spanish commission on January 7th. It was  
236 composed by Manuel Fernández de Castro (1825-1895) (president), a mining engineer  
237 and director of the Geologic and Mining Institute of Spain (*Instituto Geológico y*  
238 *Minero de España*), and the also mining engineers Daniel Francisco de Paula Cortázar y  
239 Larrubia (1844-1927), Joaquin G. Tarín (1838-1910) and Juan Pablo Lasala. An  
240 extended report with the results of the study of the commission was published on March  
241 30th (Fernández de Castro *et al.*, 1885) (Figure 3). An important part of the report was  
242 based on a survey of 33 questions that was distributed among the population and that  
243 received 500 answers. The report deals with the orography and geology of the provinces  
244 of Granada and Málaga, the characteristics of the earthquakes, the area affected, damage  
245 to different towns and villages, and effects on the ground. It establishes also norms to be  
246 followed in the reconstruction of the buildings in the affected towns and villages.

247 The French commission, organized by the *Académie des Sciences*, was presided  
248 over by Ferdinand André Fouqué (1828-1904), a professor of natural history in the  
249 *Collège de France*, and was formed by Marcel Bertrand (1847-1907), later president of  
250 the *Société Géologique de France*, Charles Barrois (1851-1939), a professor of the  
251 geology of the University of Lille, Wilfred Kilian (1862-1925), a professor of the  
252 University of Grenoble, Albert Offret (1857-1933), a professor of the mineralogy at the  
253 University of Lyon, and the geologists August Michel Levy (1844-1911) and Pierre  
254 Joseph Jules Bergeron (1853-1919). They arrived at Malaga on February 7th and  
255 remained in Spain until the end of March (Bonnin *et al.*, 2002). A series of reports were  
256 presented at the meetings of the *Académie des Sciences* and later published in CRASP  
257 by Fouqué and by other components of the commission.

258 A first report on the work of the French commission focuses on the geological  
259 structures of the region and gives a survey of the villages with greater damage and  
260 ground effects (Fouqué, 1885a). A second report defines the epicentral area as an east-  
261 west elongated ellipse comprising the area with the largest damage. Special attention is  
262 given to large ground fractures and their effects on hot springs (Fouqué, 1885b). In a  
263 new report, Fouqué refers to the presentations by Michel Levy, Marcel Bertrand, and  
264 Barrois about the geology of the region of Andalusia and to the previous works of

265 Botella de Armas, Macpherson, Orueta, and Gonzalo Tarin. Then, Fouqué establishes  
266 the position of the epicenter at the region centered on Alhama, the depth of the focus at  
267 11 km, and a discussion on the different theories proposed to explain the earthquake  
268 with his proposal of an underground volcanic source (Fouqué, 1885c). This last subject  
269 was also discussed by Fouqué in more detail in the Bulletin of the Scientific Association  
270 of France (*Bulletin de la Association Scientifique de France*) (Fouqué 1885d). The final  
271 report of the work of the French commission was published later in the Memories of the  
272 Academy of Sciences (*Academie des Sciences, Memoirs*) (Académie des Sciences de  
273 Paris, 1889), and in Spain a Spanish translation was published with commentaries by  
274 the members of the Spanish commission (Fouqué, 1890-1893). Barrois published a  
275 report in the Acts of the Geological Society of the North of Lille (*Annales de la Société*  
276 *Géologique du Nord, Lille*) (Barrois, 1885), and together with Offret, published a study  
277 of the geological structure of the epicentral region (Barrois and Offret, 1885a). A report  
278 by Barrois and Offret on the earthquake was also published in Spain in the Bulletin of  
279 the Commission of the Geological Map (*Boletín de la Comisión del Mapa Geológico*),  
280 (Barrois and Offret, 1885b). Calderón y Arana published in the Bulletin of the Free  
281 Institution of Teaching (*Institución Libre de Enseñanza*), a liberal teaching institution, a  
282 report on the work of the French commission (Calderón y Arana, 1885b). Bertrand and  
283 Kilian published later a long report in CRASP about the geology of the earthquake  
284 region in which they present a large bibliography published between 1823 and 1886  
285 about the geology of the earthquake region with 104 publications, 28 of them about the  
286 earthquake, and 13 geological maps (Bertrand and Kilian, 1889). This report was  
287 translated into Spanish and published in Spain (Bertrand and Kilian, 1892).

288 In Italy, the Royal Academy of the Linx (*Real Accademia dei Lincei*) organized a  
289 commission to study the effects of the Spanish earthquake formed by the two eminent  
290 seismologists Torquato Taramelli (1845-1922), a professor of the University of Pavia  
291 and founding member of the Italian Seismological Society, and Giuseppe Mercalli  
292 (1850-1914), a professor of the University of Catania and director of the Observatory of  
293 the Vesuvius. Mercalli is best known for his seismic intensity scale. Taramelli and  
294 Mercalli traveled to southern Spain in April 1885. After a first report (Mercalli and  
295 Taramelli 1885), they published an extended report in which they present the tectonic  
296 conditions of south Spain, a very complete list of earthquakes for the region, and the  
297 characteristics and damage produced by the earthquakes, especially the mainshock

298 (Taramelli and Mercalli, 1885). In their report an intensity map (Figure 4) is included,  
299 dividing the area into three zones named disastrous (*disastroso*), ruinous (*rovinoso*), and  
300 very strong (*fortissimo*), a precursor of the Mercalli scale. Mercalli also published an  
301 article on the Spanish earthquakes in *Rassegna Nazionale*, a Florence cultural journal  
302 (Mercalli, 1885).

303

#### 304 **Published in books**

305 In addition to the publications discussed above, there were also books of different types  
306 published on the earthquake and chapters about the earthquake in books about  
307 earthquakes. On February 15th, Macpherson gave a talk at the *Ateneo de Madrid*, a  
308 science and arts institution and which was later published as a book, in which he insists  
309 on the relationship between the earthquakes and the geology of the region and their  
310 origin in the fractures of the earth crust (Macpherson, 1885c). Orueta y Duarte  
311 published an expanded report of his field work after the earthquake, with a collection of  
312 photographs of the damage by the earthquakes on buildings (Figure 5) in a book (Orueta  
313 y Duarte, 1885c). Francisco Triviño Valdivia (1838-1910), a historian and writer, wrote  
314 a book about his visit to the villages with the largest damage produced by the  
315 earthquake (Triviño Valdivia, 1885). Repullés y Vargas published a book about the  
316 effects and damage produced by the earthquakes in the buildings and about some  
317 proposals for the construction of houses to make them more resistant to earthquakes  
318 (Repullés y Vargas, 1885b). Eduardo Feliu Boada published a book about earthquakes  
319 in general and in particular about those of Granada and Malaga and which ends with a  
320 poem about the earthquake (Feliu Boada, 1885). Cesáreo Martínez Aguirre, a professor  
321 of secondary school in Malaga, published a book with a study about the earthquake and  
322 damage produced (Martínez Aguirre, 1885). Carolina Soto y Corro (1860-1930), a poet  
323 from Jerez, and founding editor of the literary journal *Asta Regia*, wrote a long poem  
324 divided into six parts about the impact of the earthquake on the population of the  
325 affected towns and villages (Soto y Corro, 1885). Nicolás Paso y Delgado (1820-1897),  
326 a professor of law at the universities of Granada and Madrid and a member of the  
327 Spanish Parliament and Senate, published also a book of poems about the earthquake  
328 (Paso y Delgado, 1885). A stand-alone book was published in Portugal by J.B. Vieira da  
329 Cruz, Joaquim Teixeira Marinho and Alfredo Xavier Pinheiro with engravings and  
330 poems on the occasion of the Spanish earthquakes (Vieira da Cruz *et al.*, 1885).

331 Some years later, chapters on the 1884 Spanish earthquake were published in two  
332 books about earthquakes by Fouqué (Fouqué 1889b) and Charles Davison (1858-1940),  
333 a Cambridge scholar and mathematician (Davison, 1905). Fermín Lasala y Collado  
334 (1832-1918), a member of the Parliament and historian, commissioned by the  
335 government for the reconstruction of the damaged towns and villages published in 1888  
336 a book about the work achieved in the building of the new houses (Lasala y Collado,  
337 1888).

338

### 339 **Conclusion**

340 The occurrence of the large Andalusian earthquake of December 25th, 1884 and its  
341 aftershocks, which caused heavy damage and a large number of casualties, sparked  
342 interest and was the occasion for a large number of publications, a total of 58, mainly  
343 during the following year of 1885 in Spain, France, Italy, Germany, and England, many  
344 more than other earthquake of that time. The publications were articles in journals,  
345 bulletins of scientific societies, books and chapters in books of different types. An  
346 important subset was the publications with the results of the three commissions  
347 established in Spain, France, and Italy for its study. Some of the most important  
348 geologists and seismologists of Spain, France, and Italy participated in these studies,  
349 including Macpherson, Fouqué, Barrois, Mercalli, and Taramelli. In addition to the  
350 information on the damage, the effects on the ground produced by the earthquake, and  
351 the distribution of intensities, as mentioned in the introduction, the publications about  
352 the 1884 earthquake provided an opportunity for the presentation of the modern ideas  
353 that are still accepted today about the nature of earthquakes and their relation with the  
354 geology of the region where they happen. Abandoning the traditional idea that  
355 earthquakes were caused by explosive forces, the scientists of this period were  
356 promoting the idea that earthquakes were caused by the fracture of the layers of the  
357 crust due to the geodynamic processes acting in the earth.

358

### 359 **Data and Resources**

360 The source of all data used is indicated in References. Some scientific journals are  
361 available on different websites. Spanish books are available at different libraries such as

362 the Universidad Complutense, Instituto Geográfico Nacional, Biblioteca Digital  
363 Cervantes, Biblioteca Nacional, Biblioteca Real.

364

### 365 **Declaration of Competing Interests**

366 The authors acknowledge that there are no conflicts of interest recorded.

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611 **Figure captions.**

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613 Figure 1a.- Epicenter location (star) for the 1884 earthquake. The square show the  
614 region plotted in Figure 1b.

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616 Figure 1b.- Epicenter location (star) for the 1884 earthquake, with the numbers  
617 corresponding to the damaged towns.

618

619 Figure 2.- Nogués' map of the region with the greatest damage (Nogués, 1885b).

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621 Figure 3.- Title page of the report of the Spanish Commission (Fernández de Castro *et*  
622 *al.*, 1885).

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624 Figure 4.- Intensity map of the 1884 earthquake (Taramelli and Mercalli, 1885).

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626 Figure 5.- Damage at the town of Jayena (Orueta y Duarte, 1885c).

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