

EVIDENCE FOR AN ATMOSPHERIC AIRBURST OF A HUGE BOLIDE OVER SPAIN IN 939AD AS RECORDED IN MEDIEVAL CHRONICLES. J. Llorca¹, J. M. Trigo-Rodríguez², J.A. Docobo³ and H. Neira⁴.

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Introduction: Historical records of meteor showers and, more rarely, fireballs have been found in ancient chronicles all around the world [1-4]. Finding records of bolide airbursts is particularly interesting in order to better understand the influence of these events in temperature variations or other anomalies preserved in geological records [5]. In particular, direct evidence of ablated material can be found in ocean cores, ice-cores, peat and lake sediments. Indirect climatic effects associated to volcanic or extraterrestrial dust veils have been also identified in tree-ring chronologies. Among historical records, medieval chronicles preserved in different parts of Europe have been scarcely explored. We have studied medieval chronicles of Spain and have found records reporting a huge fireball that occurred in 939AD.

Results and discussion: *Chronicon Burgense* was compiled in the XVIII century by priest Enrique Flórez [6] and reports events that occurred as early as in the X century. The text is part of a relation of different historical facts preserved in an old calendar of the Burgos Cathedral. The event that probably produced a meteoritic airburst says:

“*Era DCCCCLXXVII. Kalend. Junii die Sabbati hora nona flamma exivit de mari, & incendit plurimas Villas, & Urbes, & homines, & bestias: & in ipso mari pinnas incendit: & in Zamora unum barium, & casas plurimas, & in Carrion, & Castro Xeriz, & in Burgis, & in Berviesca, & in Calzada et in Pontecorvo, & in Buradon, & alias plurimas Villas*”.

The tentative translation of this text reads: “Year 939AD, June 1st., Saturday around 3 pm, a flame exit from the sea and set on fire several villages, and large cities, and men and beasts. And the same sea was set on fire crags. And in Zamora a district and multiple houses. It also affected Carrión, Castrojeriz, Burgos, Briviesca, Calzada, Pancorbo, Belorado, and other multiple villages”.

If our interpretation is correct, this would be the oldest record preserved in Spain of a meteoric outburst. The discovery of such ancient chronicle motivated additional searches of this event in other medieval texts. In addition to the *Chronicon Burgense* text we have found evidences in other medieval chronicles. For example,

the anonymous *Poem of Fernán González* (written in old Castilian) includes also a description of the same bolide [7]:

468	<i>Vieron aquella noche venia por el aire dando muy fuertes gritos toda venie sangrienta,</i>	<i>una muy fiera cosa: una sierpe rabiosa, la fantasma astroza, bermeja commo rosa.</i>
469	<i>Fazia ella senblante semejaba en los gritos alunbrava las uestes todos ovieron miedo</i>	<i>que ferida venia, que el çielo partia, el fuego que vertia, que quemar los queria.</i>

The tentative translation of these verses reads:

468	They saw that night it came from the air giving very loud shouts all coming bleeding,	a very fierous thing: a furious snake, the terrible phantom, red as a rose.
469	It look like and her shouts look like illuminating the people all were afraid	she came wounded, the sky was broken, the fire she produced, that burn them she wanted.

The event is also mentioned in the *Estoria del sennor Sant Millan* by the famous writer Gonzalo de Berceo (1197-1264 AD). It was also described in more detail in the *Liber Miraculorum Sancti Emiliani* [8], that includes a fragment describing this event in detail:

“*Nam in istis fere temporibus talia in terra apparuerunt signa quod furor Domini uenturus credebatur in ea. In Era noningentesima septuagesima secunda, quarto decimo kalendas agusti, lumen solis die sexta feria amittens lucendi virtutem obscuratum constitit ab ora secunda in terciam. Quarta feria ydus octubris colorem eiusdem solis multi cognouerunt effectum palidum. Signa magna facta sunt in celo uento africo. Porta flamea aperta est in celo et ibant stelle et comouebant se huc atque illuc, et discurrebant contra uento affrico, et mirate sunt gentes de his signis noctis media usque mane; et fumificus uapor magnam terre partem combusit*”.

All the above texts are consistently speaking about a huge bolide that produced sound and caused important alarm to the eyewitnesses. The different texts give con-

tradictory information about the magnitude of the event. While the *Chronicon Burgense* is clearly stating that the event was producing fires and burning people, the *Poem of Fernán González* is only describing that the people had the feeling of being burned by the fireball. Consequently, we cannot be sure if the original text was exaggerating the effects produced by the bolide. We should remark that casual eyewitnesses of large bolides are typically reporting fires to emergency phones even today, so we can imagine that a meteoritic outburst in the X century would have had terrible consequences in people's thinkings and behavior.

Finally, as an example that these medieval chronicles provide a quite reliable description of astronomical events, it seems remarkable to mention some additional astronomical records found in the same texts. For example, in the *Liber Miraculorum Sancti Emiliani*, in the *Estoria del sennor Sant Millan*, and in the *Poem of Fernán González* we found descriptions of the Solar eclipse occurred on July 19, 939, and the impressive meteor display occurred several days after the eclipse. At that epoch the Perseid display was peaking around July 22nd-23rd, so we think that the chronicles were describing the meteor shower associated with comet 109P/Swift-Tuttle. This is consistent with additional displays of this meteor shower recorded in Chinese chronicles (see Table 1, pag. 601 in [9]).

Conclusions: Medieval chronicles of Spain have relevant information on astronomical events visible over the South of Europe. In particular, the impact of a huge bolide over the North of Iberian Peninsula on June 1, 939AD is described. The distribution of cities and villages affected by the event are clearly aligned, but the magnitude of the event remains unclear. We cannot be sure if the texts exaggerated the effects produced by the airburst. In any case, the location of villages affected by the event is consistent with a huge meteoric airburst of a magnitude similar to that of Tunguska. If such a description is reliable, the text would be describing a really remarkable event. We hope that these results encourage other studies aimed at searching additional evidence through ice-core, sediments, or tree-ring records. In fact, this airburst could be correlated with temperature variations preserved in ice-cores and tree-ring present in the period 930-940AD [10].

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