

Biot's inquiry about the extraterrestrial origin of meteorites (1803)

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On the 7 Floréal XI (26 April 1803), a meteorite appeared in the vicinity of L'Aigle (Orne). On the instructions of the Minister of the Interior, Chaptal, the 29-year-old Jean-Baptiste Biot, who had been a member of the French Academy of Sciences since April, left for L'Aigle on 7 Messidor (26 June) on an investigative mission that would last ten days. His report, which he presented to the academy on 18 July, twelve days after his return, reads like a scientifically rigorous police investigation.

Even in 1790, during the meteorite fall at Barbotan (Gers), local grandees and savants mocked the claims of agricultural workers, according little credibility to their accounts. Some scholars attributed some of these falls, like that at Sienna in 1798, to volcanic eruptions such as the one that had taken place at Vesuvius a few days before. The Biot report was the first scholarly text that attested to the extraterrestrial – i.e. non-terrestrial – origin of meteorite falls.

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To start with, Biot prepares for his trip by obtaining a stone from the Barbotan meteorite fall:

I asked Citizen Haüy if he would be so good as to enlighten me on the mineralogy of the region I was to explore [...] I left Paris on the 7 Messidor, taking with me a sample of the meteoric stone from Barbotan (p. 9–10).

He then begins searching for clues by gathering spoken testimonies from the population:

In the sky he saw a globe of fire that appeared in calm weather to one side of Mortagne, and seemed to fall in a northerly direction. A few instants later a loud thunder-like noise was heard [...] This noise lasted several minutes (p. 11).

It was like a very loud roll of thunder [...] lasting five or six minutes, and accompanied by several successive explosions (p. 13).

We heard [the explosion] three leagues from Avranches. — Do you have that on hearsay? — Sir, I have it on more than hearsay, for I was there. — It is thirty-six leagues from Avranches to L’Aigle (p. 16).

L’Aigle (Orne) is indeed some distance from Avranches (Manche) – thirty-six leagues, or around forty kilometres – yet the explosion was heard from that distance. As he gathered these testimonies, Biot also examined stones collected by the population:

Of all the probabilities hitherto gathered on the fall of meteoric masses, the strongest results from the harmony that exists between their composition and the origin that is exclusively attributed to them in the testimonies (p. 7).

I first showed him the one from Barbotan, and he immediately recognised it as having fallen from the sky. He then showed me what he had: it was similar to ours in every respect (p. 16).

This last sentence is a sign of the skilfulness of Biot’s inquiry: when he shows the Barbotan stone to a peasant – who, presumably, was not a mineralogist – the latter immediately recognises it as a stone that fell from the sky, just like those he was able to see in the aftermath of the phenomenon.

The evidence collected enables Biot to set out some preliminary conclusions by the middle of his report:

In the vicinity of L’Aigle on Tuesday 7 Floréal XI, at around one o’clock in the afternoon, there was a violent explosion that lasted five or six minutes and sounded like a continuous roll. This explosion was heard up to thirty leagues away in all directions ... A few moments before the explosion at L’Aigle, a luminous, fast-moving globe had appeared in the atmosphere (p. 18– 19).

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After confirming the reality of the phenomenon (a ball of fire and the noise of an explosion), Biot turns his attention to the meteorite falls and attempts to relate them to the phenomenon:

The first pieces of information I received at L’Aigle were given to me by Citizen Humphroy and concern a stone weighing 8k56, which is said to have fallen at La Vassolerie, a village situated one league to the north of L’Aigle (p. 20).

All of a sudden they heard a terrible clap of thunder above their heads ... The young man told his brothers to lie on the ground for fear that they would be struck down. Then in the nearby field they heard a terrible bang, which they liken to a filled barrel falling from on high [...] My colleague Leblond and I examined the hole from which this mass had been taken [...] Can one reasonably suppose that such a considerable mass could have existed long before without being remarked on? (p. 22)

This testimony is important because it connects the noise, and thus the phenomenon, to the stone-fall, which, as Biot confirms, could not have existed before. Biot now begins to scientifically characterise the stones, and this characterisation reinforces his convention that the stones were new and related to the phenomenon:

[The inhabitants of this farm] saw two stones fall into their courtyard: one whistled as it fell; they showed me where it had landed. It was burning hot for smoke rose from the earth all around it (p. 25).

Everyone is in agreement that the stones gave off smoke where they had just landed. When placed inside the houses, they exhaled a sulphurous odour that was so unpleasant they had to be taken outside again (p. 27).

As the peasants had removed many fragments from this mineral mass on the very spot [where it had landed] in no time at all, it seems that it did not then have the exceedingly hard consistency it has now ... Yet such a prompt transition from friability to complete solidity indicates the presence of a cause that had recently disturbed their aggregation (p. 23).

This last sentence is interesting for it heralds a future characterisation of meteorites. Unlike minerals – which are made up of a single substance – meteorites are aggregate objects whose “solidity” is disturbed by their sudden passage through the atmosphere, which warms them up and makes them friable until they return to a normal temperature and degree of solidity.

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Biot now turns to an unexpected aspect of his inquiry, namely a sociological study of the witnesses:

First there was a very respectable woman, who can have no interest in imposing; then there were two ecclesiastics who can have no good reason to alter the truth (p. 28).

Among their number are grown men, women, children and the elderly; they are simple, uncouth country folk who live a great distance from one another;

[there are] *sensible and reasonable ploughmen; respectable ecclesiastics; youths who, having been in the military, are shielded from illusions of fear: all these persons of such different professions, mores and opinions, and who are but little or unrelated amongst themselves, all of a sudden come to agreement and testify to the same event, on the same day, at the same time, at the same instant* (p. 41).

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Lastly, after attributing the fallen stones to the phenomenon of the explosion, Biot endeavours to delimit the exact zone where the stones fell. This is a serious undertaking, though it may perhaps appear less so in his description of his efforts to determine the visible trajectory of the meteorite:

After the walk I had just completed, I knew the northerly, easterly and southerly boundaries of the explosion (p. 33).

Had it exploded all at once, the stones would have been ejected over a more or less circular expanse; but the duration of the noise indicates a series of successive explosions that must have scattered the stones over an elongated expanse in the direction the meteor was moving ... One may conclude that the meteor was moving from the south-east to the north-west at a declination of around 22° (p. 44).

And, to put the finishing touches to his study of the geographical area, Biot goes to the market at L'Aigle one Sunday morning, corroborating the villagers' statements as follows:

I questioned them and, depending on the stories they told about the meteor, I could always tell in which canton they lived, for those who had seen the stones fall lived within the boundaries I had roamed, and those who had not lived outside (p. 38).

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At the end of his ten-day fieldtrip, Biot makes his definitive conclusion:

Prior to the explosion of 6 Floréal, meteoric stones had never before been seen in the possession of the local people.

The mineralogical collections, which are designed to collect specimens from the department, do not contain anything remotely similar [...] The local foundries, factories and mines yield no products or scoria bearing the slightest relationship to these substances. There are no volcanic traces in the region.

All of a sudden, at precisely the time of the meteor's appearance, these stones are found on the ground and in the possession of the country people, who know them better than any other [person] [...] These stones are found on a limited tract of land only, on terrains where the substances they contain are unknown, in places where, by dint of their sheer size, they could not have escaped previous notice.

When the largest of these stones are split asunder, they still exhale a very strong sulphurous odour from within.

After having the composition of the stones analysed by Thénard at the Museum of Natural History, Biot writes:

As we can see from this analysis, the stones that fell in the vicinity of L'Aigle are composed of the same elements as known meteoric masses; they simply contain a little less magnesium, and a little more iron.

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As stated above, this detailed report by Biot is the first scholarly proof of the non-terrestrial origin of meteoric falls. But the science did not stop there: far from it. Even among scholars who accepted the non-terrestrial origin of meteors, some thought that they were formed in the atmosphere, which, as we now know, is false. Like the vast majority of French scientists, notably Laplace and Poisson, Biot himself was convinced of the extraterrestrial origin of meteorites, but attributed the cause to eruptions from what at that time were believed to be volcanoes on the moon. Among scientists of the time, it was the German physicist Ernst Chladni (1756–1827) who, in 1794, first conjectured that meteorites are small bodies from the solar system that enter into the Earth's gravitational field.



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