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SHORT COMMUNICATION

A newly discovered historical earthquake or merely a chronological mistake? Report of Mary Eliza Rogers from October 10, 1856

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Abstract In her nineteenth century book “Domestic Life in Palestine”, Mary Eliza Rogers describes the earthquake she had experienced in Haifa in the middle of the night between the 10th and 11th of October 1856. Although she reports that the earthquake was well felt in northern Palestine and even slightly damaged structures in Haifa, she is the only one who reported the event. However, on the following night, a destructive earthquake that occurred close to Crete was reported by many contemporary sources. Rogers’ report is not cited in any of the existing earthquake catalogs or literature. Thus, the question arises is whether what she reports is an earthquake that was unknown to us till now or perhaps she merely dated incorrectly the event she had experienced. To resolve this question, I interpreted her description of the moon phase at the time of the earthquake occurrence and concluded that Rogers incorrectly dated the event whereas in fact what she had experienced was the Crete earthquake. The rest of her description is probably reliable and reinforces reports of damaged localities along the coast of northern Palestine and southern Lebanon.

Keywords Mary Eliza Rogers · Historical earthquake · Damage · 1856 · Palestine · Haifa

1 Introduction

In her book “Domestic Life in Palestine”, Mary Eliza Rogers describes an earthquake she had experienced in Haifa during the middle of the night between the 10th and 11th of October, 1856. Rogers reports that she was asleep and was woken suddenly by what she had recognized to be an earthquake shaking. She adds that the ground trembled violently three distinct times and that the second tremor was the strongest. In Haifa, the earthquake was well felt and people living close to the mosque reported that it was so violent that they were afraid the mosque would eventually collapse. A few old walls were cracked and an eye witness told Rogers that “during the shock he had observed that the sea was violently agitated, and covered with foam, though there was no wind”. During the morning after the earthquake, Rogers had met other people that felt the same murmuring in the night and in the days to come she realized that the tremor was also felt in the coastal cities of Akko, Tyre, and Sidon (Fig. 1) (Rogers 1862, 360–361).

Although Rogers reports of a damaging earthquake that affected a coastal strip of more than 50 km between Akko and Sidon, she was the only reporting source of an earthquake on that particular night. On the night after, however, between the 11th and 12th of October, a destructive earthquake occurred close to Crete and was reported by many contemporary sources (e.g., Perrey 1859; Schmidt 1879). The magnitude of that earthquake was estimated to be between 7.7 and 8.2 with an

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epicenter at 25.8°E 36.6°N (Papazachos et al. 2000; Papazachos and Papazachou 1997). The earthquake hit mainly localities in Crete such as Chania, Heraklion, and Ierapetra but also caused considerable damage in other Greek cities (Fig. 1). The earthquake was felt throughout the eastern Mediterranean region from Italy to the Nile Delta in Egypt and from Malta to Syria (Ambraseys 2009, 683–685 and references therein; Galea 2007). There is slight disagreement as to the exact time of occurrence; while Ambraseys (2009, 683–685) suggests 02:33 a.m., Papazachos et al. (2000) suggest it occurred at 02:45 a.m.; both refer to the local time in Crete. That was also the local time in Haifa since Palestine and Crete were (and still are) in the same time zone. It is worth noting that during the mid-nineteenth century there was no use of Daylight Saving Time

(“summer time”) procedure in Europe and Palestine at the time.

The proximity of the two dates and the lack of reporting sources (apart from Rogers) regarding the 10th of October night raise the hypothesis that we are not facing two separate earthquakes but rather a single event. Rogers could have experienced the Crete earthquake but might have inaccurately confused dating it. As far as I know, Rogers’ report is not cited or discussed in any of the existing earthquake catalogs or reappraisals (e.g., Ambraseys 2009; Amiran et al. 1994; Ben-Menahem 1979; Karcz 1987; Salamon 2009). Being aware of some errors, inaccuracies, and duplications of earthquakes that have already penetrated parts of the scientific literature (Karcz and Lom 1987), critical interpretation of Rogers’ report (like that of any other

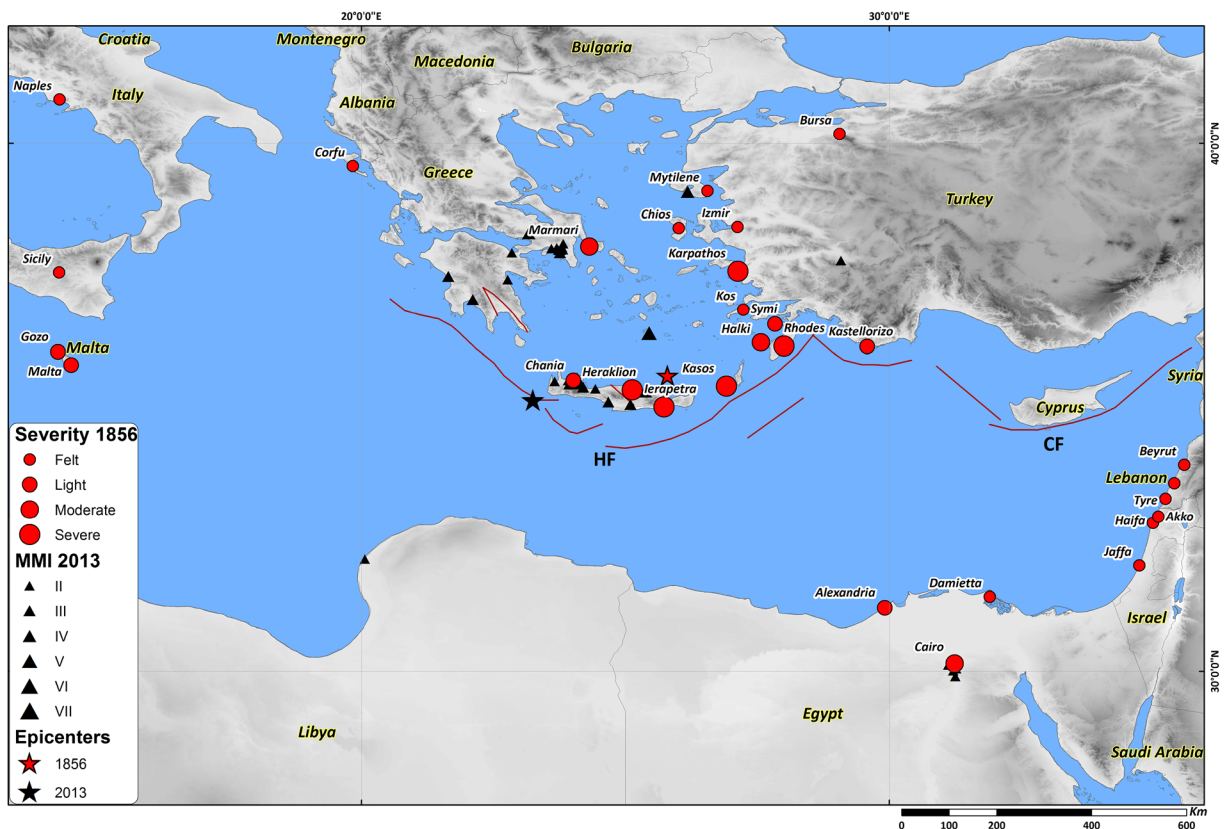


Fig. 1 Damage distribution of the Crete earthquakes on October 12, 1856 (Ambraseys 2009, 683–685; Papazachos and Papazachou 1997, 234–235; Perrey 1859; Schmidt 1879) and October 12, 2013 (USGS 2013a). The epicenter of the 1856 earthquake follows Papazachos and Papazachou (1997). Without intensity assessments, the damage severity of the former was made using a severity scale ranged from felt to severe damage (Zohar

et al. 2017). Note the four localities of Haifa, Akko, Tyre, and Sidon that were reported by Rogers. The 2013 earthquake epicenter and 52 MMI intensity evaluations were adopted from the USGS (United States Geological Survey) earthquake center (USGS 2013b). The HF and CF represent the tectonic segments of the Hellenic and Cyprus arcs, respectively

historical report) is of great importance. If Rogers' dating is accurate, a new earthquake entry should be added to the scientific list of historical earthquakes. On the other hand, if Rogers' dating is wrong, the error of a duplicated earthquake may be avoided. This paper presents an historical-geographic approach to accurately resolving the date of the earthquake.

2 Dating the Rogers report

In her report, Rogers describes the phase of the moon at the time of the earthquake occurrence: "The moon was nearly full, and just above the range of Carmel, it was as red as the sun appears to be when seen through an English fog" (Rogers 1862, 360). This is an important contribution of Rogers for the phase of the moon may serve as a chronological proxy for the date. In October 1856, the exact date of a full moon appearance as observed in the Middle East region was the 14th at 02:29 a.m. (Table 1 and Fig. 2). Accordingly, a "nearly full" moon was likely to be seen 1–2 days prior to the 14th. According to Rogers' dating, the earthquake occurred during the night between the 10th and 11th, i.e., 3 days before full moon. At that particular date, the phase of the moon can hardly be in accord with a "nearly full" description and is more likely to present only 3/4 of its full appearance. Consequently, the phase of the moon better fits the night of the Crete event between the 11th and 12th of October rather than the night before.

The second part of Rogers' report concerning the location and color of the moon at the time of the earthquake occurrence is even more interesting. She

describes a moon of a reddish color that was seen just above the Carmel range. In 1856, Rogers resided in Haifa, which was situated along the Mediterranean shore east and northeast of the Carmel range (Fig. 3) (Carmel 2011). This range, approximately 500 m above sea level (Hall and Cleave 1998), was clearly seen from the mid-nineteenth century city of Haifa (as it is today). If Rogers was able to accurately describe the phase of the moon, she must have seen the whole of it or at least the majority of its surface. The reddish color she describes implies that the moon was not high in the sky but rather low above the horizon (Fig. 4). Such an appearance can only be seen shortly after moonrise or close to moonset. Table 1 presents the moonrise and moonset between the 9th and 14th of October 1856. Accordingly, between the 10th and 12th, the moon rose before 16:21 in the afternoon. Since Rogers reports that she woke up in the middle of the night, the possibility that she had witnessed a moonrise is strongly rejected. That is, she most likely had witnessed a moonset. The latter occurred in the night between the 10th and 11th of October at 02:26 a.m. while during the following night, it occurred at 03:38 a.m.. That is, since the earthquake occurred between 02:33 and 02:45 a.m. and Rogers had in fact seen a moon above the Carmel range during the earthquake occurrence, it could have only been during the second night. Had Rogers experienced an earthquake during the first night, it must have occurred before 02:26 a.m.. In other words, if her dating is correct, she could not have experienced the Crete event. On the other hand, if her dating is incorrect by only a single day then she could have seen a moon that was about to set within an hour while experiencing the Crete earthquake. The latter option is supported also by Rogers' reports on the agitated sea on the night of the earthquake which coincides well with several reports of the Crete event describing abnormal sea currents (Ambraseys 2009, 685).

Eliza Rogers was the sister of the British consul Eduard Thomas Rogers. She was well known in the local community at the time and is considered a reliable and accurate source (Ben-Arieh 1970; Tucker 1990). Yet, there are no other sources that support her description of an earthquake occurrence at the time she refers to. In light of the mid-nineteenth century massive expansion of media and newspapers, one would expect such an event to be reported; in 1856, 23 earthquakes in the Mediterranean region were reported, even if

Table 1 The moon phases between the 9th and 14th of October 1856 based on a scientific moon rise and set calculator developed in the Raymond and Beverly Sackler Institute of Astronomy at the Tel Aviv University and maintained by Prof. Shay Zucker (Zucker 2010). These phases accord with a time zone of UTC (universal time coordinates) +2 and the location of Haifa (35.02° Lon; 32.8° Lat). The asterisk denotes the date of the full moon (see also Fig. 2)

Gregorian date	Moonset	Moonrise
09.10.1856	00:05	14:40
10.10.1856	01:16	15:17
11.10.1856	02:26	15:50
12.10.1856	03:38	16:21
13.10.1856	04:49	16:53
14.10.1856*	06:01	17:27

Fig. 2 The moon phases in October 1856 based on the NASA astronomical calculations as seen in the Middle East region (NASA 2017)



All event times are given for UTC+3:30: Middle East Time (MET) for the entire year.

they were only felt without causing any damage (Ambraseys 2009, 682–686). Had a damaging earthquake (as Rogers testified) occurred, surely

it would have been reported elsewhere, at least in the local media. The silence of other sources with respect to the night Rogers dates the earthquake in

Fig. 3 The region of Haifa (labeled “HAIFA OR KHAIFA” on the map) and its close surroundings during the mid-nineteenth century (Hull 1865). Note the range of the Carmel (labeled “MOUNT” on the map) in relation to Haifa (marked with black arrows). Accordingly, Rogers probably observed the moon at a location situated west-southwest of her residence (plausible orientation is noted with red arrow)

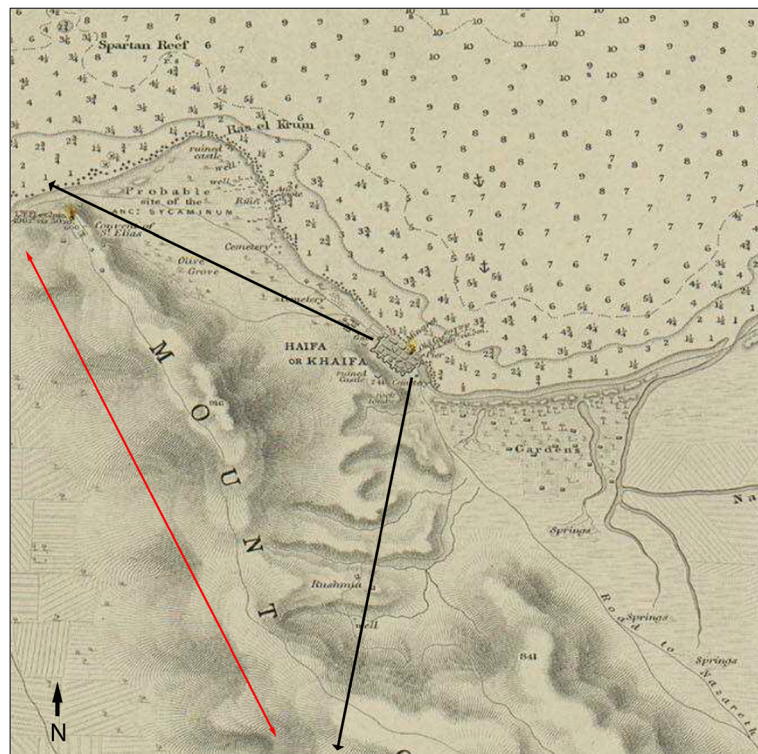
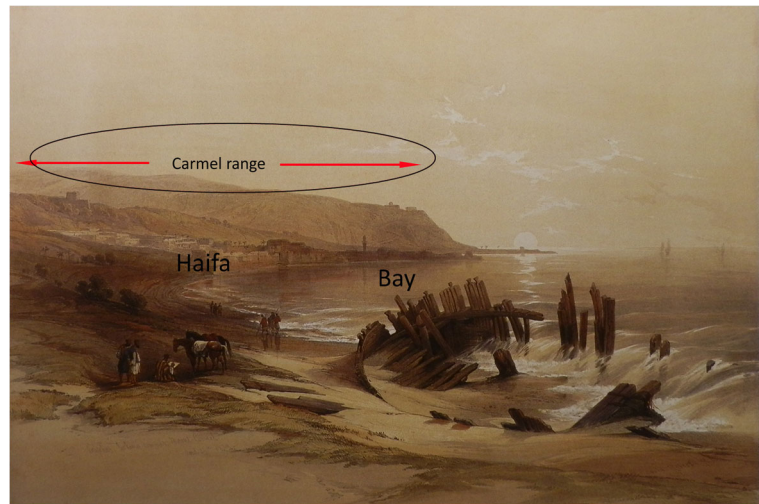


Fig. 4 Mid-nineteenth century Haifa by David Roberts (Roberts 1842–1849). The view of the Carmel range observed by Eliza Rogers is marked with *red arrows* while a plausible location of the moon as she observed is noted by a *black oval*



comparison to the wealth of reports from the night after implies that indeed she might have confused the two dates.

3 When did Rogers write her book?

Rogers' book was published in 1862, 6 years after the earthquake. At the opening of the book, Rogers dedicates it to her brother who was serving as a consul in Damascus at the time: "in remembrance of the happy years I spent with him in Palestine". That is, the book was probably written only after she had left Palestine on June 2, 1859, and reached England on the 28th of that month (Rogers 1862, 398 and 409). Yet, her memories and notes were written previously and continuously throughout her residence in Palestine, as she states in the preface of the book: "The pleasure which my notes and Journal afforded to members of my home circle, on my return to England, led me to think that possibly my countrymen would like to gain a further insight into the mysteries of the Eastern life. Hence it was that I resolved to publish this volume" (Rogers 1862, preface). Maintaining a detailed documentation of her visit in Palestine attests to the suggestion that Rogers was chronologically dating her journey. Yet, her notes were not on a daily basis and thus, it is reasonable to assume that chronological dating errors of a few days

might have occurred when writing her book few years after the accomplished journey.

4 Concluding remarks

Altogether, the fact that Rogers is the only reporter of an earthquake that allegedly occurred during the night between the 10th and 11th of October as well as the rejection of the possibility that she had witnessed a moonset during the earthquake occurrence reinforces the hypothesis that Rogers probably incorrectly dated the earthquake she had experienced. That is, she probably experienced the Crete earthquake that occurred the night after (between the 11th and 12th of October) but dated the event as occurring a day earlier, in the night between the 10th and 11th. Nonetheless, the rest of Rogers' report seems to be reliable and reinforces reports of damage in Haifa, Akko, Tyre, and Sidon (Rogers 1862, 361). The description of an agitated sea close to Haifa deserves further inspection of possible abnormal sea currents and if validated, such currents ought to be added to existing tsunami catalogs (e.g., Salamon et al. 2011; Salamon et al. 2007).

This is not the first time that events originating close to Crete affected the coastline of Palestine and Lebanon (Papazachos 1996). The most representatives of such kinds of destructive earthquakes are the 365 CE and 1303 CE earthquakes, generating also tsunami tides within the Mediterranean Sea (Guidoboni and Comastri 2005; Guidoboni et al. 1994; Karcz 1987). In modern days, a recent and notable earthquake, originating close to Crete and also felt

in present-day Israel, occurred on the 12th of October 2013 at 13:11 (UTC). The magnitude of this earthquake was M6.6 with felt reports as far away as Turkey, Egypt, and Libya (Galea 2007, see distribution in Fig. 1).

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