

The “exceptional” earthquake of 3 January 1117 in the Verona area (northern Italy): A critical time review and detection of two lost earthquakes (lower Germany and Tuscany)

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[1] In the seismological literature the 3 January 1117 earthquake represents an interesting case study, both for the sheer size of the area in which that event is recorded by the monastic sources of the 12th century, and for the amount of damage mentioned. The 1117 event has been added to the earthquake catalogues of up to five European countries (Italy, France, Belgium, Switzerland, the Iberian peninsula), and it is the largest historical earthquake for northern Italy. We have analyzed the monastic time system in the 12th century and, by means of a comparative analysis of the sources, have correlated the two shocks mentioned (in the night and in the afternoon of 3 January) to territorial effects, seeking to make the overall picture reported for Europe more consistent. The connection between the linguistic indications and the localization of the effects has allowed us to shed light, with a reasonable degree of approximation, upon two previously little known earthquakes, probably generated by a sequence of events. A first earthquake in lower Germany (I_0 (epicentral intensity) VII–VIII MCS (Mercalli, Cancani, Sieberg), M 6.4) preceded the far more violent one in northern Italy (Verona area) by about 12–13 hours. The second event is the one reported in the literature. We have put forward new parameters for this Veronese earthquake (I_0 IX MCS, M 7.0). A third earthquake is independently recorded in the northwestern area of Tuscany (I_{max} VII–VIII MCS), but for the latter event the epicenter and magnitude cannot be evaluated.

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1. Case of 1117: A Short History of the Interpretation and the Aims of this Review

[2] Very large earthquakes represent a major problem in the study of historical seismology. It is reasonable to ask whether one is dealing with a really exceptional event or a combination of undifferentiated events occurring in rapid succession. In past centuries the fact that direct witnesses could distinguish between the effects of different shocks as well as provide accurate geographical indications has been above all strongly affected by various cultural factors. A subject may perceive a phenomenon, but he or she also needs to have a network of human “sensors” capable of communicating with one another and reconstructing the image of the phenomenon and its temporal evolution using a common system of time measurement. Information in the written sources depends on this initial system of culture and

communications. The sources transmit the image of the earthquake encoded in their own culture, of which they are the expression. This image is then transmitted and passed down in the tradition of seismological studies, often without being “decoded” and thus interpreted for scientific purposes, like a sort of “message in a bottle.”

[3] We have only used textual analyses for the case presented here. It is worthwhile bearing in mind that in historical European seismology the 3 January 1117 earthquake stands out among case studies for a number of reasons: (1) this earthquake is listed in the catalogues of up to five countries (Italy, France, Switzerland, Belgium, Iberian peninsula); (2) an outstanding corpus of sources (about 94 altogether) converge in indicating the area of the low-lying plains of Verona (northern Italy) as the area with the strongest effects; (3) it is considered to be the most important historical event of northern Italy (the most densely populated and industrialized area of the country); and (4) medieval annals over a wide area of central and northern Europe mention this exceptional earthquake, felt

as two shocks, merging local effects with a straightforward citing of the event as a famous earthquake in northern Italy.

[4] For a long time in medieval Europe much was said and written about what happened on 3 January 1117: the event is recorded in numerous European annals from the first half of the 12th century, mostly written by Benedictine monks, and in many city chronicles of northern Italy. This earthquake was considered unique by contemporaries, if only because of the many “wonders” (that is, phenomena thought to be quite out of the ordinary) that accompanied it. The event soon lent itself to being transfigured by medieval religion, careful to signs and spiritual meanings. Unfortunately, only some descriptive features have been passed down in lasting form, but the breadth of the area of damage and the effects undoubtedly made the event far-famed and worthy of being handed down to posterity. The lasting impact of the account is, in our opinion, an objective historical fact, as will be seen better below, and we have tried to decode it as factual data. However, for any human event to be crystallized in the monastic memory (i.e., set down in the monks’ annals), or in chronicles, it had to go through various cultural and religious filters. What was narrated in the medieval text was an event that was above all important in the authors’ judgments.

[5] In the 1970s, when the descriptive historical catalogues in Europe began to be elaborated into parametric catalogues, the case of 1117 was proposed anew for the Italian catalogue: the reference source was *Baratta* [1901], but on that same basis different authors arrived at different conclusions: *Caloi et al.* [1970] generically located it in the Veneto region (without attributing any coordinates or epicentral intensity), *Giorgetti and Iaccarino* [1971] and subsequently *Carrozzo et al.* [1973] located the epicenter at around 15 km north of Verona (with a degree of intensity \geq XI MSK (Medvedev, Sponheuer, Kárník) and $M \sim 7$); *Bernardis et al.* [1977] located it just north of Verona; *Iaccarino and Molin* [1978] located it generically in Veneto-Lombardy (without giving any epicenter coordinates), both with an epicentral intensity of degree XI MCS. *Postpischl* [1985] located the epicenter at around 10 km northeast of Malcesine (province of Verona), near the northern banks of Lake Garda, with an uncertain intensity between X and XI MCS and M 6.5.

[6] Although it was the most violent historical earthquake known in northern Italy (today the most highly industrialized and populated area in the country), the 1117 disaster only became the subject of in-depth research in the years 1983–1985, as part of the nuclear site selection in Italy [*Guidoboni et al.*, 1985]. However, in spite of this broad-ranging research and analysis, some hazy areas remained, which the authors of the study were unable to clarify. Thus, although the mention of the two different shocks was clear from the European annals, the qualitatively complex system of time references provided by the sources had never been fully disentangled. The two shocks were believed to belong to one and the same epicenter, i.e., that of northern Italy. The reports of the European annals were thus interpreted partly as effects of a single propagating earthquake, and partly as reports on the great impact of the earthquake in the culture of the times. These elements, as we shall see, were both true, but there was more to it than just that.

[7] The 1117 earthquake was subsequently examined by *Alexandre* [1990]. In this catalogue the area of maximum effects is generically indicated in the Verona area and in the Trentino region. The sources selected by Alexandre refer to local effects, as can be inferred from his schematic map. Although incomplete from the point of view of sources (no documentary or epigraphic sources being used) and the seismological elaboration (no seismic parameters were calculated), this study has nevertheless provided a highly positive contribution to the analysis of European monastic annals, for which it provides correct dates of writing and origin. In a previous work by *Alexandre* [1984], the author very concisely studied the effects of this earthquake as limited to the area of Belgium, the Rhineland and northern France, with no hypotheses made as to an epicenter.

[8] From the purely historical point of view, *von Hülsen* [1993] presented a critique of the studies published until then on the 1117 case, confirming the historiographic relevance of the event. Hülsen reached a distinctly more pessimistic conclusion as to the possibility of understanding the effects of this large earthquake, which is again treated as a single seismic event, with its epicenter in the area of Verona.

[9] The 1117 earthquake was reviewed in the *Catalogo dei Forti Terremoti in Italia* (CFTI) [*Boschi et al.*, 1995, pp. 188–191]. Although the comment on this earthquake mentioned two shocks, the parameters were calculated on the basis of the cumulative effects, considering just one epicenter in the lower Adige Valley ($I_0 = IX$, $M = 6.8$). The transalpine locations were only partly considered, because the aggregation of the various European locations in the two shocks had never been resolved. In the subsequent catalogue issues [*Boschi et al.*, 1997, 2000] the transalpine locations were not all considered for the calculation of the parameters, leading to a lower magnitude ($M = 6.5$).

[10] An archaeological approach has pointed to a new epicenter in the Italian prealpine area (Trento) from *Galadini and Galli* [2001]: they refer to the two shocks cited just discursively in the text of the CFTI catalogue [*Boschi et al.*, 1995, p. 189], where the 1117 earthquake has, as has already been said, just one epicenter. *Galadini and Galli* [2001] do not calculate any new parameters: their archaeological hypothesis is just qualitative, not supported by data, and also shows an evident inconsistency with the corpus of known historical records, and the broader problems of method (see comment to their paper by *Guidoboni* [2003]).

[11] At the time of writing, the 1117 earthquake is listed in the catalogues of four other European countries apart from Italy: those of France, Switzerland, Belgium, and the Iberian peninsula. It is interesting to observe that, although studies were available, such catalogues have elaborated their own picture of the 1117 earthquake, and lie beyond the scope of specialist research. For example, the catalogue of European earthquakes compiled by *Van Gils and Leydecker* [1991] still cites the parameters of *Carrozzo et al.* [1973], neglecting 10 years of research. The SisFrance online database (available at <http://www.sisfrance.net/main.asp>), updated to 2002, locates the epicentral area in the Lombardy region (but also indicates “Verona,” in the Veneto region). Moreover, it provides no parameters. The Earthquake Catalog of Switzerland (available at http://histserver.ethz.ch/intro_i.html), updated to 2002, presents

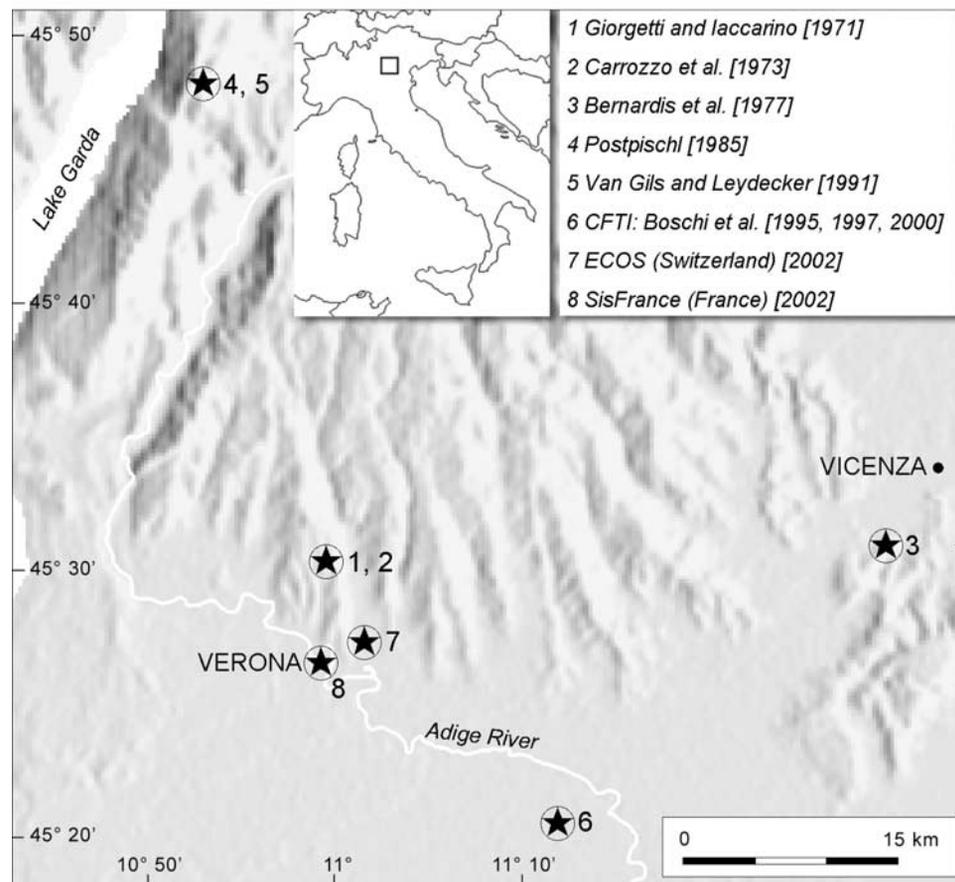


Figure 1. Epicenters attributed to the 1117 earthquake by the parametric catalogues from 1971 to 2002.

an array of sources and late historiography for the 1117 earthquake. The epicenter is said to lie in the Verona area; the damage located in Switzerland (this can only be inferred from the map) sets the state of knowledge back to before the 1990s research. Finally, it is interesting to observe that the parametric catalogue of Iberian peninsula earthquakes [Martínez Solares and Mezcuá Rodríguez, 2002] locates an earthquake dated 3 January 1117 in Lisbon (Portugal), with no indication of epicentral intensity (the bibliography cited refers back to the catalogues of the 18th–19th century and to studies of recent historical seismology). For a summary of the state of the art, the 1117 earthquake epicenter in the European catalogues and studies, see Figure 1.

[12] Hence the exact timing of this complex and exceptional event is pivotal to this new analysis. To clarify the instruments of historical seismology, it may perhaps be worth pointing out that as regards the day and the year, the dating styles in use in the 12th century do not present problems of matching with the current one. However, calculating the exact time of day is quite different. This aspect is hardly investigated by medieval historiography, as such a parameter is seldom needed. Historians of the Middle Ages rarely find dating to the hour a decisive point in textual exegesis. This problem is peculiar to historical seismology which is concerned with grasping the dynamics of an earthquake and distinguishing between the contributions of different shocks. Such an analysis, as is

well known, may prove decisive in estimating the actual size of an earthquake, and improving seismic hazard evaluations.

[13] However, a distance of nearly 9 centuries, as in this case, creates a virtually unbridgeable cultural gulf: we are aware that only marginal fragments of that culture are accessible to us from communications between contemporaries. We have tried to overcome this distance by analyzing every possible aspect of the time calculation in use in 12th century monastic Europe. Before the spread of clock towers in Europe starting from the 14th century, the time system is only known about in a very broad sense [Landes, 1983; Dohrn-van Rossum, 1996]. Whatever system existed has been little explored in its variations, linked as they are to local customs (which do not appear in treatises on time), with differences depending on the geographical area as well as modifications over the years in many cases. In the case in point, a further factor is linked to the personal culture of the various authors of the texts and thus to the semantic indications of the day, as well as the individual's own linguistic choices.

[14] The problem was thus how to decipher the fluctuating indications over a very large territory (corresponding to historical Europe) and channel them within our current reference system. At first sight, the monastic annal texts that report the two shocks show no evident overlaps (as will be seen better below) and references to the time of day only agree in a limited part of the sources. This feature led

Guidoboni et al. [1985] to suppose that the various hours indicated in the texts and the constant reference to the two shocks were two overlapping layers of memory, in a more literary than realistic manner: a commonplace where symbolic meanings (day and night) may have been prevalent in the perception of reality.

[15] In this new analysis we have proceeded to search for agreements and clues. By the term agreement we mean the search for textual concordance contained in the sources that can be traced back to a homogeneous set of indicators, compatible with the proximity/distance relationship, implicit in a territorial model of reference. By clues we mean the evidence provided by details, enabling us to work back to more general issues (in regard to the clue-based method in historiography, see *Ginzburg* [1989]).

[16] The few set points that we started from are the following:

[17] 1. On 3 January 1117 a strong earthquake indeed took place; nine texts contain a time reference to two shocks in close succession both on the third day of the month; a further 10 texts contain a time reference to just one shock;

[18] 2. The authors of the sources did not agree among themselves on the facts to be transcribed. This means that in independent texts (i.e., those not involving copying or derivation), any detectable agreement has a genuine significance;

[19] 3. In 12th century Europe the time of day was subjective, not rigorously accurate. This forms part of a common and widespread system of measurement in the monastic culture of the day. Decoding this is rather complex for us today and entails some margin of doubt, but such a system may in some points be compared to our current notions of time accuracy.

[20] With these criteria we have thus reviewed all the sources (nearly all of them listed in the CFTI 2000) in order to resolve the timing problem. Before presenting the results of the analysis we should recall the features that make the 1117 earthquake an entirely unique case study in historical seismology, especially the corpus of sources that bear witness to it (that is, contemporary texts, or ones that can be traced back directly to contemporary and authoritative texts).

2. The Corpus of Written Sources: An Overview

[21] To give an overall idea of the database available for the 1117 earthquake, we should outline the types of written sources. This corpus of 94 sources is made up of annals, chronicles, notulae, documents and inscriptions and is clearly exceptional for a 12th century earthquake in the whole of the Mediterranean. Selected contemporary sources comprise different types of texts that can be grouped together into three categories, for which we can also indicate the numerical size: (1) memorial texts, comprising monastic annals, city chronicles, universal histories, liturgical calendars, notulae: 58 texts altogether; (2) documents (so far known only for northern Italy), that is, administrative and juridical records (in the strictly archival sense): these are single acts (pergamene, according to the Italian archival classification system), and Account Book: 18 altogether; and (3) inscriptions, 18 altogether.

[22] As regards the memorial sources, most have been chosen from a basis of 126 texts, accounts preserved in 58 contemporary annals and chronicles (or, if later than the 12th century, dating back to contemporary sources lost today). The greatest semantic homogeneity is seen in the annals of the monasteries, which represent the vast majority of the texts examined. Such annals (from the 12th to the 15th century) come from a wide central European area extending over the following present-day countries: 39 from Germany, 7 from Great Britain, 14 from northern France, 6 from Belgium, 6 from the Czech Republic, 4 from Austria, and 1 from Switzerland and 1 from the Netherlands. There are also 48 citations of the 1117 earthquake contained in Italian chronicles of the major cities of Lombardy, Veneto, and Emilia.

[23] It was the Benedictine monastic world that most helped to record this earthquake, not only by remembering what actually happened at the monastery itself or in its neighborhood but also by mentioning far-off places that suffered damage, within a broad geographical vision. This was possible thanks to the continuous flow of people and the constant exchanges of information within a close-knit trading network, which linked central to southern Europe, via Austria and France. Exchanges were fostered by the use of a lingua franca, Latin, and the awareness of belonging to a single religious community. The sources agree that the strongest effects were in Italy, in the area called Longobardia, an area that today comprises many regions and in the 12th century comprised the present-day regions of Lombardy, Veneto, and Upper Emilia. In particular, the city of Verona is mentioned as being the hardest hit; other cities mentioned are Parma and Venice.

[24] A certain religious and ethical perception of the world led the authors to implicitly interpret the earthquake as a “sign” of divine intervention. In the Middle Ages the moral dimension to the account of an earthquake was often separate from precise references to space or time. However, in our opinion, only a few of our texts are based on hearsay, filtering into the network of exchanges of monastic Europe (see Appendix A, list of the European sources); most monastic texts refer to an event that was actually “perceived.”

[25] In Italy, urban chronicles (in some cities dating from before the mid-12th century) are characterized by a generally pragmatic tone (though not to the extent of giving the exact time of an earthquake). This has led us to believe that the earthquake mentioned was local, even when not explicitly stated. We know that it was not unusual for the authors of such official chronicles to refer back to previous documents or chronicles, which are lost today.

[26] As regards the documents, the previous research cited has identified 11 documents (pergamene) of the 12th century, in which this earthquake is remembered as dating important events of some local communities. The 1117 earthquake is cited in legal documents (even decades after the event) to recall disputes over the land ownership including personal facts relating to witnesses (e.g., “I can say that my memory stretches as far back as the great earthquake. . .”). Besides these types of records, there are a further seven documents: these are donations and some Ledgers (*Libri di conti*) for the restoration of the Capitular Church of Piacenza (Upper Emilia).

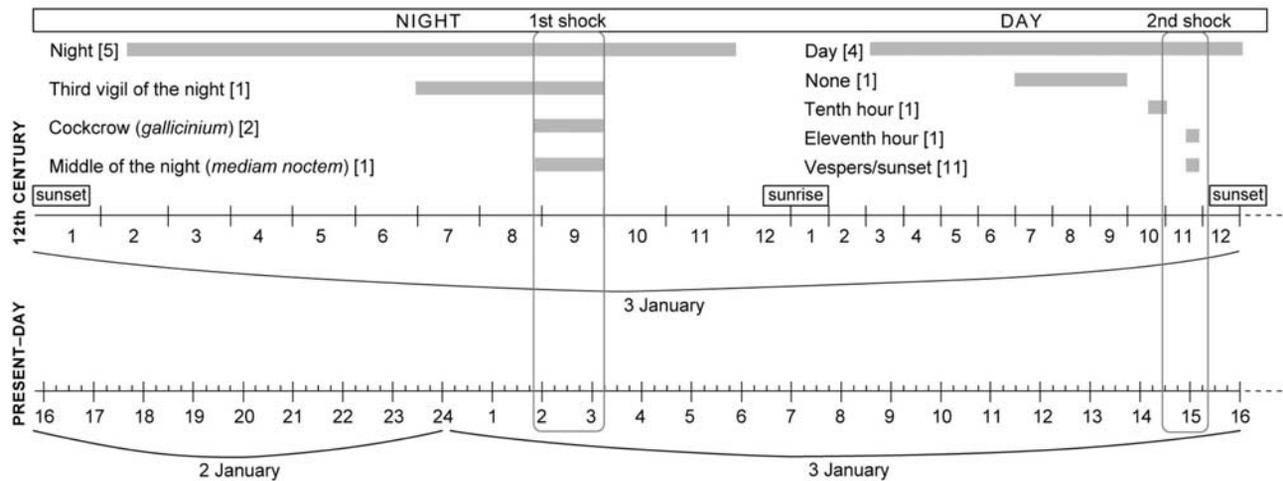


Figure 2. Chart of the matching between the time system in use in the 12th century and the current one. In grey the convergence of the annalistic sources indicates the time spectrum range for the two earthquakes.

[27] For the inscriptions we need to bear in mind that there is no corpus of medieval inscriptions relating to Italy. We thus proceeded to analyze the inscriptions preserved in church and monastic buildings within the area of damage stated by the written sources. The research was extended to erudite historiography (which, from the 15th century onward, has traditionally preserved transcriptions of lost inscriptions) and museum inventories. Eighteen inscriptions were identified and selected (from a period ranging between 1117 and 1178) attesting to the reconstruction of churches and bell towers, or parts of them, and the reconsecration of religious buildings (a practice that was performed after prolonged building work). They were located as follows: 12 in the Verona area, 3 in southeastern Veneto, and 3 in Upper Emilia.

3. Calculating the Time of Day in the 12th Century

[28] We focused on the time parameter of the earthquake reported in the Benedictine annals: 9 monastic annals indicate two shocks; 10 annals recall only one. The hour is reported in many different styles. In order to understand such time reports it is worthwhile recalling the broad time system of the 12th century and the variations introduced by the Benedictines. For the latter point we have made use of the text by *Bilfinger* [1892], which although very old, is still unique. It has been cited by recent authoritative texts on time and the history of clocks [e.g., *Landes*, 1983; *Dohrn-van Rossum*, 1996]. *Bilfinger* is indeed the only one who has so far dealt with the problem through an extensive medieval documentation. He outlines the monastic custom for calculating the hours and how this had changed over time. It was the stating of these changes (in practice and not in abstract calculation) that made it possible to decode the time references contained in the monastic annals. Comparisons between *Bilfinger's* priceless observations and our own annal texts have enabled us to formulate some new hypotheses.

[29] To give some idea of this problem, it should be noted that calculation of the hour of day was inherited from Roman antiquity, with some modifications introduced by the Benedictine monks in the early Middle Ages. Two 12-hour time cycles were used: one daytime, from dawn (mane) to sunset (vespera), and the other nighttime, from sunset to dawn. With this division of the day and night into 12 hours throughout the year, the daytime and nighttime hours had an unequal duration (*horae inaequales* or *horae temporariae*). Obviously, in the winter months the hours of daylight were shorter (by up to about 40 minutes) than the nighttime hours (which lasted up to about 80 min). The opposite occurred in the summer months. The hours were of the same duration only at the equinoxes, coinciding with the ones we use today. The day was subdivided into four intervals (these inherited from the ancient world as well), each lasting three hours, closed by Terce, Sext, and None, respectively (*hora tertia*, *sexta*, and *nona*). In Roman antiquity the night was divided into four parts as well, which corresponded to sentry duty in military camps. The nocturnal crowing of the cock (*gallicinium*, *galli cantus*) simply indicated that midnight had passed. Some of the annals examined use these ancient terms of reference (see below).

[30] With the spread of Christianity the ancient hours ended up giving their name to the phases of monastic prayer and were defined as canonical (*horae canonicae*). This system of time calculation regulated the life of the monks and also the laymen, with the tolling of the bells. In reckoning the canonical hours two new hours were added: Prime, which coincided with the rising of the sun and Compline (*compieta* or *completorium*) at the end of the day. So far these are quite well-known elements. Much less well known, instead, is the fact that integrating these two systems caused the recital of the Matins (one of the monastic liturgies) to slip toward the night and Vespers to be brought forward by about 1 hour, setting it at around the eleventh hour of the day (*hora undecima diei*). Thus, with the spread of the canonical hours there was a considerable variation, which is important as far as

Table 1a. First Earthquake, During the Night of 2–3 January 1117, Agreement of the Sources^a

Where the Sources Were Written	Time According to the Original Text (With Translation)	Sources (All Contemporary or Based on Lost 12th Century Annals)
Disibodenberg ^b G	noctem (at night)	<i>Annales S. Disibodi</i> [Waitz, 1861]
Freising ^b G	in nocte ante diem (at night before day)	<i>Annales S. Stephani Frisingenses</i> [Waitz, 1881b]
Augsburg ^b G	semel in nocte (once at night)	<i>Heimo</i> [1852]
Zwiefalten ^b G	in nocte (at night)	<i>Annales Zwifaltenses</i> [Abel, 1852a]
Melk ^b A	unus post tertium galli cantum (an (earthquake) after the third cockcrow)	<i>Auctarium Zwettlenses</i> [Wattenbach, 1851c]
Salzburg ^b A	semel in nocte (once at night)	<i>Annales S. Rudberti Salisburgensis</i> [Wattenbach, 1851b]
Saint Blasien ^b G	in galli cantu semel (once at cockcrow)	<i>Annales S. Blasii in Silva Nigra</i> [Pertz, 1861]
Petershausen (Constance) ^b G	circa tertiam noctis vigiliam (around the third vigil of the night)	<i>Casus Monasterii Petrishusensis</i> [Abel and Weiland, 1869]
Pisa I	circa mediam noctem (around the middle of the night)	<i>Guido Pisano</i> [1963]

^aAbbreviations (corresponding to the names of the present-day countries): A, Austria; G, Germany; I, Italy.

^bSources record both earthquakes.

our analysis is concerned. The liturgical night service (called nocturn), which was recited starting from the “middle of the night” (ad mediam noctem) or at the “cock’s crow” (ad galli cantum), was merged with the Matins which, as seen above, was in turn brought forward by a couple of hours, from the dawn toward the night. Thus the “gallicinium” referred to late at night or the last few hours of the night itself.

[31] Apart from these variations in time reckoning, there were local differences. The sources on the 1117 earthquake scattered throughout Europe refer to times dependent upon the longitude and latitude of where the texts had been drafted.

[32] The chart in Figure 2 depicts the 12th century time system in relation to the current one. Tables 1a and 1b list the terminology used in the annals to indicate the two earthquakes perceived. From an analysis of these references we found some agreement. It is clearly not superfluous to

point out that the memory of the nighttime earthquake was preserved in the descriptions as the monks were awake to say the prayers of the nocturnal liturgy.

[33] The sources that recall the nocturnal earthquake show a significant agreement among the time references, not detectable by means of linguistic analysis alone. The places where the sources referring to the nocturnal earthquake were drafted are situated in present-day central southern Germany and in Austria. In Italy, only one contemporary source described this nighttime earthquake as locally felt in Pisa, and this is the long annotation written by the deacon *Guido Pisano* [1963], a contemporary author (for more details, see below). To indicate the time, Guido Pisano uses a different expression, demonstrating his complete independence from these monastic texts: i.e., “around the middle of the night” (circa mediam noctem), an expression congruent with the sources that refer to the cock’s crow, enabling us to set the time of this nocturnal earth-

Table 1b. Second Earthquake, During the Afternoon of 3 January 1117, Agreement of the Sources^a

Where the Sources Were Written	Time According to the Original Text (With Translation)	LT	UT	Sources (All Contemporary or Based on Lost 12th Century Annals)
Reinhardsbrunn G	ante solis occasum (before sunset)	–	–	<i>Chronica S. Petri Erfordensis</i> [Holder-Egger, 1899b]
Aura G	ora vespertina (at the hour of Vespers)	–	–	<i>Eckehard of Aura</i> [1844]
Prague CZ	hora iam vespertinali (already at the hour of Vespers)	–	–	<i>Cosmas of Prague</i> [1923]
Bamberg G	hora vespertina (at the hour of Vespers)	–	–	<i>Ebo of Michelsberg</i> [1856]
Heilsbron G	advesperascente die (as the day drew toward Vespers)	–	–	<i>Notae Halesbrunnenses</i> [Pertz, 1859f]
Disibodenberg ^b G	diem (during the day)	–	–	<i>Annales S. Disibodi</i> [Waitz, 1861]
Rheims F	ad vespertas (at Vespers)	–	–	<i>Annales S. Dionysii Remenses</i> [Waitz, 1881a]
Rheims F	ad vesperum (at Vespers)	–	–	<i>Annales Remenses</i> [Pertz, 1859b]
Freising ^b G	ante vesperam (before Vespers)	–	–	<i>Annales S. Stephani Frisingenses</i> [Waitz, 1881b]
Augsburg ^b G	semel in die (once during the day)	–	–	<i>Heimo</i> [1852]
Zwiefalten ^b G	post vespertas (after Vespers)	–	–	<i>Berthold of Zwiefalten</i> [1941]
Zwiefalten ^b G	et die (and by day)	–	–	<i>Annales Zwifaltenses</i> [Abel, 1852a]
Melk ^b A	hora quasi 10 (almost at the tenth hour)	~15	~14	<i>Auctarium Zwettlenses</i> [Wattenbach, 1851c]
Salzburg ^b A	semel in die (once during the day)	–	–	<i>Annales S. Rudberti Salisburgensis</i> [Wattenbach, 1851b]
Saint Blasien ^b G	ad nonam (at the ninth hour)	1215/1430	1145/1400	<i>Annales S. Blasii in Silva Nigra</i> [Pertz, 1861]
Petershausen (Constance) ^b G	undecima fere hora (almost at the eleventh hour)	1545	~1515	<i>Casus Monasterii Petrishusensis</i> [Abel and Weiland, 1869]
Milan I	in hora vespera (at the hour of Vespers)	–	–	<i>Annales Mediolanenses breves</i> [Jaffé, 1863c]
Cremona I	hora vesperarum (at the hour of Vespers)	–	–	<i>Annales Cremonenses</i> [Holder-Egger, 1903]

^aAbbreviations (corresponding to the names of the present-day countries): A, Austria; CZ, Czech Republic; F, France; G, Germany; I, Italy.

^bSources record both earthquakes.



Figure 3. Map of the locations where sources containing time references to the earthquakes on 3 January were written. The numbers 1 and 2 indicate the reference to one or two earthquakes contained in the sources.

quake, albeit with some degree of approximation, to between 0200 and 0300 UT on the night of 3 January.

[34] From these elements we have been able to observe that (1) nine sources mention the earthquake on the night between 2 and 3 January and also recall the second earthquake of the afternoon on the same 3 January; (2) 10 sources only recall the earthquake of the afternoon and not that of the night; and (3) no source in northern Italy reports time references relating to the earthquake during the night, with the sole exception of Guido Pisano, a source from the Tuscan area, where the earthquake in the night is recalled as being felt with no damage.

[35] Figure 3 reports the places for which we have a time report. This distinction has allowed us to separate the two shocks and to sum the related effects together. For the relationship between the annal texts and the places where they were written, we consulted the specific critical literature (see *Istituto Storico Italiano per il Medio Evo* [1962–2004], *Wattenbach et al.* [1967–1971], and *Wattenbach and Schmale* [1976] and the critical notes by *Alexandre* [1990]). This analysis shows that only in one case out of the sources we examined was there no direct relationship between the place where the annals were preserved and the place of writing. This is the *Annales Hildesheimenses*, which for the 1109–1137 period harks back to the lost *Annales Pather-*

brunnenses, written in Paderborn (Germany), a location where we have indeed attributed the seismic effects (see Table 2a).

4. Results of the Time Reckoning Review

[36] The new points have enabled us to venture a reasonable hypothesis concerning the separation of the effects of the two shocks, on either side of the Alps. This separation is not reduced to a straightforward indication of two areas because many transalpine locations felt both shocks. The analysis confirms the epicenter more rigorously as being in the Verona area and for the first time ever connects this epicenter with the effects felt in a wider European area. Such an enlargement of the macroseismic area obviously leads to a rise in the magnitude calculated for the Verona area earthquake (see below). Furthermore, our analysis highlights two earthquakes that were previously unknown to the currently used catalogues: one epicenter is in lower Germany and the other in Tuscany (probably in the upper Serchio Valley).

[37] For a detailed picture of the earthquake with its epicenter in the Verona area, the discussion of the written sources, of the ecclesiastic buildings and the inscriptions, as well as the results and the parameters used, we refer to the

Table 2a. Lower Germany Parameters and “Felt” Reports of the Earthquake of 3 January 1117, Around 0200–0300 UT^a

Sites	Intensity MCS	Latitude, °N	Longitude, °E
Heirenbuch G	VIII–IX	48.36	10.91
Petershausen ^b G	VII	47.66	9.18
Zwiefalten ^b G	VII?	48.23	9.46
Saint Blasien ^b G	VII?	47.76	8.13
Einsiedeln CH	VI	47.66	9.18
Regensburg G	VI	49.01	12.10
Marbach F	VI	48.03	7.28
Erfurt G	V–VI	50.97	11.02
Corvey G	V–VI?	51.85	9.36
Paderborn G	V–VI?	51.71	8.76
Melk ^b A	V	48.21	15.31
Laon F	V?	49.56	3.61
Lobbes B	F	50.34	4.25
Mouzon F	F	49.60	5.08
Pisa ^b I	IV–V	43.71	10.40
Liège B	IV–V	50.63	5.56
Rolduc G	IV–V	50.86	6.08
Saint Trond B	IV–V	50.80	5.20
Disibodenberg ^b G	IV	49.76	7.70
Meersburg G	EE	47.69	9.28
Augsburg ^b G	NC	48.36	10.92
Freising ^b G	NC	48.39	11.75
Salzbourg ^b A	NC	47.80	13.05
Dijon F	NC	47.31	5.05
Brauweiler F	NC	50.96	6.78
Châlons F	NC	48.95	4.36
Ellwangen G	NC	48.96	10.13
Gembloux B	NC	50.56	4.68

^aEpicenter location is 48.00°N, 9.42°E; I_0 VII–VIII, I_{max} VIII–IX, and M 6.4. Abbreviations (corresponding to the names of the present-day countries): A, Austria; B, Belgium; CH, Switzerland; CZ, Czech Republic; F, France; G, Germany; I, Italy. The damage to the single buildings (churches, fortresses, etc.), attested to by the sources or inferred from direct observations, are classified with the symbols A, B, C, D. The relationship with the degree of intensity is understood as the effect conjectured at the site [see *Ferrari and Guidoboni*, 2000]: A, total collapse or most of the building/IX MCS; B, collapse of structural parts or high parts of the building/VIII MCS; C, minor collapses of the structural parts/VII–VIII MCS; D, cracks and lesions, collapse of overhanging parts/VII MCS. NC, not classified (indicates the lack of descriptive detail for attributing effects to the site); EE, environmental effects located.

^bLocations for which we have time reports.

CFTI catalogue [*Boschi et al.*, 2000], also available on the Web (<http://storing.ingv.it>). For the latest documentary supplements and a critical review of art history literature, we refer to *Guidoboni and Comastri* [2005]. The discussion of sources and the results on the two earthquakes of Lower Germany and Tuscany are published here for the first time.

4.1. The First Earthquake: Night of 3 January 1117, around 0200–0300 UT, Lower Germany

[38] From the sources giving time references (see Table 1a) we know that the earthquake on the night of 3 January 1117 (that is between 2 and 3 January) hit the following locations: Augsburg, Disibodenberg, Freising, Petershausen (in the vicinity of Constance), Saint Blasien and Zwiefalten (in present-day southern Germany), Melk and Salzburg (in present-day northern Austria) and perhaps Pisa (in Tuscany, Italy). Starting from these data, geographical congruence and the effects reported lead us to associate other locations with this same earthquake, albeit with a lack of explicit time references. This earthquake caused the most severe damage in the territory of Augsburg, where the castle of Heirenbuch collapsed, together with other unspecified castles; a collapsing tower caused the death of the people who were there, with the exception of a child. The earthquake was propagated over a huge area: in the churches of Liège and Saint Trond in Belgium, the

religious images and hanging lamps swayed. This aspect could be seen by the monks, since they were awake at that hour, as we have already said: the fact that they swayed in windless conditions was perhaps seen as an exceptional occurrence. Apart from some details, the annal texts are extremely threadbare and only make use of subjective terms such as “great,” “substantial,” “strong,” “terrible” (*magnus, ingens, validus, terribilis*). The macroseismic classification takes into account a range of degrees from IV to VIII–IX, drawing upon a background of experience accumulated from dozens of earthquakes in this period (see CFTI [*Guidoboni and Comastri*, 2005]). For the sources relating to this earthquake, see Appendix A1; for the list of effects by location, with the original texts of the sources, see Appendix B; to pinpoint the classified effects, see Figure 4 and Table 2a. The I_0 is of VII–VIII degree and $M = 6.4$. For the effects on the natural environment caused by this earthquake, in particular for the area between Meersburg and Constance, see Table 3a. The effects cited relating to the Rivers Mosa and Unstrut should be read tentatively: the sources appear to correlate them to the earthquake, but they could in actual fact be independent phenomena. Then there would seem to be a recollection of the effects to the ground, perhaps landslides in Svevia, impossible to pinpoint as the name refers a very large territory, which comprised the present-

Table 2b. Veronese Area (Italy) Parameters and “Felt” Reports of the Earthquake of 3 January 1117, ~1500 UT^a

Sites	Intensity MCS	Latitude, °N	Longitude, °E
Verona I	IX	45.43	10.99
Ronco all’Adige I	IX	45.33	11.24
Belfiore I	A (IX)	45.38	11.20
Bevilacqua I	A (IX)?	45.23	11.39
Isola della Scala I	A (IX)	45.27	11.00
Marcellise I	A (IX)	45.45	11.10
San Bonifacio I	A (IX)	45.39	11.27
Cremona ^b I	VIII	45.13	10.02
Padua I	VIII	45.40	11.87
Parma I	VIII	44.80	10.32
Piacenza I	VIII	45.05	9.69
Nonantola I	B (VIII)	44.67	11.04
San Faustino I	B (VIII)	44.67	10.77
Bonavigo I	B (VIII)	45.25	11.27
Cerea I	B (VIII)	45.19	11.21
Gazzo Veronese I	B (VIII)	45.14	11.07
Pescantina I	B (VIII)	45.48	10.86
San Pietro I	B (VIII)	45.18	11.27
San Pietro in Valle I	B (VIII)	45.13	11.06
Vicenza I	B (VIII)	45.54	11.54
Cisano I	B (VIII)	45.23	10.72
San Floriano I	B (VIII)	45.51	10.90
Venice I	VII–VIII	45.43	12.33
Carpi I	C (VII–VIII)	44.78	10.88
Castell’Arquato I	C (VII–VIII)	44.85	9.86
Lonato I	C (VII–VIII)?	45.46	10.48
Sommacampagna I	C (VII–VIII)	45.40	10.84
Vigolo Marchese I	C (VII–VIII)?	44.87	9.84
Piove di Sacco I	C (VII–VIII)	45.29	12.03
Milan ^b I	VII	45.46	9.18
Serle I	VII	45.56	10.36
Brescia I	VII	45.54	10.21
Monza I	VII?	45.58	9.27
San Giorgio I	D (VI–VII)	45.53	10.85
Costozza I	D (VI–VII)	45.46	11.60
Faenza I	V–VI	44.28	11.88
Ferrara I	V–VI	44.83	11.61
Bamberg ^b G	V–VI	49.89	10.89
Heilsbronn ^b G	V	49.83	10.80
Melk ^b A	V	48.21	15.31
Montecassino I	F?	41.49	13.81
Zwiefalten ^b G	F	48.23	9.46
Kladruby CZ	F?	49.71	12.98
Petershausen ^b G	F	47.66	9.18
Saint Blasien ^b G	F	47.76	8.13
Rheims ^b F	IV	49.25	4.05
Disibodenberg ^b G	IV	49.76	7.70
Prague ^b CZ	IV	50.08	14.46
Caresana I	NC	45.22	8.50
Augsburg ^b G	NC	48.36	10.92
Reinhardsbrunn ^b G	NC	50.86	10.55
Aura ^b G	NC	50.18	9.55
Freising ^b G	NC	48.39	11.75
Salzbourg ^b A	NC	47.80	13.05
Scardevara I	NC	45.34	11.24

^aEpicenter location is 45.37°N, 11.17°E; I_0 IX, I_{max} IX, M 7.0. See Table 2a footnote.

^bLocations for which we have time reports.

Table 2c. Northern Tuscany, Italy, “Felt” Reports of the Earthquake of 3 January 1117, ~1500 UT^a

Sites	Intensity MCS	Latitude, °N	Longitude, °E
Pisa ^b	VII–VIII	43.71	10.40
Lucca	VII	43.84	10.50
Ripafraffa	C (VII–VIII)?	43.81	10.40
Vecchiano	C (VII–VIII)?	43.78	10.39
Quosa	C (VII–VIII)?	43.79	10.42

^aSee Table 1a footnote.

^bLocations for which we have time reports.



Figure 4. Map of the effects of the first earthquake of 3 January 1117, lower Germany.

day German-speaking part of Switzerland, the Grigioni Canton, the Alsace, southern Baden, southern Württemberg and southeastern Bavaria as far as the River Lech. The *Chronica S. Petri Erfordensis* [Holder-Egger, 1899b] recalls that “indeed the earth, as if it were houses, rolled suddenly, falling into a precipice” (*terra enim ad instar domorum ebulliens subito in abissum dilabatur*).

[39] This earthquake is not listed in the German catalogue: the references from the sources have been interpreted as local effects of the earthquake in the Verona area. In this catalogue an earthquake in 1112 was cited, but has for some time been deleted [see Grünthal, 2004, p. 633, Figure 1]. The information on the 1112 earthquake, believed to be a false event in the German catalogues, probably derives from the late chronicles of the Benedictine monk *Trithemius* [1601], who lived between 1462 and 1516. This presumed earthquake is supposed to have destroyed the city of

Rottenburg on the Neckar (southern Germany). However, no medieval sources are known concerning this city. Trithemius, however, also provides a wealth of information on the 1117 earthquake in the Italian area. Thus an earthquake was deleted because it was not supported by sources and rightly considered to be an error. However, that error “concealed” an event that really did happen and was documented by sources. This case, which is only apparently contradictory, is by no means rare in historical seismology and offers some food for thought concerning the practices for compiling catalogues.

4.2. The Second Earthquake: Afternoon of 3 January 1117, Around 1500 UT, Northern Italy, Lower Valley of the Adige

[40] About 12–13 hours after the first earthquake, another very strong one took place, which had its most

Table 3a. Environmental Effects of the First Earthquake in Lower Germany

Phenomenon	Localization	Source
Landslides (with the lowering of some high ground); or raising of one place as compared with another	area between Meersburg and Constance (Germany)	Berthold of Zwiefalten [1941]
Sinking of the ground; luminous phenomena, “red skies”	Svevia (area lying between Switzerland, France and Germany)	<i>Chronica S. Petri Erfordensis</i> [Holder-Egger, 1899b]
Overflowing waters of the River Mosa	Susteren (Holland, on the border between Belgium and Germany)	<i>Anselm of Gembloux</i> [1844]; <i>Chronicon rhythmicum Leodiense</i> [De Clercq, 1966]
Momentary disappearance, for many hours, of the waters of the River Unstrut, into large cracks appearing in the ground	River Unstrut (effluent of the Saale), eastern Germany	<i>Annales Hildesheimenses</i> [Waitz, 1878]

Table 3b. Environmental Effects of the Second Earthquake in the Veronese Area

Phenomenon	Localization	Source
Cracks in the ground and uprooting of trees	Veronese and undetermined areas	<i>Peter the Deacon</i> [1980]; <i>Annales S. Disibodi</i> [Waitz, 1861]
Muddying of most springs	undetermined	<i>Peter the Deacon</i> [1980]
Emission of sulphurous waters from cracks in the ground	Veneto?	<i>Annales Veronenses breves</i> [Simonsfeld, 1883]
Landslides for many days blocking the flow of the Adige Valley	River Adige (area not identified better)	<i>Ann. Hildesheim</i> . [Waitz, 1878]
Rising of the waters of the Po Plain	River Po (area not identified better)	<i>Ann. S. Disibodi</i> [Waitz, 1861]
Overflowing of lakes	probably Lake Garda and Lake Iseo	<i>Guido Pisano</i> [1963]

devastating effects in the plains of the Verona area, in the lower valley of the Adige and in the upper Emilia region (Po Plain). This earthquake was also felt in various locations of the transalpine area (for the map of the effects, see Figures 5a and 5b; for the time indications see Table 1b).

[41] The contemporary sources make explicit reference to several cities that were hit: Verona is unanimously mentioned as the worst hit city. The sources are also confirmed by observations on the city's medieval heritage: numerous churches of the Romanesque period in Verona were seriously damaged, many of which never rebuilt [Guidoboni, 1984]. Various places in the lower Veneto plain were badly damaged, as well as the area along the middle course of the Adige, the Brescia and Cremona area and the northern part of the Emilia plain. Accurately described damage, also including partial collapses, to the cathedrals of Cremona, Padua, Piacenza, Parma, Modena and the church abbey of Nonantola is recorded in the texts. The sources, all from the ecclesiastic and monastic fields, preserve the memory of the damage above all to the city cathedrals. However, there is no lack of important information also for some isolated and minor monasteries or churches (for details of the effects, see *Boschi et al.* [2000] and <http://storing.ingv.it/cft>; for the texts of the sources, see *Guidoboni and Comastri* [2005]). For the list of the locations classified see Table 2b.

[42] Our revision has led to a variation in the magnitude from 6.5 [Boschi et al., 2000; CFTI 2004, <http://storing.ingv.it/cft>] to 7. This rise may seem rather contradictory, since in the corpus of the historical sources concerning the Verona earthquake we have, so to speak, subtracted the effects of two further events. This interpretation has led us to “disentangle” the two shocks, and to aggregate the evaluated sites into degrees of intensity in a new way. Indeed, 15 transalpine locations are now included in the felt area of this second earthquake (5 not classified as they are too generic). So the different distribution of such sites

has led to extending the felt area, a significant element in the calculation of the magnitude.

[43] For a summary of the effects on the natural environment see Table 3b. The list of the sources correlated to this earthquake is in Appendix A2.

4.3. Third Earthquake: Afternoon of 3 January, Around 1500 UT, Upper Valley of the River Serchio (Northwestern Tuscany)

[44] On the night between 2 and 3 January 1117, in the vicinity of Pisa, an earthquake was felt that frightened the people but caused no damage. This shock could have been a local foreshock or the perception of the first earthquake, located in lower Germany. In the afternoon of 3 January at around 1500 UT (the 11th hour according to the reckoning of canonical hours) a much stronger earthquake than the previous one caused the collapse of many towers, buildings and bell towers in the territory of Pisa. There were some deaths. The fear-stricken survivors abandoned their homes, leaving them unattended.

[45] Given the substantial distance from Pisa to the epicentral zone of the concomitant earthquake located in the Verona area and the lack of information on damage in between the two areas, we feel it reasonable to say that the collapses described by the sources and the strong effects on the environment in the Tuscany area can only be explained by the activation of an epicenter distinct from the one that generated the effects in northern Italy, about 180 km away and separated by the Apennine chain.

[46] The sources are two independent contemporary texts (see Appendix A3): (1) a detailed description written by *Guido Pisano* [1963], already mentioned previously; and (2) an ancient local chronicle, the *Annales Pisani antiquissimi* [Novati, 1910], with no time references, however. Guido Pisano's text is preserved in the codex *Vaticanus Latinus* 11564, fol. 184 of the *Biblioteca Apostolica Vaticana*, a text that we have

Table 3c. Environmental Effects of the Third Earthquake in Tuscany

Phenomenon	Localization	Source
Overspilling of waters from some wells	Pisa area	<i>Guido Pisano</i> [1963]
Overflowing of the River Arno	River Arno, some unspecified places	<i>Guido Pisano</i> [1963]

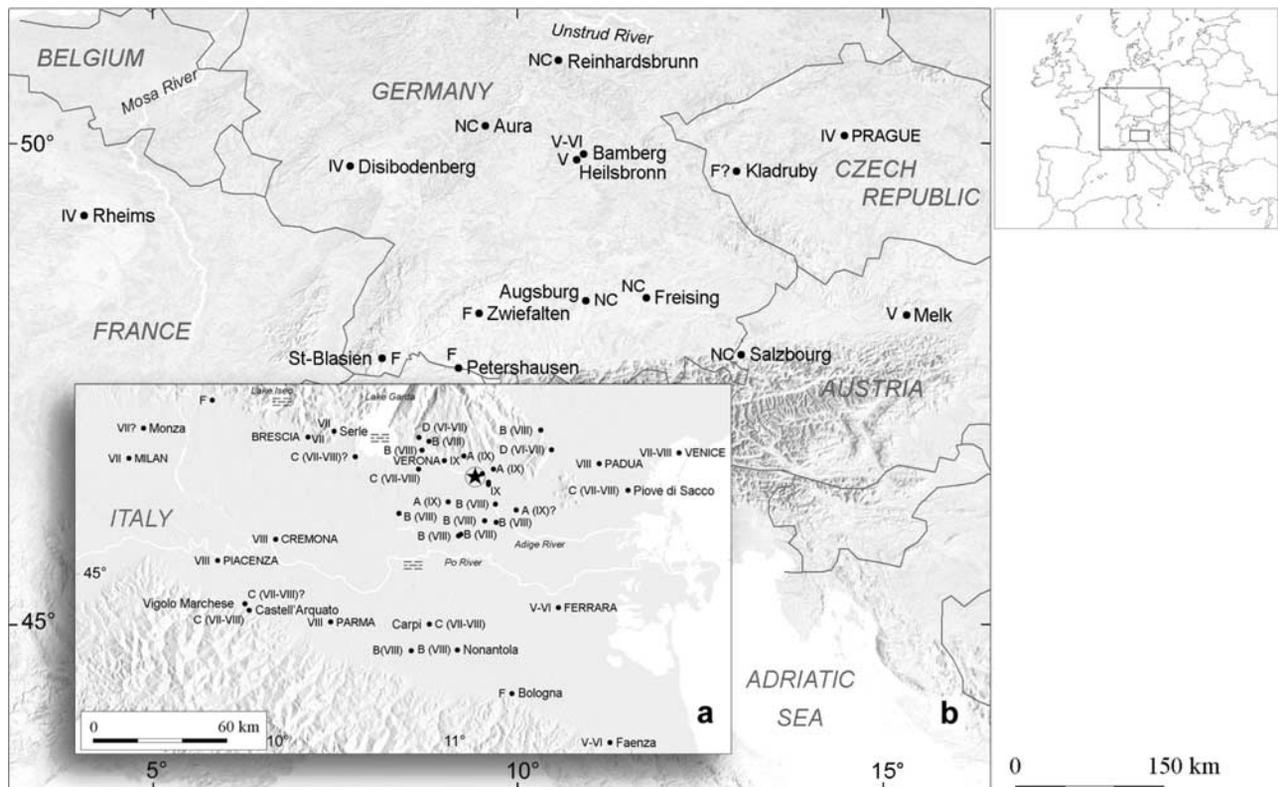


Figure 5. Map of the effects of the second earthquake of 3 January 1117 in (a) Verona area (northern Italy) and (b) Transalpine area.

consulted directly. It is a copy of 1459, which dates back directly to the 12th century original [Ruysschaert, 1959]. The part of the text that interests us here is the following:

In the name of Our Lord Jesus Christ, the Eternal God, in the year 1117 since His Incarnation, on the third day of January. In the sixth year of the reign of the Emperor Henry V in Italy, when the most blessed Pope Paschal II was at the head of the Roman church, great earthquakes such as had never before occurred in our times aroused terror in Longobardia and Tuscany and even Bari.

For towards the middle of the night, there was a great earthquake in the Pisa area; but it caused no damage, just fear. But the following day, the fourth of the week [Wednesday], there was so serious an earthquake at the eleventh hour [around 1500 UT] that most of the towers, bell-towers and other buildings collapsed into rubble, and a few men, women and children were killed in the ruins. The earthquake struck such terror into the local people that they left many of their houses unattended. Some wells also overflowed, and at some places the Arno broke its banks. Other towns and villages in Tuscany were affected, but not so badly. [...] fol. 184.

[47] Guido Pisano makes a passing mention of the city of Bari (in the Puglia region, southern Italy) almost as if to imply that in that city the same earthquakes had also been felt. Mentioning this city might, however, only have a rhetorical significance, indicating a very far-off city. Unfortunately, the lack of contemporary sources for the Apulia area does not allow us to support the reference, which remains unexplained with the present state of research and therefore unused. This same earthquake probably also hit the city of Lucca. An early 14th century chronicle entitled *Gesta Lucanorum* (or *Annales Lucenses*)

in fact refers to “great earthquakes.” However, the earthquake is dated 1112 (“MXXII”), perhaps owing to the omission of the “V” sign between the “X” and the “II.”

[48] From the references in the sources it seems plausible to believe that the worst damage, in particular to towers, occurred in the territory outside Pisa, perhaps in the lower Valley of the River Serchio: the geographical expressions used are “in the vicinity of Pisa” (apud Pisam) and “towers of the Pisans” (pisanorum turres), and indeed there are city fortifications on its northern side. An archaeological study into the medieval fortifications along the border between Pisa and Lucca, in the lower Serchio Valley, Redi [1984, p. 380] attests to reconstruction work to the castles of Ripafratta and Vecchiano and to the tower of Quosa around the mid-12th century and between the end of the 12th century and the start of the 13th. Although at the present time there is no other evidence, it is possible to speculate that the epicenter was in the mountainous area northeast of the locations cited, in the Garfagnana, a renowned Apennine seismic region. Guido Pisano wrote that other unnamed areas of Tuscany were also hit, but not so seriously (see Figure 6 for the map of the effects; see Table 2c for the list of locations classified; see Table 3c for the effects on the natural environment).

5. Conclusions

[49] The time indications contained in the direct sources concerning the “exceptionally strong” earthquake of 3 January 1117 have been revised. This event was con-

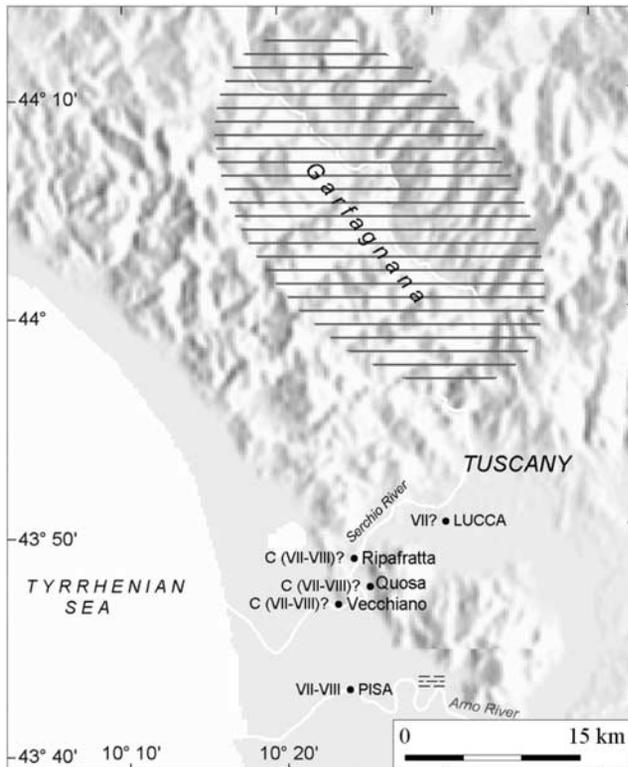


Figure 6. Map of the effects of the third earthquake of 3 January 1117 (Tuscany). The epicenter was not calculated because in our opinion the effects located here are outside the epicentral area, probably farther north, in the mountainous Garfagnana region.

sidered by seismological tradition and by the catalogues to be a single earthquake with its epicenter located in northern Italy. Our review has highlighted two more local events. As the corpus of the sources already proved to be well-defined, extensive, and authoritative, the new analysis has only examined the time of day factor, which seems to have been unsolved by previous studies.

[50] The pinpointing of the two epicenters separated by about 12–13 hours, 320 km away from each other, emerged through our analysis of the hour system in use in the 12th century Benedictine monasteries in Europe. To calculate the epicenters and the macroseismic equivalent of the magnitude, we used the method of *Gasparini et al.* [1999] and *Gasparini and Ferrari* [2000]. As can be seen from Figure 7, the three earthquakes have been located as follows:

[51] 1. The first, which occurred on the night of 3 January, roughly between 0200 and 0300 UT, in Lower Germany caused damage to buildings and had an impact on the environment, in particular in the areas of Augsburg and Constance. It was also strongly felt in Switzerland and generally felt across a very large area. According to the classification of the effects relating to 19 sites (actually 28, but nine have not been classified as they are too generic); the M calculated is 6.4.

[52] 2. The second earthquake, much stronger, occurred about 12–13 hours later on in the afternoon, at about 1600 LT (about 1500 UT) of the same 3 January: it hit the

Po Plain, in particular the Verona plain, along the mid-course of the River Adige. The damage extended besides the Veneto to Lombardy and Upper Emilia. This earthquake was also felt beyond the Alps, as far as Rheims (France) and Prague (Czech Republic). The epicenter is confirmed as per previous studies [*Guidoboni et al.*, 1985; *Boschi et al.*, 1995, 2000]. The M proves higher than that of the nighttime earthquake (Lower Germany), an element that overlaps with the picture emerging from analysis of the sources and the widescale extension and the types of effects. According to the classification of the effects at 48 sites (actually 55, but we have not classified seven as they are too generic), the value of M calculated on the basis of this review is 7.0. In previous studies, M was 6.5 because the felt area was more restricted; the transalpine locations considered here are eleven altogether and the distribution of the locations has changed.

[53] 3. The third earthquake hit Tuscany, probably with its epicenter in the upper Valley of the River Serchio, that is, in the mountainous Garfagnana region. In the night of 3 January in the vicinity of Pisa, an earthquake was felt that frightened the populace but caused no damage. In the afternoon a much stronger earthquake than the previous one caused the collapse of many towers, buildings and bell towers in the territory of Pisa. The indication of the time of day is thought to match that of the Verona area, but obviously this cannot be established with certainty, owing to the substantial approximations in the time references of the sources. We believe that the data of the written sources and the archaeological evidence do not allow us to pinpoint the epicenter, but only to speculate about one. Thus we have not calculated the magnitude value.

Appendix A: Direct Historical Sources

[54] Here we report (in alphabetical order) concise information on the chronicle sources selected for this study. These are 12th century sources, or if later, in any case referring back to contemporary sources now lost. The year spans which the narrated facts refer to are indicated in parentheses.

A1. List of Sources Concerning the First Earthquake: Night of 3 January (Lower Germany)

[55] (E2) denotes sources that contain information for the second earthquake as well.

[56] *Annales Brunwilarenses* (1024–1197) [*Pertz*, 1859a], from the Benedictine abbey of Brauweiler (in the diocese of Cologne, Germany), compiled by numerous authors between the 11th and 12th century.

[57] *Annales Corbeienses* (658–1148) [*Pertz*, 1839a], from the Benedictine monastery of Saint Peter at Corvey (in the diocese of Paderborn in present-day Germany), compiled from the 9th to the 12th century.

[58] *Annales Einsidlenses* (1–1280) [*Pertz*, 1839b], from the Benedictine abbey of Einsiedeln (in the diocese of Constance, Switzerland). They are original to the period from the middle of the 10th century onward.

[59] *Annales Hildesheimenses* (1–1137) [*Waitz*, 1878], for the period 1109–1137, they derive from an original part of a lost source the *Annales Patherbrunnenses*, compiled in the Benedictine monastery of Saint Peter

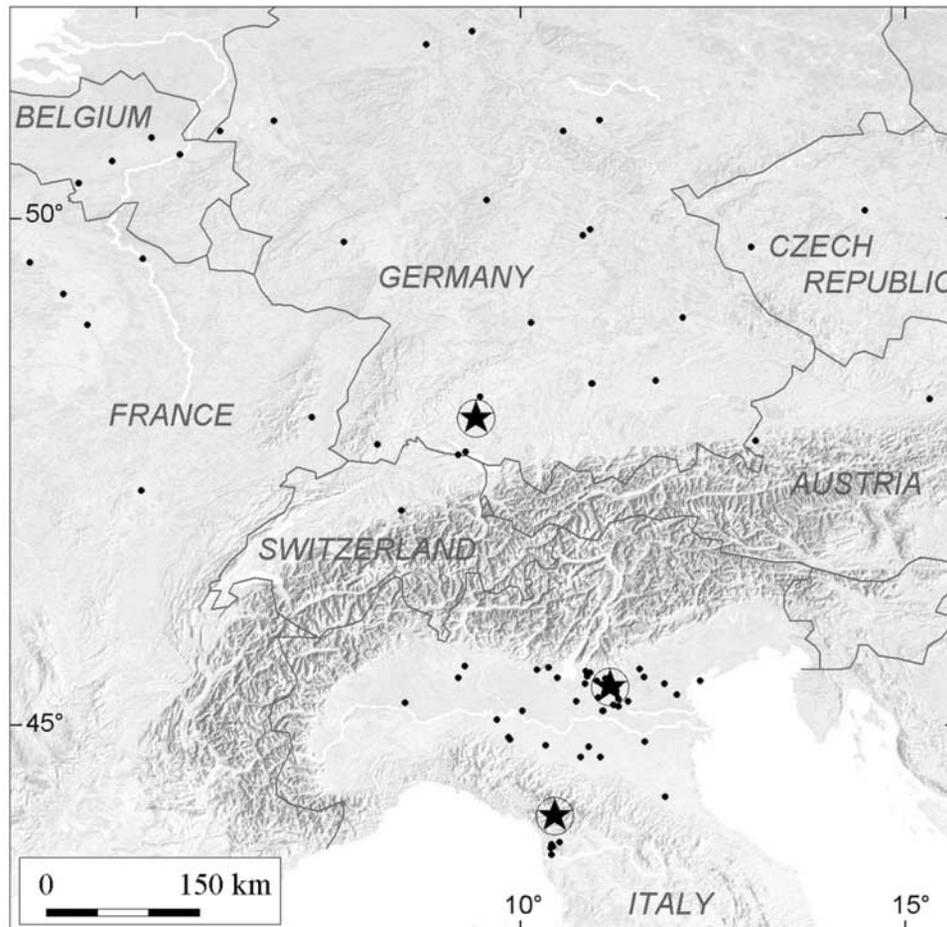


Figure 7. General map of all three earthquakes.

and Saint Paul at Paderborn or perhaps at the abbey of Corvey (Germany).

[60] *Annales Laubienses* (418–1482) [Pertz, 1841], from the Benedictine abbey of Lobbes (in the diocese of Cambrai, Belgium). They are original from the middle of the 11th century onward.

[61] *Annales Marbacenses* (631–1238) [Bloch, 1907], from the Augustinian monastery of Marbach (France) written by several authors. The news of the earthquake is dated to the year 1107 without indications as to the day or month. According to *Alexandre* [1990, p. 80], the news, erroneously transcribed as 1107 by a 13th century copyist, is supposed to refer to the earthquake of 1117.

[62] *Annales Mosomagenses* (969–1371) [Pertz, 1839c], from the Benedictine abbey of Mouzon (in the diocese of Rheims, France), compiled from the end of the 10th century.

[63] *Annales Ratisponenses* (1–1167) [Wattenbach, 1861] from the Benedictine monastery of Ratisbon (Regensburg in present-day Germany); the information up to 1130 derives in part from lost Ratisbon annals. The earthquake is wrongly dated to 2 January.

[64] *Annales Rodenses* (circa 1100–1157) [Pertz, 1859c], from the Benedictine abbey of Rolduc (Klosterrath, in the diocese of Lüttich), compiled around the mid-12th century. The source does not report the day on which the earthquake occurred.

[65] *Annales Rosenfeldenses* (1057–1130) [Pertz, 1859d], from the Benedictine abbey of Harsefeld (or Rosenfeld, in the diocese of Bremen, Germany). They are original from the early 12th century onward.

[66] *Annales S. Benigni Divionensis* (1–1285) [Waitz, 1844], from the Benedictine monastery of Saint Benignus at Dijon (France), compiled at the beginning of the 12th century and continued by many different authors. They derive from old annals of the same monastery.

[67] (E2) *Annales S. Blasii in Silva Nigra* (932–1489) (2) [Pertz, 1861], from the Benedictine monastery of Saint Blasien (in the diocese of Constance, Germany), a series of original annals from the late 11th to early 12th century; the earthquake is wrongly dated to 1116.

[68] (E2) *Annales S. Disibodi* (891–1200) [Waitz, 1861], compiled around 1125–1147 by a Benedictine monk at Disibodenberg (in the diocese of Mainz, Germany), and continued by other monks up to the end of the 12th century.

[69] *Annales S. Petri Catalaunensis* (1009–1208) [Pertz, 1859e], from the Benedictine monastery of Saint Peter at Châlons-sur-Marne (France), written in the 11th–12th century. The earthquake is wrongly dated to 30 December 1116.

[70] *Annales S. Petri Erphesfurtensis antiqui* (1078–1163) [Holder-Egger, 1899a], from the Benedictine abbey of Saint Peter at Erfurt (in the diocese of Mainz, Germany), compiled by a number of different writers from 1126 to 1163.

[71] (E2) *Annales S. Rudberti Salisburgensis* (1–1286) [Wattenbach, 1851b], from Salzburg cathedral (Austria), original from 1186 onward; the report of the 1117 earthquake derives from old Salzburg annals which are now lost.

[72] (E2) *Annales S. Stephani Frisingensis* (711–1380) [Waitz, 1881b], from the Benedictine monastery of Weihenstephan near Freising (Germany), compiled from 1021, the year when the abbey was founded.

[73] (E2) *Annales Zwifaltenses* (1–1503) [Abel, 1852a], from the Benedictine monastery at Zwiefalten (in the diocese of Constance, Germany). They are original to the period from the end of the 11th century onward. Two versions have survived.

[74] *Anselm of Gembloux* [1844], he was abbot of the Benedictine monastery at Gembloux (Belgium) from 1113 to 1136, and wrote the first *Continuatio* (1112–1135) of the *Chronographia* of Sigebert of Gembloux (who died in 1112).

[75] *Auctarium Laudunense* (928–1145) [Bethmann, 1844], original continuation, for the years 1113–1145, of the chronicle of Sigebert of Gembloux, written by a monk of Saint Vincent of Laon (France). The news reported by this source, which clearly specifies that it was a matter of an effect felt by the monks of the place (“apud nos”), should, however, be interpreted tentatively as the earthquake is dated 9 January 1118, Wednesday (“feria quarta”). *Alexandre* [1990, pp. 26, 148] believes it is plausible, but with some doubts that it may regard (owing to a dating error) the earthquake of 3 January 1117, which also occurred on a Wednesday.

[76] (E2) *Auctarium Zwetlense* (1024–1160) [Wattenbach, 1851c], from the Cistercian monastery at Zwettl (in the diocese of Passau, Austria), partial continuation of the *Annales Mellicenses*. The earthquake is wrongly dated to 1116.

[77] *Berthold of Zwiefalten* [1941], abbot of the Benedictine monastery of Zwiefalten (in the diocese of Constance, Germany). He wrote the *Chronicon monasterii Zwiefaltensis* (1089–1138) around 1137–1138. He was at Kladrau in Bohemia (Czech Republic) when the earthquake occurred.

[78] (E2) The chronicle entitled *Casus monasterii Petrishusensis* (circa 955–1165) [Abel and Weiland, 1869], from the Benedictine monastery of Saint Peter at Petershausen, near Constance (Germany), compiled toward the mid-12th century.

[79] *Chronicon Elwacense* (1–1477) [Abel, 1852b], from the Benedictine abbey of Ellwangen (in the diocese of Augsburg, Germany). The first part of the chronicle was jointly put together by compilers of the *Annales Elwangenses* and *Annales Neresheimenses*, while the second part was added by a 15th century author. The report of the earthquake derives from a lost version of the *Annales Elwangenses* and is wrongly dated to 5 January 1116.

[80] *Chronicon rhythmicum Leodiense* (1116–1119) [De Clercq, 1966], a rhyming chronicle by a canon of the cathedral of Saint Lambert in Liège (Belgium), which is contemporary with the events recorded, most probably Raimbaud of Liège.

[81] *Guido Pisano* [1963]; see section A3.

[82] (E2) *Heimo* [1852], a presbyter of the Benedictine monastery of Michelsberg in Bamberg (Germany). Around 1135 he wrote a *Chronographia* (of which two codices

survive: the codex Augustanus and the codex Ensдорfense), partly published for the years 1006–1135.

[83] *Raimbaud of Liège* [1966] was a canon at the cathedral of Saint Lambert in Liège (Belgium) between 1117 and 1149. He wrote a short text entitled *Itineraria* in which he mentions the 1117 earthquakes.

A2. List of Sources Concerning the Second Earthquake: Afternoon of 3 January (Verona Area)

[84] (E1) denotes sources that contain information on the first earthquake as well.

[85] *Annales Brixianenses* (1014–1263) [Bethmann, 1863], annals of Brescia (Italy) preserved in three codices, called A, B, and C. The annals in codex A (1117–1213) were compiled at the abbey of San Giovanni in the early 13th century, and derive from earlier annals compiled in the 12th century. The annals in codex B (1014–1263) were compiled at the abbey of San Pietro in Oliveto, and seem to go back to earlier Brescian annals, written from the mid-11th century onward, but now lost. The annals in codex C (1139–1239) are entirely original annals of the city of Brescia.

[86] *Annales Casinenses* (1000–1212) [Pertz, 1866a], from the Benedictine monastery of Montecassino (Italy) compiled from the 11th to the 13th century.

[87] *Annales Cremonenses* (1096–1270) [Holder-Egger, 1903], annals of Cremona (Italy), compiled from the mid-12th century by various contemporary authors. The first part (1096–1159) derives from earlier Cremonese annals, now lost, which were compiled from the beginning of the 12th century.

[88] *Annales Ferrarienses* (1101–1211) [Jaffé, 1863a], short annals of the city of Ferrara (Italy), which are contemporary with the events recorded. In preparing the edition of the *Chronicon Parmense* for the *Monumenta Germaniae Historica*, Jaffé [1863a] set aside this single-page text, attributing it to Ferrarese chronicle circles.

[89] *Annales Mediolanenses brevissimi* (1111–1237) [Jaffé, 1863c]. For the 12th century, these annals derive from a lost source of Milan (Italy), also used by the *Annales Mediolanenses breves* [Jaffé, 1863b].

[90] *Annales Mellicenses* (1–1123) [Wattenbach, 1851a], from the Benedictine monastery of Saint Peter at Melk (in the diocese of Passau, in Germany), compiled under the direction of Abbot Erchenfried up to the year 1123 and continued by more than one hand up to 1564. The earthquake is wrongly dated to 2 January 1116.

[91] *Annales Parmenses minores* (1038–1167) [Jaffé, 1863d], short annals of Parma (Italy), consisting of sketchy reports of famine, earthquakes and war. Nothing is known of the author. They were given the title *Annales Parmenses minores* in the edition by Jaffé [1863d] for the *Monumenta Germaniae Historica*, because he thought they were independent of the Parma chronicle tradition. In the new edition of the *Rerum Italicarum Scriptores*, however, Bonazzi [1902–1904] placed this text at the beginning of the *Chronicon Parmense*.

[92] *Annales Pragenses* (894–1193) [Pertz, 1839d], compiled at the beginning of the 13th century, and deriving from lost annals from the cathedral at Prague (Czech Republic).

[93] *Annales Remenses* (967–1150) [Pertz, 1859b], continuation of the annals by Flodoard (who lived between 894

and 966), these annals seem to derive from lost annals of Rheims (France) which were also used in the *Annales S. Dionysii Remenses* (see below).

[94] (E1) *Annales S. Blasii in Silva Nigra*, see section A1.

[95] *Annales S. Dionysii Remenses* (845–1190) [Waitz, 1881a], from the Augustinian abbey of Saint Denis at Rheims (France). They are original for the period from the second half of the 12th century onward, while for the preceding period they derive from Rheims cathedral annals, now lost.

[96] (E1) *Annales S. Disibodi*, see section A1.

[97] *Annales S. Michaelis Babenbergensis* (1066–1160) [Pertz, 1844], from the Benedictine abbey of Michelsberg at Bamberg (Germany), compiled in the 11th–12th century.

[98] *Annales S. Petri Babenbergensis* (1103–1185) [Jaffé, 1861], from the cathedral of Saint Peter at Bamberg (Germany), compiled during the 12th century.

[99] (E1) *Annales S. Rudberti Salisburgensis*, see section A1.

[100] (E1) *Annales S. Stephani Frisingensis*, see section A1.

[101] *Annales S. Trinitatis Veronenses* (1117–1223) [Pertz, 1866b], from the monastery of Santa Trinità in Verona (Italy), compiled from the second half of the 12th century onward. The material is entirely original.

[102] *Annales Venetici breves* (1062–1195) [Simonsfeld, 1883], brief annals of the city of Venice (Italy), compiled in the early 13th century. They are original for the period from the end of the 11th century onward.

[103] *Annales Veronenses antiqui* (1–1251) [Cipolla, 1908], annals of the city of Verona (Italy), written in the second half of the 13th century, and deriving largely from a common source, now lost, which was compiled from the end of the 12th century onward.

[104] *Annales Veronenses breves* (1095–1178) [Pertz, 1866c], annals deriving from earlier Verona cathedral annals, now lost.

[105] *Annales [Veronenses] veteres* (1–1250) [Cipolla, 1875], annals of the city of Verona, written in the late 13th century, and deriving largely from a common source, now lost, which was compiled from the end of the 12th century onward. The earthquake is wrongly dated to 7 January.

[106] (E1) *Annales Zwifaltenses*, see section A1.

[107] (E1) *Auctarium Zvetlense*, see section A1.

[108] (E1) *Berthold of Zwiefalten*, see section A1.

[109] (E1) *Casus monasterii Petrishusensis*, see section A1.

[110] *Cosmas of Prague* [1923], deacon of the Cathedral of Prague, born in 1045, died in 1125. Between 1119 and 1125 he wrote the *Chronica Bohemorum*. For the second half of the 11th century this chronicle derives from lost ancient annals of Prague cathedral.

[111] *Chronica S. Petri Erfordensis* (1072–1335) [Holder-Egger, 1899b], from the Benedictine monastery of Saint Peter at Erfurt (in the diocese of Mainz in Germany). The first part of the chronicle was written at the beginning of the 12th century; the report of the 1117 earthquake derives from annals now lost (1110–1150) compiled at Reinhardsbrenn in the first half of the 12th century.

[112] *Ebo of Michelsberg* [1856], a monk at the Benedictine abbey of Michelsberg, near Bamberg (Germany),

who died in 1163. Around the years 1147–1159 he wrote a life of Bishop Otto of Bamberg (*Vita Ottonis episcopi Babenbergensis*).

[113] *Eckehard of Aura* [1844], a Benedictine monk born around 1050 who died after 1125. He was abbot of the monastery of Aura (in the diocese of Würzburg, Germany) from 1108. He wrote a universal chronicle (1–1125), original from 1099 onward.

[114] (E1) *Heimo* [1852], see section A1.

[115] *Notae Halesbrunnenses* (1117, 1133, 1338) [Pertz, 1859f], notes written in a manuscript from the Cistercian abbey of Heilsbronn (in the diocese of Eichstätt, Germany); the earthquake is wrongly dated to 5 January.

[116] *Chronicon Faventinum* (20 B.C. to 1236 A.D.) [Rossini, 1936–1939], compiled from 1189 onward by Tolosano, a canon of Faenza cathedral (Italy). He was struck down with apoplexy in 1219 and died in 1226. For the period 1219–1236, his chronicle was continued by another canon of Faenza. The earthquake is recorded as occurring in the year 1142 (MCXLII), but *Alexandre* [1990, p. 103] has suggested that it may really be that of 1117. It is possible that the copyist made a simple error in transcribing the year.

[117] *Landulf the Younger* [1934], born around 1077, died after 1137. He is called “the Younger” in order to distinguish him from the Milan chronicler of the same name who lived about half a century earlier. In 1136, he began writing the *Historia Mediolanensis*, a work which deals with the principal events at Milan in the years 1095–1137.

[118] *Notae Modoetienses* [Frisi, 1794], a church obituary from Monza (Italy) containing various original notulae about earthquakes. The one for 1117 contains a slight mistake in the date, stating 4 instead of 3 January.

[119] *Notae S. Mariae Mediolanenses* (931–1253) [Jaffé, 1863e], notes written in a liturgical calendar from Milan cathedral (Italy), originals for the period 1100–1138.

[120] *Otto of Freising* [1912], born between 1111 and 1114, died in 1158. The son of Leopold of Austria and Agnes, daughter of Henry IV; bishop of Freising (Germany) in 1138. Between 1141 and 1146, he traveled at least four times between Austria and Italy. The first of his two main works is a universal chronicle in eight books (*Chronica sive Historia de duabus civitatibus*), probably written in Germany between 1145 and 1146.

[121] *Peter the Deacon* [1980] entered the abbey of Montecassino (Italy) as a youth, but was obliged to leave the monastery in 1128. He was able to return about 3½ years later. He continued the *Chronica Monasterii Casinensis* up to 1138.

A3. List of Sources Concerning the Third Earthquake: Afternoon of 3 January (Northern Tuscany)

[122] *Annales Pisani antiquissimi* (1004–1117) [Novati, 1910], these are brief notes in annal form concerning the city of Pisa (Italy) and the Pisan wars in the Mediterranean. They were transcribed by a 12th century librarian into Ms. LXXIX in the Biblioteca Statale in Cremona. According to *Novati* [1910], these notes derive from contemporary 11th–12th century sources.

[123] *Gesta Lucanorum* (or *Annales Lucenses*) (1087–1304) [Schmeidler, 1930], annals compiled around 1304–

1305 by a chronicler residing in Lucca (Italy). The material is original from 1295 onward. For the period from the mid-12th century to 1276, his sources are old annals of the city of Lucca, now lost.

[124] *Guido Pisano* [1963], he may perhaps be identified as the deacon Guido who took part in the conquest of the Balearic Islands by the Pisans in the years 1113–1115. In codex *Vaticanus Latinus* 11564, fol. 184, in the Biblioteca Apostolica Vaticana (a 1459 copy which very probably derives from the 12th century original) there is a long and detailed description of the effects of the various shocks in January 1117.

Appendix B

[125] Transcribed in this appendix are the texts of the sources relating to the locations that we have selected for the first earthquake on 3 January 1117, Germanic area.

B1. Heirenbuch (in the Territory of Augsburg, Germany)

[126] The source is the *Chronicon monasterii Zwiefaltensis* by Abbot *Berthold of Zwiefalten* [1941]: “In the twenty-third year of the same abbot [Ulrich], on 3 January (1117) after Vespers, [...] there was a great earthquake. [...] In the territory of Augsburg, the castle of Heirenbuch collapsed, among other buildings. A woman of that same town [Augsburg] was at that very moment suckling her child in the tower; all those in the tower were killed, and she too was crushed with many others beneath a heap of rubble and was soon found dead with a few others, while the baby was found sitting alone on a pile of rubble and wood, and not only was the child alive (wonder of God!), but unharmed as well.” (Vigesimo tertio eiusdem abbatis anno, III Non. Ianuarii post vespertas [...] terraemotus factus est magnus. [...] In territorio Augustensi quoddam castellum Haigirimbuc nominatum inter cetera nunc est eversum. Domina vero eiusdem urbis eadem hora in turri residens, lactantem filium in sinu continens, omnibus extinctis et ipsa sub acervo lapidum oppressa cum multis et vix mortua inventa cum paucis, solus infantulus super congeriem lapidum, super struem lignorum sedens repertus est non solum vivus (mirabilis Deus!) sed et incolomis.)

B2. Petershausen (Near Constance, Germany)

[127] The source is the chronicle entitled *Casus Monasterii Petrishusensis* [Abel and Weiland, 1869]: “Of the earthquake. In the year of the Incarnation of the Lord 1117, on 3 January around the third vigil of the night, and again on the same day nearly at the eleventh hour, there was an extraordinary earthquake reaching the four corners of the earth, so much so that many churches and certain cities were in ruins following the immense shock.” (De terre motu. Antehac anno dominicae incarnationis 1117, 3 Non. Ianuarii circa tertiam noctis vigiliam, et iterum in ipsa die undecima fere hora, terrae motus ingens factus est longe lateque per orbem, ita ut ecclesiae multae et quedam urbes ex immensa concussionem subruerentur.)

B3. Zwiefalten (Germany)

[128] The source is the *Annales Zwifaltenses* [Abel, 1852a]: “1117. On the third day before the Nones of

January [3 January], there was a great earthquake twice, at night and during the day, and many people were crushed to death.” (1117. 3. Non. Ianuar. terre motus factus est magnus bis in nocte et die, multique homines oppressi sunt.)

B4. Saint Blasien (Germany)

[129] The earthquake is defined as being “strong” (validus.) The source is the *Annales S. Blasii in Silva Nigra* [Pertz, 1861]: “1116. On 3 January everywhere there was such a strong earthquake that the towers and many buildings collapsed, once before cock crow, and a second time at the ninth hour.” (1116. Tercio Non. Ianuar. terre motus fuit ubique tam validus, ut turres aliaque edificia plura subruerent, in galli cantu semel, et ad nonam secundo.)

B5. Einsiedeln (Switzerland)

[130] There was an earthquake defined as being “great.” The source is the *Annales Einsidlenses* [Pertz, 1839b]: “1117. There was a great earthquake on 3 January.” (1117. Terrae motus factus est magnus 3. Non. Ian.)

B6. Regensburg (Germany)

[131] There was an earthquake defined as being “great.” The source is the *Annales Ratisponenses* [Wattenbach, 1861]: “1117. On 2 January there was a great earthquake.” (1117. 4 Non Ian. terrae motus factus est magnus.)

B7. Marbach? (France)

[132] There was an earthquake defined as being “great.” The source is the *Annales Marbacenses* [Bloch, 1907]: “1107. [...] In the following year there was a great earthquake.” (1107. [...] Altero anno terre motus factus est magnus.)

B8. Erfurt (Germany)

[133] There was an earthquake defined as being “great.” The source is the *Annales S. Petri Erphesfurtensis antiqui* [Holder-Egger, 1899a]: “1117. On 3 January there was a great earthquake.” (MCXVII. III. Non. Ian. Terrae motus magnus factus est.)

B9. Corvey (Saxony, Germany)

[134] The *Annales Corbeienses* [Pertz, 1839a], a source drafted at Corvey reports that there was an earthquake defined as being “great” in Saxony: “1117. There was a great earthquake in Saxony.” (1117. Terrae motus magnus in Saxonia.)

B10. Paderborn (Germany)

[135] There was an earthquake defined as being “terrible” and “unprecedented.” The source is the *Annales Hildesheimenses* [Waitz, 1878]: “1117. On the eighth of Saint John the Evangelist [3 January] throughout the world the earth was shaken by a terrible shock, a hitherto unprecedented earthquake.” (1117. In octava sancti Iohannis Euangelistae late per orbem terribili et inaudito hactenus terremoto terra concutitur.)

B11. Melk (Austria)

[136] There was an earthquake defined as being “great.” The most complete source is represented by the *Auctarium Zwettlense* [Wattenbach, 1851c], which contains a version of

the *Annales Mellicenses*: “1116. [A great earthquake took place over the whole of the territory of Germany and Italy on 3 January] twice, once after the cock’s third crow, and another on the same day nearly at the tenth hour.” (1116. [Terre motus factus est magnus per universam Theutonium et Ytalicam terram 3. Non Ian.] bis, unus post tertium galli cantum, alter die eodem hora quasi 10.)

B12. Laon (France)

[137] There was an earthquake: no other information is reported. The source is the *Auctarium Laudunense* [Bethmann, 1844]: “There was an earthquake here on the fifth day before the Ides of January [9 January], on the fourth day [Wednesday].” (1118. [. . .] Terremotus factus est apud nos 5. Idus Ian. feria quarta.)

B13. Lobbes (Belgium)

[138] There was an earthquake defined as being “great.” The source is the *Annales Laubienses* [Pertz, 1841]: “1117. In this year there was a great earthquake.” (1117. Hoc anno fit terrae motus magnus.)

B14. Mouzon (France)

[139] There was an earthquake; no other information is reported. The source is the *Annales Mosomagenses* [Pertz, 1839c]: “1117. The earthquake appeared on 3 January.” (1117. Terraemotus visum est 3. Non. Ianuar.)

B15. Liège and Saint Trond (Belgium)

[140] Hanging objects were seen to sway in the cathedral at Liège. The same thing happened at Saint Trond. [the effects are already described in the text]. The source is the *Chronicon rhythmicum Leodiense* [De Clercq, 1966]: “In the year 1117 of Jesus Christ [. . .] There was a great tremor in the cathedral at Liège, but the people were spared. The danger caused great terror. The crucifix was seen to sway, together with all hanging objects, the baccinia, crowns and lamps, as reliable people saw. The same thing happened at Saint Trond [. . .].” (Millesimo centesimo anno/ Iesu) Xristi septimo decimo/[. . .] Leodij in monasterio/magna urbis contigit motio/sed pepercit Dominus populo;/maior metus fuit periculo./Crucifixus moveri visus est,/et cum eo quicquid pendulum est,/baccinia, coronae, lampades,/quod viderunt persone celebres./ Idem fuit apud Sintruuium [. . .].) In this case, the source is using the term monasterium to refer to the cathedral, where the crucifix hung from the triumphal arch at the entrance to the choir stand. The term baccinia may perhaps mean oil lamps [Alexandre, 1990].

B16. Rolduc (Germany)

[141] There was an earthquake defined as being “great.” The source is the *Annales Rodenses* [Pertz, 1859c]: “1117. There was a great earthquake in January.” (1117. Terrae motus factus est magnus in Ianuario.)

B17. Disibodenberg (Germany)

[142] There was an earthquake defined as being “terrible.” The source is the *Annales S. Disibodi* [Waitz, 1861]: “On two occasions between the day and the night there was a terrible earthquake all over the world, so terrible that many buildings collapsed and the men hardly managed to flee.” (1117. In octava sancti Iohannis ewangelistae terrae motus

bis inter diem et noctem tam terribilis per totum orbem terrarum factus est, ut multa aedificia corruerent et homines vix effugerent.)

B18. Meersburg (Germany)

[143] The effects are in the table of environmental effects. The source is the *Chronicon monasterii Zwiefaltensis* written by Abbot Berthold of Zwiefalten [1941]: “In the twenty-third year of the same abbot [Ulrich], on 3 January (1117) after Vespers [. . .] there was a great earthquake. [. . .] You may learn from the following example, dear reader, that even mountains and hills were laid low: the church towers and other similarly tall buildings in the town of Constance could never be seen from the castle of Meersburg before this earthquake; but now they were suddenly revealed to general view [. . .].” (Vigesimo tertio eiusdem abbatis anno, III Non. Ianuarii post vespas [. . .] terraemotus factus est magnus. [. . .] Montes etiam et colles tunc defluxisse, hoc exemplo, lector, poteris colligere: Cloclea cum aliis aedificiis aequae altis in Constantiensi civitate constituta de castello Mercisbure dicto ante hunc terraemotum nunquam visa, modo cunctis cernentibus apparuit universa.)

[144] The following locations have not been classified (NC) owing to a lack of descriptive elements.

B19. Augsburg (Germany)

[145] The source is the *Chronographia* by Heimo [1852]: “1117. There was a great earthquake everywhere on the earth, once by day, once by night.” (1117. Terremotus magnus ubique terrarum, semel in die, semel in nocte est factus.)

B20. Freising (Germany)

[146] The source is the *Annales S. Stephani Frisingenses* [Waitz, 1881b]: “(1117). In this year there was an earthquake on 3 January in the night before the day, and on the second day it happened before the Vespers of the fourth day [Wednesday].” ((1117). Hoc anno contigit terre motus in 3. Non. Ian. in nocte ante diem, et in die secundo contigit ante vesperam feria 4.)

B21. Salzburg (Austria)

[147] The source is the *Annales S. Rudberti Salisburgensis* [Wattenbach, 1851b], “1117. The earthquake happened; once during the day and once during the night.” (1117. Terre motus semel in die, semel in nocte accidit.)

B22. Dijon (France)

[148] The source is the *Annales S. Benigni Divionensis* [Waitz, 1844]: “1117. Great earthquakes in various places and lightning bolts killed many people.” (1117. Terre motus magni per loca et fulgura multos occiderunt.)

B23. Brauweiler (Germany)

[149] The source is the *Annales Brunwilarenses* [Pertz, 1859a]: “1117. In this year on 3 January there was an earthquake in the whole world.” (1117. Hoc anno 3. Nonas Ianuarii accidit terremotus per universum orbem.)

B24. Châlons (France)

[150] The source is the *Annales S. Petri Catalaunensis* [Pertz, 1859e]: “1117. On 30 December (1116) there were

earthquakes in various places.” (1117. 3. Kal. Ianuarii terrae motus visi per loca.)

B25. Ellwangen (Germany)

[151] The source is the *Chronicon Elwacense* [Abel, 1852b]: “1116. There was an earthquake on 5 January.” (1116. Terrae motus factus est in Nonis Ianuarii.)

B26. Gembloux (Belgium)

[152] The source is the *Continuatio* (of the *Chronographia* of Sigebert of Gembloux) by *Anselm of Gembloux* [1844]: “1117. On 3 January, in the fourth day [Wednesday] in some places but not everywhere there was an earthquake, at times more clement, at times more violent, so much so that it is said that certain cities and churches collapsed to the ground.” (1117. Mense Ianuario 3. Non. ipsius, 4. feria, in aliquibus locis, sed non usquequaque, terremotus accidit, alias clementior, alias validior; adeo ut quarundam urbium partes cum ecclesiis subruisse dicatur.)

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