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Exploring the potential of seismological compilations: J. Schorn (1902) and the seismicity of Tyrol

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Abstract
Seismological compilations of the past two centuries have represented one of the main sources of supporting data for the compilers of current parametric earthquake catalogues. On the one hand, their quality and reliability was proved as varied and, in many cases, fairly low; on the other hand, it is not clear whether all the earthquake records they supply have been exploited to become part of the present knowledge of the historical seismicity of some European countries. This paper analyses one of these compilations, *Die Erdbeben von Tirol und Vorarlberg*, published in 1902 by J. Schorn, which covers an area today shared among Austria, Switzerland and Italy, with the aim of checking its reliability and its usefulness towards a revision of the knowledge on the seismicity of historical «Tyrol».

Key words *historical seismology – Tyrol – seismological compilations*

1. Introduction: seismological compilations

From the middle of the 18th century to the early 20th century, a growing interest in earthquakes led several scientists in Europe to investigate their history. Authors like Bertrand (1757), von Hoff (1840-1841), Perrey (1848, etc.), Mallet (1853-1855), Volger (1857), Mercalli (1883), Baratta (1901) and many others assembled a great amount of historical earthquake records, collected from a rich as well as non homogeneous set of sources, and published a number of «seismological compilations».

This wording is used here – as, for instance, in Guidoboni and Stucchi (1993) – to define volumes consisting of collections of earthquake information spread over years, decades or centuries. Information concerns either the whole world, as for instance in the work by von Hoff (1840-1841), or a region, as in many works by Perrey (*e.g.*, 1848), or even a single place. Generally, earthquakes are presented in chronological order: earthquake records can be the literal transcription of the sources or their contents can be summarised by the author, who established a link among them, based on the time of occurrence. The way data are processed is rarely explained by the authors and it turned out in many cases to be the main origin of mistakes, such as duplications or the invention of fake earthquakes.

In recent times many of these compilations have been used as basic material by the compilers of parametric catalogues. For instance, the information on Italian seismicity up to 1850 in the Italian catalogue (Postpischl, 1985) was derived from the compilations of Baratta (1901) for 85% and of Mercalli (1883) for 10%. However, the methods of investigation and historical interpretation of these forerun-

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ners of historical seismology appear now obsolete: it is then evident that their synthesis should be carefully reconsidered, with special reference to their coherence with original earthquake records.

Pointing out mistakes and inaccurate historical reconstruction only, one can conclude that these compilations should not be used for the compilation of parametric catalogues. As a consequence, some researchers suggest that parametric catalogues including such compilations among their sources should be thrown away and rebuilt starting from a new research based on the rules of historical criticism (see for instance Alexandre, 1990; 1994).

On the other hand, some others believe that the labours of those scientists succeeded in gathering a large amount of scattered historical earthquake records and that their results can still be used. Seismological compilations can be used as «working boxes», from which pieces can be extracted and put together in a proper way. For instance, recent experience has shown that mistakes or misinterpretations can be easily detected by simply going back to the original sources of the seismological compilations and re-interpreting the historical records (Castelli *et al.*, 1991; Moroni and Stucchi, 1993; Guidoboni and Stucchi, 1993; Bellettati *et al.*, 1993).

This procedure was also adopted for allowing a complete, though not exhaustive, investigation of the information supporting the most damaging earthquakes in Italy, in the frame of the compilation of a new parametric earthquake catalogue of Italy (Stucchi, 1991). At the beginning of the research it was doubtful whether all seismological compilations had been used by the previous compilers and their potential already fully exploited; a thorough use of several of such compilations (65 for the Italian territory) led to particularly rewarding results (Stucchi and Albini, 1992; GNDT, 1992; Stucchi and Zerga, 1994).

This paper explores the case of a seismological compilation scarcely known in Italy, *Die Erdbeben von Tirol und Vorarlberg*, published in 1902 by J. Schorn, which has the particularity of dealing with Tyrol, an area today shared between Austria and Italy and close to Switzerland.

2. Tyrol and its seismicity

The territory of «Tyrol» to which Schorn refers in the title of his study includes the subregions of today's Tyrol and Vorarlberg (Austria), Südtirol and Trentino (Italy). The term Tyrol will be used hereafter in this sense, though it has to be stressed that there were many changes in Tyrol's borders and rulers through the centuries. Just to recall the most significant of them, from the 11th through the 18th century, the Bishop Princedoms of Trento and Bressanone (Brixen) controlled Trentino and part of east Südtirol, while the rest of Tyrol was under the dominion of the «Earldom of Tyrol» (fig. 1a,b). The increasing power of the Austrian Monarchy led in 1802 to the annexation of the former Bishop Princedoms of Trento and Bressanone. In 1815 the territories of Trentino, Südtirol and today Tyrol constituted a single Austrian dominion, first as a County and then as an autonomous district together with Vorarlberg, until 1919, when Trentino and Südtirol were annexed to Italy.

For the period up to 1900 the seismicity of the area of Tyrol can be described by means of Van Gils and Leydecker (1991) catalogue. For Austria, Van Gils and Leydecker (1991) presumably rely upon Toperczer and Trapp (1950), who consider events with $I_{max} \geq 6$ only; for Italy, they definitely rely upon Postpischl (1985); for Switzerland, the Swiss entries of Van Gils and Leydecker (1991) come from an unpublished data-file. Seismicity appears moderate in the northern part and low in the southern one (fig. 2).

How reliable is this picture? As in most cases, the picture of pre-1900 seismicity proposed by the national parametric catalogues mostly depends on the information supplied by some seismological compilations.

In this case, some doubts may arise from the fact that Toperczer and Trapp (1950) list, for the area of Tyrol, all the events reported by Schorn (1902). On the other hand, Schorn (1902) is not among the sources of Postpischl (1985), who in his turn mainly relies upon Baratta (1901). Actually, when J. Schorn published his work in 1902, the whole Tyrol, including today Trentino and Südtirol, was part

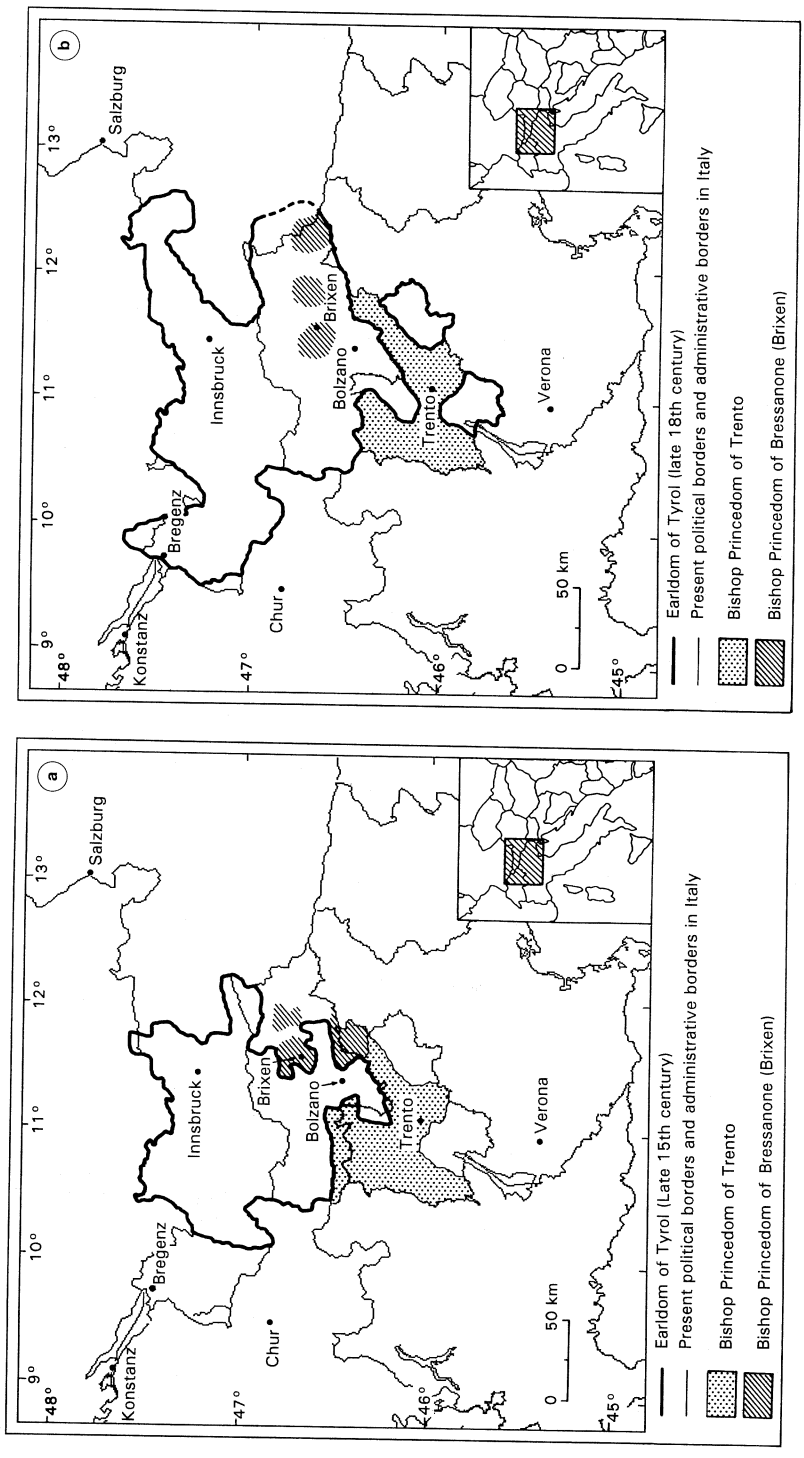

Fig. 1a,b. Geo-political changes in Tyrol (15th-18th centuries). a) Late 15th century; b) Late 18th century.

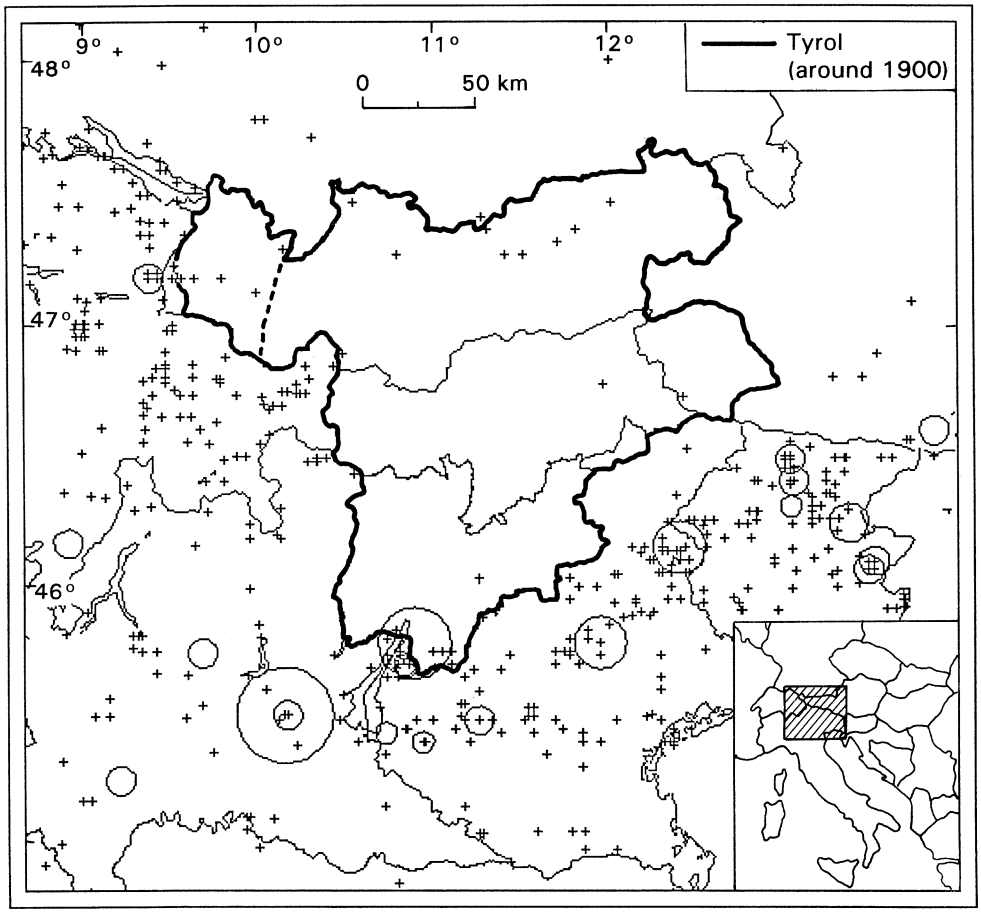

Fig. 2. Seismicity of the Alps up to 1900 according to Van Gils and Leydecker (1991). Thick line indicates the maximum territorial extension of Tyrol (19th century).

of the Habsburg empire (fig. 3). For the same reason Baratta, who published his book *I terremoti d'Italia* in 1901, did not devote to the seismicity of Trentino and Südtirol the same attention as to other Italian regions. Figure 3 clearly shows that Schorn's compilation covers a part of the Italian territory (Trentino and Südtirol) not covered by other seismological compilations.

As for Switzerland, the data-file mentioned above presumably owns most information to the compilation by Volger (1857), mainly devoted to Switzerland, but containing information on some Tyrol earthquakes as well.

3. The seismological compilation by J. Schorn (1902)

Die Erdbeben von Tirol und Vorarlberg by J. Schorn (1902) covers a large time span, from 369 to 1895. It is the most consistent collection of historical earthquake records of Tyrol, and represents Schorn's contribution to the already mentioned studies on the seismicity of the previous centuries. Josef Schorn (Bolzano, 14 November 1855-Innsbruck, 2 December 1937) studied Natural Sciences at the University of Innsbruck. He taught at secondary schools for

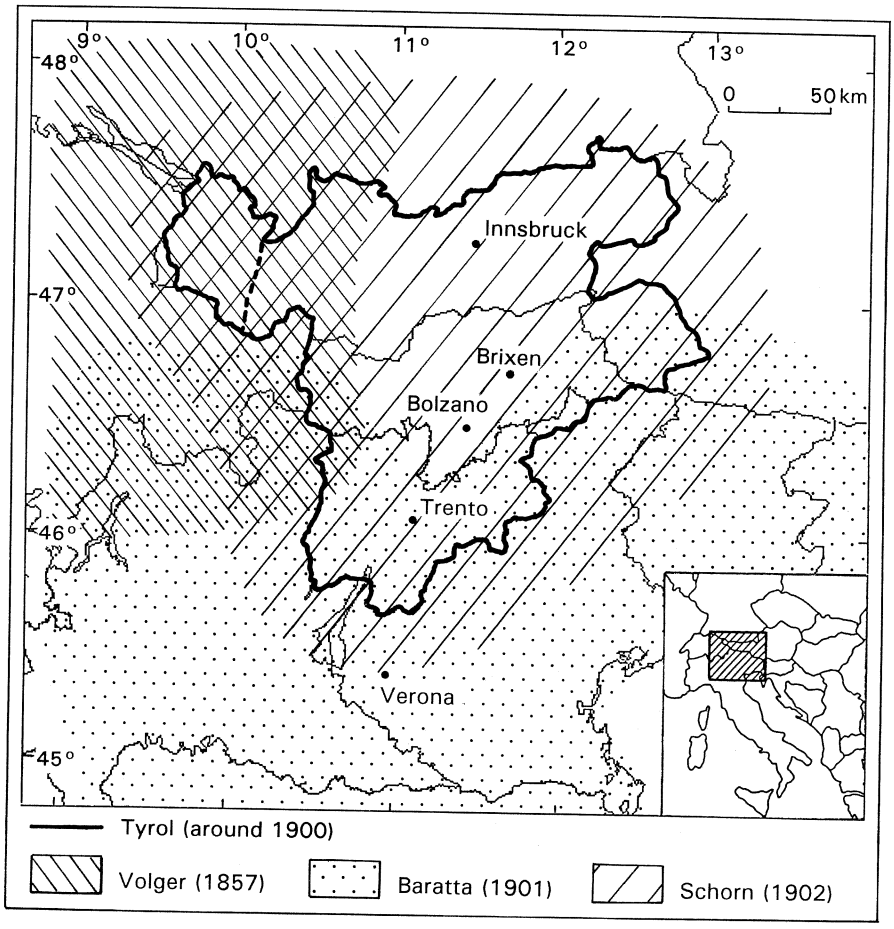

Fig. 3. Screens show the areas covered by the seismological compilations of Volger (1857), Baratta (1901) and Schorn (1902).

some years and then worked at the Museum of the Ferdinandeum in Innsbruck, by official appointment from 1893 to 1922. In 1896 he was officially charged by the *Erdbeben Kommission* of the *Kaiserliche Akademie der Wissenschaften* in Vienna with the task of collecting the macroseismic information for the German speaking Tyrol (*Deutschtirol*) and Vorarlberg; in the same period Prof. Damian from Trento took care of Trentino (*Welschtirol*) (Schorn, 1902).

In the introduction Schorn explains the approach he used. He considered mainly the earthquakes originated inside Tyrol and Vorarlberg; then, for the sake of completeness, he also dealt with earthquakes originated outside those territories, the effects of which were documented in Tyrol and Vorarlberg as well.

Earthquake records are proposed by Schorn in a chronological order, to form an *Erdbebenchronik*. Each paragraph is entitled to one year and it supplies:

– date of earthquake/s which occurred in that year;

– description/s of earthquake/s effects, mostly reporting the original records;

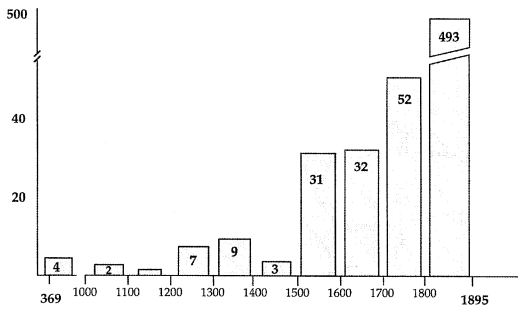

Fig. 4. Number of events per century in Schorn's *Erdbebenchronik.*

– sometimes a comment on the reliability of the source or of the record; in some cases, when a record is judged doubtful or fake, Schorn suggests that the information can be referred to a previous or a following earthquake;

– source reference.

The compilation lists 634 events or clusters of events, as grouped by Schorn himself; their time distribution is shown in fig. 4.

Clusters can be referred to 64 localities or districts which can be assumed as «barycentres» of the events in a preliminary way. Some of them are quoted for one or a few earth-

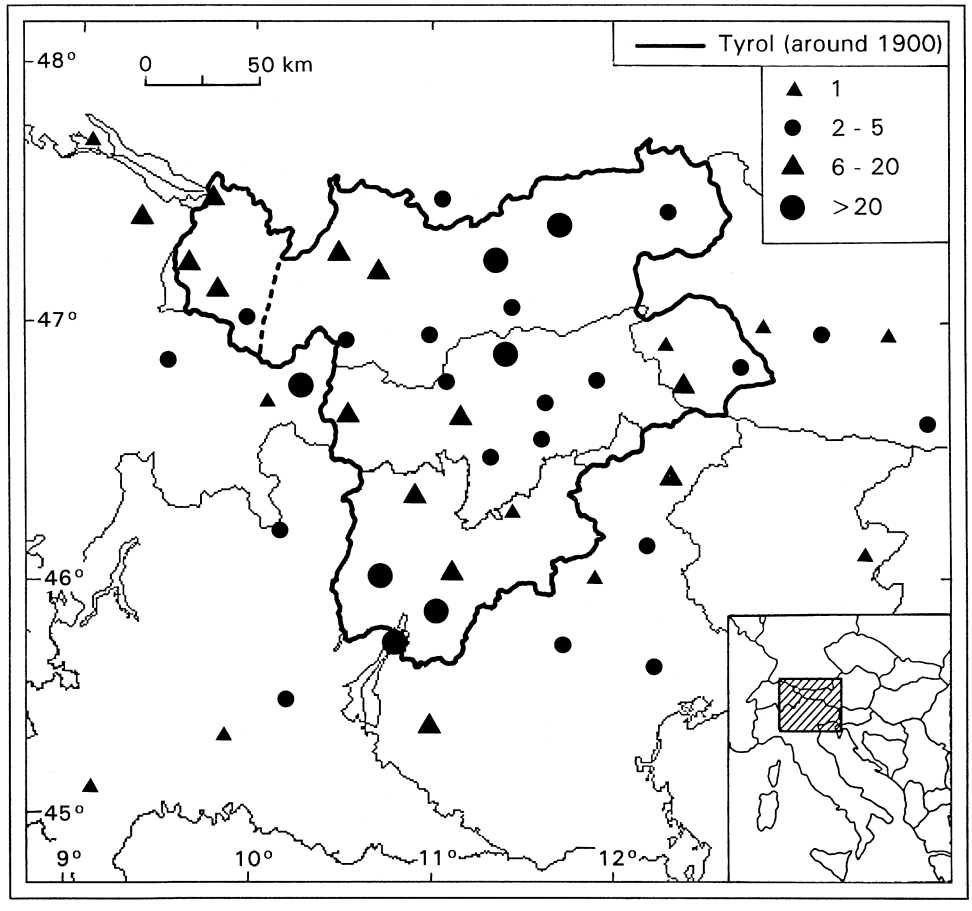

Fig. 5. Distribution of the 64 earthquake barycentres listed by Schorn (1902).

quakes only, while most information clusters around some places in Tyrol, *e.g.* Innsbruck (190 events listed), Jenbach (25 events) and Vorarlberg (40 events with barycentre in three localities). A smaller number concerns Südtirol (61 events, 8 barycentres), while 83 events (5 barycentres) are referred to Trentino (fig. 5).

4. The contribution of Schorn's compilation

4.1. *Earthquakes unknown to current parametric catalogues*

As a first step it has been checked to what extent the information supplied by Schorn is known to the already mentioned current parametric catalogues covering the area of Tyrol, with special reference to the strongest earthquakes.

Austria – For the present Austrian territory, the comparison with Schorn's information was performed using the Austrian records included in the European catalogue (Van Gils and Leydecker, 1991), which, as already said, rely in their turn upon Toperczer and Trapp (1950). The results are: about 280 earthquakes described by Schorn are not included in Van Gils and Leydecker (1991) catalogue; their barycentres mainly cover Innsbruck (176 events), Imst (13 events), Feldkirch (16 events) and Jenbach (20 events); 12 of them are reported as damaging.

The three examples presented in the following mostly refer to damaging earthquakes though, of course, also non damaging earthquakes are important for a moderate seismicity area. They are meant as an example of available information and not as final study of the earthquakes themselves.

– September 1509. For this earthquake Schorn relies upon the scarce information taken from a late source (Trithemius, 1640), which reports: «*terraemotus per diversa Germaniae loca magni et impetuosi ... maxime in Carinthia, Stiria, Tiroli, Austria et Suevia*». Schorn does not make any comments on the reliability of this source. In Toperczer and Trapp (1950) the date is completed by the day, 14, and the time of occurrence, but there is a question mark instead of a value of I_{max} in the proper column.

– 12 March 1833. *Bote von Tirol und Vorarlberg* (1833) reports: «*zwischen 11 und 12 h p. bedeutendes Erdbeben von Welsberg bis Lienz und in den Seitentälern Sexten, Tilliach und Villgratten, ... Die meisten Leute erwachten, Mauern bekamen Sprünge*» (Between 11 and 12 p.m. a strong earthquake was felt from Welsberg to Lienz and in the nearby valleys of Sexten, Tilliach and Villgratten. Most people awoke, and cracks opened in the walls).

– 3 December 1874, 1.22 a.m. Three local newspapers (*Tiroler Stimmen*, 1874; *Bote von Tirol und Vorarlberg,* 1874; *Innsbrucker Tagblatt,* 1874) report that at Innsbruck pieces of wall fell down: at Hall, the candles fell and some wagons on a blind track were moved; at Absam-Aichet hanging objects fell from the wall; at Seefeld many people awoke.

Switzerland – The comparison with the Swiss records included in the European catalogue up to 1800 (Van Gils and Leydecker, 1991), which rely, as said above, on an unpublished data-file, gave the following results: Schorn reports 6 earthquakes in Engadina Valley (1 June 1372, 20 March 1384, 25 June 1651, 3 August 1651, 21 September 1781, 5 February 1783) which are not reported by the European catalogue; among them, the 1384 one is indicated as damaging. Moreover, an earthquake on 13 January 1629 around Schaffausen is also reported; this earthquake is not mentioned by Volger (1857).

Italy – Up to 1800 Schorn reports 4 earthquakes which are not included in the Italian catalogue (Postpischl, 1985) and, therefore, in the European catalogue (Van Gils and Leydecker, 1991): 1301, Trento; August 1681, Trento; 25 May 1683, Giudicarie; 17 January 1696, Bolzano. Here follows an example.

– 25 May 1683. This is a damaging earthquake, unknown to Baratta (1901). Schorn starts describing what happened at Innsbruck, reporting what a manuscript by Lustrier a Liebenstein (17th-18th centuries) says: «*1683 – Den 25 Maii vormittag umb 9 uhr ist aber-*

mahl (zu Innsbruck) ein zimblich gross schittlender erdbiden gewest». (1683 – On May 25th at 9 h in the morning there was again [an earthquake occurred at Innsbruck on January 26 also] a strong earthquake at Innsbruck, with many shakings).

Then Schorn adds that in the same day an earthquake occurred in southern Tyrol (Trentino), too. It was felt at Trento and caused damage in the Giudicarie, according to what a manuscript by Bertelli (1689), who lived in Trento at that time, reports: «*1683 – Li 25 Maggio dopo il mezzo giorno fu un breve, ma terribile terremoto, e maxime nelle Giudicarie, dove fece qualche danno atterrando parte de recinti con due torri del Castello Campo, e con spavento grande de Popoli. Tremò tre volte la terra, la prima de quali fu tremenda, e l'altre due più lievi*». (1683 – On May 25th after noon there was a short, but horrible earthquake, and especially in the Giudicarie, where it caused some damage making parts of the precincts and two towers of the Castle of Campo collapse, and panic was great among the people. The earth shook three times, the first of which was tremendous, and the other two lighter).

Apart from Schorn's sources, further information on this earthquake has been found in a work by Tovazzi (1803), who lived in Trentino and had access to documentary sources of the

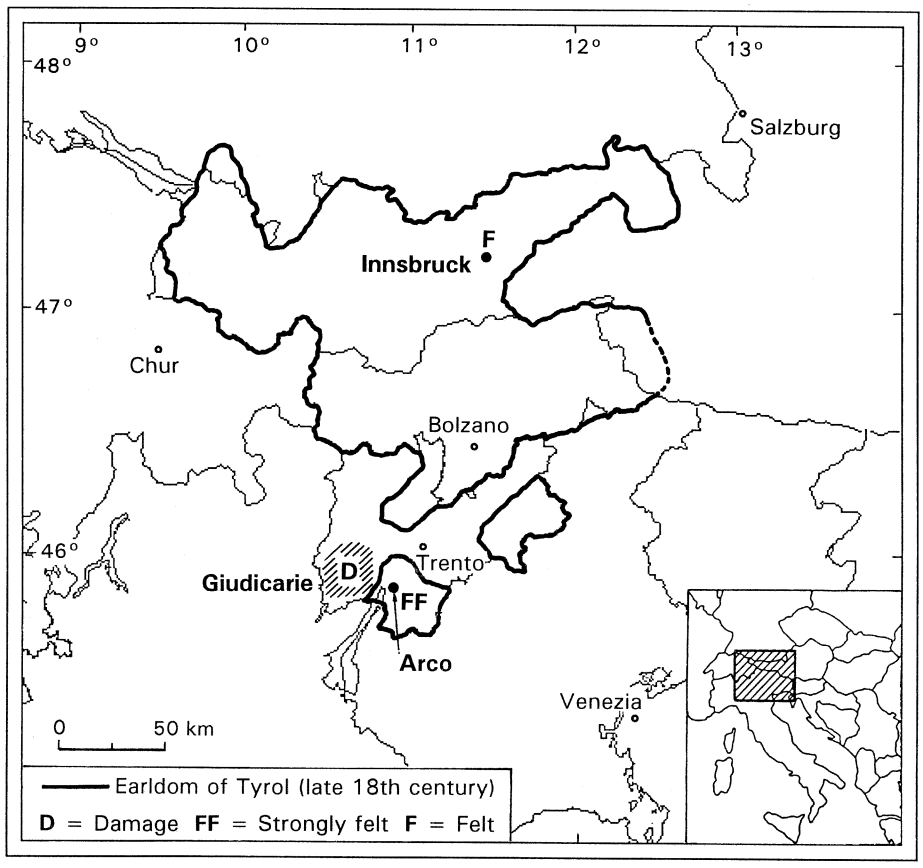

Fig. 6. Localities affected by the 25th May 1683 earthquake. D = damage; FF = strongly felt; F = felt.

area of Giudicarie (Tovazzi, 18th-19th centuries). He supplies an information found in the documents of the monastery of Santa Maria delle Grazie at Arco, where he took the Holy Orders in 1756 and lived for some years: «*Alli 25 maggio 1683 il giorno di Sant'Urbano, alle hore 13 italiane et un quarto, si sentì qui in Arco et in altri paesi circumvicini un terremoto sì spaventoso che pareva volesse cader la chiesa et il convento e durò lo spazio di due Ave Marie circa. In Giudicarie fece maggiore ruina, dubitandosi fosse la fine del mondo*». (On May 25, 1683, the day of Saint Urbano, at 13 hours and a quarter according to the Italian style here at Arco and in the neighbouring villages an earthquake was felt and it was so frightening that the church and the monastery seemed to collapse and it lasted two Ave Maria. In the area of Giudicarie it caused more damage, and they doubted whether it was the end of the world).

This set of data, derived from local and coeval sources, suggests the occurrence of an earthquake with damaging effects (I_{max} = VI-VII MSK) located in the Giudicarie Valley, in the western part of Trentino (fig. 6).

Between 1800 and 1895 Schorn reports about 150 earthquakes not included in the Italian catalogue (Postpischl, 1985). For most of them descriptions report only low intensity effects; 10 are reported as damaging, while 4 of them did not affect Trentino but neighbouring Italian regions (*e.g.*, Veneto).

4.2. *Earthquake records*

Schorn's contribution is not only limited to earthquakes unknown to parametric catalogues: for most of the known earthquakes in Tyrol, Schorn often provides descriptions of effects in a larger number of localities with respect to the other compilations.

Furthermore, Schorn also provides earthquake records at single localities; some of them, though not directly suitable for assessing earthquake parameters, are nevertheless useful for compiling the seismic histories at the site. For instance, this is the case of the 1301 shaking at Trento, which represents the maximum

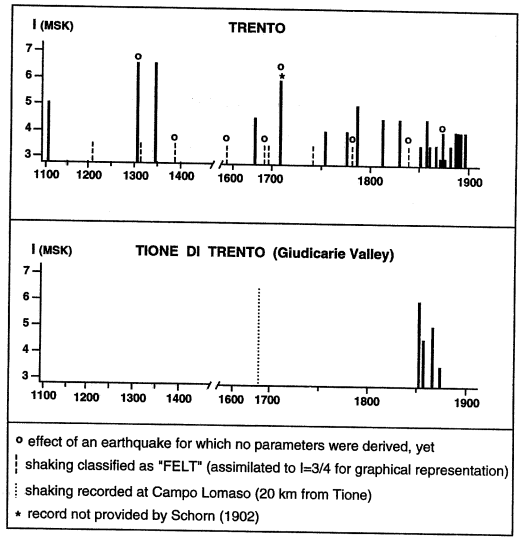

Fig. 7. Seismic histories of the localities of Trento and Tione di Trento.

effect for the town but for which no epicentral parameters have been determined yet (fig. 7).

The rate of the record provided by Schorn follows the typical European pattern: good all through the last millennium for the most important towns, such as for instance Trento, and limited to the last centuries for the marginal areas. This is the case, for instance, of Tione di Trento (fig. 7), main town of the Giudicarie Valley, an area which shows a moderate but persistent seismicity in the last 100 years.

5. Schorn's sources

Schorn affirms to report *Erdbebennotizen* (earthquake records) as they are given by *Original-Quellen* (original sources), so that the reader will directly evaluate their reliability. The records are reproduced in the original version and language, because, as Schorn himself explains, «the coeval language is often more expressive than today's one».

He also explains that he made use of the *Erdbebenkataloge*, that are the seismological compilations by Seyfart (1756), Bertrand (1757), Keferstein (1826), von Hoff (1840-

1841), Perrey (1845; 1848 and ff.), Volger (1857), Bittner (1874), Höfer (1880), Fuchs (1886), Gümbel (1890), Lorenz (1894), Baratta (1901) and Hörnes (1901). However, their information was considered only if in contrast with what Schorn considers the «original» record.

Since Schorn does not explain what he considered to be *Original-Quellen*, a critical survey of his set of sources was performed. In general, he seems to tribute a good reliability to sources coeval to the event, though he does not supply details on his critical approach. On the contrary, one could fiercely criticise the fact that he considers reliable the information on the earthquakes of 369, 452, 543 as supplied only by two Italian authors living during the 17th century in Trentino: Mariani (1673) and Bertelli (1689).

From 801 through the 15th century, Schorn relies upon the information supplied by published sources – collections of Monumenta Germaniae historica, Rerum Austriacarum, Tirolische Geschichtsquellen – and on few local sources also, available hand-written only at the Library of the Museum of the Ferdinandeum, the University Library and the State Archives of Innsbruck (*e.g.*, *Bozner Chronik*, 14th century; *Graduale*, 14th century).

For this period (late Middle Ages), the analysis has shown that most sources used by Schorn to describe the earthquakes of 1021, Bayern (7 sources) and 1201, Styria (11 sources), are the same used by Alexandre (1990). Both authors come to similar conclusions (table I), though they choose different ways; actually, Alexandre (1990) considers fake some 11th to 13th century earthquakes re-

Table I. Fake or very doubtful earthquakes from 11th to 13th century in the evaluation given by Schorn (1902) and Alexandre (1990).

Earthquake date and location	Sources available to *Schorn, 1902*	Sources or seismological compilations quoted by *Alexandre, 1990*	Evaluation *Schorn, 1902*	Evaluation *Alexandre, 1990*
1046 Nov. 9 Trentino	None	*Ann. Corbeienses*, 12th century; *Ann. S. Emmerammi Ratisponenses*, 11th century; *Ann. Ratisponenses*, 12th century	Not mentioned	True
1111 Northern Italy	Bertelli, 1689	Schorn, 1902	Very doubtful	Fake
1120 Trentino	Allg. Nationalkal..., 1846; Bittner, 1874	von Hoff, 1840; Perrey, 1848; Milne, 1911	Very doubtful	Fake
1226 Veneto, Tirol, Brescia	von Hoff, 1840; Allg. Nationalkal..., 1846	Giessberger, 1922	Same event of 1222	Fake
1231 Alps	von Hoff, 1840; Perrey, 1848; Volger, 1857	Schorn, 1902; Giesseberger, 1922	Very doubtful	Fake
1238 Trento	Bertelli, 1689	Schorn, 1902	Doubtful	Fake

ported only by compilations or catalogues of the last one hundred years – Schorn (1902) included – for the fact that they are not reported by the main coeval narrative sources. Schorn (1902) reached similar conclusions on the basis of criticism of the information supplied by the available sources of information.

There is only one earthquake reported by Alexandre (1990) and missing in Schorn (1902): an earthquake which, according to some coeval sources (*Annales Corbeienses*, 12th century; *Annales S. Emmerammi Ratisponenses minores*, 11th century; *Annales Ratisponenses*, 12th century), might have happened in 1046 in Trentino. However, the description given by one source (*Annales Corbeienses*, 12th century) reminds a rock-fall rather than an earthquake; this might be the reason for which it was disregarded by Schorn (1902).

For the Modern Age (15th-18th centuries) Schorn reports information taken mostly from local chronicles and diaries (*e.g.*, *Haller Vermischte Nachrichten*, 14th-18th centuries), and from meteorological observations (*e.g.*, *Ephemeris*, 17th century – this source seems to be lost nowadays; Zallinger, 1833). A good level of accurateness in Schorn's work is evident with respect to this period. For instance, a recent study on the 17 July 1670, Tyrol earthquake (Guidoboni and Stucchi, 1993) considers positively Schorn's way to report and summarise the available information. In fact, reporting the information concerning Tyrol (damage at Innsbruck and Hall) and other localities outside Tyrol where the earthquake was felt only, he permitted to the compilers of the Austrian catalogue (who partially relied upon his information) to give a correct parameterisation. On the other hand, the effects of the same earthquake are referred by Baratta (1901) to Italy only, leading to another set of parameters, with a consequent duplication in the European catalogue (Van Gils and Leydecker, 1991; see also Camassi *et al.*, 1994).

Information on the 19th century seismicity was supplied by local, German and Italian newspapers. The Library of the Museum of the Ferdinandeum has a very rich collection of them, and they were systematically studied by Schorn.

Summarising, Schorn mostly relies on local sources, available at the archives and libraries in Innsbruck. This is certainly a limit, but it turns out to be one of the main values of Schorn's compilation, since his sources cover an area for which the available information on earthquakes is in general scarce.

6. Conclusions

A systematic analysis revealed that Schorn's compilation contains a number of pieces of information not yet used for compiling the current parametric catalogues of the region between Austria, Italy and Switzerland. It follows that the available picture (fig. 2) of the historical seismicity of Tyrol might not be very reliable. In particular, a few damaging earthquakes and a number of non damaging ones are to be added to the Austrian and Italian catalogues, with special reference to the areas of Innsbruck and Südtirol.

Furthermore, Schorn supplies earthquake records which, though they do not allow us to derive a full set of earthquake parameters, can contribute to improve the seismic histories at the sites.

As far as the sources are concerned, most of them turned out to be reliable and valuable. This applies especially to locally produced sources, such as hand-written – and not yet edited – chronicles and diaries for the Middle Ages and the Modern Age, as well as 19th century newspapers with a circulation limited to small areas inside Tyrol itself. On the other hand, the majority of the sources are narrative ones, since Schorn did not consider in a systematic way the documentation produced by local and central administrative institutions. This aspect should be taken into account when planning further investigations on the seismicity of historical Tyrol.

In conclusion, Schorn's compilation represents a valuable, though not exhaustive tool for upgrading parametric catalogues dealing with the area of Tyrol, and for addressing further investigations, with special reference to the last five centuries.

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