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HISTORICAL SEISMICITY IN FRANCE.
ITS ROLE IN THE ASSESSMENT OF SEISMIC RISK
ON FRENCH NUCLEAR SITES.

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IAEA interregional project seismic data
for NPP siting workshop "historical seismicity
on eastern mediterranean".
(Casaccia (Italie), 27-29 octobre 1987)

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Abstract

Since 1975 in order to be in conformity with the requirements of the French nuclear program, a review of historical seismicity was undertaken in France. The assessment of seismic hazard for the safety of nuclear plants is in fact based upon a seismotectonic approach which needs to take into account the seismic activity over as long a period of time as possible. The method adopted for reviewing historical earthquakes entails a systematic consultation of the original sources and a critical analysis thereof in the light of the historical, geographical and political contexts of the time. The same standards apply where the acquisition of new elements of information is involved. Each item of information is assigned a degree of reliability, then compiled in a computer file, updated annually; this file currently contains more than 4,500 events covering a period of time of about a millenary.

Résumé

Depuis 1975 pour répondre aux exigences de sûreté imposées par le développement du programme nucléaire français, une révision de la sismicité historique de la France a été entreprise. En effet, l'évaluation de l'aléa sismique pour la sûreté des centrales s'appuie sur une approche sismotectonique qui nécessite la prise en compte de l'activité sismique sur une période de temps aussi longue que possible. La méthode de révision des séismes historiques consiste en un retour systématique aux sources originales et analyse critique de celles-ci en tenant compte des contextes historique, géographique et politique de l'époque. La recherche d'éléments nouveaux est entreprise dans le même esprit. Chaque information est affectée d'un degré de fiabilité puis est consignée dans un fichier informatisé mis à jour annuellement qui contient actuellement plus de 4.500 événements sur une période de temps de l'ordre du millénaire.

1. INTRODUCTION

It was under the aegis of the Institut de Protection et de Sureté Nucléaire (IPSN) of the Commissariat à l'Energie Atomique (CEA) that a review of historical seismicity was undertaken in France in 1975. The state of knowledge about seismicity in France at that time did not, indeed permit of an assessment of seismic risk in conformity with the requirements of the French nuclear program. It was to meet this need that the Commissariat à l'Energie Atomique, Electricité de France (EDF), The Service Central de Sureté des Installations Nucléaires du Ministère de l'Industrie and the Bureau de Recherches Géologiques et Minières (BRGM) decided to finance the seismotectonic map of France project, the preparation of which was entrusted to the BRGM. This project resulted, in 1980, in a comprehensive map comprising six headings : historical seismicity, instrumental seismicity, tectonics, neotectonics, geophysical discontinuities and lineaments.

In France (1), the assessment of seismic hazard for the safety of nuclear plants is based essentially upon a seismotectonic approach, comparable in its conception with foreign regulations (2,3) and IAEA Safety guide (4). It entails determining the active faults or tectonic units, then taking into account the historical earthquakes, defining the most severe earthquake corresponding to each active fault or tectonic unit in order to make a pessimistic estimate of the effects on the site, for conservatorial purposes.

These reference earthquakes, from which the plant to be protected, are characterized by their intensity at the site, their magnitude and their focal distance. Based upon these parameters, the ground motion is then calculated and used in designing the structure (5).

An accurate determination of the characteristics of the reference earthquakes is necessary in the seismotectonic approach, for on this depends the definition of the ground motion.

Intensity, which is the description of earthquake surface effects, is the only characteristic available for events of past centuries. It is also the most important one for safety purposes, because it enables one to assess the severity of an earthquake at any given point on the ground surface. The data concerning historical seismicity in France must accordingly be as complete and reliable as possible.

Concomitant with the seismotectonic project, a revision of these data has been carried out in view of compiling a homogeneous historical seismicity computer file (6).

2. METHOD

From the outset of the "Seismotectonic Project", the insufficiencies of the traditional, event recent, catalogues became manifest : an important effort involving a review of historical seismicity was accordingly initiated under the supervision of J. Vogt. The main principles of the method used (7) are as follows :

a) Consultation of the original sources via a methodical perusal of departmental, municipal, occasionally parochial archives, or those from the contemporary national or regional press, and critical analysis of the latter, taking into account the historical, geographical and political contexts of the time. This consultation has been carried on not only in France but also abroad (Belgium, Germany, Switzerland, Italy, Spain, Great Britain) for earthquakes felt in France.

b) Assessment of the degree of reliability of the materials and interpretations (intensity, location of the macroseismic epicenters) contained in a computerized data file.

c) Evolving character of the information catalogued in the file, which is up-dated on a annual basis.

The procedure put into practice in France, which differs considerably from that of other countries, has two aspects :

- On a continuing basis, an overall approach is applied, in which the most accessible materials are compiled. This systematic researching of the archives yields new information on earthquakes, the number of which is more or less contingent upon the intensity of the event, as well as upon the continuity of the research.

- Selective, in-depth research is conducted on the initiative of the EDF, the BRGM or the CEA. This effort consists, for certain earthquakes more important in the assessment of the seismic risk to nuclear sites, in a precise examination of municipal and parochial archives, of the local press, of the work of local scholars, etc. in the region of the earthquake. The findings which result therefrom are used in a regular up-dating of the file on historical seismicity in France.

3. STATUS OF THE SOURCES

The logical procedure engaged in seeking access to the original sources began with a consultation of the most accessible traditional catalogues, progressing by successive steps towards the source of the information (national or regional press, scholarly works, monographs, governmental documents, parish registers, historical or monastical chronicles, inscriptions on monuments), up to the contemporary documents by first-hand witnesses.

The status of the sources is characterized by several criteria, namely : accessibility, abundance, and reliability. In terms of these, basically three periods can be defined :

a) The period of historical archives prior to the appearance of the national press, that is, up to about the middle of the 17th century. This period was marked by pronounced regionalism, when the historical, geographical and political contexts influenced the information to a considerable extent.

b) The period of intermediate sources characterized by the appearance of the press, which first began to flourish in the 1770's and continued to thrive throughout the 19th century, with the development of a regional, and then local, press providing abundant and detailed information, albeit spotly from a geographical standpoint.

c) The period of recent sources, contemporary with the era of instrumental seismicity began with the 20th century and is characterized by the advent of detailed macroseismic investigations. The contribution of these documents is essential, offsetting to a certain extent the insufficiencies of instrumental monitoring, particularly at the beginning of the century and for moderate earthquakes.

3.1 The Period of Historical Archives :

The reinvestigation work carried out on this period required the close cooperation of regional historians and archivists, especially for the medieval period. Serious problems of chronology, toponymy and terminology (local dialects and foreign languages) were encountered. Interesting information is frequently found :

. on inscriptions in castles or churches (Fig.1) :

. in monastic records and parish registers (baptismal, marriage and burial certificates) (Fig. 2) ;

. in municipal or regional chronicles which reproduce eye-witness reports (Fig. 3) or letters (Fig. 4), sometimes illustrated with maps. For example (8), that of the Genoese merchant, F. Maggiol concerning the 20th July 1564 Haute-Vésubie earthquake written to his correspondent in Nuremberg, F. Salamon (Fig. 5). The Italian original text of this letter, since last, was translated into German and then reproduced. It drew considerable attention on the part of contemporaries, since at least four versions of it, edited in Nuremberg, Strasbourg, Augsburg and Dillingen, are known. The resulting confusion was at last brought to light and explained by R. Almagia in 1914, in an article dealing with the first "seismic maps" (9). ;

. in municipal records (Fig. 6). Some first-hand accounts are reproduced by historians in monographs or chronicles or by their compilers. The original texts are often deformed by the latter due to injudicious excerpts, erroneous translations, deformation of words, mix-ups regarding place names and dates, causing either a duplication of earthquakes, or extravagant extensions of the effects, or even the appearance of "false earthquakes" (10) confused with other natural events (hurricanes, landslides) or artificial occurrences (explosions). Case exemplary in this respect involves an earthquake on 20th July 1564 in the Haute Vesubie (the countryside inland from Nice), in which La-Bollène-en-Vésubie, with 600 declared dead and the destruction of the village, became Bollène, located in the Rhone Valley.

3.2 The Period of Intermediate Sources

For the period, characterised by the appearance first of the national press, toward the middle of the 17th century (La Gazette de France, Le mercure Galand, le Journal des Savants), then of the regional press, as of the beginning of the 19th century, information became abundant, easily accessible, but of very diverse reliability. The development of the press, which freed the regions from their isolation, prompted a renewed interest in the earth sciences and severe natural catastrophes. Beginning with this period, geographical coverage of the more important events was homogeneous throughout the entire country.

Initially, the information remained very fragmented. La Gazette de France, the first paper to be quoted in such a connection, alluded to the Remiremont (vosges) 12th May 1682 earthquake, which affected several French cities; it, however, did no more than make passing mention of the event. As the press developed, the information conveyed covered an ever wider area. The reporting was more and more detailed and was often accompanied by illustrations (Fig. 7), or photographs (Fig. 8) 4, as in the case of 23rd February 1887 Ligurian earthquake. At the same time, regional development, in relation with an organized government, gave rise to clear and detailed information. The slightest damage formed the subject of an expert's enquiry, whether it involved civil or religious administration. This was the case in the 18th century in the Bordelais, where a number of expert appraisals on particular buildings, church or civil property, damaged during the earthquake of 10th August 1759 were made, as well as in Touraine, where a "Memorandum at the request of the St. Martin de Candes chapter, in the diocese of Tours, concerning the "repairs to be made to their church" following an earthquake on 6th October 1711 (Fig. 9) was drafted. The appraisals became more and more detailed, with damage calculated in the FF currency of the period. C. f. the Report of the Departmental Architect on the situation of communal buildings following the earthquakes of 14th and 19th July 1873 - Valence. 26th July 1873" (Fig. 10). Municipal records also provide precious information: shoring up of façades, evacuation of government buildings - schools, town halls, etc. Nonetheless, collections of these communal files are often found to be incomplete for reasons relative to the origin of the series or methods of conversations.

The governmental sources, very rich in some departments, are deficient in others for historical or political reasons: thus, the absence of a request for assistance and the assumption of repairs to a church by hostile peasants attached to a neighbouring parish was inadvertently discovered in Belley following the earthquake of 19th February 1822.

This period saw a rise in the work of local scholars: theses and monographs on natural catastrophes affecting various regions became plentiful: Chevremont for the earthquakes of the Norman-Brittany Gulf. Mgr. Billiet for those in Savoie. Palassou for the Pyrénées. Port and Soland for Anjou. Bourlot for Alsace, etc. Theses more or less thorough-going regional studies, or unequal reliability, were completed by the prodigious work of Alexis Perrey, who made an inventory of earthquakes not only in France but also abroad.

The world-wide fame of this author has long inhibited any revision of historical seismicity. It is uncontested that, regardless of his merits, his goals and the conditions of his investigation, his work no longer constitutes a tool that is up to modern standards.

3.3 The Period of Recent Sources

This period, which coincides more or less with the development of seismic instrumentation, is often defined by opposition to the preceding phase, considered as the period of true historical seismicity. It is in fact necessary to insist on the complementarity of instrumental seismicity and of macroseismic enquiries, the latter permitting a more precise location of an epicenter than a limited number of seismic stations, as was particularly the case between 1920 and 1940, when the number of stations decreased in France.

Macroseismic enquiries were first carried out in some cases by the Bureau Central Météorologique (BCM), then more systematically, as of 1919, by the Bureau Central Seismologique Français (BCSF) installed at the Institut de Physique du globe (IPG) in Strasbourg, under the direction of Professors E., then J.P. Rothé. The results of these investigations have been published in the Annaires and Annals of the Strasbourg IPG. However, their presentation varies considerably. For some earthquakes, observations are very detailed; for others, especially notable earthquakes, they consist in mere summaries, recording only mean intensities for "cantons".

A review of the original files has provided much supplementary punctual information. For some major earthquakes several hundred reports are available, whereas several dozen localities only are listed by printed sources. Besides critical revision led to a reestimation of numerous epicentral locations displaced by tens of kilometers, and epicentral intensities modified by one degree, or sometimes more.

In addition to these "official" enquiries, other enquiries, in some cases more detailed are sometimes carried out for notable events, such as the Provence earthquake of 11th June 1909, which killed 46 people and caused severe damage (FIG. 12).

The discovery of an unpublished document consisting of the very detailed investigations carried out by Commandant Spiess between 1909 and 1914 in the affected area, which was analysed by the CEA (11), changes previously-held views and

enables a more precise conclusion to be drawn. This large file was found in the library of the French Geological Society. Commandant Spiess, who was officially instructed by the War Ministry on July 13, 1909 to study the effects of the earthquake in the affected area, spent a total of three months, spread over several visits, inspecting the area. Only a precis of this detailed investigation has been published so far (12).

Exclusive of the letters which help to reconstruct the history of the document, of 189 questionnaires returned by the townships and of 27 questionnaires drawn up for the description of damage to particular buildings or factories, the file is made up essentially of the study itself. This study deals mainly with the area in which damage was incurred (about 350 square kilometers) covering 61 townships, and with very detailed descriptions of the damage noted both in towns and villages and in hamlets, chateaux and farms situated within the township. The following type of information is given : ground formations , damage in the locality and to specific buildings (town halls, schools, churches, chateaux, farms, factories, etc.) and to public works (railway lines, canals, roads, etc), effects on the ground, on springs and wells, seismic noises and miscellaneous effects (flashes of light, smells of sulphurous gas). Sometimes information is given on the previous condition of a building or a sketch showing the way it faced, the direction of the shockwave and the position of the damage.

Going through this large file has made available a large number of observations (reinterpreted on the MSK scale) in the damaged area : 207 townships and 602 hamlets with intensities of at least VI for the most part. A bargraph (FIG.12) shows the contribution of the Spiess file for each intensity class, compared with information supplied by Angot at the time of the event (13) and those mentioned in the "Sirene" computer file of historical seismicity of France (14). This type of bargraph which should show a regular increase in the percentages as the intensity decreases, that is, as the area involved increases, shows a number of irregularities which enable us to draw the following conclusions :

. the data provided by the Angot enquiry (BCM) is insufficient and heterogeneous in the epicentral area but very complete in the far field ;

. the density of the points given by the "Sirene" computer file is very irregular (too many points for intensities IX and VII and not enough for intensities lower than VI-VII) :

. the data obtained from the Spiess report is the most coherent down to the intensity VI, corresponding to the damaged area ; further out, information is clearly lacking.

4. CONSTITUTION OF A COMPUTERIZED FILE

All the individual items of information gathered in the course of the archive research phase has been entered into a computerized file called "Sirene", which currently includes more than 65,000 macroseismic data items. For safety analysis purposes, this file is consulted by the CEA and numerous programs have been prepared : maps of epicenters (FIG.13), histograms of the distribution of earthquakes per age and intensity category (15) (FIG. 14), attenuation of intensity as a function of distance (5), laws of frequency, probabilistic studies (15), etc... This file is always evolving, since it is up-dated annually ; it contains only macroseismic information, falling under three headings :

4.1. Identification of the earthquake

Under this heading more than 4, 500 events are catalogued, with characteristics identifying each event, accompanied by a quality coefficient for each of them. These data are summarized in Table I, with the number of events per category : 4155 "True earthquakes", 51 "False earthquakes" and 459 "Doubtful earthquakes".

4.2. Characteristics of the epicenter

All the characteristics of the epicenters of true earthquakes are placed under this heading, with a quality coefficient and the distribution of data per category (Table II).

Epicenters localized with coefficients D, E and I must be used with circumspection. For the D epicentres, the localities concerned are for the most part either lacking in a description of effects, or very far apart, making an epicentral localisation difficult. For E epicenters, the earthquake is only catalogued in two or three, localities, without any intensity assessment often widely separated and localisation is hazardous. Most of these epicenters correspond to very old or very low level earthquakes, which are accordingly poorly known. As regards the I epicenters, they correspond to isolated observations and should not be considered as epicenters on a par with the others.

SIRENE FILE (1986)

TABLE I : IDENTIFICATION

NUMBERING

- . Catalogue number (map scale 1/250 000)
- . Department number (or zone number outside in France)
- . Earthquake number

DATE-TIME

- . Quality coefficient :
 - A = Reliable
 - B = Fairly reliable
 - C = Questionable : needing verification

NATURE OF THE EVENT

- VS = Genuine earthquake (4155)
- FS = Mistakenly identified as an earthquake (51)
- SD = Doubtful earthquake (459)

INTER-EVENT RELATIONSHIP

- = Main shock
- P = Foreshock (+date of associated main shock)
- R = Aftershock (+date of associated main shock)
- E = Swarm (+date of initial event)
- Z+000 = Several shocks
- Z+999 = Numerous shocks
- Z+N = N shocks

MOST RECENT UP-DATE

TABLE II : EPICENTER

NUMBER

LOCATION

- . Geographical and Lambert coordinates (precision)
- . Quality coefficient :

- A = Precise, withing a well-defined area of maximum intensity (149)
- B = Relatively precise, withing a relatively well defined area of maximum intensity (249)
- C = Imprecise, withing a poorly defined area of maximum intensity (167)
- D = Supposed (1347)
- E = Doubtful (379)
- I = Isolated observation (1864)

INTENSITY (MSK)

- . Quality coefficient :
 - A = Certain : reliable evidence, well-described macroseismic effects (299)
 - B = Relatively certain : reliable evidence, macroseismic effects incompletely described (477)
 - C = To be substantiated : unreliable evidence, macroseismic effects at variance with the event's context (716)
 - I = Isolated observation (548)

EXTENSION

- . Average radius of the felt zone (km) : precision and quality coefficient (A,B,C)
- . Average radius of a well-defined isoseismal (km) : precision

MOST RECENT UP-DATE

The interpretation of the epicentral intensity must be correlated to its quality coefficient. For example, the VII-VIII intensity, with a coefficient of A, signifies that the description of effects is sufficiently precise in a good number of localities close to the epicenter to estimate that the epicentral intensity corresponds to a level of damage between VII and VIII. The same value, with a coefficient of B, signifies that the epicentral intensity may be VII or VIII, but with a good reliability of the sources. With the C, epicentral intensity is doubtless of the order of VII or VIII, but the sources are not very reliable and verification would be necessary. Sometimes the value of the intensity is preceded by the + sign when it involves either an offshore epicenter or one which is located in a mountainous area, or is defined by too wide-spread a maximal intensity area.

The extension of effects allows an assessment of the focal depth and a summary estimation of the magnitude of the earthquake. The parameter normally used is the felt area radius but its estimation is more or less deformed in terms of the accessibility of the information, which varies with time. It can be estimated that the letter corresponds to an approximate intensity V for earthquakes occurring before 1500, to intensity IV up to 1800, to intensity III up to the beginning of this century and to intensity II for recent events in which such observations are made on the upper floors of buildings.

4.3. Localities catalogued

All the localities catalogued under the third heading in the file (approximately 55,000), with information concerning them, are summarized for each earthquake in Table III.

The intensity assigned to the locality must, in order to be interpreted at its true value, be closely correlated to its quality coefficient. For example :

. intensity VII with the coefficient of A signifies that the description of effects in the locality is precise and reliable, and that the value given is considered certain :

. intensity VII with a coefficient of B means that the description of the effects is imprecise and contains few details, and that the value given is approximate (intensity about VII).

. intensity VII with a coefficient of C signifies that the description of the effects might correspond to degree VII of the intensity scale, but that because the sources are not very reliable this value should be verified by cross-checking with other, better sources. More research is needed.

4.4. Bibliography consulted

The bibliography is given under the 4th heading, for each earthquake, with the list of references consulted and a quality coefficient. This information is summarized in Table IV. All these documents are currently in the archives of the partners stored by BRGM. However, an archive project entailing the computerizing of all these data for the entire bibliography is currently under consideration. This program, financed by the three partners (BRMG, EDF and CEA), is expected to begin in 1988 and permit the easy management, of and direct access to the archives from a reading station installed in each organization.

SIRENE FILE (1986)

TABLE III : LOCALITIES

NUMBER

SITUATION

- . INSEE Code (Department number + Township number)
- . Township name
- . Geographical and Lambert coordinates

INTENSITY (MSK) :

- II to IX = felt
- 0 = not felt

. Quality coefficient

- A = Certain : reliable evidence, well described macroseismic effects,
- B = Relatively certain : reliable evidence, macroseismic effects at variance with the event's context, effects not necessarily ascribable to the earthquake.

ASSOCIATED EFFECTS UPON THE ENVIRONMENT

- EE = Altered flow-rate of springs, changes in rivers and the level of wells
- MT = Modifications in the terrain,
- RZ = Tidal wave, abnormal sea level
- PL = Luminosity phenomenon

MOST RECENT UP-DATE

TABLE IV : BIBLIOGRAPHY

NUMBER

REFERENCES

- . Author, title, source of the document
- . Quality coefficient :
 - = Reliable
 - 0 = Unreliable, such as second hand source or compiler's catalogue
 - I = Incomplete
 - N = Mentioned, without having been investigated

MOST RECENT UP-DATE

5. CONCLUSION AND FUTURE DEVELOPMENTS

Over the past years, the efforts made in the area of historical seismicity review in France have led to the creation of a computerized file including not only the characteristics of earthquakes and their epicenters, but also all the local intensities for each event. All data are catalogued on the one hand by code, taking account of the varying degrees of reliability of the sources and interpretations, and of the year of its up-date, on the other. The principle whereby each item of data is subjected to a critical analysis in order to ascertain its reliability was made necessary by the file's use for safety purposes. It differs in this respect from the majority of existing data files.

Revisions were made based on traditional catalogues through research of the original sources for the period prior to the development of instrumentation as well as for the current period. The documents thus gathered have undergone in-depth critical analysis bringing to light new elements then have been reinterpreted on the MSK intensity scale, thus imparting a homogeneous nature to all the data. This characteristic of homogeneity in the estimation of intensities, together with a criterion of the codification of its reliability, are two important factors which contribute to meeting safety requirements in seismic hazard assessment for nuclear sites.

Independently, the CEA has effected a further development of this general file devoted essentially to intensities by assigning to the different events, wherever possible, estimates of focal depth and magnitude deduced from the macroseismic data. An analysis of early instrumental records of major earthquakes with abundant macroseismic data is currently in progress in view of determining magnitudes for these events. The purpose of these studies will be to establish regional correlations between source parameters and the effects observed, which is essential to the definition of the reference ground motions of nuclear sites.

Currently, research is being pursued more particularly in the field of the macroseismicity of border regions which give rise to discordant interpretations in both neighboring countries. A regional cooperation among all countries concerned is desirable, on the model of that which was set up for the Pyrenees region (geological synthesis of the Pyrenees), or for the Channel area (UKAEA - CEA agreement).

Moreover, an effort is currently being made in the area of computerized archiving of all the documents composing the bibliography, so as to facilitate its management and accessibility.

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Fig. 1 - Inscription at the Charolles château (Maconnais) :
1477 Auvergne earthquake

**LA CURIEUSE INSCRIPTION DU CHÂTEAU DES SIRS
DE LA MAGDELAINA A CHAROLLES**

Il existe à Charolles, à l'est de la ville, sur la colline, près du prieuré, un important bâtiment de la fin du xv^e siècle, dont les vastes proportions et l'ornementation sobre trahissent la noble origine, « c'est une maison fort belle » au dire d'Antoine Mallette. Reste de l'ancienne demeure seigneuriale des sirs de la Magdelaine, illustre famille charollaise, dont les armoiries sont répétées maintes fois sur les linteaux et clefs de voûte.

Ce bâtiment se trouve malheureusement englobé dans ceux de la falencejie d'art fondée en 1844 par Hippolyte Prost, sur l'emplacement du château et dans ses dépendances.

Dans la façade, sur la cour tournée au nord, entre deux fenêtres au-dessus de la porte d'entrée, qui donne accès à un escalier à vis, se détache une pierre de 0,80 x 0,80, sur laquelle sont gravées des inscriptions, très bien conservées, relatant divers phénomènes et calamités qui affligèrent les populations de la région entre les années 1471 et 1481.

Voici le texte de cette inscription en gothique minuscule de huit vers médiocres en français de l'époque :

L'AN MCCC LXXI APPARUT LA COMETE
VII ANS APRES PLUIT SANG AYUON
III SOLEILS VEHUS MAITRES FOIS II FUT ETRANGE PLANETIE
DONT S'ENSUIT GRANDE CONFUSION
TERRE TREMBLA T LA CHIERRE SAISON
SURVINT L'AN QUATRE VINS ET UNG
MORTALITE, FAMINE, GUERRE, SANS ACHOISON
ONT DESTRUIT L'EGLISE, NOBLESSE T LE COMUNG

soit en français actuel :

L'an 1471 apparut la comète
7 ans après pluie de sang avons
3 soleils vus maintes fois, 2 étaient d'étranges planètes
Dont s'ensuit grande confusion
Terre trembla toute la belle saison
Survint l'an 1481
Mortalité, famine, guerre, sans relâche
Ont détruit l'église, la noblesse et le commun.

LA CURIEUSE INSCRIPTION DU CHÂTEAU DE LA MAGDELAINA

Ces deux quatraines sont flanqués de deux phylactères d'une saillie plus forte, portant des inscriptions de mêmes caractères mais en latin ; ce sont des vœux pour la cessation de ces fléaux.

Sur le cordon de droite on lit :

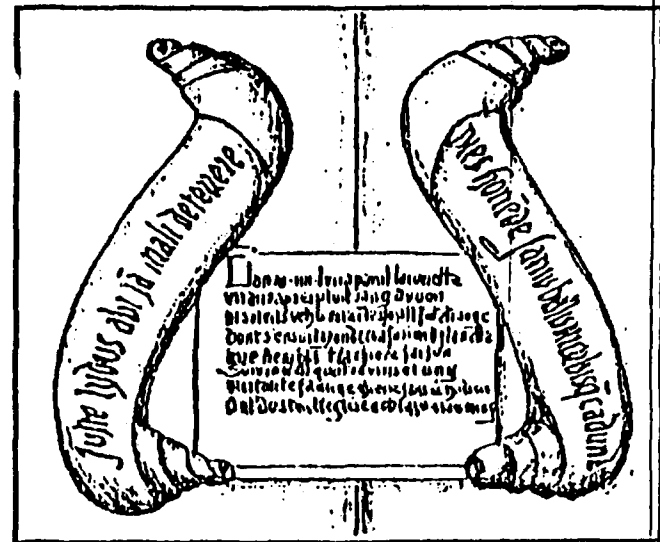
DIES HORRIDE PANIS BELLI MORBUSQ CADUNT.

Des jours horribles découlent des famines, des guerres et des épidémies.
Sur le cordon de gauche :

IUSTE SYDUS ABI JA MAIL DETERRERE.

Astre du mal, il est temps, cesse de nous épouvanter.

La hauteur, entre 6 et 7 m du sol, à laquelle sont situées ces curieuses inscriptions explique qu'elles soient restées ignorées du public, tout porte à penser qu'elles furent peu lues et peu connues après la mort de leur auteur, car non seulement il n'en est parlé nulle part, mais nous ne connaissons aucun historien du Charolais qui en ait fait en quelque endroit mention, pas plus que des calamités publiques qui y sont consignées (sauf Léonore Lex et Jean Ronlet qui en donnent un texte erroné)... Seule la Revue du Charolais en 1812 écrit au sujet de ces mystérieuses inscriptions : « Celles-ci nous ont paru destinées à perpétuer le souvenir des événements terribles qui ont épouvané nos contrées pendant les dix années qui ont précédé l'entier achèvement de la construction, dans la façade de laquelle nous les voyons incrustées. Sans doute



17

Il prete Gio Andrea Salicis, priore della valle di Blora latino scritto ne 'pui libri della parrocchia' after seguito la 5 maggio 1564 un terremoto che la scossa duro un quarto d'ora e che la parrocchia di S. Giacomo in ditto valle alla principal parrocchia di San Dalmazzo val di Blora di (...) si schisso e restavi morto il Sr. Claudio Guigo e che i libri baptizator e tutti gli altri della parrocchia restaronvi Sepolti, che in seguito di tal (...) formar da viciso una capella fatti di tavole di boscu pendante un anno e mezzo di facere la funzioni parrochiali e che il luogo della Rocchia quasi tutto si subbisto per fatto di terremoto e restaronvi morte 50 persone, il luogo della Rocchia e luogo mezzano Dalmasso e la Bolena (...).

TRANSCRIPTION

Il prete Gio Andrea Salicis, priore della valle di Blora latino scritto ne 'pui libri della parrocchia li 5 maggio 1564 un terremoto che la scossa duro un quarto d'ora e che la parrocchia di S. Giacomo in ditto valle alla principal parrocchia di San Dalmazzo val di Blora di (...) si schisso e restavi morto il Sr. Claudio Guigo e che i libri baptizator e tutti gli altri della parrocchia restaronvi Sepolti, che in seguito di tal (...) formar da viciso una capella fatti di tavole di boscu pendante un anno e mezzo di facere la funzioni parrochiali e

Che il luogo della Rocchia quasi tutto si subbisto per fatto del terremoto e restaronvi morte 50 persone, il luogo della Rocchia e luogo mezzano Dalmasso e la Bolena (...).

Fig. 2 - Eye-witness account by Gio Andrea Salicis, Prior of Valdeblora, concerning the 1564 Haute-Vesubie earthquake, related in his "Libri della parrocchia della Dalle di Blora" (ca. 1570)

Piu distintamente nota Gio' Francesco Blancardi di Sospello aver questo Terremoto fatto danno grandissimo alla Boltena con la morte di 600. persona, e quantita grande di bestiami. A Belvedere aver ucciso persone 80., à Roccabigliera molta gente sino dentro la Chiesa; li stesso aver fatto à Venansone; finalmente à Clans aver gettato à terra 14. case con grand' uccisione d'Animali.

TRANSCRIPTION

Piu distintamente nota gio' Francesco Blancardi di Sospello aver questo terremoto fatto danno grandissimo alla Bolena con la morte di 600 persone, e quantita grande di bestiami. A Belvedere aver ucciso persone 80, à Roccabigliera molta gente sino dentro la chiesa ; li stesso aver fatto à Venansone : finalmente à Clans aver gettato à terra 14 case con grand uccisiana d'animali.

Fig. 3 - Account by Gio Francesco Blancardi di Sospello relative to the 1564 Haute-Vesubie earthquake, found in the "La Citta di Nizza" chronicle (municipal archives of Nice)

TRANSCRIPTION

"Je cuide que vous avez entendu la désolation qui est en ces montagnes de Terre-Neuve (val d'Entraunes et Comté de Beuil), du val de la Tinée et val de Lantosque, où sont périss jusqu'à dix ou douze que villes, que bourgs, et morts de huit à neuf cents personnes, aient commencé telle mortalité et fléau de dieu le 20 juillet passé. Si qu'une ville tombe aujourd'hui, une autre demain. Les montagnes se fendent par le milieu, les rochers se brisent et dispersent avec un bruit de tonnerre épouvantable, de sorte que ces pauvres gens ne peuvent être sûrs, ni avoir retraite aux champs ni aux villes ; le bétail demeure regardant au ciel comme implorant, par quelque instinct de nature et mortelle tristesse, la souveraine miséricorde. On entend dans les cavernes de grands cris et hurlements effroyables. Encore même, mercredi passé, beaucoup de maisons tombèrent ; les deux tiers des habitants de Nice couchent aux champs. Une grande partie du château de Vintimille est tombé par terre avec la moitié du couvent. Comme que tous les quartiers des montagnes se fendent d'heure en heure. Enfin tout en est désolation...".
(écrit le 20 juillet 1564) ...

Fig. 4b - Letter written in Nice on August 20, 1564 and addressed to the Count of Tende, governor of Provence, reproduced by Michel de Notre Dame in his "Histoire de Provence".
1564 Haute-Vésubie earthquake.
Transcription

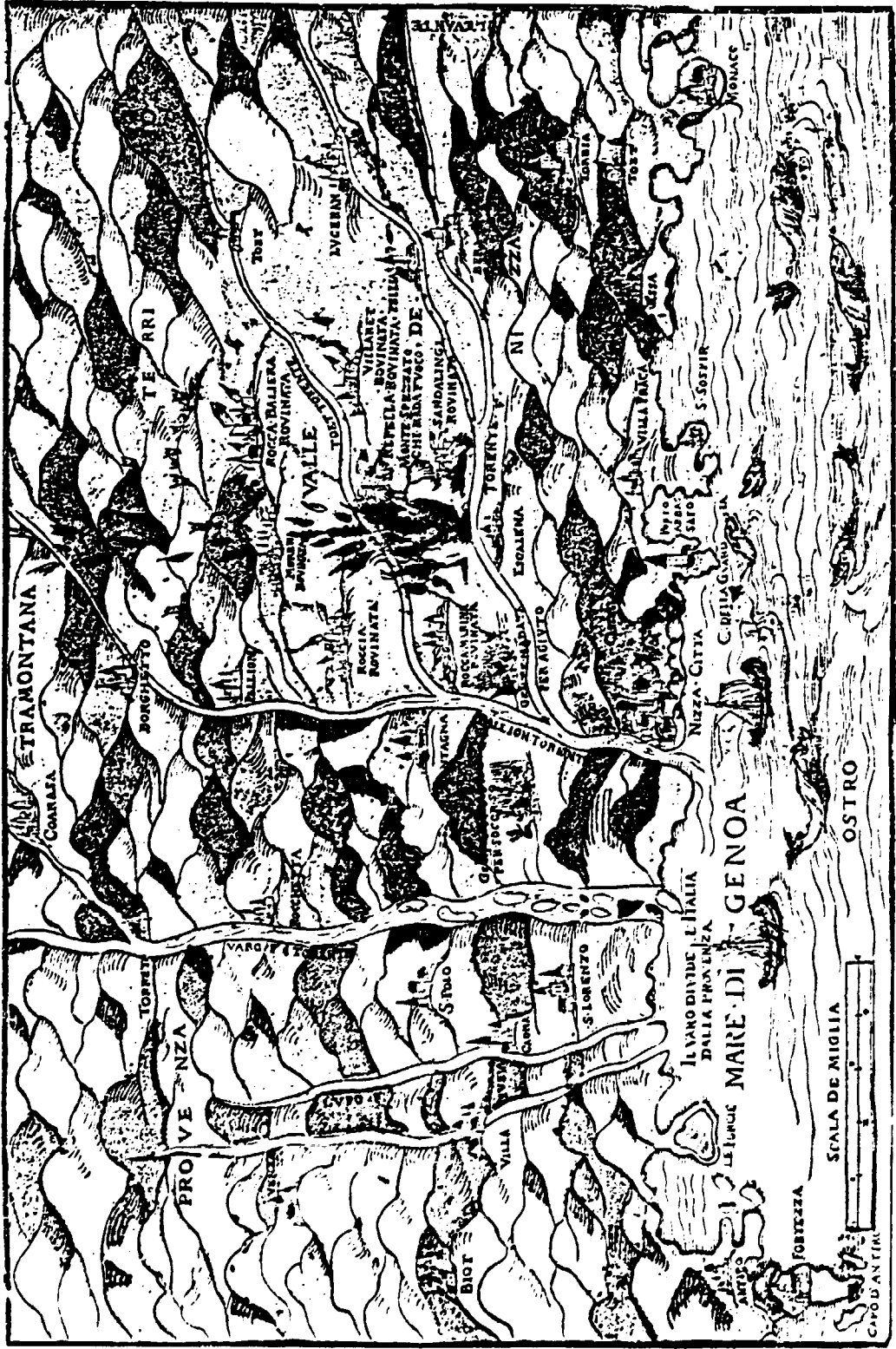


Fig. 5 - Map illustrating a letter of the Genoese merchant F. Maggiol. 1564 Haute-Vésubie earthquake.

De Bosco presche ceste caresme en
la présente ville et cité de Clermont
et que on a aystimé de donner ung
prit ou don aux précheurs quat préchet
le caresme et pour ce ont requis lesdits
esleuz quil feust advisé si on luy
donra ung prit ou don.

Item plus que le avoit abbatu et
gecté par terre plusieurs tours dela
ville et entre aultrez la tour dela
maison dela ville et des portes
des Gras et de saint Pierre et que il
estoit neccéssaire dabbatre ce que le
tremble avoit cassé.

Item plus que les messagiers et
Breymond Chaslard avoit retiré
les tiltres sal pestre et aultres besognes
dela ville que estoient dans la
tour timbée deladite maison dela
ville et quil estoit neccéssaire
de lez poyer de deux journées que
lesdits Chaslard et les deux messagiers
de la ville avoient vacqué aretirer
lesdits tiltres et sal pestre
que estoient entre les (mot barré)
pierres deladite toure timbée.

Fig. 6b - Municipal record of Clermont-Ferrand, session of March 3, 1490.
1490 earthquake.
Transcription.

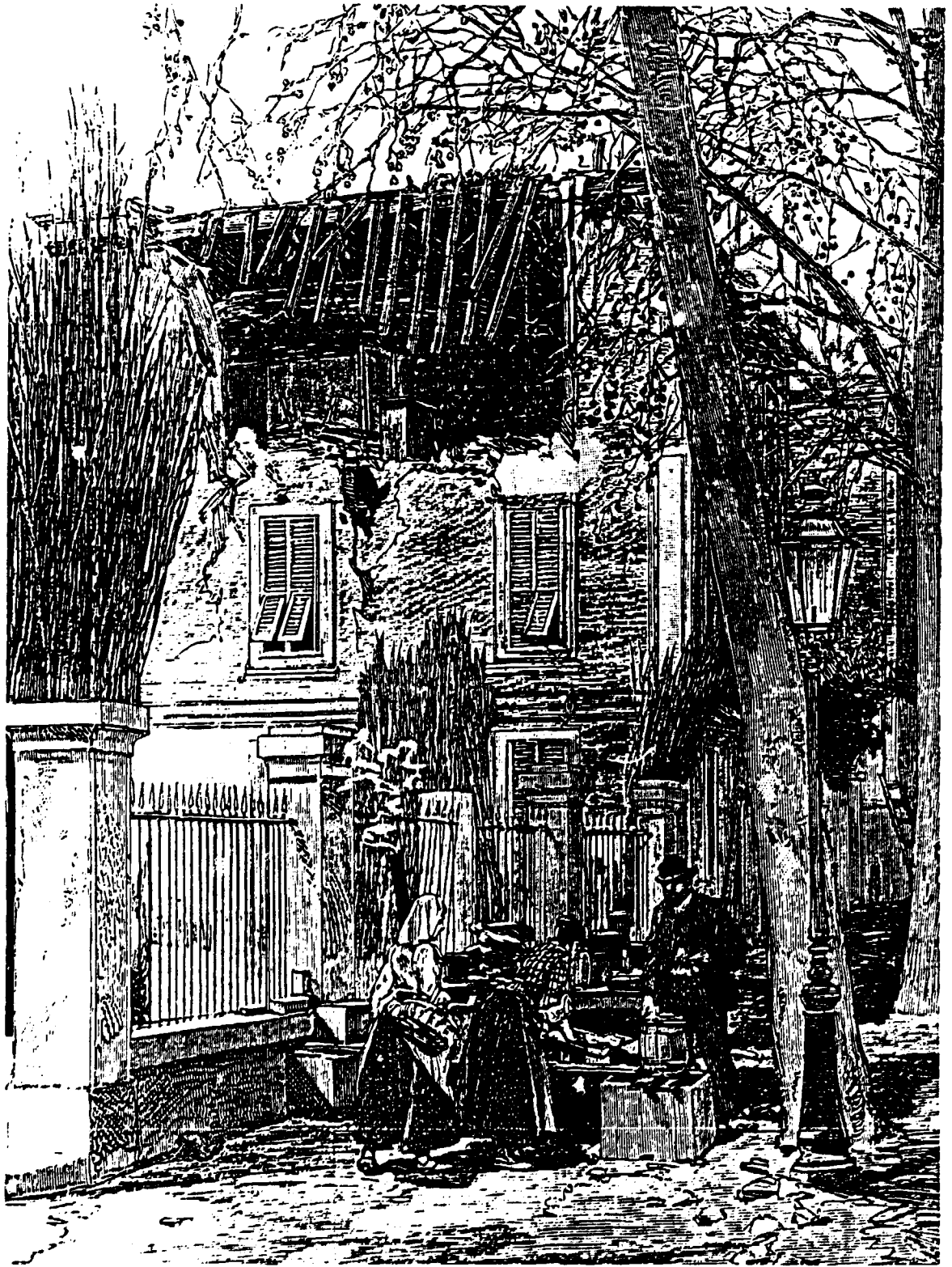


Fig. 10 - Illustration of structural damage at Menton (from l'illustration of March 5, 1887). Ligurian earthquake of February 23, 1887.



Fig. 8 - Destruction at Bussana resulting from the Ligurian earthquake of February 23, 1887 (photograph G. Capponi et al.)

MEMOIRE sur la demande du
Chapitre de St. Martin de Candes diocèse
de Tours concernant les reparations à faire
à leur Eglise.

Le Chapitre, Chanoines, et chapitre de St.
Martin de Candes Diocèse de Tours ont donné
place au Roy tendant à ce qu'il plust à Sa
Majesté leur recorder un secours suffisant pour le
retablissement de leur Eglise.

Sur ce que cette Eglise bâtie et fondée par
l'opulence des Roys, d'ailleurs recommandable par le tombeau
de son Patron, son antiquité, et la beauté de son Edifice
a receu des secours si violents par les tremblemens
de terre arrivés en 1711 que le 18. octobre de la même
année, un des pilliers de la nef tomba et par sa chute
entraîna les Voutes qu'il soutenoit et endommagea
deux autres pilliers dont l'un soutient le clocher et
les Voutes du chœur, En sorte qu'on doit à tout moment
craindre le cabrement entier de toute l'Eglise dans
laquelle est la paroisse, et que le Clergé et le
peuple sont dans un danger continuel d'estre
ensevelis sous ses ruines.

Que M. l'Archevêque de Tours en a fait faire
Procès Verbal le 20 may dernier, Et nous en avons

Fig. 9 - Declaration of repairs to the St Martin-de-Candes church
(Touraine). October 6, 1711 earthquake.

Procès-verbaux
de séance des 14
et 19 juillet 1873

Commune de Châteauneuf-du-Rhône (Eure)

Copie

Rapport

de Monsieur l'Architecte du Département sur la situation
des édifices communaux après les tremblements de terre des 14
et 19 juillet 1873.

Salon, le 30 juillet 1873

à Monsieur le Préfet de la Seine
Monsieur le Préfet,

À la suite des tremblements de terre qui ont eu lieu à
Châteauneuf-du-Rhône les 14 et 19 juillet de ce mois, je
me suis transporté d'après vos ordres le 30 de ce mois dans
cette localité pour examiner dans quel état se trouvent
les bâtiments publics et particuliers et évaluer les dommages
et intérêts qui s'en sont suivis.

Accompagné de M. Pajon en l'absence du Maire, de
M. le Curé et de quelques membres du Conseil municipal,
ma première visite a été pour l'église paroissiale.

Dans cette église, des dégradations considérables se sont pro-
duites, le mur de la façade principale menacé de ruine, la
voûte de la grande nef s'est non seulement effondrée en
divers endroits, mais encore elle s'est affaissée dans une partie
de sa surface, il sera nécessaire de la relever et de la
solidifier, afin d'éviter de graves accidents.

Évaluation des reconstructions de la toiture de la voûte
de l'église et de la façade, de même que la réparation des autres
parties de l'église s'élèveront à une dépense de huit
mille francs, ci

8.000

Il faut à faire pour reconstruire la route du
Bucher au Pré-Hère et réparer l'ensemble de la maison
d'habitation à la somme de trois mille francs, ci

3.000

Quant aux maisons particulières, l'évaluation de
la dépense à faire, soit pour la reconstruction partielle
des édifices qui ont été le plus endommagés, soit pour la
réparation et consolidation de celles qui ont éprouvé
des avaries moins graves à la somme totale de quatre
vingt mille francs, ci

80.000

Total général

91.000

J'ai l'honneur d'être etc. etc.

Signé: Lepailly

Pour copie conforme le Maire Général de la Commune

Signé: Laroze

Pour copie conforme le Sous-Préfet

Signé: Boancy

Pour copie conforme le Maire, Signé: Lepailly

Fig. 10 - Appraisal by the Departmental Architect of the damage incurred by the township of Châteauneuf-du-Rhône. July 1873 earthquakes.

LAMBESC

LA NUIT DU 11 JUIN

ee ee ee

MES IMPRESSIONS SUR LE TREMBLEMENT DE TERRE



Vendredi, 11 juin 1909.....! Cette date fatale restera à jamais gravée dans ma mémoire; son seul souvenir fera toujours revivre en moi, les heures atroces que nous avons passées et le spectacle navrant d'une population désolée.

Une vieille habitude veut que je me trouve chaque soir, après le souper, au Café Nicolas, situé sur la Grand'Rue; je passe là quelques heures agréables en compagnie de bons amis.



Phot. Brustonac-Détaille

LAMBESC. — Ce qui reste d'un ménage. Une seule table, quelques autres meubles, et le mobilier d'usage de la ménagère, dans un salon — après d'énormes dégâts causés — aux habitants de famille, sans aucun fortement débris.

Fig. 11 - Photograph of destruction at Lambese caused by the June 11, 1909 earthquake.

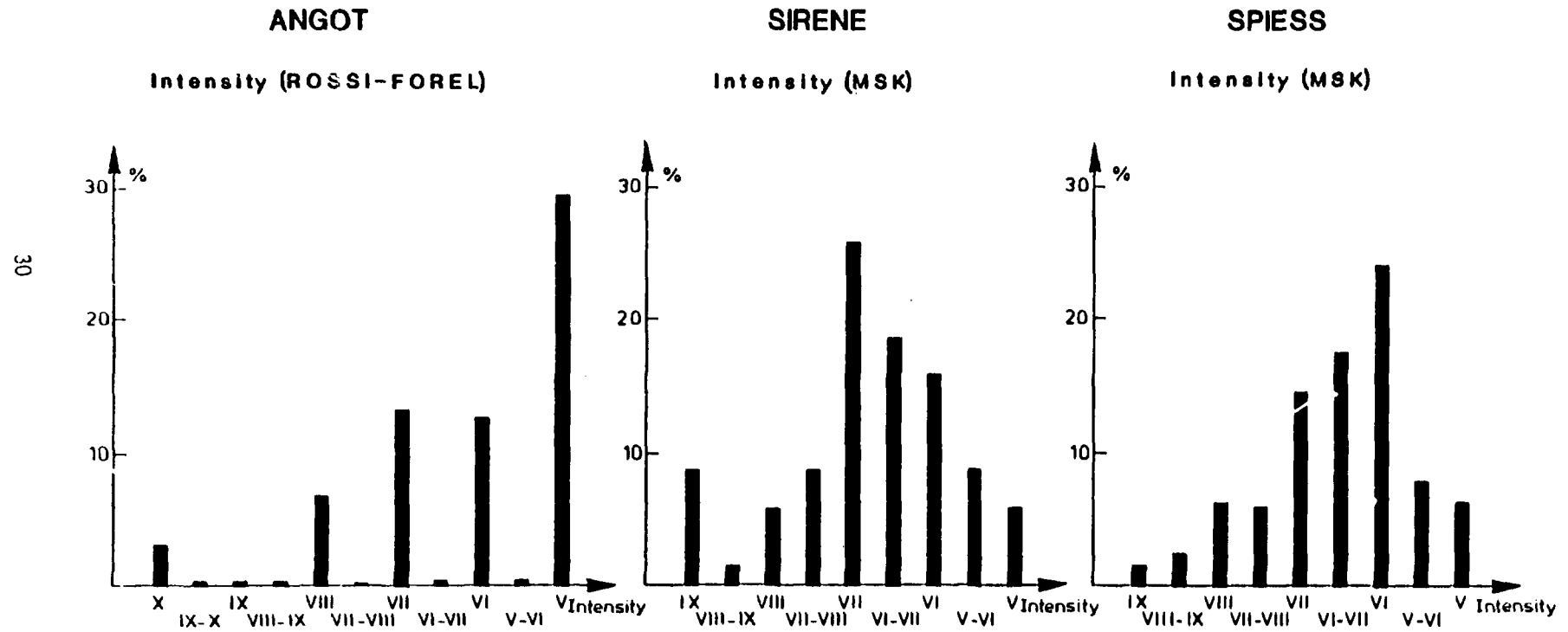


Fig. 12 - Bargraphs of data according to intensity class showing the contribution of the Spiess data compared with information supplied by other sources.

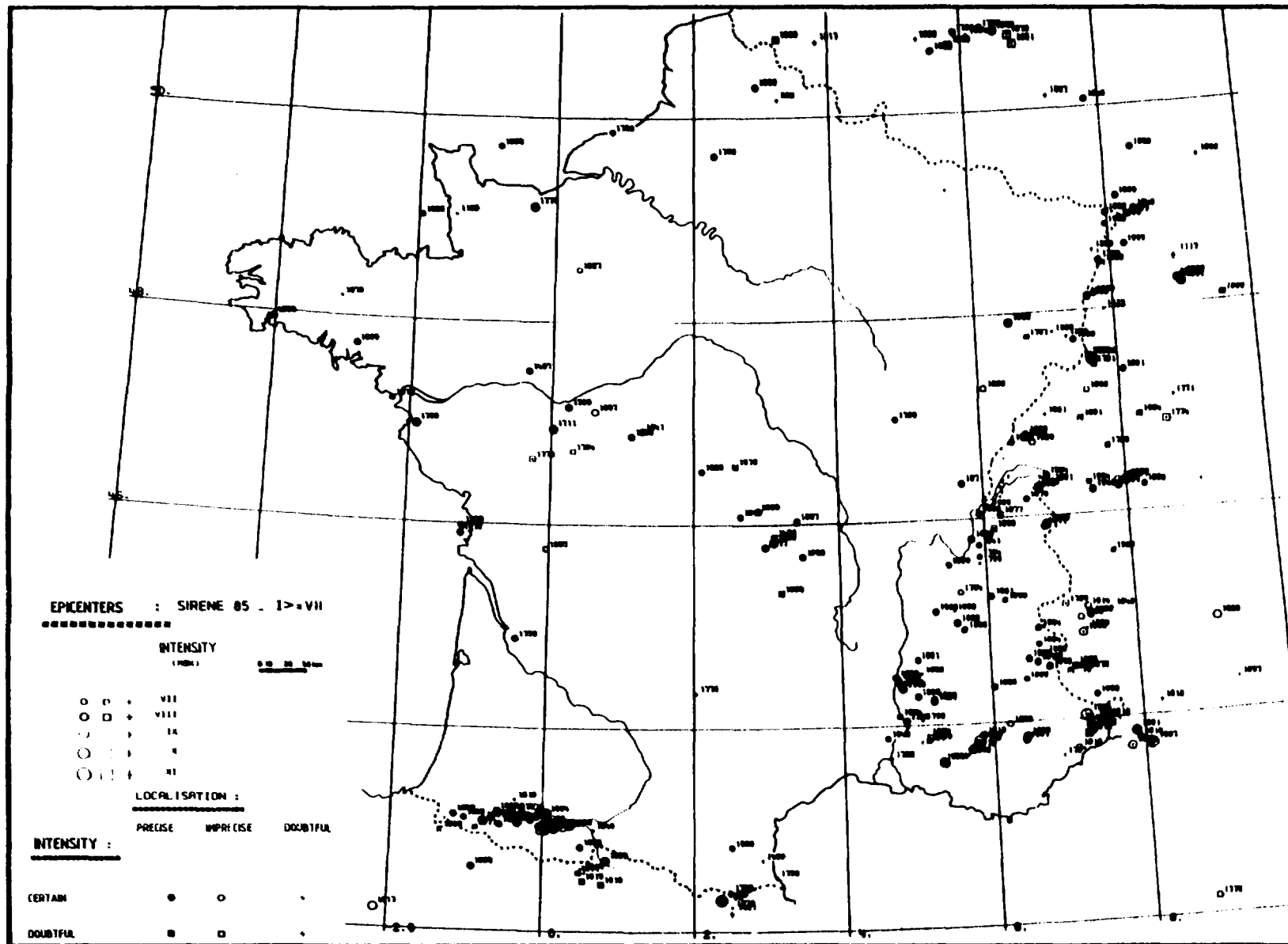


Fig. 13

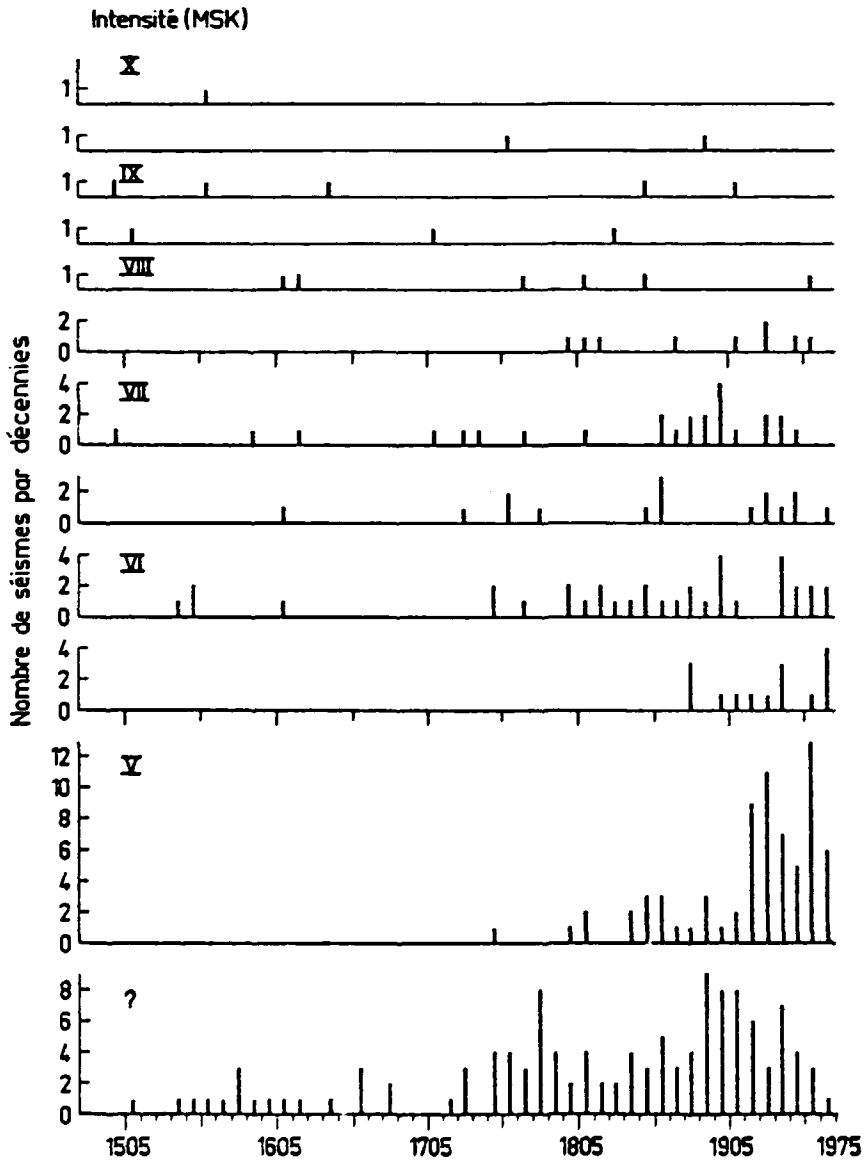


Fig. 14 - Bargraph relative to earthquakes in southeastern France, by ten-year periods and by half degree intervals of intensity.

Novembre 1987

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IPSN : M. CANDES
DRSN : M. BUSSAC
DRSN : M. PELCE
DAS/DIR
DERS Cadarache
SES Cadarache
SERE Cadarache
SIES Cadarache
SESRU Cadarache
SRSC Valduc
SEAREL
DPS/FAR + DPS/DOC : Mme BEAU
DPT/FAR
DSMN/FAR
CDSN/FAR : Mme PENNANEACH
UDIN/VALRHO
DEDR Saclay
DRNR Cadarache
DRE Cadarache
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DEMT Saclay
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