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Preservation of seismograms from Observatori Fabra first seismic station (1906-1913)

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In this poster we detail the historical patrimony of the seismic section of Fabra Observatory (*Observatori Fabra*). It has been operating in Barcelona since 1904. It was created and maintained by the Royal Academy of Science and Arts of Barcelona (Reial Acadèmia de Ciències i Arts de Barcelona – RACAB), an association of investigators of science and its applications established in 1764. It has always been devoted to astronomical, meteorological and seismological observations and studies.

Seismic observations started in 1906 and have been maintained active since then. Josep Comas I Solà was the head of the first seismic station from the beginning of the Observatory until 1913, when the new head of the section dismantled it to perform some refurbishments of the spaces and installed a new station with new instruments. Near one thousand seismograms and some parts of the instruments have been conserved from that epoch. Each of those seismograms have been revised, photographed, inventoried, restored and archived under better conditions to ensure a proper preservation and to make them available to study. Here we aim to expose our experience and results in these tasks, explaining in detail each stage of the project and the different dilemmas and decisions taken.

Study and Preparations

Detection of the problem and proposal to solve it

Source: M.T.Merino

Observatori Fabra seismic station started operations in 1906. But in 1914, after dismantling the older seismograms and major refurbishments of the facilities, started to operate a new second seismic station with new seismographs working with smoke paper until 1998. Smoke paper seismograms from this second seismic station were properly processed and meticulously archived following contemporary customs in most similar seismic stations, being preserved in considerably good state of conservation. In contrast, seismograms from the first station stayed rolled up into boxes during most of the XX century without further study or consideration and after near 100 years showed serious signs of deterioration.

Source: M.T.Merino

Participation in EUROSEISMOS program made us aware of the importance and the state of conservation of all of our seismograms in smoked paper, specially the oldest ones.

A global review of Observatory Fabra seismograms archive was made during the project and the following years. It made clear that those oldest seismograms needed a more specialized intervention than the rest to ensure their preservation.

We started to collaborate with the restoration workshop of the Department of Painting of the Faculty of Fine Arts of the University of Barcelona to seed our best options to proceed.

Under this collaboration, a master's thesis was elaborated about our seismograms archive status of conservation with an specific proposal of actions to ensure its preservation in optimal conditions adapted to the reality of the present resources and limitations of the Observatory. This work included

Source: M.T.Merino

- Professional analysis of the places were the archive was kept and possible options to place a new archive considering conservation and necessary use purposes: ambient and meteorological conditions such as light, humidity, temperature,… ; use and activities on and around; security in front of theft or accidents; possible risks of infestation, plagues, fire, ….
- Laboratory explorations of the different of papers to evaluate their state of conservation and necessary interventions: type of fibers, acidity, possible infestations, …
- Interviews with present and past personnel related to the archive to know it past, present and desired future use and expectations.
- A proposal for a new archive and the most urgent interventions to make adapted to the possibilities of the Observatory

It was recommended hard or mild restoration on everyone of the seismograms from the first seismic station (1906-1913) and a posterior new archive and handling with specific details that were made the guidelines of the subsequent works.

Study of the history of the first seismic station

A study about the first seismic station history was don with support of *Institut Geològic de Catalunya* (ICG). It included a deep revision of all documents, photographs and own and external bibliography related, including previous reports by past personnel or collaborators, with the main purpose of update previous summaries with newer findings and try to document properly and clarify some doubts and inconsistencies that had arisen.

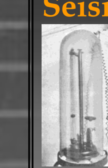
That was a very dynamical long stage of the whole project were both the historical study helped the intervention work on the seismograms and the details arisen during the intervention on the seismograms helped the study.

The head of the first seismic station, Josep Comas i Solà, produced a weekly report of their detections and some special issues about seismic phenomena and other news published on local media. In addition, he participated to some international congresses and published other more academical studies in local and foreign scientific journals.

The first seismic instrumentation consisted of an Agamennone seismoscope, Cancani and Agamennone seismographs and a Vicentini microseismograph.

The instruments, working on smoked paper or ink on paper, were strongly modified several times during those early years of the instrumental seismology to experiment with different configurations.

Seismoscope Agamennone



Inverted pendulums motion closed electric circuit.

Associated clock placed upstairs alerted personnel in charge of the seismographs.

Source: "El Mundo Científico"

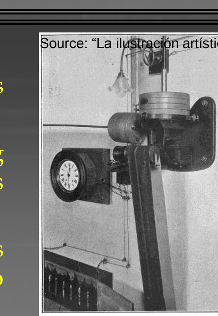
Vicentini

Source: "Observatori de Sant Julià de Vilatorta" photographic archive

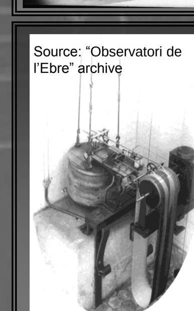
First seismograph on duty, registered "The big one" earthquake destructor of San Francisco with only few days of operation. Only significantly altered the time signals operation during the period.

Vertical component (Z) with 1.2m long and 50 kg pendulum. Horizontal ones (N-S and E-W) due to a 100kg 1.28m long pendulum. Recorded from 1906 to 1913 on smoked paper at 5mm/min speed and amplifications 158 (Z), 82 (N-S), 75 (E-W)

Suffered an important refurbishment on 1913 because it was transformed to be added to the instruments operating in the second seismic station. Stopped from regular use in 1992 as a result of the difficulties to maintain the smoked paper logistics without permanent staff. Sporadic use untill 1998.

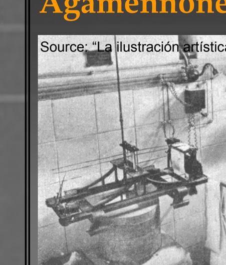

Source: "La ilustración artística"
Observatorio Fabra.—Microsismógrafo Vicentini

Cancani – Conic Pendulum


Source: "Observatori de l'Ebre" archive

It operated with a 220kg 3,60m long pendulum recording on smoked paper at 37mm/min and suffered major transformations in 1910 from working with two horizontal c components NE-SW and SE-NW with 17,3 amplification and designated Microsismometrograph Cancani to record only one component N-S with 30 amplification and being designated Pèndol Cònic.

Agamennone seismograph – Vertical pendulum


Source: "La ilustración artística"

It had a 3,44m long pendulum. It started recording two horizontal components (NE-SW,SE-NW) with ink on paper bands. In 1909 changed from 200kg 35mm/min and 10,3 amplification to 520kg, 37mm/min and 100 amplification. In 1911 changed to be designated as Vertical Pendulum and recording only one component NE-SW on smoked paper with 28mm/min and 72 amplification.

Intervention on seismograms

Detailed inventory

The first action on the preserved bands was to explore them one by one and to realize a complete detailed inventory of:

- their state of conservation and necessary individual restoration
- seismogram operative data: initial and final time and date, instrument identification and properties, etc
- inscriptions or registrations on the bands or in complementary documentation (phases, clock corrections, additional comments about earthquakes registered, etc)

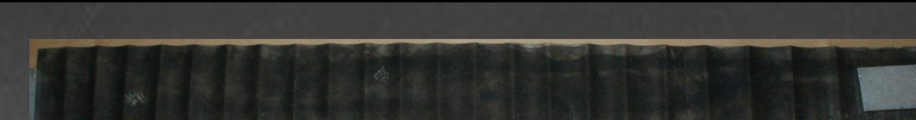
This was a slow and meticulous work, supported also by ICG, but very useful for every posterior stages of this project and for any future use of their data.

Nº	Tipus	Inici Registre						Fi Registre						Comentaris
		Dia	Mes	Any	Hora	Min.	Seg.	Dia	Mes	Any	Hora	Min.	Seg.	
1	Vicentini	18	4	1906										"Terremoto de San Francisco de California 18 de abril de 1905"
2	Vicentini	1	8	1906	9			3			11			
3	Vicentini	9	8	1906	9	45								
4	Vicentini													"Sismograma del terremoto de Valparaíso. 17 de agosto de 1906. Observatorio Fabra Barcelona. J.Comas Solà.
5	Vicentini	19	8	1906	12	30	1c	21			18	15	4c	
6	Vicentini	24	8	1906	9		1c	26			20	30	4c	"Después de arreglada la corriente marca el primer cuarto a las 12 y media. Ultimo cuarto dia 26 a las 20h30min"
7	Vicentini	26	8	1906	20	45	1c	28			17	45	4c	
8	Vicentini	7	9	1906	8	15	1c	9			13		4c	
9	Vicentini	9	9	1906	13	15	1c	11			19	45	4c	
10	Vicentini	18	9	1906	19	15	1c	21			8	45	4c	
11	Vicentini	21	9	1906	9		1c	23			11	30	4c	
12	Vicentini	25	9	1906	23	30	1c	28			7		4c	"Día 26 marcado a las 20"
13	Vicentini	28	9	1906	7	15	1c	30			9	45	4c	
14	Vicentini	30	9	1906	12		1c	2	10	1906	19	45	4c	
15	Vicentini	2	10	1906	20		1c	5			7	15	4c	
16	Vicentini	5	10	1906	7	30	1c	7			14	15	4c	"Tachado por trabajadores el dia 5 y el 6"
17	Vicentini	10	10	1906	7	15	1c	12			7	45	4c	"Día 11 por no haber corriente dejó de manejar y fue despues el primer cuarto a las 15,15. Lleva el reloj 4min de retraso"
18	Vicentini	12	10	1906	8		1c	14			14	45	4c	
19	Vicentini	21	10	1906	9	45	1c	23			19	30	4c	
20	Vicentini	23	10	1906	15	45	1c	26			7	15	4c	
21	Vicentini	28	10	1906	18	30	1c	31			8	30	4c	
22	Vicentini	31	10	1906	8	45	1c	¿1?	¿11?		7	45	4c	"Disparado sismoscopio a las 8,15. Quitado papel a las 7,45 último cuarto
23	Vicentini	4	11	1906	14		1c	7			6	45	4c	
24	Vicentini	9	11	1906	7	15	1c	9			12	15	4c	"día 9 péndulo 12h30min cronómetro 12h46min30seg"
25	Vicentini	9	11	1906	7	30	4c	12			7	45	4c	
26	Vicentini	14	11	1906	8	45	1c	16			8	30	4c	
27	Vicentini	23	11	1906	8		1c	25			9	45	4c	
28	Vicentini	2	12	1906	10		1c	5			9	19	4c	"El péndulo adelanta 1min"

Example of some registers of the reduced inventory with only operative data and comments.

The registers of the final inventory are:

- 391 Vicentini (in 15cm x 266 cm smoked paper bands)
- 444 Cancani – Conic Pendulum (in 15 cm x 180 cm smoked paper bands)
- 8 Agamennone (+ 4 reused pieces with useless records) with 13 cm x variable length paper with ink bands
- 151 Vertical pendulum (in 10 cm x 212 cm smoked paper bands)
- A few more special cases (experimental or unidentified)


Source: M.T.Merino

A proper scan the seismograms was not considered feasible because of the damages that would have provoked onto those so much fragile bands. However, complete and detailed photographs of each band were taken before restoration, resulting in a digital archive of > 6500 photographs such as the examples here shown.

Source: M.T.Merino

The interest and convenience of a proper scan of the bands after restoration is still under consideration.

Restoration

The restoration of the bands with seismograms was performed following all the adequate procedures thanks to the collaboration with the specialized staff and facilities of the restoration workshop of the library of the University of Barcelona (*CRAI Taller de Restauració*) with support of Ajuntament de Barcelona.

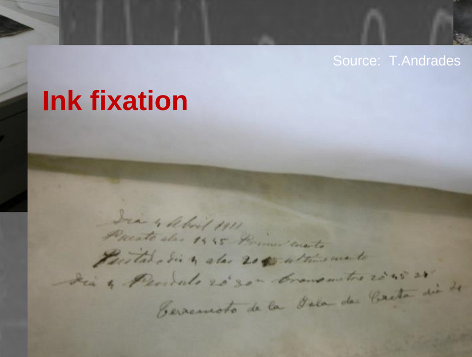
Each band required individual attention and use of one or more of the following procedures:

Disinfection
Source: T.Andrades

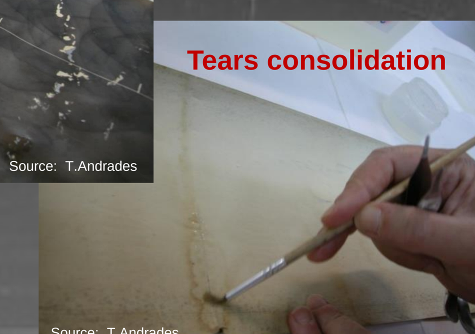
Source: T.Andrades
Reduction of acidity

Source: T.Andrades
Flatenning

Drying
Source: T.Andrades


Source: T.Andrades
Ink fixation

Reintegration of pieces
Source: T.Andrades


Tears consolidation
Source: T.Andrades

Archive

New dependencies were adequate in Observatori Fabra to allocate the new archive of seismograms thanks to the support of Ajuntament de Barcelona:

- Smoked paper seismograms at two aluminum anonized tallboys
- Paper + ink seismograms in phN boxes prepared to be used for exhibition.

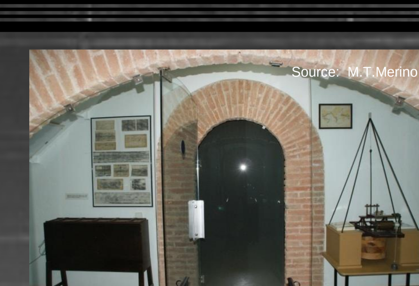
With constant monitoring of temperature, humidity and parasites , and with automatic humidity correction.

Source: M.T.Merino

Source: M.T.Merino

Preparations included:

- Selection of storage and exhibition materials.
- Careful and slow packing, transport and unpacking from old storage.
- Elaboration of custom-made remay+melinex envelopes and separating phN papers.
- Proper individual cuts for Vicentini bands (>130cm).
- Arrangements in chronological order.
- Strategic position to ensure proper flattening of each column of bands in storage.


Source: M.T.Merino

Source: M.T.Merino

Source: M.T.Merino

Exhibition and security preparations for possible selected visits were a requirement.

- Chronological order to ease consult.
- Individual separation by phN special papers or boxes.
- Selected bands with melinex+remay on each top.
- Selected pieces, furniture, books, etc for decoration.
- Locks at every room and piece of furniture.

Conclusions

- ✓ **Small old observatories have interesting seismic patrimony.**
- ✓ **Seismic historical patrimony can be very useful for both divulgation and science but it needs to be properly maintained**
- ✓ **Getting to know what do you have is a first step to recover it. To believe in its value is the second.**
- ✓ **There are many projects doable with limited resources.**
- ✓ **Collaboration is the key to be able to face big projects.**

We are looking forward to contact to share experiences and collaborate with institutions and individuals with similar interests and goals

….. are you interested?

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http://www.fabra.cat

Acknowledgements

All this has been possible thanks to the support of the following institutions: *Reial Acadèmia de Ciències i Arts de Barcelona* (RACAB), *Institut Geològic de Catalunya* (IGC), *Ajuntament de Barcelona, Taller de Restauració del Departament de pintura de Belles Arts de la Universitat de Barcelona (UB), CRAI Taller de Restauració de la Biblioteca de la Universitat de barcelona (UB)* … and many more.

And especially thanks to the great performance and implication of the family made by the personnel and collaborators of Observatori Fabra, too big in number and value to be included here one by one.