

Toponymisches *Heft*

E d i t o r
New Society for Applied
Toponymy

No. 3

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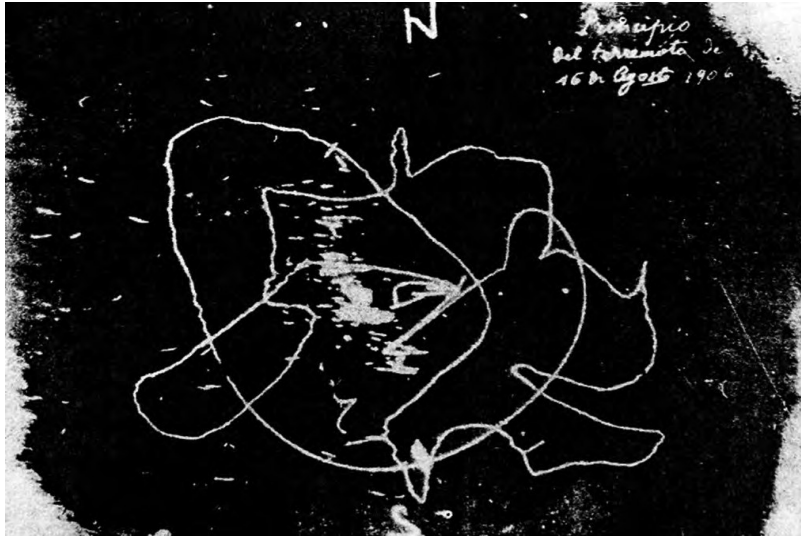
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Place where something stops or ends



“Beginning of the earthquake of August 16 1906”¹ scraped into the smoked paper

Foreword Seismology

Chile is the most seismic country in the world.² In some places, such as La Ligua, the earth trembles almost daily. On average, inhabitants of the region will experience some hundred *temblores* (quakes, slight ground motion)³ and at most two powerful *terremotos*

(earthquakes)⁴ in their lifetime.

The causes for the country’s volatile state are located deep underground, at the heart of the attritional relationship between continent and ocean, where two tectonic plates are moving towards each other at a speed of

¹ A seismoscope located at the National Observatory in Santiago records the event which occurred at 19:55 local time in Valparaíso/Chile. Due to the strong vibrations the recording needle snapped.

² Seismic, more seismic, most seismic.

³ Many people who live in South America have an intimate relationship with temblores. Some even report lying down on the ground the better to sense the vibrations.

⁴ Albin Belar recommends that “the word earthquake should only be used when truly integral parts of our earth’s

crust start to quake and when many seismometers across the world indicate the disequilibrium of the earth’s strata; when such events are confined to smaller areas, however, and even then are barely perceptible to the human senses, it is better to use one of the following terms: earth shock, seismic shock, ground vibration, ground shaking or earth movement, slight or swaying ground motion. People will choose the word which most closely matches their perceptions; first, however, it will be necessary to familiarize ourselves with the records of our measuring instruments and to compare these with human perceptions.

This is the only way in which we can come closer to understanding the nature of earthquakes.” Albin Belar: Was erzählen uns die Erdbebenmesser von den Erdbeben, in: *Die Erdbebenwarte*, Ljubljana 1906/1907, pp. 102–103.

eight centimeters per year. The South American Plate slides over the top of the much heavier Nazca Plate, forcing it down into the mantle at a thirty-degree angle. As it descends (a process known as *subduction*)⁵ the two plates interlock, building up a huge amount of tension. Crustal rocks melt, the earth quakes, volcanoes erupt. This much we know. But have we really understood?

Tectonics as outlined above is part of a science whose history we are concerned with here – or rather, with the bodies through which knowledge arises/arose. (We must adopt a different perspective for a moment, and look down on things from above:)

Seismology is a young science.⁶ For a long time earthquakes were seen as manifestations of divine punishment. In some parts of the world people still assume that quakes occur in times and places with particularly high levels of vice (see ‘boobquake’ e.g.) The first seismologists had to distil their data at painstaking length from eyewitness

accounts. Immanuel Kant was one of the first to make the move towards disregarding the “history of the misfortunes, (...) of cities destroyed and inhabitants buried under their ruins” and devoting himself to the real “work of Nature”.⁷ Not until the mid-nineteenth century did seismology manage to almost completely free itself from human catastrophe and death.⁸

Coincidentally, on 17 April 1889, a horizontal pendulum in the cellar of the Institute for Astrophysics in Potsdam recorded the world’s first teleseism.⁹ (This would be the moment to talk about the “birth of modern seismology”.) Observatories and seismographs were set up all over the world. Now, for the first time, tremors could be recorded as a function of time without reference to their effect on human beings. Waves of energy radiated through the dark inner of the earth, formerly known as *Hell*, which could now be divided up into concentric spherical shells and modelled in geophysics departments.

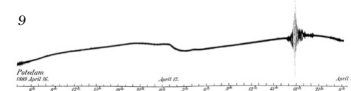
⁵ During our research we spoke to many geologists. They always resorted to using their hands at this point.

⁶ The noun seismology (Greek σεισμολογία *seismós* = earthquake, *sefein* = to shake and -λογία, -logía = science, knowledge) appeared in English for the first time in the 1850s. The term was coined by Irish geophysicist and civil engineer Robert Mallet. 1858 saw the publication of Mallet’s *Earthquake Catalogue of the British Association*, a record of over 6831 geological events and their effects. Mallet himself carried out explosion

experiments to determine the duration of seismic waves. During the Crimean War he developed a grenade launcher (“Mallet’s Mortar”) capable of firing 1.1-ton shells over a distance of 2.4 km. In 1857–58 he carried out a series of tests. The mortar was badly damaged in the process and so was never used in combat.

⁷ Immanuel Kant: *Geschichte und Naturbeschreibung der merkwürdigsten Vorfälle des Erdbebens, welches an dem Ende des 1755sten Jahres einen großen Theil der Erde erschüttert hat*, Königsberg 1756.

⁸ See Deborah R. Coen: *The Earthquake Observers. Disaster Science from Lisbon to Richter*, Chicago 2013, pp. 1–14.



At the climax of the quake (Tokyo) the light was too dim to expose the recording film (Potsdam). Ernst von Rebeur-Paschwitz died at the age of 34 from tuberculosis.

Two different pathways emerged within seismology. One was the geological or descriptive direction, involving “quake effects that are visible and tangible for human beings”, also known as macroseismology. The other was a physical direction which was interested in the “mechanics of earthquakes” and captured seismic waves in the form of images using sensitive measuring instruments. These images in turn formed the “basis of physical and mathematical investigations”.¹⁰

In the early decades of the 20th century, these two pathways still ran side by side. Words and figures, feelings and measurements met in long lists. Man, woman, animal or household object – anything and anyone could act as a measurer of vibrations. Seismology handbooks were mostly aimed at laymen, and tried to elucidate the practice of earthquake research and its phenomena in the clearest way possible: landslides and landslips, sea waves and water columns, and light and sound

phenomena¹¹ coursed through the ranks of a knowledge-hungry readership. These were euphoric times! In 1901 the first International Seismology Conference was held in Strasbourg. Stations across the globe collected data from both technological and human sources. Geologists proclaimed a new “art of observation” (Heim).

In 1908 the Servicio Sismológico was founded in Santiago. Under the aegis of Fernand Montessus de Ballore, 34 stations were set up across Chile. 530 “benevolent observers” reported from 425 locations. They filled out questionnaires and sent telegrams. Every detail (a barking dog) was of potential significance, and was listed and analysed.

In the mid-1930s, with the introduction of the Gutenberg–Richter scale, quantitative seismology and its experts started to gain the upper hand. References to sentient beings gradually disappeared from the lists of the seismological services. Ever since then,

¹⁰ August Sieberg: *Geologische, physikalische und angewandte Erdkunde*, Jena 1923, p. 3.

¹¹ “Although there are many and varying descriptions of the kind of sounds an earthquake makes – e.g. ‘booming, whining, droning, organ-like, whistling, rumbling, thundering, crashing, rattling, clashing, gurgling, roaring etc.’, most of them are comparable to the types of sounds which also accompany shocks on the earth’s surface. Generally speaking, it is possible to distinguish between two main groups – on the one hand, long-drawn-out sounds

resembling the rumble of thunder or a lorry driving across a bumpy surface, and on the other hand, short, abrupt sounds like exploding mines.” August Sieberg: *Geologische, physikalische und angewandte Erdkunde*, Braunschweig 1904, pp. 117–120.

quakes have primarily been measured using instruments and assessed according to their strength (magnitude).¹² Phenomenological methods exist to this day, of course. The impact of quakes (intensity) on buildings and landscapes can only be described and felt by and through human beings – that is an unshakable fact. Macroseismology, therefore, is by no means old hat but a recognised field of research. Its common forms and formats, however, are not very flexible. And as anyone who has ever found themselves on trembling ground will know, that experience blows any questionnaire out of the water.

We now come to a hotspot which drives the texts in our publication forward in a subterranean manner. It is the revival of an almost forgotten experiment: when does an event begin; can it be felt? How can we write a quake? And – can geology save us from sentiment?¹³

¹² See moment magnitude scale or seismic moment . The scale goes up to 10.6, the value which would indicate that the earth's crust had completely broken apart.

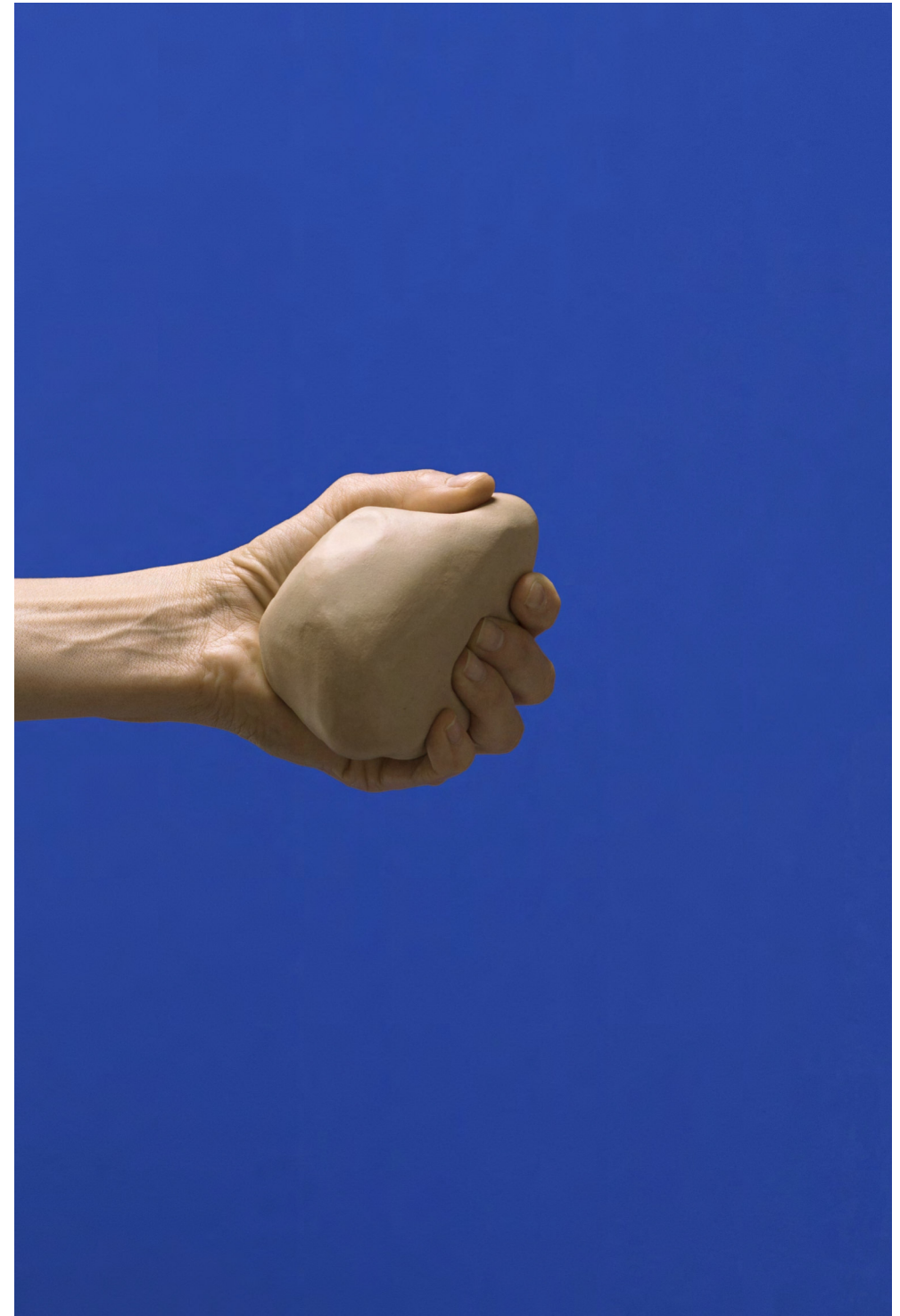
¹³ See also J.C. Duenkel's essay *Wie muss der Körper beschaffen sein, von dem ich in Ruhe schreiben kann, ohne dass sich das Ich mitbewegt?* (1966): "In macroseismic observation, Man emerges from his self-incurred immaturity. Centuries after the invention of the soul and its oppressive introspection, feeling once again swings in the open. The perceptions of the shaken

subject become true; they can be shared with others, located, usable or not; at any rate, they are radically material. Long live the geopsyche – the in-feeling of rocks, seas and grounds!"

¹⁴ Erschütterungskunde

Toponymisches Heft No. 3 is devoted to the entire spectrum of expression of seismic mediums. It features contributions to a study of tremors¹⁴ recalling its own significance. In the interests of accuracy, we shall dub it seismology.¹⁵

¹⁵ Seismology is not a typo. It studies the shakings of science, things and beings being moved by elastic wave forms of all kind. A stammering sister of seismology, it lulls logic, recovering what discipline has left behind: footnotes, finger tips, forgotten verbs in a field report. Slowed down by syllabic doubling the seismologist is chronically too close or too far from the phenomena in question.



1st - 8th of January 1910
Benevolent Observers

LIST OF ABBREVIATIONS

B. O.	Bosch Omori (Seismograph)
Wh.	Wiechert horizontal (id)
Wv.	Id. vertical (id)
St	Stiattesi (id)
P. F. P.	Beginning of main phase
P. S.	Preliminary phases
L	Main phase
C.	Tail of seismogram
m. 2a L	Double amplitude maximum in main phase
T. (L).	Period of oscillations in main phase
F. C.	National Railway Official
T.	Telegraphs
F.	Lighthouses
B.	Benevolent Observers
E. P.	Elementary Schools
E. C.	Catholic Schools
P.	Press
F. C. A. B.	Antofagasta - Bolivia Railway Line
E. M.	Meteorological Station
S. M.	Subdivision of the Marines
E.	Seismic Station

NOTE: The localities marked in bold, indicate where a quake was first observed.

[January] 1

- 0.46.0. **Copiapó.** Quake, 4", 3rd degree oscillations, preceded by a strong, prolonged sound. E.
- V.2. **San Ramón.** Strong quake without sound. F. C.
- VII.30.30. **Copiapó.** Quake, 8", with 3rd degree intensity. E.
- XX.5. **Chañarcito.** Palpable quake. F. C.
Inca. Palpable quake. F. C.
XXI.25. *San Pedro.* Palpable quake preceded by a sound. F. C.
- XXIII.27. **Membrillo.** Strong subterranean sound, 10 ". F. C.
- XXIII.30. *Bulnes.* Slight quake, with sound, one oscillation. F. C.
- XXIII.40. *San Carlos.* Slight quake, E. P.
- XXII.43. *Chillán.* Quake. E.
- XXIII.45. *Curanipe.* Strong quake of short duration. E. P.
- XXIII.48. *Yungay.* Slight quake. A sudden, vertical oscillation. E. P.
- XXIII.48.11,25 (P. F. P) **Santiago.** BO. Component N/E. Nothing. Component N/W. Without preliminary phase. L C = 1'. 52". m. 2 a. L (1 st und 2 nd oscillations) = 0^m/m 8. The main phase seems to consist of one big wave of an amplitude of 0^m/m 5 and a travel time of 11", 25 with many superimposed vibrations. Signs of movement at 1'39".
- 2 (?) XXIII.47. *Concepción.* Quake. E.

[January] 2

- I.1. **Curtiduría**. Slow quake and very slow sound. 4" F. C.
- X.55. **Chañarcito**. Slight quake. F. C.
Inca. Palpable quake. F. C.
- XI.4. *El Carmen*. Slight quake. F. C.
- Pueblo Hundido*. Strong quake. 6". F. C.
- XI.10. *Animas*. Palpable quake. F. C.
- 1 (?) X.57. *Chañaral*. Soft quake, one oscillation and sound during the quake. E. P.
- XVI.45. **Pueblo Hundido**. Very slight quake, 5 ". F. C.
- XVIII.5. *Islón*. Slight quake. F. C.
- 3 (?) XVII.45. *Animas*. Palpable quake. F. C.

3

- VIII.10. **San Pedro**. Palpable quake with preceding sound. F. C.
4 (?) VIII.10. *Chañaral*. Soft quake, much noise. E. P.
- XXI.28.29.9 (P. F. P) **Santiago**. BO. 1st Seismogram. P S: a long wave of an amplitude of 1^m/m und duration of 5" with superposing vibrations of an amplitude of 0^m/m 7. L: starts abruptly with a vibration of an amplitude of 5^m/m. Afterwards declining oscillations. C = 30". A warning movement at XXI.28.0. precedes the diagram. 2nd Seismogram. P S = 30 ", with almost unperceivable vibrations, which lead to believe, that we're not dealing with the pre-phase of the very event but with warning precursors. L: only two or three vibrations of an amplitude of 2^m/m. C = 30 ". *Note*: The types of waves can't be distinguished, because of a recording error of the observer. Wh. Both wave forms. Without pre-phases. L C = 33". m. 2nd L (1. deflection) = 1^m/m, 5. Then slowly declining oscillations. St. component W/O. Without precursors. A warning movement precedes the diagram 8" before primary wave L = 9", 2. m. 2nd L (1. deflection) 1^m/m, 5, together with a displacement of the recording needle, 1^m/m, in direction of the other wave. C = 46". Wave direction NS.
Without precursors. L= 9"2, made up of three groups of oscillations, separated from each other. The 1st commences with a 1st oscillation of a

amplitude of 3^m/m, and spreads until 3",45 after the beginning of L. The second is located at 4",6 after the beginning of L, with oscillations, not over an amplitude of 1^m/m and thirdly at the end of the wave phase with an amplitude of 2^m/m. C = 46".

4

- II.35. **San Ramón**. Quake with regular tremor. F. C.
- XIX.25. **El Carmen**. Slight quake. F. C.
Chañaral. Strong quake, sound during y after the quake, an oscillation from N/E to S/W. E. P.
- XIX.30. *Animas*. Slight quake. F. C.
- Pueblo Hundido*. Strong quake, 6". F. C.

5

- 4 (?) **Lo Campo**. Very strong quake. F. C.
- 0.2. **Curimón**. Slight quake. F. C.
- 0.5. *Los Andes*. Average strong tremor, a lot of noise. F. C.
- San Felipe*. Strong quake. Sleeping people were awoken. E. P.
- Las Vegas*. Palpable quake. F. C.
- XII (?) *Bellavista*. Subterreanean sound. F. C.
- XII.2. (?) *San Felipe*. Slight quake. F. C.
- Los Nogales*. Strong tremor, accompanied by an extended sound. F. C.
- XII.5. (?) *La Calera*. Strong quake. F. C.
- 3 (?) XII.5. *Ocoa*. Slight quake. F. C.
- II.4. **Coligües**. Subterranean sound. F. C.
- V.30. **Llico**. Strong quake. Several oscillations. E. P.
- VI.44. **Concepción**. Quake. E.
- IX.20. **Coligües**. Subterranean sound. F. C.

6

- VI.37. **Concepción**. Quake. E.



Hotel Los Polvos
Cordula Daus

Where to put her extremities? Out in front of her, stuffed into the gaps or shoved under the seat. There was no room for Margot's legs on this ship, in this seat, in this position she couldn't hold any longer, that upset her in spite of herself. She'd paid for a reclining seat and been given a stiff armchair. She wouldn't give up – she was going to fill the space that was stopping her sleep, push back the armrest, disregard the ridges, ignore the crevices cutting into her body, cram them as tight as she could with scarves and sweaters, flatten out the row of seats. Sleep! Her head and shoulders stuck out at one end and her feet at the other. She was too long. She had had enough of this. She'd take off her head and legs and place them in the overhead compartment, store all appendages away, so the rest of her could get some rest. She sat up abruptly. A little boy was darting through the rows on all fours, nimble as a hare. No, a jackalope, every limb its own rock song, in perfect disharmony. Where did kids like that grow, she wondered. Wherever it was she wanted to go there, up up and away. The sea gurgled against the portholes. It must be five in the morning. She collected herself and shuffled off to the toilet in her socks. There was a piece of paper stuck to the wall above the cistern: "Por favor, no votar papel!" [Please do not vote paper]. A thousand wrongs make a right, in Chilean toilets and elsewhere. Here the "please" had been stretched and warped with use, with increasing paper consumption, into rightness – and so be it. There were two women sitting at the bar with their hoods up, drinking beer. Headlines flickered above their heads. Four years of war in Syria, flooding in northern Chile. Margot wanted whisky, but there wasn't any. Rum, calm, flowed deep into her belly, and the ship hummed beneath her feet. On the way back she saw him asleep in his seat. His slumbering body, seemingly tailor-made for the seat, his legs folded peaceably to one side. Snarr, the mermaid. Only an aisle's breadth away from her seat, he

was arranged in exactly the same position as the last time she'd looked. What did he weigh, for how long had she submerged him, as profoundly as if he had not existed for quite some time, or indeed ever.

At six o' clock the ferry spat them out onto dry land. The paths were lined with rhubarb. Thick hairy leaves that the mist clung to. *Gunnera tinctoria* – their local name was “nalca”, said the beekeeper, as they waited at a little petrol station. The rhubarb, he told them, had been the first to poke out from under the ash. Now they couldn't get rid of the stuff. In New Zealand, apparently, it was on a list of national pests – anyone contributing to its spread or deliberately propagating it was fined. Snarr puffed, the beekeeper pointed out to sea. Ash, he said, as far as the eye could see. The volcano had spewed out a new beach, larger than the town itself, and now they had to keep digging out the seabed so that the ships could come in to shore. All his bees had died after the eruption, he told them. It had taken him five years to build a colony that would consent to stay put. Now he sells honey as far afield as Denmark. When his bees went off foraging, that was his thinking time, and he'd come and stand out here on the beach. His plan was to start selling queens – the mass extinction of bees was working in his favour. The first lights went on behind the curtains in the town. They walked down a rough draft of a street. Two sunken strips of grass followed the course of the water beneath. Bent-backed poles leaned against wooden houses. At a crossroads the gravel track hardened into thick tarmac, the grass disappeared and the water flowed out into the open, exposed and naked. They passed a police station, two restaurants, a school. Three girls straddled a wall, a football lying dull at their feet. Many of the houses were empty and dark or were they just asleep, with black-painted numbers, signs forbidding entry: “Propiedad fiscal”. Margot had lost her bearings, and zoomed herself out into the world of Google Earth: Chaitén, a crooked crossword puzzle, twelve by five grid squares with a river slicing through the middle, the tightening of a belt around a fat gut of ash. By the time she had copied out the address, “Almirante Riveros Number 53”, they were there.

“La proxima vez digan con luz!” said Marisa, laughing. Snarr heaved his backpack out of the windowless room. Luz – light – was something they'd forgotten to mention on the phone. Windows didn't come standard here. They paid 5000 pesos extra for a room on the first floor, a room with light. Margot drew back the curtains. Across the road was the butcher's house, a red flag flapping from one of the windows. “Man, six years I've been screwing you now,” said Snarr. The gap grinned through his teeth, the pitch-black curtain which would get wide and wider every year as his gums receded, and end with the applause of his falling teeth. Margot straightened the pillow behind her back and started typing.

Hotel Los Polvos

A hotel for every hour.
A room for every mood.
A house that holds fast.
A self-supporting household.
House and home.

Snarr had met Margot at an opening. She was watching a film by Kenneth Anger, standing in the glow of the screen, green eyes, flaming hair. Her profile cast a shadow on the wall. He spoke to her that same evening, and she told him her name was Margot. No, she was *MARJORIE*. He'd conjured her up himself! *PLEASURE*, please. He told her about the screenplay he wanted to write on Parsons, maybe he'd turn it into a song. She offered to buy him a drink, gin and tonic; he nodded and she disappeared. He met her again on the dancefloor. They sat by the speakers and yelled at one another. Margot-Marjorie wanted Snarr to bite her neck to prevent him kissing. He spat on the floor, sealing the pact.

Snarr stared at the butcher's house. What did the red flag mean? He wished he had a cow – no, a goat. He'd make it his signet, the hotel's figurehead. Creatures that could not be reasoned with. That acted as buffers between human beings. Birds, fish or cloven-hoofed animals! Years ago he'd written about the healing properties of such mediums; at the time he'd been selling hot water bottles made of goat intestines. Half the time he lived in a houseshare with his ex-girlfriend, the other half he was supported by his girlfriend, with an ex-ex-girlfriend providing his dental care. Something had rocked the ground beneath him, rendered him incapable of standing on his own two feet. This fragility was not a problem unique to him, however, “but the problem of being human per se”. Snarr looked at Margot. He was holding a shoe. Human beings, he said, had become “individual containers, without the rich abundance, the stimulant of mythical creatures”. He shone the shoe. Lace-ups, loafers, moccasins – he used to get the top quality product from a French gentleman based in L.A. The man was dead now, unfortunately. Snarr scratched himself – something had irritated him. Margot shouldn't go getting any ideas. He was a seasoned man of fifty. His mother needed to realise that too. *Boss* just wasn't his brand. He would wear ripped jeans till his dying day. Fuck it. He slipped into his shoes and stood up.

What did he mean by “stimulant”? Margot looked at his hand. Snarr was going to take her with him. On his index finger they rode into a field of vibrant references, names and isms. A boy in boots led them on a white horse past burning patches of ground, Margot became Nico, Denise Marie Roberte,

LELAND STANFORD JUNIOR UNIVERSITY

OFFICE OF THE PRESIDENT

Stanford University, Cal.,

June 5, 1906.

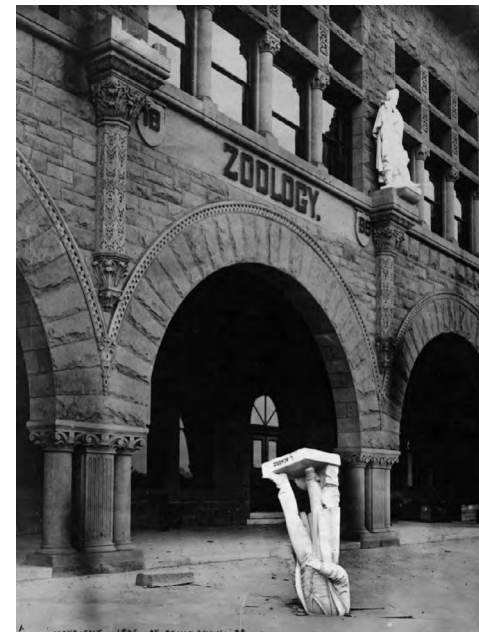
Major C. E. Dutton,
Englewood, N.J.

Dear Sir:

I take pleasure in writing to Major De Montessus de Ballore in accordance with your kind suggestion. If he wishes to be a factor in the rebuilding of San Francisco, I suggest that he might to good advantage visit the city at once.

Very truly yours,
David S. Jordan

Jordan, David S.



The statue of the scientist Louis Agassiz, which fell headfirst from a portal at Stanford University during the San Francisco earthquake. Alexander von Humboldt, who was just to the right, remained standing.

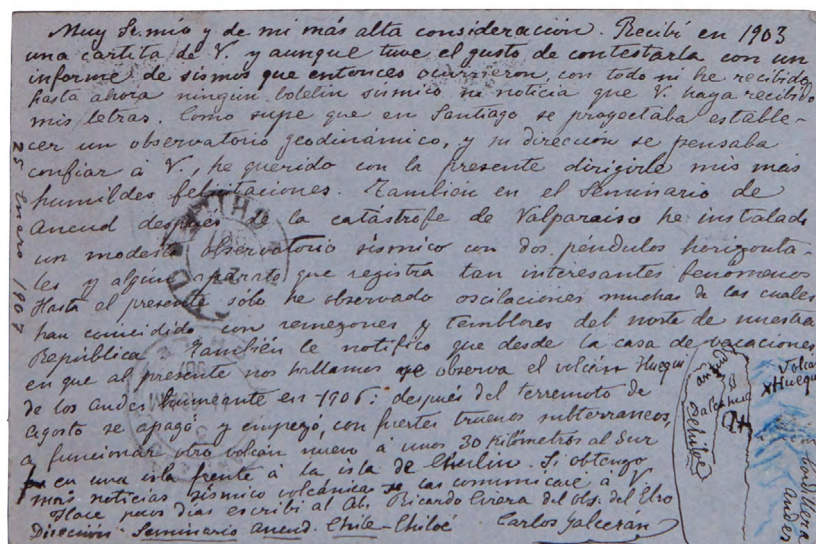


Universal Post Union
CHILE

Mr. Comte Montessus de Batllore
Abbeville

France

THE ADDRESS SHOULD ONLY BE
WRITTEN ON THIS SIDE



January 25, 1907

Dear Sir. In 1903 I received a letter from you and although I had the pleasure of answering you with an update on the earthquakes that have occurred until now, I have not received any seismic bulletin or news from you that you've received my letters. As I have learned that in Santiago a geodynamic observatory has been planned and you are being considered as its director, I would like, with this letter, to offer you my humblest congratulations. Also, after the catastrophe of Valparaiso, I have installed a modest seismic observatory in the Seminary of Ancud with two horizontal pendulums and an apparatus that registers interesting phenomena. Until now I have only observed oscillations, many of which have coincided with earth tremors and earthquakes in the northern region of our republic. I would also like to inform you that from the vacation home, where we are currently staying, one can observe the Huequi Volcano of the Andes that was steaming in 1906. After the August earthquake it became inactive and another volcano on an island, some thirty kilometers to the south, near Chulín Island, began to emit powerful subterranean rumblings. If I obtain more seismic volcanic news I will communicate them to you. A few days ago I wrote to Ab. Ricardo Cirera del Obs. del Ebro. Address: Seminary of Ancud, Chile-Chiloé.

Carlos Galcerán

Ancud
Dalcáhue
Chiloé
Volcán Huequi
Cordillera Andes

Galcerán is a Jesuit priest. In a previous letter he had informed Montessus about a series of experiments – “communications with the earth” – he undertook with students of his seminary. Please note the depiction of the Andes in blue pencil: The paper

is worn at one spot. Galcerán must have accidentally placed the volcano too far to the south and had to erase it. He most likely added the lines with colored pencil later to conceal the ungainly abrasion.

Galcerán, Carlos

Paris, 2 fév. 1907

Mon cher camarade,

Aujourd'hui seulement j'ai trouvé
le temps de répondre à votre dernière
lettre.

Vous tombez bien, en vérité,
quand vous venez me demander
de m'associer à votre campagne
pour la diphtongue ei!

Cela me prouve que vous n'avez
même pas lu le chapitre Sismo-
logique de ma 5^e édition, où
j'ai carrément accepté la modi-
fication contraire!

Margerie, avec la fougue
un peu juvénile qui souvent
le possède, vous a très mal
conseillé. Il n'y a pas un

Paris, Febr. 3, 1907

My dear comrade,

It is only today that I have found the time to answer your
last letter.

Your request to join your campaign for the
diphthong ei, comes at the perfect moment! It proves
that you haven't read the seismological chapter of my 5th
edition, where I plainly plead the opposite option!

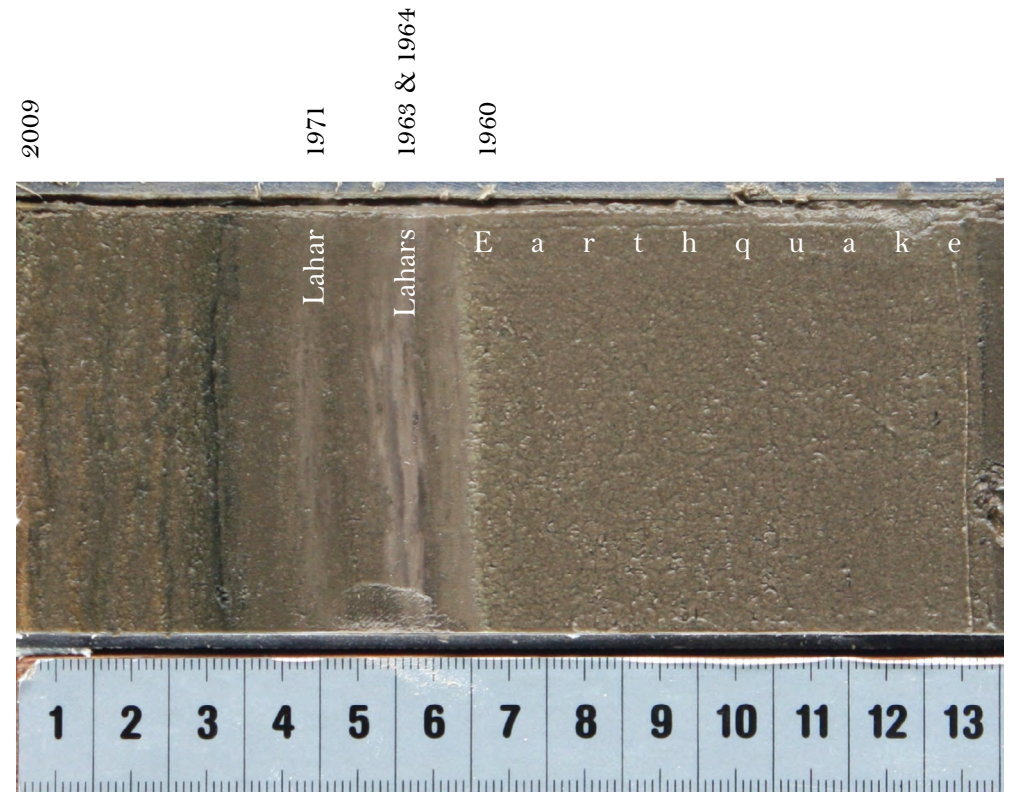
Margerie, who is often carried away by his
youthful impetuosity, has given you very bad counsel.

There is not one

- 5) What type of soil is at the observation site? (Bedrock, scree or peat; how deep is the scree from the bedrock, etc.?)
- 6) How many shocks were felt and at what intervals?
- 7) What was the nature of the movement? (Impact from below, short side jerk, slow swaying, undulating, a mere quiver etc. etc. In the case of more than one shock, did the different shocks differ etc., what was the movement comparable to, what effect did it have on the observer?)
- 8) From which direction was the shock felt?
- 9) How long did the shocks seem to last and how long was the subsequent tremble?
- 10) What were the effects of the earthquake? (See descriptions above.)
- 11) How did this earthquake differ from others, which the same observer had already encountered?
- 12) Was there a sound to be heard, and if so what was its nature? (A thundering, clattering, a bang or ongoing etc.?)
- 13) Did the sound precede the earthquake or follow it, and how long did it last in comparison to the duration and the intervals of the shocks?
- 14) What other side effects were observed? (Behavior of animals, drying up or muddying or renewed activity of natural springs, rustling of leaves, concurrent stormy gusts, abnormal, especially notable weather conditions and the like.)
- 15) What could be observed at lakes?
- 16) Were weaker shocks observed before or after, and at what time?
- 17) Could you quote even further observations of acquaintances or from your neighborhood, or make note of the addresses of persons who would be willing to complete a questionnaire wholly or partially?

From: *Albert Heim, Die Erdbeben. Auf Veranlassung der Erdbeben-Commission der Schweizerischen Naturforschenden Gesellschaft, chap. 3 and 4, Basel 1880.*

Talking with the Lake
about the Volcano
Interview with Jasper Moernaut

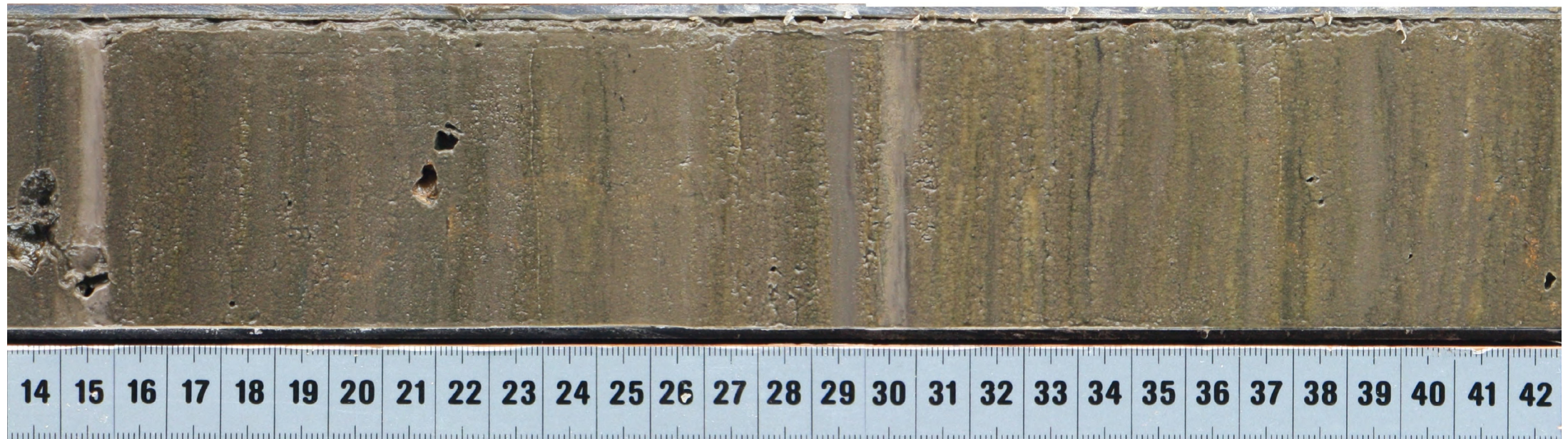


Rule of thumb

- lahar = mudflow related to volcanic eruptions due to the melting of the ice cover of the volcano's summit by lava flows
- volcanic ash = material ejected by the volcano falling out of the sky into the lake
- turbidite = a geologic deposit of a sediment gravity flow related to earthquake shaking
- a year with a lot of algae (diatoms) related to climate conditions
- slightly darker, less green/yellow sediment since the arrival of the European colonists (although hard to see in this core)

1948

arrival of European colonists



Cordula Daus: As a paleoseismologist you analyze geologic sediments for signs of ancient earthquakes or volcanic eruptions. You brought a sediment core which now lies in front of us. Maybe we can take this object as a point of departure to talk about geological evidence and about what we see...

Jasper Moernaut: This sediment core was taken from Lake Calafquén six years ago. So what we see on one end is the year 2009. On the other end we are looking at a time 1000 years ago.

In a meter of sediment we can be a thousand meters deep in years?

Yes. Every year a layer of 1 mm of sediment gets accumulated at the bottom of the lake. If nothing happens...

That's like the rings in a tree, nature's yearly routine...

Yes, these background sediments

or laminations represent the annual deposits in the lake. And then, when something extraordinary happens, a volcanic eruption or an earthquake, you get a special layer. An “event deposit” – that’s how I call it.

What are we actually able to see in these sediments with our mere eyes?

To count the years you would need a microscope. What we can recognize are signs of big events. Do you see these rather homogenous packages of earth with some sand at the base and a thin top of clay? These are turbidites[■], geologic deposits produced by landslides. During an earthquake or volcanic eruption the bottom of the lake might get filled by three centimeters in a single day. This interrupts the normal pattern. An earthquake of high intensity will remobilize and deposit a lot

