On shaky ground
the history of earthquakes in Ethiopia

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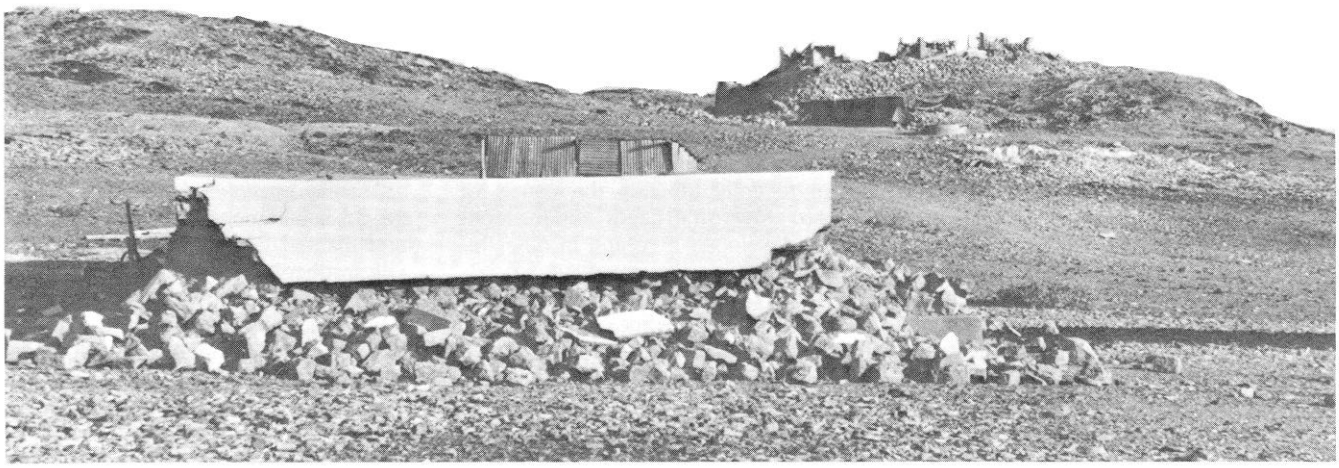


"In the year 87, Zara Yakub was crowned emperor and took the name Constantinos I. That year there was a total eclipse of the sun and the earth shook many times."

Ancient historians, in Ethiopia as elsewhere, were fond of linking the date of birth or coronation of their sovereign to a spectacular natural phenomenon. Modern historians suspect that their ancient colleagues may even have added a few earthquakes and comets here and there in order to give a little more importance to certain special moments in the lives of the great. But no one has cast such suspicions on the chronicler of Zara Yakub's reign. There is no need to invent tremors in a country where the earth quakes on the average of twice a day.

Today the facts recounted by the ancient historian can be found in a new history of Ethiopia — a very special history in that it is a seismic account of the "land of bronzed faces" written by a more specialized successor of the old chronicler. Entitled *Earthquake history of Ethiopia and the Horn of Africa,* the new Ethiopian chronicle is the work of Pierre Gouin, a Jesuit and founder-director of the Geological Observatory in Addis Ababa.

Very few people know more about the history of Ethiopian substrata than Gouin. Born in Montreal, he received a degree in geophysics from Boston University, and taught on the subject and worked as a geophysicist in Ethiopia for almost 30 years. He became the father of Ethiopian geophysics, so to speak, and was a recipient of the Haile Selassie Prize Trust award in 1969, along with anthropologist Louis Leaky.

In 1976 the University of Addis Ababa published Pierre Gouin's first work, entitled *Seismic zoning in Ethiopia.* This book, produced at the request of the Addis Ababa government, and supported by IDRC, is essentially a seismic map of Ethiopia. It contains the magnitude, and probabilities of earthquakes in 650 locations across the entire country, including 32 towns and villages and 60 existing or planned dam and reservoir sites. Evaluating seismic risk is of particular importance in Ethiopia because of the frequency of tremors and the fact that many communities are located at the edge or at the foot of steep cliffs. Landslides set off by earthquakes could therefore bury entire villages. Such a disaster has already struck the regional capital of Ankober, which was completely destroyed by a landslide in 1842.

Seismicity, as described in *Seismic zoning in Ethiopia,* was determined chiefly through a computer analysis of reams of seismograms recorded between 1900 and 1975. It is in fact only since the turn of the century that modern instrumentation has recorded Ethiopian earthquakes with enough detail to provide accurate data for computer analysis. Consequently, the forecasts in *Seismic zoning* are based on tectonic activity over the past 75 years, an extremely short period in geological terms. According to Gouin, it was necessary to situate the seismic phenomena of this period within a much larger time frame in order to determine if it was truly representative of Ethiopian seismicity. This meant that data from the "instrumentation" period had to be compared with all information available on the "pre-instrumentation" period. Before the advent of seismographs, the only available data were facts related by historians. Gouin therefore undertook to gather all the information that had been written on Ethiopian seismic activity. He would then be in a position to compare the "instrument seismicity" with the much longer period of "historical seismicity".

"It is fortunate that in Ethiopia, it is possible to consult written documents spanning many centuries, some dating as far back as the 9th century BC", says the geophysicist, who was able to consult some very ancient chronicles.

Gouin brought together all this information in *Earthquake history of Ethiopia and the Horn of Africa,* which will be published by IDRC in 1979. "This second volume", he says, "is, in a manner of speaking, a justification of the probabilities contained in the first book." He acknowledges that he had to break new ground: "My work will, nevertheless, suffice for the needs of the seventies, at

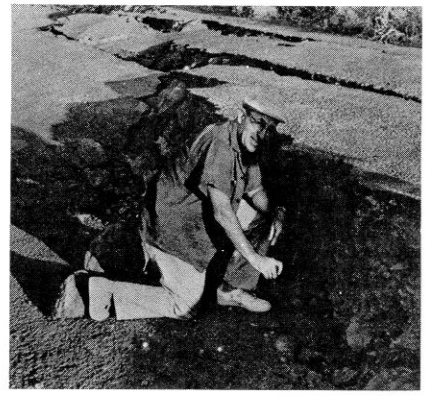
least. But beyond that, if they decide to build nuclear power stations, for example, it will be necessary to make more precise calculations than those contained in *Seismic zoning*. Thanks to the second book, it will be easier to revise my calculations. This seismic history of Ethiopia contains all my personal notes on the subject."

These notes cover the past 575 years of written Ethiopian history: the first geological activity is recorded in a document dating back to the eruption of the Dubbi volcano, on the Red Sea coast, in 1400 AD. The text was written by a historian from neighbouring Yemen, reporting the accounts of sailors who had seen "an immense column of black smoke turn into a great mass of land" and "become a series of hills in a place where, until then, no hills of any sort had ever been seen". This first account of a seismic occurrence was relatively easy to find as the Arabic text had been incorporated into a history of the Yemeni kingdom written by a Briton. However, Pierre Gouin's historical research was to lead him further afield, among other places, to libraries in Rome and the Vatican where numerous Italian works on Ethiopia are kept. He also consulted a great many other sources, including the diary of a French Capuchin monk, Russian seismological bulletins from the beginning of the century, and manuscripts by Ethiopian monks, translations of some of which were conserved in the Bibliotheque Nationale in Paris.

The relative abundance of such documents guaranteed a plentiful harvest of recorded tectonic occurrences, but at the same time raised some difficult problems. The authors often came from totally different cultures — Arab, Egyptian, Italian, French, Russian, and others — so Pierre Gouin was faced with numerous conflicting chronological systems and almost as many spellings of place names as there were sources.

He had to correlate no fewer than 17 different calendars, from the era of the Creation of the World, which began in 5492 BC, to the era of the Incarnation, which began in 8 BC and is currently in effect in Ethiopia, to the Diocletian era, or time of the Martyrs, which began in 284 AD. The situation was further complicated in that although certain chroniclers referred to the same era — that of Diocletian, for example — some assigned to it a year zero, while others did not. In order to make some sense out of all these calendar systems, in which years

Pierre Gouin, measuring the upheaval produced by an earthquake in Ethiopia. On the opposite page, an indication of the destruction . . . a roof lies on shattered walls.



did not always have the same starting point or length, the geophysicist became an astronomer. "Because computers have enabled us to determine with great precision the dates of eclipses from 2000 years before Christ, I was able, by finding references to certain eclipses in each calendar system, to determine to which days in the Gregorian calendar (the present universal calendar) the dates mentioned in the various other systems corresponded", Pierre Gouin explains. This meticulous work even made it possible for him to correct certain errors committed and repeated from author to author down through the ages. At the same time — and this was the end he was striving for — he was able, by reconciling the calendars, to avoid counting the same earthquakes more than once. Ethiopia had quite enough earthquakes of its own without his inventing any!

Another major difficulty stemmed from the fact that most of the country's towns, villages, mountains, and rivers do not yet have official names. There are 80 distinct Ethiopian languages and dialects, and each observer, whether foreign or Ethiopian, had transcribed the local pronunciation of place names in his own way. As a result, there were as many as 15 different variations of the names of certain towns. Once again in order to avoid exaggerating the number of earthquakes, Gouin had to undertake real detective work and consult at length Ethiopian elders and scholars.

The author of *Earthquake history of Ethiopia and the Horn of Africa* accepted all these challenges and produced a work that will no doubt be consulted for a long time to come, regardless of his own modest assessment of its useful life. The book comprises a detailed description of seismic events, with many photographs, maps, and charts. And because the Ethiopian plateau is the only place in the world where there is a surface example of basaltic intrusion — which, according to the theory of continental drift, is how the oceans originated — the book will undoubtedly not only be indispensable to Ethiopia, but will also contribute to the science of geophysics itself.

There is another important facet to Pierre Gouin, the author of geophysical works, that of teacher.

Gouin has contributed to the training of an entire generation of Ethiopian geophysicists who have already begun to serve their country. In addition to participating in theoretical research on the spectacular faults running across Ethiopia, his students have become involved in exploration for copper, iron, and bauxite deposits, leading to the establishment of a number of commercial mines. More recently, the government asked them to devote their efforts to finding underground water sources, supplies that are becoming vital because of drought.

Gouin has travelled all over Ethiopia and says he is struck by the country's immense energy resources, both hydroelectric, on the Blue Nile, and geothermic, in the north. Unfortunately, despite the country's pressing needs, development of such potential is thwarted by the prohibitive cost of transmission lines, and Pierre Gouin concedes that geophysics cannot move these resources closer to population centres. He is nevertheless confident that the Ethiopians will one day reap the benefits of their geophysical wealth.

When asked about future projects, Gouin says he is hesitating between pursuing his career in the Philippines — friends have been asking him for a number of years to come and write that country's seismic history — and working on other books, including a geophysics textbook for African students with examples taken from Africa, and another book on the numerous calendar systems that so greatly complicated his task. □

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