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„... *Earthquakes occur on specific points and lines which ... mostly coincide with traceable fracture lines* ...": Eduard Sueß' study of earthquakes in Lower Austria and southern Italy (1873, publ. 1874/5) helped pave the way for modern seismotectonics

Jürgen STREHLAU, Kiel

In the spring of 1871, Eduard Sueß (aged 40) went on one of his frequent field trips to Italy. Accompanied by a few colleagues, among them Gerhard vom Rath (professor of geology at the University of Bonn) who subsequently published his travel diary [vom Rath 1871], Sueß climbed Vesuvius and Etna and hiked in Calabria, a tectonically active region that has suffered many catastrophic earthquakes [e.g., Galli & Bosi 2003]. In fact, on their way to the town of Cosenza, Sueß and vom Rath passed through villages which had been struck by a large earthquake just half a year before (Cosentino earthquake of 4 October 1870, magnitude ~6.2 (estimated macroseismically [Gruppo di lavoro CPTI 2004]).

Sueß later mentioned in his autobiography [Sueß 1916, p. 232] that upon their arrival in Cosenza, „the first thing that gripped us was the collapsed theater", bearing in mind that just a few days earlier they had visited an Easter Passion play in the theater at Stilo which had not been affected by the earthquake. In a popular-science presentation, Sueß [1880, pp. 22-23] described the strong impression that the „ruins of deserted villages" and accounts of „undescribable horrors" told by survivors „living yet uneasily in newly built villages" had made on him. He also stated that this experience had been an impetus for him to study the relationship between earthquakes and the structure and tectonics of mountain ranges.

Back in Vienna, Sueß consistently pursued his idea (beside his political activities for the construction of the water pipeline which was completed in 1873). In two papers presented to the Imperial Academy of Sciences in Vienna in June and November of 1873 (published in 1874 and 1875), he proceeded „... to investigate whether ... great fracture lines ... have an effect on the distribution of earthquakes or not" [Sueß 1874, p. 61]. A further aim was to seek „insights ... about the potential extent of a link between seismic and volcanic activity" [Sueß 1875, p. 12]. He argued that both earthquakes and volcanoes are associated with deep-reaching fracture zones which he regarded to be closely related to the process of mountain building.

The idea that earthquakes are associated with sudden displacements on fractures and faults had been considered previously since about 1830, primarily by British geologists (e.g., Charles Lyell, Charles Darwin, William Hopkins, Robert Mallet, and Osmond Fisher; see Sibson [2006]). Initially, however, the concept of seismogenic faulting was controversial and evolved gradually over several decades, mainly for two reasons: (1) Observations of surface faulting were still rare and anecdotal, and were increasingly and convincingly documented only from the late 1880s onward (photographs of fresh fault scarps offsetting roads, fencelines, railroad tracks etc.); (2) Many Earth scientists traditionally adhered to the plutonistic view that earthquakes are exclusively of volcanic origin, or believed them to be caused only by the collapse of subterranean cavities (see the review by Oeser [2005]).

Progress began to accelerate when Eduard Sueß plotted the locations of maximum felt intensities of historical earthquakes in Lower Austria and southern Italy. He found that epicentral areas were not distributed diffusely but seemed to be aligned along specific lineaments, e.g. the Mur-Mürz line (a section of the „Vienna Basin Transfer Fault"; e.g., Hammerl & Lenhardt [1997], Hinsch & Decker [2003]). Similar alignments of felt earthquakes on a larger scale (called „seismic bands") had already been noticed on one of the first global seismicity maps (1858) by Robert Mallet and his eldest son, John W. (see Dean [1991], Ferrari & McConnell [2005]), but Sueß was probably the first who used aligned epicenters to infer the presence of tectonic faults.

Sueß deduced from his observations that earthquakes occur on „... lines remaining constant for centuries, representing fractures or faults or some other discontinuity in the Earth's crust" [Sueß 1874, p. 94]. In other words: „As the most important result it appears that the earthquakes [in southern Italy and Lower Austria] occur on specific points and lines which ... mostly coincide with traceable fracture lines or tectonic dividing lines of mountain ranges" [Sueß 1875, p. 32]. Because most of the earthquakes were spatially distinct from volcanic areas, Sueß concluded that earthquakes are mainly associated with tectonic processes rather than volcanism.

Sueß' results motivated other scientists, among them Rudolf Hoernes (Graz), Arnold von Lasaulx (Bonn/Breslau/Kiel), and Hermann Credner (Leipzig), to correlate the strike and orientation of lineaments inferred from felt intensities of earthquakes with tectonic faults that had previously been mapped in the epicentral regions (the effect of local site conditions on ground shaking was still largely unknown). The results supported Sueß' suggestions, and helped to resolve the question as to whether earthquakes cause faulting or whether faulting causes earthquakes (e.g., Koto [1893]). Consequently, by the early 20th century, tectonic faulting had become widely accepted as a major cause of earthquakes.

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Author's address:

Jürgen STREHLAU
Institut für Geowissenschaften
Christian-Albrechts-Universität Kiel
D-24098 Kiel, Germany