

## FOOTNOTES



p1: A few days before the Kobe Earthquake in 1995 some people said their dogs didn't want to go to the local park. These reports may have had nothing to do with the earthquake but the special sensitivities of animals are known and used in detection of drugs (by dogs) at airports and (by canaries) in detecting poisonous gases. [Back](#)



p2: Fish in ponds aligned themselves in the same direction and others were seen leaping out of the water just before the Kobe Earthquake. In laboratory tests, minnows stimulated by electric pulses turn side-on to the direction of the electric field to minimize the amount of exposure. Just before the Tangshan Earthquake in China, goldfish reportedly jumped squeaking out of the water ([see Figure 1](#)). [Back](#)



p3: Ducks would not enter a river before the Chinese Tangshan Earthquake (240,000 casualties). Crocodiles came out of their pool before the Izu earthquakes in Japan. The same thing was reported in a Turkish zoo. *Earthquakes and Animals* argues that electric current was flowing in the water before the earthquakes making the aquatic environment distressing. [Back](#)



p4: There is an old Japanese saying, *Earthworms emerging from the soil during the cold is a sign of an earthquake*. A huge number of earthworms appeared above ground before earthquakes in Rumania and Taiwan and also before big aftershocks (see photo right). In laboratory tests they emerged when pulsed current was applied to wet soil. [Back](#)



p5: Before big earthquakes cats have been reported climbing high into trees and, meowing plaintively, leaving the house carrying their kittens in their mouths ([see Figure 2](#)). Rats were reported to have disappeared before the Kobe Earthquake. Photos of rats fleeing along a cable wire were taken before an earthquake in China. [Back](#)



p6: Some people reported feeling irritable, or had headaches before the Kobe Earthquake. Thirty percent of children who were at the epicenter of the quake woke up before the quake, and some of them got into their mothers' beds ([See Figure 3](#)). [Back](#)

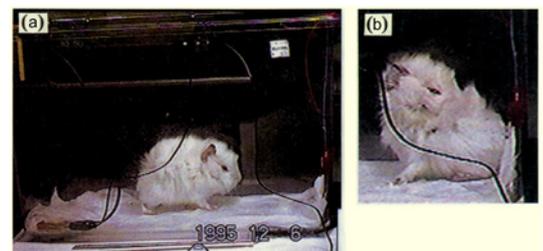


p7: Can earthquakes affect the atmosphere? Tornado-like clouds and parallel bands of cloud have been reported before earthquakes. Earthquake clouds can be formed in a laboratory by creating intense electric fields in a super-cooled atmosphere ([see Figure 4](#)). Intense electric fields in the Earth's atmosphere can produce earthquake fogs. They can also indirectly cause pink sunsets by light scattering. [Back](#)



p8: Animals are reported to have come out of hibernation and moved around before earthquakes ([see Figure 5](#)). [Back](#)

p9: Hamsters have been reported fighting and biting each other before earthquakes. Right (a) a guinea pig before application of electric pulses, (b) grooming behavior during application, probably to soothe irritation. Mice, observed for biorhythmic studies at Osaka University with an automatic device, became unusually active before the Kobe Earthquake. There were many reports of disturbed budgerigars in Turkey before the Izmit Earthquake (M7.4, 1999) and one hour beforehand one parakeet made such an unusual fuss it woke its owner. [Back](#)



p10: Electromagnetic (EM) noise can make mobile phones malfunction erratically. Although this is not necessarily a warning sign of an earthquake, it may be if there is no other known source of EM waves and the device is not failing. [Back](#)



p11: An old Japanese proverb says, *Be wary of earthquakes, thunder, fire and your father*. Thunder is caused by electric discharges in the atmosphere. These discharges release EM waves. EM waves are also released when rocks restraining fault movement give way causing an earthquake. Animals are sensitive to both electric fields. [Back](#)



p12: Atmospheric phenomena before an earthquake may occur when tiny drops of water produced in an electric field do not develop into earthquake fogs or clouds but scatter light. When those drops of water move, it can make stars look like falling stars. The proverb, *The shimmering of distant mountains is a sign of an earthquake*, probably comes from this phenomenon. The elongated moon (right) may be due to lensing effects caused by bands of cloud. [Back](#)



p13: Flashes and red-light emission in the sky before earthquakes have long been recorded. Light emission can be explained as an atmospheric electric phenomenon. Strong electric fields can produce light at night and, during the day, drops of water that appear as fogs or clouds. [Back](#)



p14: EM noise can make electric appliances malfunction. Refrigerators can switch on and off spontaneously, making odd noises. Fluorescent lamps may dim due to EM waves from earthquakes and from thunder. Short horizontal lines of light or “barber pole” color bands can appear on TV screens before earthquakes and the channel setting may not work. Image disturbance in a TV program broadcast eight hours before the Kobe Earthquake, was



video-taped and analyzed and later replicated in EM fields in the laboratory. Strong EM interference with TV reception was reported more than an hour before one quake at a locality 20-30 km from the epicenter. Above: Disturbance on a TV screen before the Kobe Earthquake. The left picture is normal but color banding and speckling appear in the right. [Back](#)



p15: Before the Izmit Earthquake in Turkey and the Taiwan-921 Earthquake, people reported erratic hand movements in quartz clocks. In the laboratory (see right) when strong EM waves cause a short circuit, the second hand of a clock stops or rotates two, four or eight times as fast. [Back to Book](#)  
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pp 16 & 17: Some fish (e.g. catfish) have small holes in the skin called electroreceptors which detect weak bioelectricity emitted by their prey in the mud and sand. They can detect an electric field as weak as 0.005 mV/meter. Ordinary fish also communicate with each other using tiny electric signals created by muscle movement. They would also be receptive to electric fields created by EM waves before earthquakes. Land animals, as well as aquatic animals, may sense electric fields through their whiskers and body hair. Though it is not clear which organs might be affected by electric fields, the heart may be. Certainly electric current flows freely through animal eyes and tongues. [Back](#)



P18: During lightning storms electrical fields are created when positive and negative charges are separated. Many scientists also agree similar electrical fields (seismo-EM signals (SEMS)) are observable before earthquakes. So animals, electric appliances and electronic objects reacting to these electrical fields may be reacting to an approaching storm or the build-up of pressure on rocks before earthquakes. [Back](#)



P19: Before big electrical storms animals may become distressed by the irritation in their tissues caused by EM pulses and some may run away. However, unlike storms, EM disturbance created before earthquakes has no associated noise. More intelligent mammals may fear an invisible predator. [Back](#)



p20: There are many legends that say, *When underground animals move violently, an earthquake occurs.* Those animals are the catfish in Japan ([see Figure 6](#)), dragons in China, and water buffalos in India. They may be based on the observed behavior of these animals before earthquakes. (A tornado cloud could be said to resemble a dragon.) [Back](#)



p21: An Indonesian legend says that a huge turtle supports the land on its back, but that if people forget to placate it with offerings, it can become violent causing earthquakes and tsunamis. It's only a legend but it hints again at ancient associations between earthquakes and unusual animal behaviour. Not long before the great Aceh earthquake off the coast of Sumatra in December, 2004 (250,000 casualties), there were media reports of zoo animals including elephants fleeing to the safety of the hills. [Back](#)



p22: In the center of the earth, there is a hot iron mass called the core, which is surrounded by a semi-fluid mass called the mantle. Layers of rocks floating on the mantle are called the crust. Heat convection moves plates that are part of the crust. These plates underlie oceans and landmasses and become stressed as they push against each other, causing contortion and destruction of rock. Finally an earthquake occurs as the ground moves. [Back](#)



p23: Plate boundary earthquakes occur when an ocean plate slides under a continental plate and the continental plate finally rebounds upwards. Inland earthquakes occur as a result of sudden fault movement due to the accumulation of pressure caused by relative movement of tectonic plates under landmasses. [Back](#)



p24: Mimosa plants will close their leaves and bow their stems in response to an electric discharge ([See Figure 7](#)) . [Back](#) [Back to Postscript](#)



p25: Many people have reported deep groaning sounds coming from underground before a quake. It is not clear what the sound is but reports of dogs and cats trying to pull their masters away – as if to protect them - have come from many countries. [Back](#)



p26: You can reduce your own chances of injury by taking measures to stop furniture and household items sliding and falling, especially if a quake occurs at night. Once you've prepared well for disaster, don't worry too much. [Back](#)



p27: After a big earthquake, the usual services may not be available so keep a three-day supply of food and water and other necessary items handy. Don't forget to update them. We can't stop an earthquake but we can improve our chances of survival. [Back](#)



p28: It is good to familiarize ourselves with the ordinary behavior of domestic animals and their unusual behavior at times of rain or snow, before a storm, or when seasons change. Observing the world around us and knowing some of the old earthquake legends will refine our awareness of earthquake signs. In the event of an earthquake as large as the Kobe earthquake (M7.2) unusual phenomena can occur within a radius of 200 km from the epicenter. [Back](#)



p29: Radio waves from radios or TVs are too weak to affect animal behavior, but EM waves from engines and thunder are strong enough to do so. EM waves generated by rock stresses before earthquakes do provide an explanation integrating very diverse animal and plant behaviors and electronic phenomena. Some people argue that magnetism, low frequency sound or electrified dust can also explain earthquake precursor phenomena. [Back](#)



p30: The USA, Russia, France and Italy are exploring the possibility of earthquake forecasting based on seismo-EM signals (SEMS) and have launched satellites to observe EM waves before earthquakes. I hope and believe that scientists in the future will refine a forecasting method based on pre-earthquake EM emissions that will help reduce damage and injury. In the past 10 years, there has been considerable progress in this field. [Back](#)

See [Postscript](#) for further figures and information

See [Tables](#) for a summary of reported earthquake precursor events

