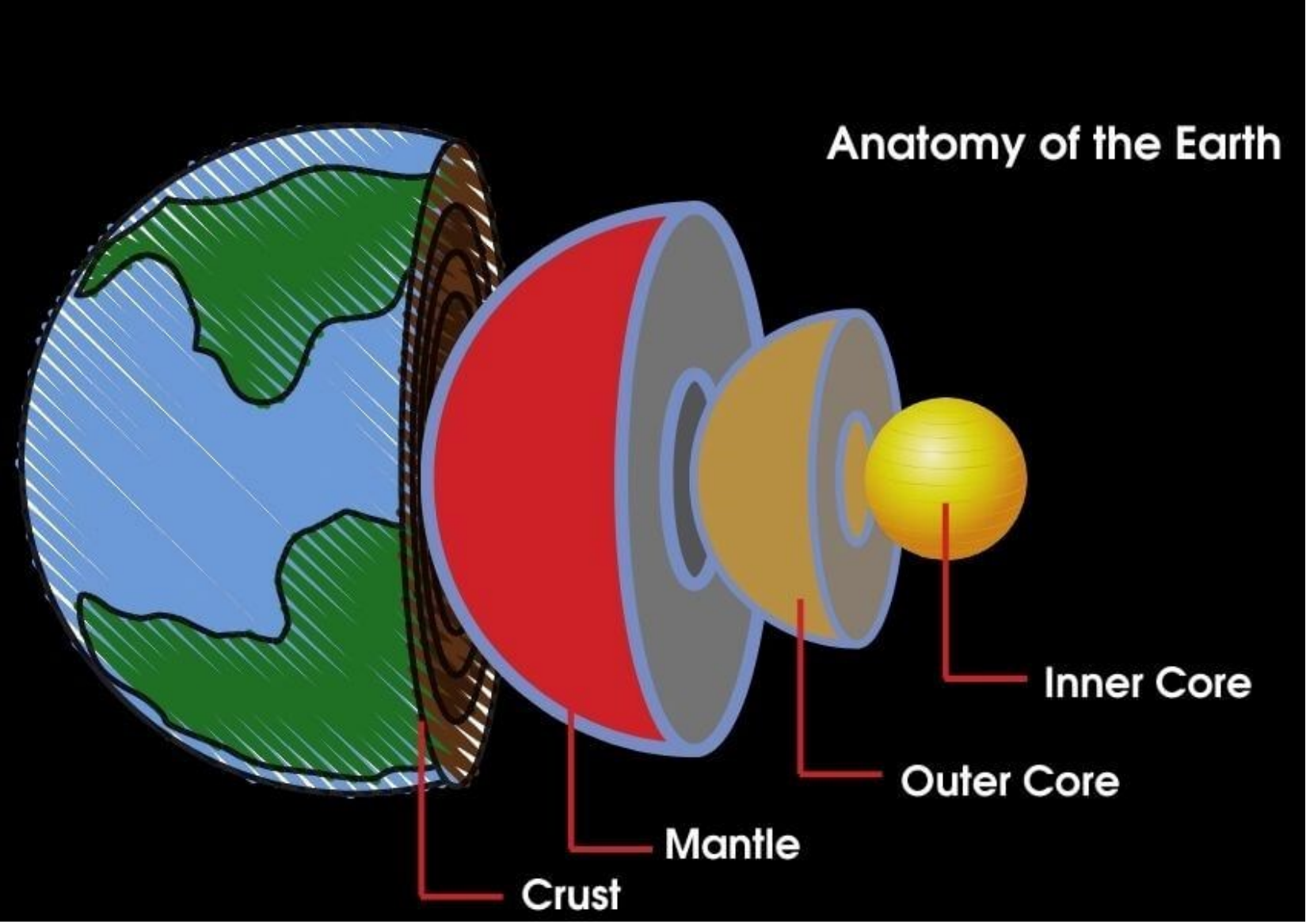
The animals that detect disasters

Crucially, Grant also found evidence of what might be triggering the changes in local animal behaviour, in the shape of a series of strong perturbations in local atmospheric electric charges every two to four minutes, starting two weeks before the earthquake. A particularly large fluctuation was recorded around eight days before the Contamana earthquake – coinciding with the start of the second stage of the animals disappearing from view.

Perturbation /ˌpəːtəˈbeɪʃ(ə)n/ noun: deviation in the motion

Scientists are now exploring whether these electromagnetic perturbations in the atmosphere prior to earthquakes could be a warning sign of impending quakes which animals may be sensing.

Earthquakes are invariably preceded by a period when severe stresses arise in deep rock – stresses known to create electronic charges called "positive holes".



These highly mobile electronic charge carriers can flow quickly from the crust to the Earth's surface, where they ionise air molecules above where they appear.

Ionize /ˈʌɪənʌɪz/ verb: convert (an atom, molecule, or substance) into an ion or ions, typically by removing one or more electrons.

Such ionisation has been noted prior to quakes across the globe. As these positive holes flow, they also generate ultra-low frequency electromagnetic waves, providing an additional signal that some animals may be able to pick up.

"Earthquake precursors aren't well documented scientifically," says Matthew Blackett, associate professor in physical geography and natural hazards at Coventry University. But some scientists theorise that animals could have evolved a seismic escape mechanism, he says. "Perhaps they detect pressure waves before earthquakes arrive, perhaps they detect changes in electric field as fault lines when rock starts to compress. Animals also contain a lot of iron, which is sensitive to magnetism and electric fields."

Precursor /prɪˈkəːsə/ noun: forerunner, predecessor

Seismic /ˈsʌɪzmɪk/adjective: relating to earthquakes or other vibrations of the earth and its crust.
"after a few days of seismic activity the volcanic eruption started"

Positive holes could also cause certain toxic chemicals to appear before quakes. For example, if they come into contact with water, they can trigger oxidation reactions which create the bleaching agent hydrogen peroxide. Chemical reactions between the charge carriers and organic matter in the soil could trigger other unpleasant products such as ozone.

Trigger: /ˈtrɪgə/ verb: cause (a device) to function.
Smoke triggered the fire alarm.

Meanwhile, days before the 7.7 magnitude Gujarat earthquake in India in 2001, a surge in carbon monoxide levels was picked up by satellites over a 100 square kilometre (39 sq mile) region centred on what turned out to be the epicentre of the eventual quake. Scientists have suggested that carbon monoxide gas could be forced out of the earth due to the build-up of stress in rocks as quake pressure builds.

Many animals, of course, are equipped with highly developed sensory apparatus that can read an array of natural signals on which their lives may depend – so it seems perfectly possible that some animals may be able to pick up any earthquake precursors. Unpleasant chemicals could be sniffed out, low frequency waves picked up, and ionised air sensed by sensations in fur or feathers.

Sniff out something: find something through smell
She put perfume on her wrist and sniffed it.

With earthquakes so difficult to anticipate, these findings beg the question: could humans actually predict earthquakes by animal observations, and thus be able to warn people they are coming?

Beg the question: to cause someone to ask a specified question as a reaction

In a 2020 paper, Wikelski and his colleagues set out a prototype for an earthquake early warning system using animal activity monitoring sites, based on data from his research in Italy. He estimated that farm animals above the point of origin of the imminent earthquake which were able to perceive it in some way would show activity 18 hours before it hit.

Imminent /ˈɪmɪnənt/ adjective: about to happen.
They were in imminent danger of being swept away.

Animals situated 10km (6.2 miles) away from the epicentre should show warning signs eight hours later, followed by animals at farms 20km (12.4 miles) away a further eight hours later. "If correct, this would indicate an earthquake is imminent within the next two hours," he says.

Researchers will need to observe a larger number of animals over longer periods of time in different earthquake zones around the world before they can be used to predict earthquakes. For this, Wikelski and others are turning to the global animal observation system Icarus on the International Space Station to gather movement data for animals globally.

Icarus stands for International Cooperation for Animal Research Using Space. Scientists taking part in the Icarus-initiative are working together to study the behavior of animals.

Icarus (International Cooperation for Animal Research Using Space) is an initiative set up by a global collaboration of scientists in 2002. It aims to provide an accurate global observation system for an array of tagged small animals (such as birds) to provide data and clues about interactions between the planet's animal life and its physical systems.

China, meanwhile, has already created a Quake Alert system based at its earthquake bureau in Nanning, monitoring the behaviour of animals much closer to the ground – specifically, snakes in farms across a wide quake-prone region.

Snakes possess a powerful array of sensory mechanisms geared to detecting tiny changes in aspects of their environment, and it was in part sudden changes in the behaviour of snakes and other animals which prompted authorities to evacuate the Chinese city of Haicheng in 1975, just before a major quake struck – an action that saved countless lives.

"Of all the creatures on the earth, snakes are perhaps the most sensitive to earthquakes," Jiang Weisong, then director of the Nanning bureau, told China Daily in 2006. "When an earthquake is about to occur, snakes will move out of their nests, even in the cold of winter."

Earthquakes are not the only environmental dangers animals seem to have advanced warning of. Birds are increasingly in the spotlight for apparently being able to detect other approaching natural hazards.

In 2014, scientists tracking golden-winged warblers in the US recorded a startling example of what's known as an evacuation migration. The birds suddenly took off from their breeding ground in the Cumberland Mountains of eastern Tennessee and flew 700km (435 miles) away – despite having just flown 5,000km (3,100 miles) in from South America. Shortly after the birds left, a terrifying swarm of over 80 tornadoes struck the area, killing 35 people and causing over $1bn (£740m) in damage.

Startling /ˈstɑːtlɪŋ/ adjective: very surprising, astonishing, or remarkable.
A startling cultural transformation occurred in post - war Britain.

Swarm /swɔːm/ noun: a large number

The suggestion seemed clear – the birds had somehow sensed the twisters coming from more than 400 km (250 miles) away. As to how, initial focus is on infrasound – low frequency background sounds inaudible to humans, but present throughout the natural environment.

Twister /ˈtwɪstə/ noun NORTH AMERICAN: a tornado

"Meteorologists and physicists have known for decades that tornadic storms make very strong infrasound that can travel thousands of kilometres from the storm," Henry Streby, a wildlife biologist at the University of California, Berkeley, said at the time. He further noted that infrasound from severe storms travels at a frequency the birds would have been well attuned to hearing.

Attune /əˈtjuːn/ verb (past tense: attuned; past participle: attuned): make receptive or aware.
A society more attuned to consumerism than ideology.

Detecting variation in infrasound is also thought to be the mechanism by which migrating birds seem able to dodge storms on vast ocean crossings – an idea now being tested by the ongoing Kivi Kuaka study in the Pacific Ocean.

Dodge /dɒdʒ/ verb: avoid (someone or something) by a sudden quick movement.
They managed to dodge the reporters by leaving through the back exit.

This study was inspired by a radio programme French navy officer Jérôme Chardon listened to about a bird called the bar-tailed godwit, which every year migrates 14,000 km (8,700 miles) between New Zealand and Alaska. As an experienced coordinator of rescue operations across Southeast Asia and French Polynesia, Chardon knew how treacherous this journey would be.

Treacherous /ˈtrɛtʃ(ə)rəs/ adjective: dangerous, hazardous
Snow and ice have left many roads treacherous, and motorists are warned to drive slowly.

Fierce storms frequently lash the Pacific and its diaspora of isolated island communities. So how were bar-tailed godwits seemingly able to make their annual journeys without being hindered by these ever-present stormy hazards?

Diaspora /dʌɪˈasp(ə)rə/

Hinder /ˈhɪndə/verb: make it difficult for (someone) to do something or for (something) to happen.
Language barriers hindered communication between scientists.

Set up in January 2021, the project involves a team from France's National Museum of Natural History fitting 56 birds of five different species with GPS trackers to follow the routes they take across the ocean. The International Space Station provides oversight, receiving signals from the birds as they fly – and observing how they respond to natural hazards en route. Their tags also collect meteorological data to help improve climate modelling and weather forecasting across the Pacific.

Kivi Kuaka will also look at whether bird behaviour could warn against more infrequent hazards like tsunamis, which are known to generate distinctive infrasound patterns that race ahead of the actual waves. The project aims to test birds' possible contribution to an early warning system informing the imminent arrival of a typhoon or tsunami, says Francesiaz.

The team is currently in the process of retrieving GPS tags on curlews to examine whether they reacted to an infrasound wave registered by French meteorological balloons in the Pacific a few hours after the recent volcano eruption in Tonga.

Samantha Patrick, a marine biologist at the University of Liverpool, is also examining infrasound as a method by which birds can detect and avoid natural hazards – and, by extension, perhaps alert humans too. "I think we can say it is possible that birds can sense changes in infrasound," she says. Patrick is currently looking at whether albatrosses show a preference for areas of high or low infrasound, although the analysis is not yet complete.

Not all experts think that animal early warning systems are a viable option for predicting disasters. And even if they do help, animal movements alone are unlikely to be enough to provide: people will need to rely on a combination of early warning signals to get the full picture.

Still, while we may not be able to talk to animals quite yet, perhaps it's time to pay more attention to their warnings.