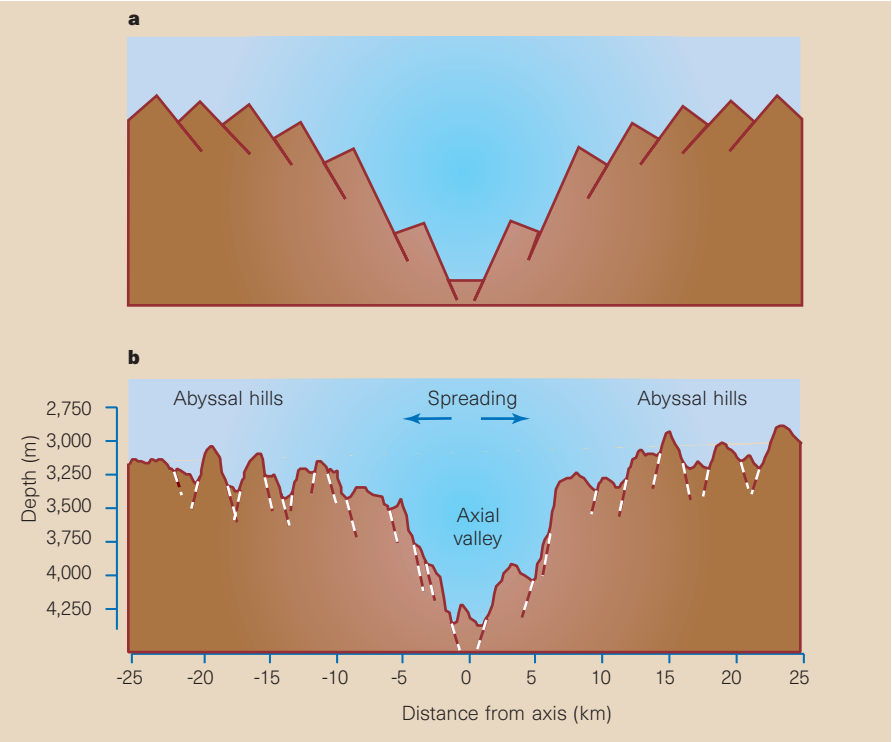

Figure 1 **Two views of the formation of abyssal hills.** a, **An idealized representation of faulting at a mid-ocean-ridge rift axis with an axial valley. The idealized faulting does not reproduce the chaotic-looking nature of abyssal hills, as shown in** b. b, **Bathymetric profile across the southeast Indian Ridge near 115° E, typical of mid-ocean ridges with slow to medium spreading rates. Hypothetical fault locations are shown by dashed lines. Faults are driven by spreading localized at the mid-ocean-ridge axis, leading to the formation of an axial valley and, eventually, abyssal hills. Buck and Poliakov's numerical faulting model[5], discussed here, reproduces the chaotic appearance of abyssal hills, thereby increasing our ability to predict the behaviour of such complex systems from physical principles.**

steam. After too many measurements of the fractal dimension of this or the fractal dimension of that, a collective 'Now what?' seemed to rise from the scientific community. What does the fractal dimension, or any other statistical measurement for that matter, really mean? What do these descriptions tell us about the physics, geology or biology of the process being described? There is a gulf between merely describing the statistical behaviour of a natural phenomenon (which can also include properties such as mean, variance and correlation, as well as fractal dimension) and understanding the physical principles which lead to such behaviour, especially as one moves beyond the quantum world into the macroscopic.

That gulf has been bridged in select circumstances. For example, in 1948 von Kármán published an elegant treatise on the statistical theory of turbulence[8], in which he used physical principles to infer how velocity cells cascade to ever smaller cells. From such arguments he derived the well-known 'two-thirds law' which characterizes the power law exponent of the spectral density function (a statistical description) for a turbulent velocity field. The power law exponent is, in essence, a proxy for the fractal dimension.

Von Kármán's work was one of the first successful attempts to connect a physical description of a chaotic, macroscopic natural phenomenon (turbulence) with a quantitative statistical characterization of the same phenomenon. It also led to a generic descriptive statistical model that has been successfully used to quantitatively characterize a wide variety of completely unrelated geophysical phenomena, including abyssal hills[2].

Although it is perhaps the simplest example of faulting on the Earth, faulting at mid-ocean ridges is still too complex a system to derive statistical character from physical principles. Rather, these systems must be investigated numerically with models that incorporate as much of the relevant physics as possible. Buck and Poliakov's paper[5] is the latest product of this line of research. Each new study of this kind has the advantage of increased computer power over previous ones, and a few years ago it would have been impractical to attempt to numerically model such a large and diverse faulting system as that which gives rise to abyssal-hill morphology. But Buck andPoliakov have also added a simple butcritical innovation that allows for the spontaneous development of faults when a failure criterion is met; that is, when the stresses generated by plate

100 YEARS AGO

In this brochure, Mr Moxly expresses his dissatisfaction with the theory of the tides, as ordinarily accepted, and submits an alternative explanation. Although he opposes the views generally held, he does not exhibit that spirit of antagonism and adopt the language of abuse that too frequently disfigures the writings of those who dissent from authoritative teaching. … The author considers that the tides are heaved up by the earth's gravity. The differential attraction of the sun and moon simply gives an opportunity for the earth's gravity to display itself in this manner. This action is illustrated by reference to a football. When the leathern covering is injured, or a seam gives way, the inner india-rubber case bulges out through the opening in the outer cover. "The pressure of the outer case had been removed from one region of the ball, and the pressure of the part which remained did the rest. This, I take it, is exactly how the pressure of the earth's gravity produces the tide." We are all prepared to admit with the author, that the tide-raising force is directly opposed to the action of the earth's gravity, though we might not adopt his phraseology. But another elementary proposition shows that the tide-raising force varies inversely as the cube of the distance from the disturbing body, and we fail to derive this from the football illustration …

From *Nature* 17 March 1898.

50 YEARS AGO

For two hundred years, popular writers have attacked traditional religious beliefs in the name of science and pretty well undermined the faith of the plain man. Now, however, the sceptical attitude is turned against science itself, at a moment when, thanks to recent developments of physical theory, science appears vulnerable intellectually and, thanks to recent developments of military and political technique, still more vulnerable morally. Modern men, finding themselves with nothing to put their faith in, fill the spiritual vacuum with bogus religion based on bogus science, like Nazism and Communism. Even the more modest alternative, the assurance that all problems are technological and that the salvation of mankind depends on bigger and better gadgets, is not entirely satisfactory.

From *Nature* 20 March 1948.