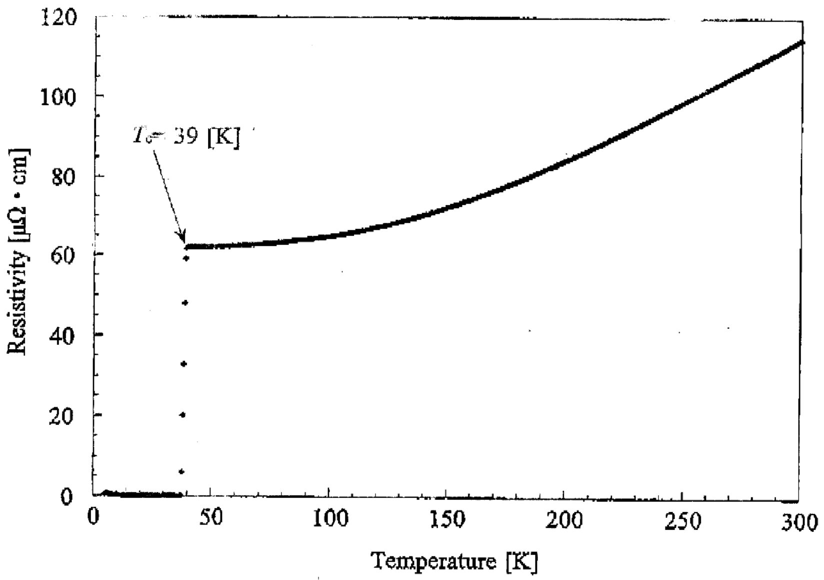

Figure 6. Temperature dependence of the resistivity of MgB_2 under zero magnetic field[2]. Reprinted by permission from *Nature* (2001, **410**, 63–64). Copyright (2001), Macmillan Magazines Ltd.

conductivity is bulk in nature. Numerous other compounds crystallize with this structure. Whether all of them will exhibit superconductivity, some perhaps with higher transition temperatures is an open and tantalizing question.

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Random selection

Catastrophic Events, Fluids and Fault Lines

Why large earthquakes are rather rare
G. Golitsyn
Quantum, Jan/Feb. 2000, p. 4.

Beno Gutenberg and Charles Richter were interested in the relationship between the magnitude of an earthquake and the amount of energy it releases. The largest known earthquake (typically of magnitude 9 on the Richter scale) releases a million times more energy compared to the earthquake at the threshold to damage (typically of magnitude 5 on the Richter scale). The magnitude of an earthquake is proportional to logarithm of (maximum of amplitude of Earth's motion). So, for example, when one compares a magnitude 8 earthquake to a magnitude 4 earthquake, the ground is moving 10,000 times more in the magnitude 8 earthquake compared to that in the magnitude 4 earthquake. Gutenberg and Richter were also interested in the number of earthquakes of various magnitudes M. It was noted that the number of earthquakes of magnitude M is proportional to 10^{-bM}. Although b varies from place to place somewhat, generally it is equal to 1.

In the article under selection, Academician Golytsin deals with how 'various applications of science require knowledge of fluid flow. We will see why a large and interesting event requires a longer waiting period (expectation time) and how long one must wait (on average) to observe such an event'.

After dealing with droplets and tubes, Golytsin considers the nature of turbulence under the Earth's crust and then moves on to earthquakes *per se*. Seismologists usually express the distribution law for mean occurrence rate of earthquakes of magnitude equal to or greater than M as,

$$N(\geq M) \approx P/M^n, \quad (1)$$

where P is the power fed into the system and the exponent is $\approx 0.66 \pm 0.03$. According to Golytsin, considering that 'the heat flux, the ultimate source of the stresses in the crust is delivered to an area of the crust S_m of thickness h, the affected volume V_m is,

$$hS_m = h(M/\Delta\sigma)^{2/3} \quad (2)$$

and

$$MN(\geq M)/V_m = a_s P/(hS_m), \quad (3)$$

which gives ultimately,

$$N(\geq M) = 0.4PM^{-2/3}h^{-1}(\Delta\sigma)^{1/3}. \quad (4)$$

Here $\Delta\sigma$ is the stress accumulated during the displacement of lithospheric plates. The author states 'this formula, which I published in 1996, not only explains the nature of the exponents $0.66 \pm 0.03 = 2/3$ but also reveals the factors that are conducive to earthquakes'.

From the archives

CURRENT SCIENCE

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The Baluchistan Earthquake of 31 May 1935*

W. D. West, Geological Survey of India

The earthquake which occurred in Baluchistan on May 31st was remarkable in two respects. It was of high intensity at the epicentre, causing great mortality and much damage to property, yet it was felt over a comparatively small area, a little over 100,000 square miles. This is a rather characteristic feature of earthquakes in Baluchistan, and indicates that they must have a shallow focus. The epicentre, where the greatest damage was sustained, extended from the north-west of Quetta to half-way between Mastung and Kalat. Its position is shown on the accompanying map, together with the epicentres of the earthquakes of 1931 and 1909.

Since most of the inhabitants were asleep at the time of the earthquake, little information was forthcoming regarding the beginning of the shock. It so happened, however, that night operations were being carried out that night at a place about 4 miles to the north of Quetta, and it appears from the evidence of those taking part that about 5 to 10 s before the main shock started there was a preliminary tremor sufficiently strong to be recognized as an earthquake shock. The main shock came from the south and was accompanied by a noise like the roar of a train in a tunnel. The motion was described by the same observers as being like the action of a small boat in a choppy sea. People in Quetta itself generally described it as a sharp horizontal shake.

Another feature of the earthquake which aroused much interest was a line of fissuring in the ground which extended on and off for over 70 miles, from the south side of Chiltan to near Kalat. In places along this line the alluvium was severely fissured, in other places the ground had subsided two or three feet on one side or the other, while elsewhere the ground had heaved up a foot or two. Careful examination of this area, however, showed that the fissuring was purely a surface phenomenon, coinciding with the line of greatest intensity of shock, and it was clear that it did not penetrate the solid rock beneath. Where this line of fissuring crossed the railway line from Quetta to Nushki, the rails were severely crumpled.

The enormous death roll which occurred at Quetta is directly attributable to the very poor manner in which nearly all the buildings were constructed. Owing to the scanty rainfall in this part of India, it has been the practice in the past to use a mud mortar. Such a mortar has very little bonding power, and when an earthquake occurs, the very heavy lateral force to which the building is subjected simply causes the bricks to slide over one another, and the building collapses. In the case of the present earthquake a feature of great interest was provided by certain North-Western Railway bungalows which had been built since the 1931 earthquake and had been designed on earthquake-proof lines. Although surrounded by smashed buildings, they are without a single crack. It is difficult to imagine a more striking illustration of the efficacy of sound earthquake-proof construction, in which rigidity has been the main consideration. By making a building as rigid as possible, instead of the building falling apart during an earthquake, due to the different parts of the building behaving differently, it will move as a whole and so avoid being cracked. That these Railway bungalows did move as a whole was clearly shown by the fact that those who were living in them were so severely shaken that they were unable to stand up inside the bungalow during the earthquake, while heavy almirahs were also thrown down.

It will be seen that the centre of earthquake activity has gradually moved north-westwards since 1909. It is doubtful, however, if any conclusion regarding the location of the next earthquake can be inferred from this. Such knowledge as we have of previous earthquakes, in Baluchistan shows that they jump about from place to place in accordance with no apparent law. If, however, an earthquake be regarded as affording relief to the strains which have accumulated in the rocks, then it may be fairly safely predicted that the next earthquake, when it occurs will not be located along the same line as the present one.

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