S100: Science: a foundation course
S100/22: Earth structure

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Clip transcript: The nature of P and S waves.

Russell Stannard:
Well a physicist is interested in many different types of wave, sound waves, waves on the surface of water, waves going down springs and waves on ropes and all these waves have in common the fact that their velocity depends upon the nature of the medium through which they're travelling. Now we can divide these waves into two main classes. There are the compressional waves, and these are waves in which the medium moves at right angles to the direction, sorry along the direction of the wave motion itself. Then there are the transverse waves which move at right angles to the direction of the wave motion. Well let's take a look at these two waves and fix the difference in our minds.

Here we have a row of dots representing a row of atoms. If we give them a nudge you see the pulse is passed on from one to the other. And so on down the line. If we repeat this motion many times over then we get a series of pulses or a wave train, and the distance between these arrows is a wavelength. Now if you fix your attention on just one of those particles you'll see that it's not in fact moving from left to right down the line. All it is doing is just oscillating about its mean position and if we have an extended solid like the Earth, then of course we have several of these rows of atoms. And so this is the effect that gets produced. Now this is the other type of wave, the transverse wave, here the humps and troughs are moving from left to right. But if you notice the particles, they are not moving in that direction at all, they're just moving up and down at right angles to the motion of the wave. And here in the Earth we have a great many of these rows of atoms, we can imagine them now in layers moving up and down relative to each other. The disturbance still going from left to right.

Right well the geophysicists are interested in both of those types of wave. The first they call P waves and the second S waves. And these waves are created in earthquakes and we have here a famous earthquake region, it's the San Andreas Fault, the, we can see that in fact the picture is divided into two parts. You've got a line running along here, and this is in fact the line of the fault and over here we have the direction of a river which comes down to this point here and then suddenly jumps discontinuously over there. Well it's quite clear that what has happened is that part of the Earth's crust there has moved along the fault line relative to the other part.

Now one can demonstrate what is happening here with the aid of this model. I've got here two blocks with springs attached to them and with the help of this model we can in fact put the Earth's surface features back to where they were before the earthquake occurred, in other words, let's move it along like this so as to join up the rivers there and there. And what happened in the past then was that stresses built up over the whole of this region and suddenly they gave way, you got a sudden slip and of course when you get this mass of earth moving this generates all kinds of waves and this is why we've got these springs here, with the help of these waves we can investigate the types of wave that we get in these various directions. Well let's first of all take a look at a direction which is at right angles to the line of the fault. Okay here we go. As you saw, the movement was a side to side movement. In other words, an S wave. Let's do it again. Forget about any reflections that you see coming back along the springs from the support, it's obviously got nothing to do with it. So there we are we, at right angles then to the line of the fault we have S waves. Now how about here?

How about along the line of the fault and in the direction, in the direction in which I'm going to move the block? Okay here we go. Right, well once again forget about the reflection. What you saw was a compressional pulse moving along, the springs closed up as I pushed the block against them and it was this bunching effect which you saw moving along. Let's try it again. Once more. Okay well let's see that in slow motion now. Here comes the pulse. Just move the spring back to where it was. Repeat it once again, there we are.