

# The Hologram tells the whole story

To judge a book by its cover' is sometimes pretty good physics, says S.Ananthanarayanan.

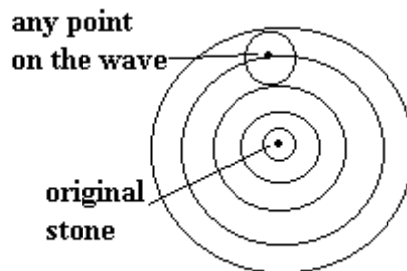
It has to do with how waves behave and a principle that if we know how strong the waves are at the periphery of a surface, then we can work out what happened inside

## Its simpler than it sounds

Say a stone is dropped into a pond. The water where the stone fell is pressed down and that spot bobs up and down for a few seconds. When it first goes down, it pushes the water all around it, in a circle around it, just a little 'up'. All this water then comes 'down', as all things must, and pushes the first, middle part right back 'up'. In doing that it also pushes 'up' the water outside the circle.

The water 'outside' also falls back in and pushes the water in the first circle back 'up' and also pushes up water in yet another 'outer circle'. And so on.

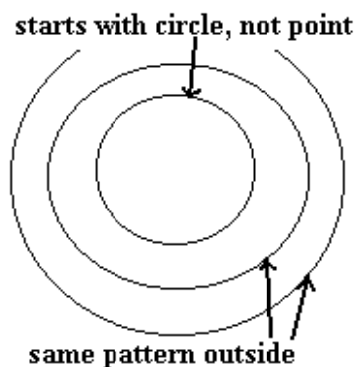
The important thing that each bit of water is set into motion in its own right and can be thought of as setting off new expanding, concentric circles of ripples. But because of how the effects add up, the net result is always of circles expanding from where the stone first fell.



## Forgetting history

What this also means is that if we could just start with water raised like at the top of a wave, in a circle, some 10 metres across, this circle would expand as if it had started not 10 metres across but as a smaller circle. And what is more, a person measuring the wave a few seconds later would think it all began with a stone at the center of the circle.

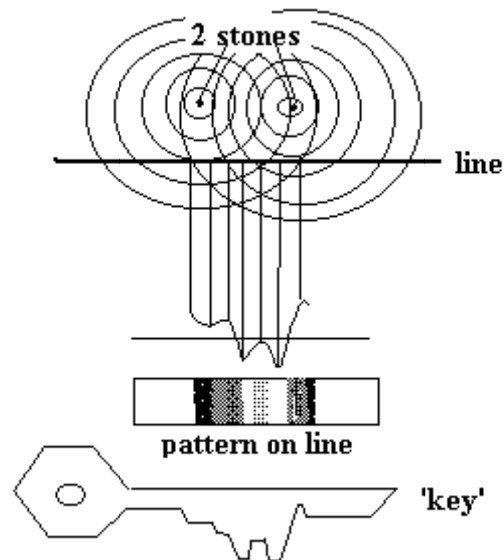
This implies that in the real case of a wave caused by a stone, if we just captured part of the wave and took it somewhere else, then the falling of the stone could be experienced again by just looking at the scrap of wave.



## Two stones

If two stones are dropped into a pond, then the two sets of circles 'interfere', and a rather complex pattern is formed. But here again, if even part of the pattern is captured and preserved, the events that took place 'behind' the pattern are recorded. The pattern along a straight line placed near the two stones, for instance, consists of a succession of 'ups' and 'downs'. The 'ups' are the points where the waves from the two spots 'added' and the 'downs' are where the two waves 'cancelled'.

Now, if this pattern along a line were converted into a 'key', with teeth where there were 'downs' and gaps where there were 'ups', then the key could reproduce the pattern from which it was made. If 'waves' were recreated like this, by pushing the key into the water, then the 'expanding pattern' would be just like it was in the original case, because the pattern along the line preserves the history that went before.



## The hologram

When a real, 3-dimensional object is bathed in laser light, the light from the laser lamp and the light reflecting off the object form an interference pattern. If the pattern is captured on a photo film the effect is of a series of dark and light stripes.

Now, if the laser light is later viewed through this pattern of stripes, the original object is seen, in the full three dimensions, and the eye would have no means of telling it apart from the real thing.