



The Physical World

Waves: Electro magnetic waves

ANGELA: Countless generations of mariners braved the perils of the sea with only their shipmates for company. But thousands of years of isolation changed in just a few short decades when in 1897 the first radio communication was sent over water across the Bristol Channel. This revolutionary form of communication used a mysterious new type of wave.

ANDREW: In the early years of the 19th century people like Michael Faraday and Joseph Henry were doing experiments with electricity and magnetism and showed that the two were linked. Then in the 1870's a Scottish scientist, James Clerk Maxwell, showed that they were really just two parts of the same thing, and he showed that electro-magnetic waves could exist, transporting energy from place to place via electric and magnetic fields. It was only after his death that Heinrich Hertz produced these radio waves and not until the early 1890's that Marconi showed there was a real use for them, and indeed radio waves are now the basis of our whole communications industry.

ANGELA: Radio seemed like magic. It could send messages fantastic distances, between continents and beyond. To do that radio waves must obviously be very different to sound waves, I mean I can't shout to America from here, but I could send a radio message, a message that would be carried by electro-magnetic waves.

ANDREW: There's a link between electricity and magnetism, in fact a changing electric field generates a magnetic field, and a changing magnetic field generates an electric field, and that's what an electro-magnetic wave is, it's a self-propagating, changing electric and magnetic field. Now whereas a sound wave is longitudinal in that the oscillation is in the same direction that the wave travels, then an electro-magnetic wave is a transverse wave. The oscillation is in one direction but the wave travels in a perpendicular direction to that, and that's rather more like these water waves.

ANGELA: In an electro-magnetic wave the electric and magnetic fields vary together, oscillate up and down in sympathy. You can't see it but energy passes from the electric field to the magnetic field and back again. A radio transmitter sends out oscillating electro-magnetic energy into space like the ripples on a pond or the waves on the sea. The energy in a water wave can travel across the oceans; well the same is true with electro-magnetic radio wave, but it can also travel out across space.

ANDREW: Although electro-magnetic waves travel in a similar way to other waves like sound waves or water waves, there is one important difference. Now water waves require a medium to travel, that's the water; sound waves also require a medium like air, but electro-magnetic waves don't require a medium. They can travel through empty space through a vacuum, and that's why we were able to send and receive radio messages to astronauts on the Moon.

FOOTAGE OF ASTRONAUTS

ANGELA: So Marconi getting a message across the Atlantic was the equivalent of talking to the Moon. His transmitter was set up down the coast here in Cornwall at a place called Poldhu. 2,170 miles away on the other side of the Atlantic Marconi's makeshift receiving aerial was a cable held aloft by a kite. Despite a howling gale, he managed to get it a hundred metres into the air and, to everyone's astonishment except Marconi's, it worked. England spoke to America wireless for the first time on 12th December 1901, and the rest is history.

TONY PAWLYN: It was a strong push to get radio at sea because of the total isolation of ships. It was probably more than the merchants and the owners who wanted it than the captains, although there was obviously many reasons why a radio would be useful when you were at sea in emergencies, etcetera, but many captains resented their loss of independence. The moment radios were effectively available, then the owners could issue commands at any time of the night or day, and tell the skipper what to do. But it also meant that wives at home could listen in for the first time to the messages their husbands were sending.

SHERRYL MURRAY: I've got it fixed up in the kitchen and I can listen to all the gossip. He'll even say to his friends sometimes can't say a lot today because I think we've got ears, but on the whole it's nice to actually listen to, even if it's just the other fishermen and not Neil that I can hear, it makes you feel closer than you perhaps were before.