

DR. WILLIAMS: I would, very briefly, because I do not have much time. I think this is an important point. Let me give you an historical example. At the end of the 18th Century, the great achievement of 18th Century physics was to reduce the universe to particles in space acting at a distance upon one another. Why? When I say reduce it, what I mean is this. Ponderable matter was composed of atoms acting upon one another by gravitational force. Electricity was supposed to consist of two electrical fluids--positive and negative--in which the same fluids repelled one another; opposite fluids attracted one another. But notice still, particles repelling and attracting one another.

Magnetism was considered to be two magnetic fluids doing the same thing as the electrical fluids, the difference being that whereas electricity could flow from bodies, magnetism seemed to be somehow inside the molecules and could not get out. Light was also considered to be particulate; refraction, for example, could be understood as the drawing in of the light particles, reflection as their repulsion.

Heat was considered to be composed of particles of caloric which repelled one another. There is the universe; particles in empty space; attracting and repelling one another.

There was a school of thought in Germany using the same facts, that argued this way; ultimate reality is not particles--not billiard balls--but the two forces of attraction and repulsion. These forces manifest themselves in certain ways--you see, what I feel from this stage--I do not feel atoms or electrons as they whirl around us but something pushing me up--I feel a repulsive force. And if I jump up I will feel an attractive force. So that, in German philosophy--this ultimately goes back to Kant--it was suggested that reality was the conflicting forces and that matter was one manifestation; light was another; electricity still a third; magnetism a fourth, et cetera.

Here you see you have the same facts, but notice the difference in interpretation. On the one hand, with particles you would never look for electromagnetism; you would never look for the production of magnetism by electricity. You cannot transmute electrical particles into magnetic particles. This is one of the astonishing things in the history of science; that 20 years after the discovery of current electricity the orthodox physicist never looked for electromagnetism. Hans Christian Oersted was a believer in the German