# Faraday's Intuitions

"On 11th April, 1846, the distinguished physicist Charles Wheatstone was scheduled to give a lecture at the Royal Institution in London. Michael Faraday was to introduce Wheatstone to the audience. At the last minute, just as Faraday and Wheatstone were about to enter the lecture hall, Wheatstone got stage fright, turned around, and ran out into the street. Faraday had to improvise and give a lecture himself. Normally, Faraday discussed in public only his actual experiments. But on this occasion he revealed certain speculations which, as he later admitted, he would never have made public had he not suddenly been forced to speak for an hour— although these speculations soon changed physics.

"What Faraday revealed concerning his intuitions on that occasion went well beyond those concening the ostensible topic of the role of electrical and magnetic lines of force toward the resolution of the nature of light. He suggested that his intuition led him to believe that the electromagnetic and gravitational 'fields' associated with basic particles might be all there is to matter – that, in fact, those fields are what basic particles 'are'. This is counter to the concept of particles being somehow 'real' objects in themselves, independent of their effects, as had hitherto (and since) been thought. The established notion was, and still seems to be, that these 'particles' are actors in generating lines of force. Faraday began his lecture with the following:

"You are aware of the speculation [M. Faraday, Phil Magazine, 1844, Vol XXIV, p136; or Exp.Res.II.284] which I some time since uttered respecting that view of the nature of matter which considers its ultimate atoms as centres of force, and not as so many little bodies surrounded by forces,…for that which represents size may be considered as extending to any distance to which the lines of force of the particle extend: the particle indeed is supposed to exist only by these forces, and where they are it is."

"Let us not be confused by the ponderability and gravitation of heavy matter, as if they proved the presence of the abstract nuclei; these are due not to the nuclei, but to the force super-added to them, if the nuclei exist at all…

We share Faraday's disdain for defining metaphysical entities whose effects are the only means by which they can be detected. There is, to be sure, considerable ambiguity to the concept of a 'center of force' as against a physical actor at that point. In either concept there is a vague notion of 'indivisibility' that needs to be retained. One tends to think of an object as 'in possession of' its attributes such as a red or heavy ball, whereas to suggest that there might merely be a geometrically spherical domain with varying degrees of redness or heaviness is harder to grasp. This is probably because we are concerned with what restricts the redness or heaviness to that domain? To eliminate the ball from consideration one must demonstrate that the restriction of the redness or heaviness to a region of space derives from its very nature and not from a secondary attachment. That is missing from Faraday's intuition, i. e., what accounts for the lines of force coalescing about a central point. We demonstrate the cause of this restriction in the fundamental 'particles' of nature. They are, in fact, nothing but the 'indivisible' charge and mass distributions that maintain an identity all their own by virtue of any variation in the distribution violating conservation laws as embodied in the solution of the Poisson boundary value problem. That is not a feature that can be attributed to an abstract 'point' particle using a Dirac delta function.