De l'importance des analogies dans la démarche scientifique elle-même : l'exemple des travaux de Maxwell

En introduction a son premier mémoire d'électromagnétisme *'On Faraday's Lines of Force'* en 1856, *J.C. Maxwell,1856* décrit sa conception des analogies en physique et leur rôle dans la démarche scientifique.

"We must therefore discover some method of investigation which allows the mind at every step to lay hold of a clear physical conception, without being committed to any theory founded on the physical science from which that conception is borrowed, so that it is neither drawn aside from the subject in pursuit of analytical subtleties, nor carried beyond the truth by a favourite hypothesis. In order to obtain physical ideas without adopting a physical theory we must make ourselves familiar with the existence of physical analogies. By a physical analogy I mean that partial similarity between the laws of one science and those of another which makes each of them illustrate the other."

Il se réfère ensuite à une analogie en particulier, formulée par William Thomson (alias Lord Kelvin):
"The laws of the conduction of heat in uniform media appear at first sight among the most different in their physical relations from those relating to [gravitational] attractions. The quantities which enter into them are temperature, flow of heat, conductivity. The word force is foreign to the subject. Yet we find that the mathematical laws of the uniform motion of heat in homogeneous media are identical in form with those of attractions varying inversely as the square of the distance. We have only to substitute source of heat for centre of attraction, flow of heat for accelerating effect of attraction at any point, and temperature for potential, and the solution of a problem in attractions is transformed into that of a problem in heat. (...)This analogy between the formulae of heat and attraction was, I believe, first pointed out by Professor William Thomson in the Camb. Math. Journal,Vol. III."

Ceci lui permet d'introduire de façon très pédagogique un aspect clés de sa méthode:
"It is by the use of analogies of this kind that I have attempted to bring before the mind, in a convenient and manageable form, those mathematical ideas which are necessary to the study of the phenomena of electricity."

Dans la suite de son mémoire, en s'inspirant des travaux de Michael Faraday, Maxwell va décrire les champs électriques a travers une imagerie géométrique, composée de lignes et de tuyaux de force qui coupent des surfaces équipotentielles, à laquelle s'ajoute une analogie avec un fluide incompressible imaginaire.