

formulae and results of analysis in the two subjects. Maxwell said light was an electromagnetic action. The undulatory theory of light, already established, said light was a transmission of energy through an elastic medium by a vibrating action. Maxwell said this undulatory action is electromagnetic: the two have the same properties and characteristics, deduced analytically from the formulae based on experiments in the two subjects.

In 1884, I designed a series of experiments for producing a magnetic field or an electric current directly from the solar radiation, which would be a direct proof of Maxwell's analytically prediction. No XIX of Faraday's Researches showed that a magnetic field rotates the plane of polarization of a beam of light. Would rotating the plane of polarization of a beam of light passing through the other or material substances set up a magnetic field? [A brief description of apparatus and experiments read from *Electrical Engineer*, March, 1889.] The imperfect apparatus and bad conditions for doing such work in the old college building prevented the obtaining of a positive answer from this series of experiments.

In September, 1889, Dr. Sheldon published, in the *American Journal of Science*, some experiments of his, identical in principle on the same subject, claiming a positive result in the affirmative. This was questioned by Dr. Brackett; and there were some articles in the *Phil. Mag.* by English physicists on their experiments in this line.

Turning from these attempts, whether more or less successful, at direct experimental proof, we have an unquestionable experimental proof in the work of Dr. Hertz, though not quite so direct. He showed that electric discharges, which are oscillatory, set up undulations in the surrounding ether having the properties known to be possessed by the undulations constituting light, and moving with the known velocity of light.

It is no longer necessary to seek to verify by direct experimental proof the electromagnetic nature of light. What is called light, and is known to be identical in nature with both shorter and

longer radiations than effect the eye, is electromagnetic. The solar radiation, the energy coming to us from the sun, is in the form or state producible by various apparatus and known to us as electromagnetic.

The world, at one time using only muscular energy to do its work, and not having capacity to use other; then rising in capacity and using some natural forces, as wind and water; later using, for some three hundred years, steam power; has now sufficient capacity to use, and its needs are calling for, a less costly, more efficient, and in many respects very different source of power. Half a million, or more of men are doomed to the coal mines, and to pay a human life for every 100,000 tons of coal. And then the energy of but one-fifth, or less, of this can be utilized through thermic engines; moreover, the very apparatus precluding its application to uses which the age demands; for, among other things, greater speed on the earth must be had, and the air must become a highway of travel. The million, or two or three millions of laborers, directly and indirectly engaged in coal work must be freed for better work; and energy must be available so abundantly and cheaply, in a form to be used so efficiently, by apparatus of such adaptability, that the whole army of labor needs to be engaged in the strife for material existence but a few hours daily.

Determinations of the "solar constant," the energy per square minute per second received from the sun, show that on a surface about nine feet square, perpendicular to the solar rays, one horse power is received. This, however, is really the energy measured after it is transformed into heat. Unless the transforming substance has an efficiency equal to unity, the actual downpour of energy is greater than the accepted "solar constant." But, at the least, here is an outpouring on the world of an inconceivable, inexhaustible supply of energy. And this energy is in the very form or condition that the world in this age wants. Moreover we have machinery for utilizing this form of energy with an efficiency, under