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Fibs of the Electromagnetic Spectrum: Or, The Lighter Side of Mathematical Physics

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In the beginning… there was darkness… and God said:

$$\oiint \underline{\mathbf{D}}\, d\underline{\mathbf{A}} = \iiint \rho dV$$

$$\oint \underline{\mathbf{E}} d\underline{\mathbf{s}} = -\, d/dt \iint \underline{\mathbf{B}} d\underline{\mathbf{A}}$$

$$\oiint \underline{\mathbf{B}} d\underline{\mathbf{A}} = 0$$

$$\oint \underline{\mathbf{H}} d\underline{\mathbf{s}} = \iint [\, \underline{\mathbf{j}} + \partial \underline{\mathbf{D}} / \partial t \,]$$

… and there was light.

Much, much later, a very pedantic German, who happened to be so brilliant at numbers that he was nicknamed "Princeps Mathematicorum" (Prince of Mathematicians) figured out what became known as Gauss' laws:

$$\oint_S \boldsymbol{D} \cdot \mathbf{ds} = \int_V \rho \, \mathrm{dv} \quad \equiv \quad \nabla \cdot \boldsymbol{D} = \rho$$

$$\oint_S \mathscr{B} \cdot \mathbf{ds} = 0 \quad \equiv \quad \nabla \cdot \mathscr{B} = 0$$

However, lots and lots of very industrious experimentations of a self-taught Englishman, called Michael Faraday, yielded the following law:

$$\oint_C \mathfrak{E} \cdot d\mathbf{l} = -\, d/dt \int_S \mathscr{B} \cdot \, d\mathbf{s} \quad \equiv \quad \nabla \times \mathfrak{E} = -\, \partial \mathscr{B} / \partial \mathrm{t}$$

Of course, the French will never let the English outdo them; therefore, behold Ampère's law:

$$\oint_C \mathscr{H} \cdot d\mathbf{l} = \int_S \mathscr{J} \cdot \, d\mathbf{s} + d/dt \int_S \boldsymbol{D} \cdot \, d\mathbf{s} \quad \equiv \quad \nabla \times \mathscr{H} = \mathscr{J} + \partial \boldsymbol{D} / \partial t$$

Finally, a shrewd Scot with a mordant wit put it all together in 1876 under the label "Maxwell's Equations" in free space:

$$\oint \boldsymbol{E} \cdot d\boldsymbol{A} = \boldsymbol{Q} / \epsilon_0 \qquad \oint \boldsymbol{B} \cdot d\boldsymbol{A} = 0$$

$$\oint \boldsymbol{E} \cdot ds = -\, d\varphi_{\mathscr{M}} / dt \qquad \oint \boldsymbol{B} \cdot ds = \mu_0 \boldsymbol{I} + \mu_0 \epsilon_0 \, d\varphi e / dt$$

Although these elegant equations were no different from what God had said in the first place, they were recognized as such only 11 years later in 1887, when another stubborn German, Heinrich Hertz, proved them by producing the first radio waves, exactly as predicted by Maxwell. Soon thereafter, the entire electromagnetic spectrum from long-wavelength, low-frequency radio waves to high-frequency, short-wavelength gamma and cosmic rays became fully "operational" in pure and applied physics. The rest is history…

Naturally, it *would have been* far easier to maintain "…and God said: 'Let there be light,' and there *was* light." But from there to being able to flick on a light switch… Oh well—who knows? Maybe that's life.