Lorenz or Lorentz?

The name of the Dutch physicist, Hendrik Antoon Lorentz, is familiar to anybody interested in Electromagnetism. Particularly well-known are his article, "Ueber die Grundgleichungen der Elektrodynamik für bewegter Körper," published in 1890 in the *Annalen der Physik und Chemie*; his extended paper on "La théorie électromagnétique de Maxwell et son application aux corps mouvants," written in 1892 and published in the *Archives néerlandaises des Sciences exactes et naturelles*;" and his book on the *Theory of Electrons*, which came out in 1909 (and has been reprinted by Dover Publications). Lorentz was present at the birth of Relativity, and published his famous transformation formulas, which connect the 4-coordinates in an inertial frame to those in another frame, at the turn of the century. Even more familiar are the "Lorentz retarded potentials," based on the "Lorentz condition." In this instance, however, a case of mistaken paternity seems to have taken place. The undersigned was recently glancing through Whittaker's monumental *History of the Theories of Aether and Electricity*, and read with interest, on p. 268 of Volume 1, that the paternity for the retarded potentials should really be assigned to L. Lorenz, a Danish physicist who introduced them in three articles written in 1867 (Lorentz was 14 years old at the time). One of the articles, entitled "On the Identity of the Vibrations of Light with Electrical Currents," was written in English, and appeared in Volume XXXIV of the *Philosophical Magazine*. It is most interesting. The author first quotes the Kirchoff expression for the electric field, viz.

$$
\begin{aligned}
u &= -2k\left[\frac{d\Omega}{dx} + \frac{4}{c^2}\frac{d\alpha}{dt}\right] , \\
v &= -2k\left[\frac{d\Omega}{dy} + \frac{4}{c^2}\frac{d\beta}{dt}\right] , \\
w &= -2k\left[\frac{d\Omega}{dz} + \frac{4}{c^2}\frac{d\gamma}{dt}\right] .
\end{aligned}
\tag{1}
$$

We nowadays use the more compact form

$$\bar{e} = -\mathrm{grad}\ \phi - \frac{\partial \bar{a}}{\partial t} . \tag{2}$$

The quantity c in (1) is a given constant. Lorenz then writes the scalar potential as

$$\Omega = \iiint \frac{dx'\,dy'\,dz'}{r}\ \varepsilon'\left[t - \frac{r}{a}\right] + \int \frac{ds'}{r}\ e'\left[t - \frac{r}{a}\right] \tag{3}$$

where ε' and e' stand for the volume and surface charge densities, respectively, and he gives corresponding expressions for the vector potential (α, β, γ). The retardation effect appears clearly in (3), where the symbol a is the velocity of light. Lorenz assumes that c^2 in (1) is $2a^2$, and mentions that the best value of c known at the time was 284736 miles per second. Towards the end of the article, he proves that

$$\frac{d\Omega}{dt} = -2\left[\frac{d\alpha}{dx} + \frac{d\beta}{dy} + \frac{d\gamma}{dz}\right] \tag{4}$$

which is the well-known condition

$$\mathrm{div}\ \bar{a} + \frac{1}{a^2}\frac{\partial \phi}{\partial t} = 0 . \tag{5}$$

Lorenz' work is remarkable, since it was performed in parallel with that of Maxwell. The reader will probably agree that the paternity suit must be decided in Lorenz' favour. It appears that the various authors of textbooks who sinned against historical accuracy—the undersigned being regretfully one of them—should amend their references in future printings of their books!

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