

commenting on C. R. Hagen's letter he says "That the classical non-relativistic and relativistic theory of electric charges and magnetic monopoles is consistent does not appear to be in doubt."

In a paper many years ago, I gave a rigorous proof that no action principle exists for the classical relativistic electromagnetic field when its sources are both charged particles and magnetic monopoles, unless an extra condition, not derivable from the action principle, is assumed.¹

The arguments for magnetic monopoles are essentially aesthetic. The fact that the electric-charge-magnetic-monopole system, if it existed, would be the only classical system whose dynamical equations could not be derived from an action principle destroys any aesthetic advantage for me, and thus any attractiveness to the concept. Even the asymmetry of Maxwell's equations without magnetic monopoles is artificial, since if they are written in spinor form the asymmetry disappears.

Lastly, P. A. M. Dirac's² first monopole paper, while original and beautiful, has so little mathematical rigor that it is more of a suggestion than a rigorous argument.

References

1. D. Rosenbaum, *Phys. Rev.* **147**, 891 (1966).
2. P. A. M. Dirac, *Proc. Roy. Soc. (London)* **A133**, 60 (1931).

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I believe there is a consistent theory of the interactions of electric charges and magnetic monopoles (or "dyons"). The questions raised by C. R. Hagen, Daniel Zwanziger and others can be resolved if one goes back to the sources of theory and treats the singularity surface (string) of the potential as an additional dynamical field, as Dirac did (1948). Equations of motion of the string follow from the action principles. Strings or equivalent dynamical boundary conditions cannot be completely eliminated [see *Nucl. Phys.* **B81**, 477, (1974)]. The quantization of all fields guarantees not only covariance, but also the equivalence of charge, angular momentum and flux quantizations, and spin-statistics connections for half-integer n values.

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Pro metric

I take exception to the letter by David Bartlett and Chris Zafiratos (February, page 15) opposing a ten-year program to make SI units the general unit system of the United States. I wish to make the

following points:

► The primary reason that the present (or any) adult population should be forced to adjust to new measures is because the main fault of the present system is its lack of universality—it is a non-system. How many average home owners can figure for their houses the amount of incident and exit energy, the electrical usage, the amount of specific fuels required to maintain certain temperature differentials, and the cost of various alternatives with the current mix of BS and practical electrical (SI) units? This is the sort of thing requiring simple arithmetic that almost every citizen should be able to do for himself, particularly in an era of scarcity of energy and materials. How can any system of units not based on at least a single common integer serve the needs of a modern people? Poorly.

► While the binary number system is popular with switches and logical sub-units, the decimal system is the standard means of reckoning numbers among humans. I doubt that any physicists balance their checkbooks in binary.

► With regard to the ten-year timetable for metrification, it seems that a century or so is a long enough time to wait before starting such a system. A coordinated timetable is necessary to minimize the economic costs of conversion, to allow for long-range planning in all sectors. For example, it is probably more advantageous for manufacturers to retool gradually by equipment replacement.

► One of the most pressing reasons for the US to adopt the metric system widely is that our archaic unit system costs us money in the world market. If our manufactures were repairable using available metric parts, people abroad would be more likely to buy them. The BS also costs in unnecessary calculation and conversion effort, and effort is money. As a person on a relatively fixed income, I object to an inflation of expenses due in part to our trade situation not being as good as it might be.

A final point: failure to support a change in the current scheme of measures simply because some people are unfamiliar with it is to buckle under to stupidity, and that is something that I detest personally as a teacher of physics. Adoption of the metric system is an opportunity for growth, a chance for the US public to learn something (that a majority of it has already been taught).

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Correction

October, page 30—In the first paragraph under the head "Switching," the switching process is described as being "very fast (about 4 sec)"; it should read, "very fast (about 1 nsec)."

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