history, political science, sociology, and other subjects. For example, instead of just teaching about the history of World War II and asking students to repeat information on tests or in term papers, we could ask them what might have happened if the US had entered the war at a different point in time or not at all and then have them consider the logical consequences of each possibility. Getting students to hypothesize and follow a logical sequence should begin well before they study physics or any other science.

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Magnetic monopoles and a cheap detector

The letters from Ken Frankel and Christopher Harrison (PHYSICS TODAY, June 2017, page 13) in response to Arttu Rajantie's article on the history of searches for magnetic monopoles (PHYSICS TODAY, October 2016, page 40) brought back a memory. After Blas Cabrera's 1982 publication of a candidate monopole event detected with a superconducting loop,[1] three groups[2]—a University of Chicago, Fermilab, and University of Michigan collaboration; IBM; and Imperial College London—built Faraday induction detectors with larger areas. Using a coincidence technique of two gradiometer detectors in a nonzero but pinned magnetic field, Joe Incandela and coworkers showed that a likely explanation of the candidate event was a flux jump rather than the transit of a monopole.[3] I was invited by the organizers of the First Aspen Winter Conference to give a review talk of the hot though cryogenic topic.[4]

I had been a graduate student at the University of California, Berkeley, and had great admiration for Luis Alvarez, so I sent him a draft asking for comments. I had leaned over backwards to give him credit for inventing the Faraday induction technique, as my looking in depth at monopole detection by ionization brought home that there was no way to calibrate the ionization detector, and hence a nondetection could never be definitive. Faraday detection, however, can be calibrated with a "pseudopole," a very long but small-diameter, tightly wound, magnetic solenoid much akin to a Dirac string.

I was working at my desk when my phone rang, with a furious Luis on the other end. Without any introduction, he barked, "Henry, this was my idea, and I should be the first reference." I was stunned, as I thought I had done him proud, but I managed to say, "Luis, the guys ahead of you are not to be sneezed at—Faraday, Maxwell, Dirac. . . ." Still angry, he said, "Yes, but who are these other guys?" Luis later sent a nice note praising the review, and all was well.

A brief addendum: Sunil Somalwar's PhD thesis followed up on Incandela's superconducting gradiometers by showing that using just copper wire and a field-effect transistor operating at liquid nitrogen temperature, one could build an inexpensive detector, capable of covering large areas and sensitive to a single Dirac charge.[5]

References

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The problem of the electron's mass

As I read "An electron–proton collider could bridge the gap between the LHC and its successor" (PHYSICS TODAY, May 2017, page 29) and how it would serve in high-precision studies of Higgs decays as a portal to new physics, I was disappointed. I saw no mention of a long-standing problem in connection with the electron: What fraction of the electron's mass is due to its interaction with the quantized electromagnetic field? Despite its enormous success in quantum electrodynamics, renormalization does not solve the problem, nor does it even tell us how to tackle it. Furthermore, the Higgs contribution to the electron's mass is unknown. We also don't know how to measure those respective contributions. Perhaps in thinking about the electron–proton collider, one should be thinking about opening portals to these long-neglected areas as well.

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Energy efficiency in motion and thought

Simon Sponberg's article (PHYSICS TODAY, September 2017, page 34) addresses important topics in the physics of insect locomotion in terms of muscle motion, sensing, and information processing. However, one especially important and astonishing aspect of physics, common to living objects and unattainable by manmade machines, is the energy efficiency in both muscle motion and information processing. One impressive example is the energy consumed by the human brain in playing Go or chess with a supercomputer. Although humans now lose both games, the energy consumed by the human brain while playing is five to six orders of magnitude less than that of the supercomputer.[1]

Reference

1. See, for example, Y. Yanagida, Y. Ishii, *Proc. Japan Acad. B* **93**, 51 (2017).

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