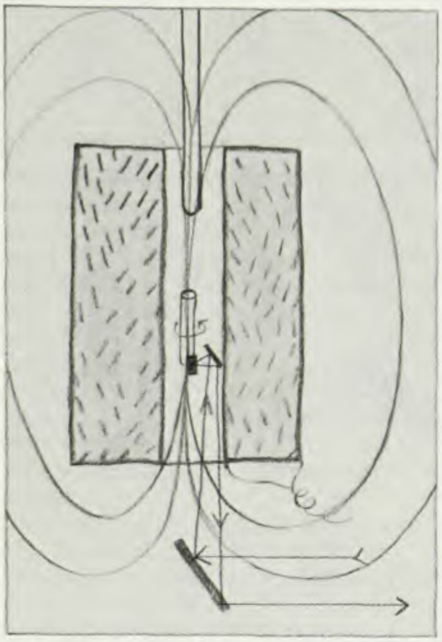
letters

Simplifying physics history

At the time of his death this March (see page 75) John Quincy Stewart was best known for his work in social physics, which used concepts from potential theory and kinetic theory as aids in understanding demography and economic geography. It is less known that in the years from 1915 to 1917 Stewart measured the gyromagnetic ratio of the charge carriers that cause permanent magnetism in iron and nickel.[1] This was done by magnetizing a suspended iron or nickel wire along its length, then demagnetizing it and measuring its angular recoil. For iron the result was $(0.51 \pm 0.04)(2m/e)$, and for nickel $(0.47 \pm 0.11)(2m/e)$, or about half what it would have been had the charge been carried by the orbital motion of electrons.

It was an important discovery, for it helped to start one of the trails that led to the concept of electron spin. It was a difficult experiment that reflected great credit on the experimenter. Yet generically the procedure is called the Einstein–de Haas experiment, and probably most physicists believe that the unexpected gyromagnetic ratio was discovered by Einstein and W. J. de Haas. In fact, the basic scheme was suggested by O. W. Richardson in 1907,[2] and was attempted several times in the Princeton Physics Department. Stewart's experiment was the first of these attempts to work. Though Einstein and de Haas did the experiment in 1915,[3] they did not make the vital discovery. Their measured gyromagnetic ratio was too high, and they concluded wrongly that ferromagnetism was caused by orbiting electrons. Their experiment was slightly different from Stewart's in that it used repeated reversals of magnetization to set the sample into resonant oscillation on its suspending fiber. An experiment by de Haas alone in 1916[4] led to the same wrong conclusion. Finally, in the hands of E. Beck[5] the resonance method gave the right answer in 1919.

S. J. Barnett[6] anticipated Stewart's discovery in 1915, but later recanted.[7] In doing the inverse experiment, that is, rotating an iron bar at high speed and measuring the resulting magnetic



moment, he first found the gyromagnetic ratio to be half the expected value. But on repeating the experiment in 1917 he found it to be higher and declared it consistent with orbiting electrons.

Stewart's relative eclipse falsified the scientific history of the time. Whatever name the experiment bears now, it was Stewart, and, in spite of his recantation, Barnett, whose data started people thinking. See, for example, A. H. Compton's 1921 paper[8] proposing a spinning electron.

Stewart, and to a lesser extent, Barnett and Richardson have been overshadowed by the magic of Einstein's name. The natural assumption that whatever Einstein did he did better than anyone else is in this case wrong, and has led people to overlook good work by other good physicists.

This is a common phenomenon in science, more the rule than the exception. It happens because science cannot, in a sense, ever know its own past, and synthesizes a false history to fill the gap. We can never be sure what led someone to make a particular discovery: sometimes he does not know himself. We can, if we try, often find out who did what, and when he did it. But the interconnections between scientists, the *why* of who did what, are a great boiling uncertainty.

As scientists we want to know our place in the universe, so we create a history simple enough to understand, one populated by a small number of infallible giants who build, step by logical step, on each other's contributions, and do everything that matters.

This tidy synthetic picture is both unfair and dull. It sweeps out of sight the genuine drama, the successes and failures, of brilliant men, such as Stewart, well worth our attention and respect.

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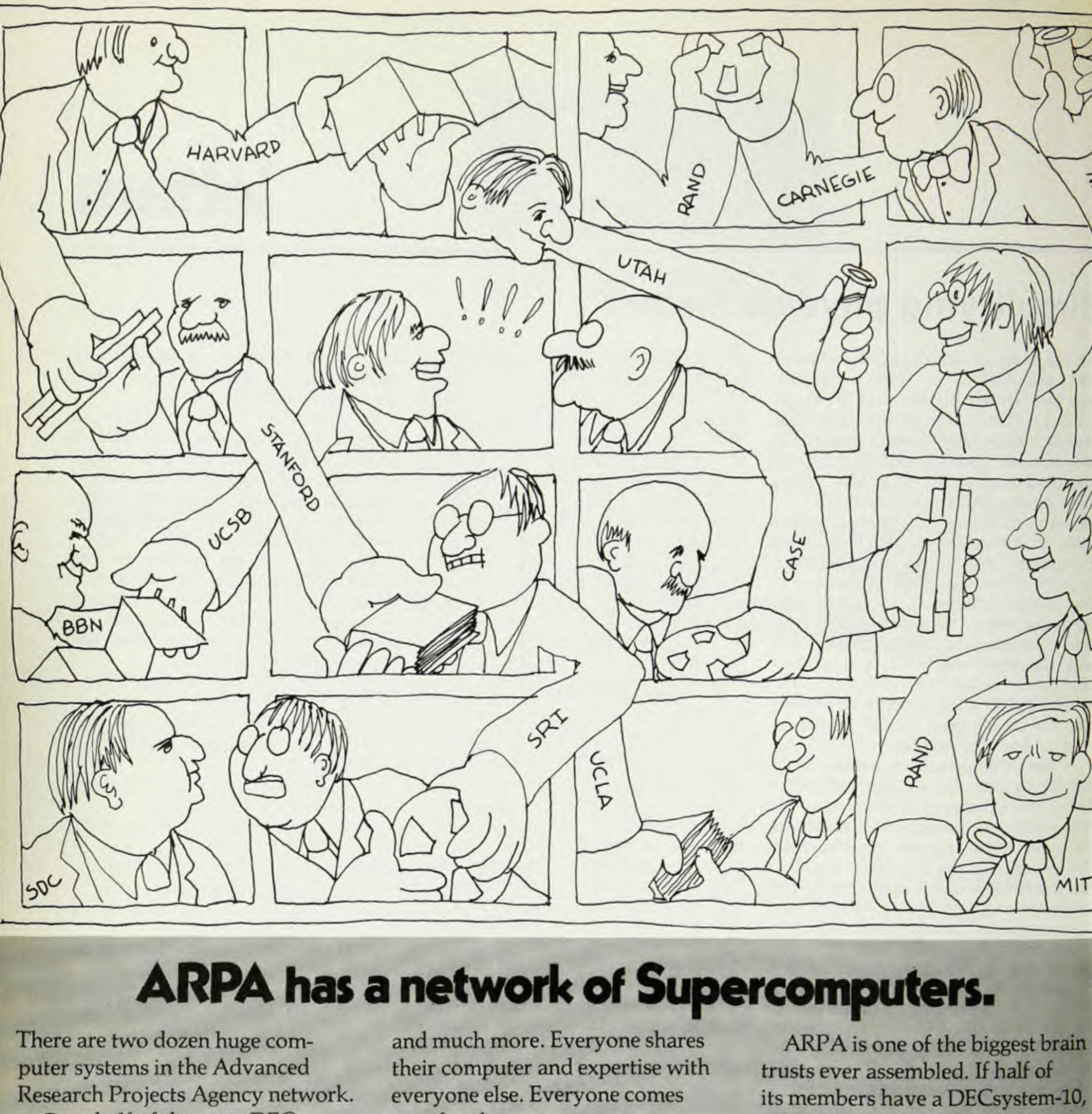
Missing names supplied

A total of 29 letters were sent in by readers in response to our challenge to name the unidentified faces in the group picture published in the December issue (page 9). The following names can now be added (or corrections made) to the list originally published (refer to December issue for numerical key):

17. Reginald J. Stephenson
25. Wave H. Schaffer
28. Carole Rieke
31. —Peck
32. Alois Bragagnolo (shop)
34. Omar Polk
37. Eula Snyder Wager
38. Fritz Dietz



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40. Warren Nyer
42. Anthony Turkevich
43. Aaron Sayvetz
44. Bernard Smaller
45. —Hanna
46. Theodore Novey
47. Arthur G. Barkow
48. Leonard Lieberman
50. Lloyd Lewis
51. J. M. Bradford
62. Leslie Coad
63. Gerhard Groetzinger
64. *not* Francis Shonka
65. James B. Coon
66. Fitzhugh Marshall
67. *not* Serge Golian
69. Serge Golian
71. —Newman
73. George R. Carlson
74. Donald A. Edwards
75. Ted Wahlschlagel
78. Lester Skaggs
81. L. W. Phillips
85. Warren Henry
87. E. Newman Pettitt
88. —Sawyer
89. Joe Novak
91. Harry M. Allred
92. Henry E. Duckworth
93. William Frye
96. Joseph Getzholz
98. Jack (?) Moulton
99. Duilio N. DiConstanzo

Besides identifying himself as 91, Harry M. Allred insists that the picture was taken at the University of Chicago in 1940. The winners were Mark Fred (80) and Stanley Siegel (29) of Argonne National Laboratory who supplied 26 new names.

The Editor

More clock paradox

Enough would seem to have been said on Mendel Sachs's article itself (September 1971, page 23 and January 1972, page 9). But I would like to call attention to a related matter. James Terrell states: "Acceleration with respect to Lorentz reference frames is an absolute matter, readily detected, as any one who has been a passenger in an automobile or airplane knows." In a similar vein, Victor Korenman asserts "... the *felt* acceleration of the travelling twin is sufficient asymmetry to remove the paradox ..." Such statements are found in many treatments of relativity, but they are incorrect. If for example the "travelling twin" undergoes his accelerations under the influence of gravitational fields, rather than rocket motors, he need "feel" no acceleration whatever; and if the earthbound twin is spun in a circle, he will "feel" an acceleration. So you see the problem is not so simple as merely deciding who feels an acceleration. Determination of field derivatives will similarly not solve the problem, since arbitrarily large ones may be introduced without any net acceleration by using large and small masses suitably positioned. The fact is that there is no simple experiment that the twins can do inside their respective cubicles to reveal the asymmetry. They must either look at the fixed stars, which are the source of the asymmetry in Mach's sense, or they must wait until they are together again, in order to see which one it was that took the trip.

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There is no need to add to the numerous excellent replies to Mendel Sachs that appeared in your January issue. I wish only to call attention to some earlier discussions that deserve to be read and to emphasize a point that has not been made.

The superb expository paper[1] in which P. Langevin replaced Einstein's bare clock[2] by a space traveler sending and receiving electromagnetic time signals contains a lucid derivation of the result.

In calculating what is observed in the frame of the traveling twin it is necessary to allow for the effect of the longitudinal acceleration. Max Born[3] has pointed out that the principle of equivalence and the formula (derived[4] from it and special relativity) for the effect of a gravitational field on clocks suffice for this calculation. C. Moller[5] has given the corresponding exact general-relativity calculation, as have Born and Walter Biem[6].

The twin who stayed at rest in one inertial frame, using special relativity, and his accelerated brother, using the principle of equivalence as well, come to the same conclusion. The twin problem is not a paradox. It is a thought-experiment demonstrating the logical consistency of special relativity and the principle of equivalence[7].

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3. M. Born, *Die Relativitätstheorie Einsteins* (3. aufl.) J. Springer, Berlin, 256 ff. (1922), now available in a revised English translation: M. Born, *Einstein's Theory of Relativity*, revised edition with G. Leibfried and W. Biem, Dover, New York (1962) pages 354–356.
4. A. Einstein, *Jahrbuch der Radioäktivitat*