

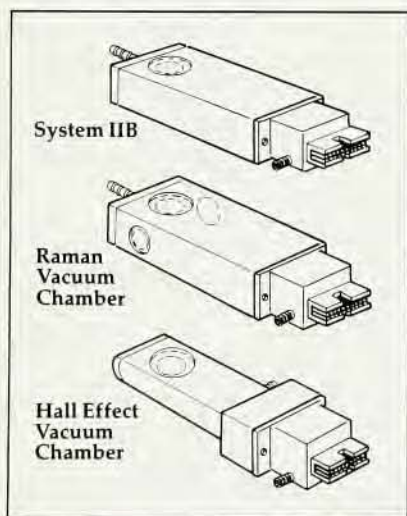
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informed discussion of this issue difficult.

The "vindictiveness" attributed to the local school board in Mowbray's article consisted of an attempt to discourage any teachers from leaving classes mid-year without strong reason. The teacher contract is, in our opinion, mutually binding for teachers and the school system and exists in part to ensure that students have a full year of competent instruction. By county policy, any teacher who leaves mid-year without reasonable cause violates the contract and is subject to those penalties allowed under Maryland law. In Mowbray's case, those penalties were applied.

If it is difficult to obtain qualified physics teachers given adequate time and the availability of new graduates from colleges and universities, the problem is even more difficult on short notice in the middle of the school year. As a result, the education of students suffers when their teacher leaves under such circumstances. Any discussion of school-board-teacher relationships needs to recognize the reciprocal responsibility both parties have to students.

As a further point in the same article, Mowbray describes his frustrations at the unwillingness of the school board to approve higher pay for science and mathematics teachers. In fact, the major opponents of such differential pay are not local boards of education, but Mowbray's fellow teachers. Our local experience has been that teachers in non-science and math specialties, and their local education associations (the designated collective bargaining agents under Maryland State Law) have resolutely opposed any discussion of differential pay.

In collective bargaining, issues flatly opposed by one negotiating party are not easily won. In addition, it is arguable whether this is the best way to improve the supply of qualified teachers in the sciences.

The issue of physics education, specifically, and of science and math education, generally, is an important one in which The American Physical Society, through its various professional organizations, can play a role in focusing public attention on this urgent problem and on recommending solutions. However, it is essential that the Society provide accurate information to its members if the discussion is to be fruitful. I suggest that, in the future, PHYSICS TODAY provide an opportunity for "peer review" of allegations such as those made in Mowbray's article. Finding "villains" for social problems is sometimes a convenient way to mobilize public opinion, but it is fundamen-

tally demagogic and has no place in a discussion at the professional level expected by members of the Society.

This discussion in no way responds to the real issues of quality science teaching, the recruitment and compensation of competent teachers, and the adequacy of curriculum and graduation standards. Howard County, among others, has taken a number of significant steps to attempt to meet these challenges. I would be happy at another time to summarize some of these steps and to give a local board of education perspective on the political, personnel and fiscal aspects of these problems and possible solutions that might be considered.

JOHN C. MURPHY

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10/83

Physics on microcomputers

At the risk of excessively belaboring a point, I would like to offer a few additional observations on the relative performance of micro- and mainframe computers. These differ sufficiently from those reported by Albert DePristo and Stephen Elbert (July, page 15) to cast personal computers in a significantly more favorable light relative to mainframes. A Sanyo MBC 550, using the 8088 at 3.6 MHz plus the 8087 coprocessor, runs their demonstration program in 83 seconds, using Microsoft's FORTRAN 77 version 3.2 compiler (decent, though not ideal) and generating in-line code for the 8087. This is considerably less than the 194 seconds reported by DePristo and Elbert for the 4.77 MHz IBM PC. Incidentally, the same hardware, using Borland Turbo Pascal, which is a single-pass compiler (in contrast to the two-pass optimizing Microsoft compiler), executes the program in 300 seconds, illustrating the importance of good software. It also demonstrates the kind of savings one could obtain, as Per Bak evidently has, by working in assembly language rather than depending on less than optimal software. Finally, a DEC 11/23 with floating-point unit executes the program in about 400 seconds under RT11 FORTRAN. This was the first 16-bit microprocessor produced and it illustrates the kind of progress which has been made since.

It should also be noted that the test program does not include trigonometric functions, at which the 8087 shines. Consider, therefore, the following program:

```
real*8 difsq, pihalf, step, a, b, c
pihalf = 1.5d0
read(*,*)niter
difsq = 0.0d0
a = 0.0d0
```


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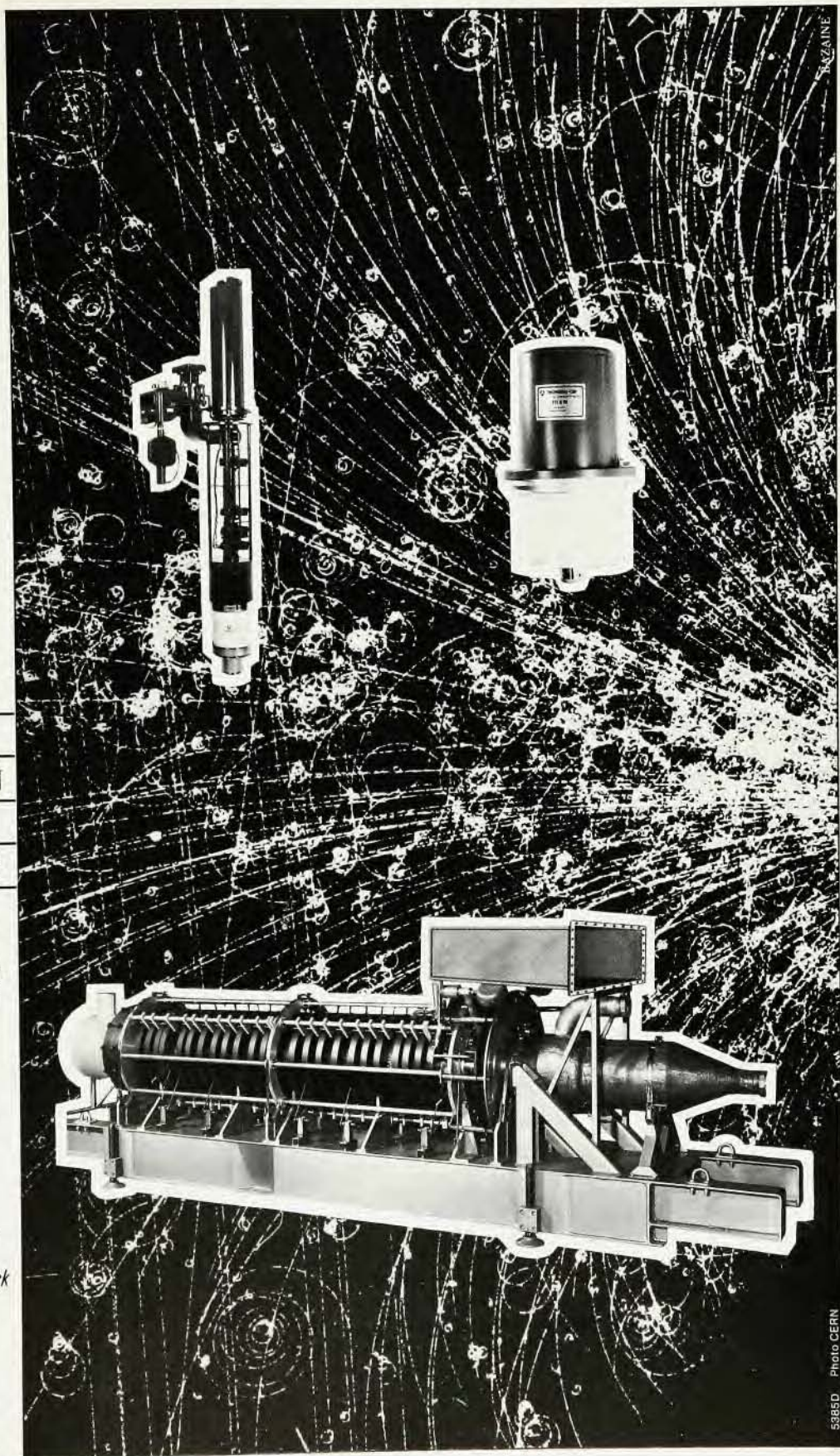
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step = pi/2/niter

do 1 i = 1, niter

a = a + step

b = dsin(a)

c = dasin(b)

b = dcos(c)

c = dacos(b)

b = dtan(c)

c = datan(b)

b = dexp(c)

c = dlog(b)

difsqr = difsqr + (a - c)*(a - c)

1 continue

difsqr = difsqr/niter

This somewhat artificial example tests both the unit's speed and accuracy in evaluating commonly used exponential functions. For 10 000 iterations, this took 70 seconds, and difsqr was 3×10^{-33} , indicating an accuracy of better than 15 digits, on the Sanyo 8088 and 8087 combination. The DEC 11/23 took 450 seconds to execute a similar program; however, trading speed for accuracy by running in single precision gives difsqr 3×10^{-14} in 255 seconds. Because the 8087 does all its calculations with 80-bit accuracy, there is little time-saving for the latter in single precision. It is important to keep this difference in mind in making comparisons.

These tests confirm what a variety of reviewers have concluded: that the 8087 in combination with an 8088 or, preferably, an 8086 or 80286 processor with higher clock rate and faster memory access, as announced by IBM in its new \$6000 AT personal computer, is less than a factor of 10 slower than a VAX and several hundred times behind a Cray. This point is discussed further in *Byte's* February 1984 issue and its special issue on the IBM PC. Indeed, in the latter, Stephen Fried reports on an application program which the PC executed only 180 times slower than a Cray. When one folded in the turn-around time on the Cray and its 100 or so users, the PC was only half as slow. He concludes that a microcomputer is suitable for operations involving less than 100 million floating point operations. For such calculations, a micro seems cheaper as well, when one compares the price-to-performance ratio of a PC (\$5k/1) to that of a VAX (\$500k/10) or a Cray (\$10 000k/500). Moreover, a PC has many other uses. I'm writing this letter on mine; I plot data on it, and I can carry it home with me to play games on. It doesn't have busy times at the end of the semester, it doesn't shut down on weekends, and only I can crash the system. Overhead is minimal; when it dies in a few years, I can happily throw it away and buy something better. While it's important to choose one's machine properly for the

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MARTEN DENBOER

Polytechnic Institute of New York

8/84

Brooklyn, New York

SURA upgrade

In June, MIT submitted a proposal to the Department of Energy for upgrading the Bates electron accelerator facility to continuous-beam operation at energies below 1 GeV. Your news article on the SURA accelerator in the Washington Reports section of the September 1984 issue (page 55), creates the impression that the proposed upgrade be viewed as an alternative to the 4-GeV accelerator (CEBAF) recommended for construction at Newport News, Virginia, under SURA management. On the contrary, the NSAC Long Range Plan for Nuclear Science and the reports of NSAC subcommittees on Electromagnetic Interactions (chaired by Peter Barnes), on Electron Accelerator Facilities (chaired by D. Allan Bromley), and on a 4-GeV Electron Accelerator (chaired by Erich Vogt) have all identified the lower-energy electron continuous-beam capability as a major scientific opportunity complementary to that offered by CEBAF. Thus our proposed upgrade, which has a cost about a factor of ten less than those of the major construction projects endorsed by NSAC, is fully integrated with NSAC recommendations for providing national research capabilities at the forefront of nuclear science.

ERNEST J. MONIZ

Bates Linear Accelerator Center
Middleton, Massachusetts

9/84

No such impression or implication was intended. It is true that DOE and Congress heard arguments from physicists that several projects may be more worthy of funding than CEBAF. It is also true that those projects were not suggested as alternatives to CEBAF but as projects worth doing in their own right. The news account of the controversy surrounding CEBAF does not say or suggest that the Bates machine at MIT or any other existing facility would replace the cw electron accelerator proposed by Southeastern University Research Associates. The troubled waters around CEBAF are now considerably calmed by a new report from a subcommittee of the Nuclear Science Advisory Committee. A news story about that report appears on page 59.

—IG

Corrections

June 1983, page 54—In the article on synchrotron radiation, written by Arthur Bienstock and Herman Winick, the caption for figure 6 should have included a reference to R. Z. Bachrach, L. E. Swartz, S. B. Hagstrom, I. Lindau,