

22 April, 1931—(from Signal Corps Laboratories) "We wish to advise that the vacancies in the position of Associate Physicist in these Laboratories have been filled . . ."

There came the day, however, when a bit of sun broke through the clouds. It was summer and the year was still 1931. In the same week there came two job offers, one from the Signal Corps and the other from RCA—salary for both about \$2500. I accepted the first one with a special-delivery letter, reporting to Fort Monmouth on 7 August, 1931. Thirty-five years later, now the Director of Research, I retired—this time voluntarily, rejoining the ranks of the unemployed.

HAROLD A. ZAHL
Holmdel, N.J.

Letters by the dozen appear on my desk—letters of application for a job teaching physics. I am appalled, not by the number of applications, but by the naiveté of their authors. Of every ten, nine are *mimeographed form* letters. Some of them lack even a salutation.

I have the impression, when I talk to my fellow chairmen elsewhere, that such letters to them end up where mine do—in the wastebasket.

Is it too much to expect that the applicant recognize the enormous diversity of the educational institutions to which he is applying? If he wants to be considered at a particular college or university, let him say why he thinks he would be happy there. More importantly, let him also say how he thinks his interests and talents would mesh with what he conceives to be the needs of the department to which he is offering his services.

An imaginative personal letter will put the writer near the top of my list of candidates entitled to first consideration.

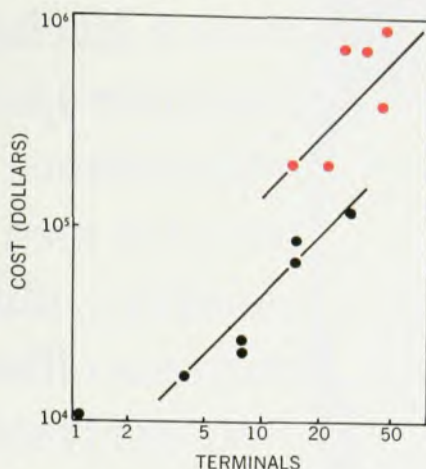
EDWARD P. CLANCY
Mount Holyoke College

Computer learning costs

The article by Guenter Schwarz, Ora Kromhout, and Steve Edwards (PHYSICS TODAY, September, page 40) is a good review of the *possibilities* of using computers to aid the learning process, but does not answer the *practical* questions on the necessary invest-

ment of time and money that newcomers to the field need.

A plot of the purchase price of 13 CAL systems versus the number of (time-shared) terminals is shown in the accompanying figure. The black



dots represent systems primarily intended for computational use having a minimum of one high-level language (such as BASIC) available. The colored dots represent larger systems with expensive mass-storage devices and communications hardware especially adapted to computer-supervised instruction (CSI) as well as computation. With some imagination, both of these sets may be fitted with a line of unit slope, showing the basic price to be about \$4000 per terminal for the computation systems and \$15 000 per terminal for the CSI systems.

To compute the actual instructional cost, exclusive of the cost of programming, we must add maintenance charges (which can amount to 30–75% of the purchase price over a five-year period), the costs of machine operators or monitors, and the costs of supplies (such as teletype paper). If the terminals are made available a minimum of 1600 hours per year, the instruction costs of all the circled computational-type systems lie in the range 50–90 cents per student terminal hour when amortized over five years, which compares favorably with the costs of college instruction.

The actual cost of instruction on the systems represented by colored dots fluctuated widely from a low of \$1.75 to a high of \$4.50 per student terminal hour, indicating that a little shopping might produce a "best-buy" in this area. Very few manufacturers offer a CAI language compiler that enables relatively untrained authors to write programs easily, and only two offer operating systems on which CAI and

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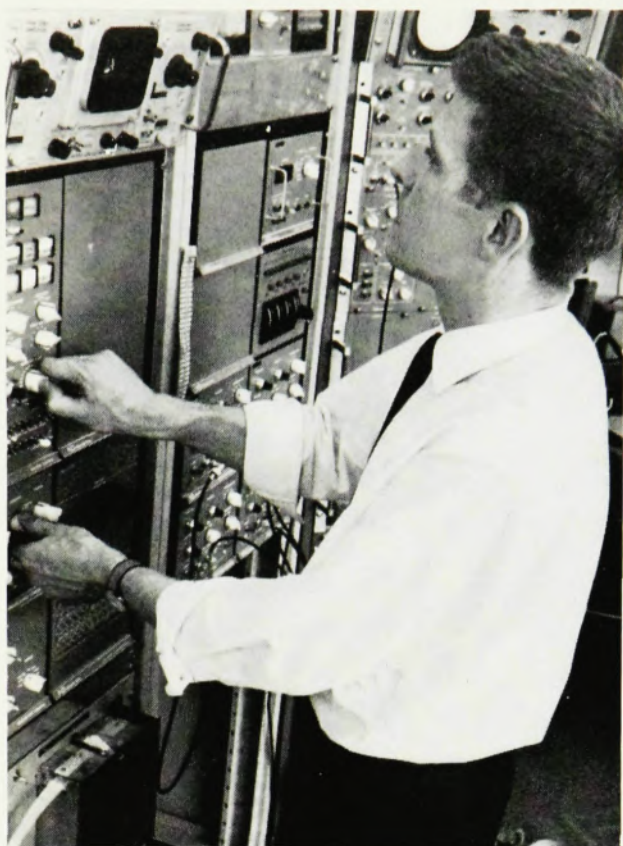
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computation can be offered at different terminals simultaneously.

Schwarz's article also does not bring out the tremendous investment in preparation of CAI teaching programs, perhaps tens of man years for one course. This programming cost might equal the operational cost above, so it is apparent why CAI is as yet unattractive to administrators, and why it will not become economically feasible until many installations can share the same teaching programs and split the preparation cost. Unfortunately, many of the systems mentioned in the article on which the most work has been done are "orphans" or are now extinct. The publication of CAI programs must then be in such a form that they may be easily adapted to many different computer systems.

It seems a shame that the CMI project at the Naval Academy and New York Institute of Technology was not given more prominence. This seems to be a workable and much cheaper alternative to computer supervision of a lesson sequence than the CGI technique used at Florida State.

Finally, it is a pity that workers still have not standardized their nomenclature in this field. I would like to suggest that until national educational organizations adopt official definitions, the following nomenclature be used:

Computer Assisted Learning (CAL), the generic term recommended by the Irvine conference, would include all uses of the computer in education, including *Computational Programming by Students (CPS)* as well as instructors, *Computer Interactive Simulation (CIS)* and the other modes mentioned below.

Computer Supervised Instruction (CSI) would include all situations where the progress of a student through a sequence of lesson units is controlled by the computer. **Computer Administered Instruction (CAI)** would be restricted to situations where essentially all the instructional material is presented via the computer terminal devices, **Computer Guided Instruction (CGI)** where much of the instructional material is presented via other media, and a conversational program presented at a terminal guides the student to his next assignment. **Computer Managed Instruction (CMI)**, as presently used, is an off-line, nonconversational program

where the student's responses to key questions, perhaps on self-punch cards, are used to guide him to the next lesson unit. I certainly would not insist on any of these definitions, particularly the acronyms, some of which are esthetically repulsive. The important thing is to be sure that when somebody mentions CAI he is referring to the teaching mode, not the proprietary program or any old use of computers by a teacher.

DONALD L. SHIRER
Valparaiso University

Book-review rebuttal

R. G. Sachs's review of my book "The CP Puzzle: Strange Decays of the Neutral Kaon" (Academic Press, London 1968) in your August issue adopts a very different tone from that of reviews that have appeared in other journals. A reviewer is perfectly entitled to express whatever opinion he holds of a book, but if he quotes statements as examples of "important errors of principle," the author is bound to reply. I do not accept the allegation of error for any of the statements cited by Sachs.

(1) On page 78 Sachs states that "Students should be especially cautious of accepting such statements as, '... if all interactions are C-invariant, the K_+^0 state could decay only to states with $C = +1$...' (page 4)." As he cautiously refrains from disclosing what he considers to be dangerous about this statement, one can only guess at his suspicions and hope that he does not question the correctness of my assertion. The wording differs little from Gell-Mann and Pais's original statement: "According to the postulate of rigorous CC invariance, the quantum number C is conserved in the decay; the θ_+^0 must go into a state that is even under charge-conjugation..." (*Phys. Rev.* 97, 1389, 1955). [θ_+^0 is what I call K_+^0].

(2) Including his correction published on page 17 of the September issue, Sachs continues with the surprising remark: "Semileptonic states that are not eigenstates of C have apparently been overlooked by the author in this statement." Semileptonic states were not overlooked in reaching the stated conclusion, which is *not* invalidated by the fact that states like $\pi^+ e^+ \nu$ may not be C-eigenstates; just as the fact that a state in which a π^+ and a π^- have equal and opposite momenta along the z -axis (which

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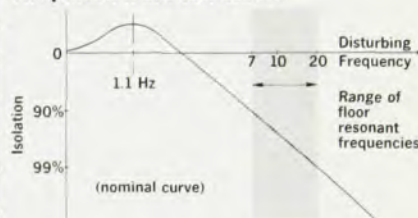


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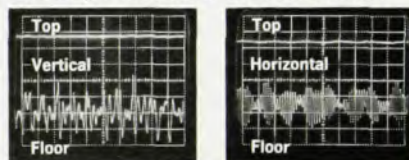
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