on the subject of "The Interaction of Technologies", the first prize of 250 guineas has been awarded to Dr. J. Rose, principal of Blackburn College of Technology and Design, and the second prize of 200 guineas shared between Professor J. A. Allen, professor of chemistry at the University of Newcastle, New South Wales, Australia, and Mr. D. J. Simpson, deputy librarian at University of Manchester Institute of Science and Technology.

THE Hugh L. Dryden Memorial Fund is being created at the request of friends and professional associates of the late deputy administrator of the National Aeronautics and Space Administration, it has been announced by Mrs. Dryden, Mr. James E. Webb, administrator of NASA, and Dr. Frederick Seitz, president of the National Academy of Sciences. Shortly after Dryden's death last December, a group of his closest associates presented to the Academy a private fund together with a request to support the creation of a committee of distinguished individuals to devise a lasting memorial to their late colleague. After some deliberation, the committee decided that the long association of Dryden with the Academy, and his many contributions to science, engineering and national goals in aeronautics and space, might be most appropriately recognized by the provision of a long-needed auditorium in Washington, to be constructed as an integral part of the main building of the Academy on Constitution Avenue. The funds raised will also be used to establish an honorary award in recognition of outstanding contributions in a professional field closely associated with Dryden's career.

THE seventh seminar on "Electrochemistry", arranged by the Central Electrochemical Research Institute, is to be held at Karaikudi during December 27–30. Further information can be obtained from Dr. C. V. Suryanarayana, Convener, Seventh Seminar on Electrochemistry, Central Electrochemical Research Institute, Karaikudi-3, India.

CORRIGENDUM. In the article entitled "Resistance of Fish Embryos to Chronic Irradiation", by V. M. Brown and W. L. Templeton (*Nature*, **203**, 1257; 1964), microcuries (μc.) should read millicuries (mc.) in Tables 3 and 4.

CORRIGENDUM. In the article entitled "Manganese-54: Fractional Distribution in Wheat and Occurrence in Other Foods" by Doris C. Sutton and John J. Kelly, which appeared on p. 1081 of the March 12, 1966, issue of *Nature*, the final sentence which reads ". . . is approximately 4,000 pc. . . ." should read "is approximately 4×10^6 pc. . . ."

CORRIGENDUM. In the article entitled "Low-temperature Fluorography induced by Tritium-labelled Compounds on Thin-layer Chromatograms", by Dr. U. Lüthi and Prof. P. G. Waser, which appeared on p. 1190 of the March 20, 1965, issue of *Nature*, the caption of Fig. 2 should read ". . . Solvent: acetic acid/hexane/diethylamine (75·5/17·5/5)".

CORRIGENDUM. In the captions of Figs. 1–3 of the communication entitled "Radiation Protection by an Auxin Analogue β-2,4,5-Trichlorophenoxyethanol, in *C57BL/6J* Mice exposed to Cobalt-60 Gamma Radiation", by Dr. R. D. Schultz, Mr. C. W. Steers and Dr. D. Norman, which appeared on p. 207 of the April 10, 1965, issue of *Nature*, "β-2,4,5-trichlorophenoxyacetic acid" should read "β-2,4,5-trichlorophenoxyethanol".

ERRATUM. In our issue of August 6 we incorrectly attributed the $5 million grant from the Sloan Foundation to Stanford University rather than the California Institute of Technology.

COMPUTERS IN THE HOME

By our Special Correspondent

Dartmouth, New Hampshire, September 29.

THE newest status symbol in this isolated university town, best known for the success or at least the roughness of its football team, is the possession of a personal computer console—something on which to work in the evenings and something on which the children can do their homework. These are only some of the benefits of a multiple access computer, provided with a simple computer language and accessible to several institutions at the same time. Computer consoles are being scattered about the neighbourhood to satisfy a great variety of needs or potential needs. Ten of them are housed in a students' computing room, carved by means of temporary partitioning out of a kind of barn in which young men (there are no women) are still to be heard playing pool and table tennis, and the mathematics department has been able to arrange that all its students should go through a course on computer programming. Specialist academic departments, such as economics and engineering, have their own consoles on the spot. Within the past year, remote terminals have also been installed at a number of schools in New England, and have been enthusiastically welcomed by teachers of mathematics. Finally, as is now customary, the Dartmouth computer can be linked by telephone circuits with others of the same kind at a dozen locations in the United States.

This network of computer terminals is of interest and importance because it offers a way of testing the claims of the enthusiasts for multiple access systems. The best known of the experiments in this direction is perhaps the MAC system at M.I.T., but the 25 consoles linked to that system tend to be used by academics seeking the same kinds of services, frequently the retrieval of information. At Dartmouth, diversity is obtrusive. The belief that multiple access computers can cater for such a diversity is one of the chief arguments of those who urge their advantages.

Whether the computer system being developed for use by British universities and research councils should consist of multiple access machines is still, for example, an open question, and will not be resolved until there is at least some working experience with the computer to be installed at the computing centre at Edinburgh.

The system at Dartmouth is based on a computer built by the General Electric Company, with assistance from the National Science Foundation. Software for the system has been developed by a team at Dartmouth under Professor John Kemeny (Mathematics), Professor Thomas Kurtz (Director of the Computation Centre) and Professor Myron Tribus (Dean of Engineering). Its principal feature is a computer language called BASIC, which—according to its authors—differs from those like FORTRAN in being designed specifically for a computer working on time sharing principles. In practice, BASIC seems also to be even simpler to use, though it is probably also somewhat limited in scope.

The mechanics of time sharing in the Dartmouth computer are accomplished by means of a piece of switching equipment, originally developed for quite a different purpose, which is connected both to the main computer and to a disk storage system in such a way that signals from up to 35 different consoles can be dealt with so as to present a uniform flow of instructions to the computer. The switching equipment ensures that no single console has access to the computer for more than 5 seconds at a time. If a console should present the system with a piece of work which cannot be dealt with in such a time, the work in progress at the end of five seconds will be discharged on to a disk store and then reworked when the console concerned has another turn. Although this could mean that delays of up to 2·5 minutes might occur when all 35 consoles are fully occupied, in practice much shorter and barely perceptible delays are customary.

It is intended that there should be a considerable extension of this system in a year or so, when a faster computer will be installed. It will then be possible to operate with up to 600 independent consoles linked to the computer through four sets of switching equipment. By that time it is also likely that similar installations elsewhere in the United States will have multiplied to the point at which a substantial network of compatible computers will be at the beck and call of all with access to a console.

The uses being made of the system at Dartmouth suggest that there is no prospect that the demand on this system will be satisfied in the foreseeable future. Of the 800 students who enter Dartmouth each year, 650 now take a course in computation which is reckoned to be at least sufficient to enable them to form a real appreciation of the potential power of this kind of machinery.

A great many students do much more than this, however. In the engineering departments, homework and design projects are now prepared on the assumption that students will carry them out when sitting at one of the consoles in the computing centre. The same is true in the business school, where the analysis of business records by machine has now become a routine for most students. Then members of the faculty use the consoles in their departments not only for the majestic problems by whose solution they will advance their careers, but also for the much more trivial tasks which would, a year or two ago, have meant the use of slide rules or tables of logarithms.

The informality of the system is probably its most striking feature. Among the students to be found at the computing centre are many who are not part of any formal course, but who have borrowed a manual from a friend and who have set out to teach themselves computing in an afternoon. Such ambition seems to be entirely realistic. This afternoon one student in psychology was well dug into the calculation of correlation coefficients after roughly ten minutes of experience and a quick reading of the first twenty pages of the manual.

The cheerful flexibility of this system is well illustrated by the following sequence of events, all part of a casual process for constructing a programme to obtain the roots of a quadratic equation.

The first step is to indicate that the quadratic equation $Ax^2+Bx+C=0$ is characterized by the three coefficients A, B, and C. The next is to point out that the quantity B^2-4AC is the first quantity to calculate. The third instruction in the sequence (150) is the programmer's statement of the value of one of the roots, and the next (160) an indication that he had forgotten to divide by 2A. This done, however, both roots can be specified, and instructions given to the computer to print out the results of its solutions. Unfortunately the instruction 190 had no sooner been typed than it was recognized that solving $x^2+1=0$ would lead to a trouble not yet anticipated, for there is nothing in the programme to deal with the solution of equations with imaginary roots. Instruction 190 is accordingly deleted, and more reasonable values of the parameters for a test of the programme are provided with instructions 105 and 106. It remains to be specified that the computer must spell out the solutions of quadratic equations as complex numbers, but the software with which it is provided is already sufficient for it to print warning legends to the effect "SQUARE ROOT OF NEGATIVE NUMBER IN 150".

This simple illustration is a proof of the directness with which people can engage themselves with the machines. It is true, of course, that a much better first attempt at a programme to solve quadratic equations could have been obtained if more care had been devoted to the planning of the work in advance, and if the whole programme had been written down on paper before being typed into the machine. The advocates of multiple access claim, however, that direct interaction between the programmer and his machine leads to the development of programmes much more elaborate and much more powerful than would otherwise be created. But writing programmes is also splendidly informal.

Table 1

```
LIST


QUAD        14:56   SEPT. 29, 1966

100 READ A,B,C
110 LET Z=B↑2-4*A*C
150 LET X1=-B+SQR(Z)
160 LET X1=(X1/(2*A))
170 LET X2=(-B-SQR(Z))/(2*A)
180 PRINT "FØR A,B,C="A;B;C;"X1="X1,"X2="X2
190 DATA 1,0,1
200 END


100 FØR A=1 TØ 5 STEP 2
105 READ B,C
190  DELETED
105 LET B=4
106 LET C=3
190
EN DELETED
RUN


QUAD        14:58   SEPT. 29, 1965


FØR WITHØUT NEXT


TIME:    0 SECS.



190 NEX T A
180 PRINT A,B,C,X1,X2
50 PRINT "A","B","C","X1","X2"
60 PRINT
LIST


QUAD        14:59   SEPT. 29, 1966

50 PRINT "A","B","C","X1","X2"
60 PRINT
100 FØR A=1 TØ 5 STEP 2
105 LET B=4
106 LET C=3
110 LET Z=B↑2-4*A*C
150 LET X1=-B+SQR(Z)
160 LET X1=(X1/(2*A))
170 LET X2=(-B-SQR(Z))/(2*A)
180 PRINT A,B,C,X1,X2
190 NEX T A
200 END
```

But what about the cost ? This is the most immediate obstacle to the spread of multiple access computers around the world. At Dartmouth it is reckoned that the cost of putting a student through the now customary computer course is roughly \$50 (which is charged notionally to the appropriate college department). The cost of computer time as such is reckoned to be seven cents a second, and everybody seems cheerful about the prospect of reducing this substantially in the immediate future. Indeed, the real cost seems to be that of hiring and operating the consoles sited remotely from the computer, where reasonable use entails a charge of something like \$1,000 a month. "This is what really hurts", as someone said. And, of course, it remains a fact that the development of communications with computers has not yet reached the point at which these are at once as reliable and as easy to set up as the managers of computers would require. That, however, is likely to be only a passing difficulty.