

of addition and subtraction. (Perhaps the convention that a desired order of computation is indicated by parentheses should be adopted.) In the translation of ALGOL, for example, expressions involving variables and numbers could be reorganized so as to do as much computation at compile time as possible, at very little cost in compile time.

### Acknowledgements

Professor D. B. Gillies of the University of Illinois Digital Computer Laboratory contributed many suggestions both on the form and on efficient methods of programming the assembler for a small-memory machine. I am also grateful to Dr. H. Jarosch and Mr. J. Nievergelt for their assistance with the programming.

## Correspondence

The Editor,  
The Computer Journal.

Sir,

In his letter in the October *Journal*, Dr. Samet suggests that we should design a 5-track paper tape code specifically for the representation of ALGOL, so as to be able to use cheaper equipment. I disagree with this proposal. Considering not only ALGOL but also other similar languages, such as CPL, I do not think that a representation of such a language in 62 characters can possibly be tolerated except as an unfortunate and strictly temporary expedient. One of the purposes of such languages is to make it easier for the programmer to communicate his problems to the machine, and much of this ease of communication is lost if one is constrained to work in a system with, for example, only one sort of bracket and only one case of letters. One of the features of ordinary mathematics is the large number of different characters used: indeed multi-character names only occur for standard functions. Anyone who doubts the virtues of a large character set should compare the examples of NELIAC programs produced using the FORTRAN character set and using the CDC1604 Flexowriter set, given by Halstead in his book "Machine Independent Programming" (Spartan Books 1962). I would regard the 88 characters of a Flexowriter as an absolute minimum, and if anybody produced a device with more characters I should be delighted.

There is, however, a more important principle at issue. The suggestion is that 5-track equipment is available and relatively cheap, therefore we should adapt our programming systems to suit it. This attitude is unfortunately prevalent in various aspects of computer design and use, and I think the time has come to reject it. Programmers have for too long been pushed around and made to conform to the dictates of available hardware: it is time they rebelled. The purpose of a computer is, ultimately, to solve problems for the user, and therefore that which is convenient to the user should be the first consideration. The tape-preparation equipment is the main point of contact between the user and the computing system, and therefore warrants some trouble and expense. If we feel that seven and eight track equipment is unnecessarily expensive our response should not be to use five-track equipment but rather to demand of the manufacturers why they cannot produce seven and eight track machines at reasonable cost.

Yours, etc.  
D. W. BARRON.

The University Mathematical Laboratory,  
Corn Exchange Street,  
Cambridge.  
25 November 1963.

To the Editor,  
The Computer Journal.

Dear Sir,

"Hardware representation for ALGOL 60 using five-hole tape code"

In amplification of the letter by P. A. Samet (this *Journal*, Vol. 6, p. 286), you may be interested in the following information on the 5-hole tape code used at the Royal Radar Establishment to implement ALGOL 60.

The character set and tape representation were specially selected and did not have to comply with any existing code. We have enriched the normal character set by the provision of two non-feed characters, for which the teleprinter carriage does not move, so that the subsequent character overprints. The two non-feed characters are the underline and vertical stroke used in composing the relational operators  $\leq$ ,  $\geq$ ,  $\equiv$  and  $\neq$ , and for other purposes. The basic set, not counting composite symbols, contains 55 characters:

lower case alphabet  
digits 0123456789  
operators + - \* / < = >  
separators , . 10 ; ←  
brackets ( ) [ ]  
non-feed \_ |

Carriage return is on "figures" only, but line-feed, space, letter-shift and figure-shift are common to "letters" and "figures," so complying with different makers' limitations.

Our correspondence with reference ALGOL may be summarized as follows:

Reference ALGOL	RRE hardware
Upper case alphabet	Absent
Bold type	Lower case underlined
÷	Absent
String quotes	← →
∧ ∨ ]	and or not
: =	← (Note 1)
×	* (Note 2)
↑	-

Notes: (1) The assignment symbol is conveniently one character, is readily available, and avoids the possible error of omitting the colon. We read this as "becomes."

(2) Multiplication signs available are not markedly different from a sans-serif letter  $x$ , so the asterisk was chosen.

[continued on p. 367