Reference to the text of my paper will show that I agree entirely with Mr. Paine's closing remarks.

Mr. J. A. Fotheringham (*Ferranti Ltd.*): Do you have any trapping procedure in your input routines for spurious or illegal characters, so that the programmer can program his own warning characters?

Mr. Hoare: No, but there are ways of programming warning characters as indicated in the answer to an earlier question.

Mr. K. A. Redish (*University of Birmingham*): Since the dominant consideration in the design of ALGOL is that it should be universal, in some sense, will the two authors explain why they have not constructed identical conventions?

Mr. Hoare: It is certainly undesirable to have a divergence in methods of specifying input and output in ALGOL. Unfortunately, at the time when a conference of ALGOL implementors was arranged, it was found that we had adopted radically different approaches to the problem. We considered that the convenience of the user was the most important factor, while Mr. Duncan was more interested in keeping to the letter of the syntax of the ALGOL report.

The most striking advantage of our system is that input and output of several numbers may be specified without repeating the words "print" and "read." This is, of course, impossible if these are procedures, since an ALGOL procedure can only have a fixed number of parameters.

Mr. F. G. Duncan: It is indeed a great pity that the two systems have so little in common. The fundamental cause of the difference lies of course with the ALGOL report itself, which gives no guidance on questions of input and output. (Whether it should have said anything on this subject is another story.) On the other hand, it does suggest procedures with bodies in non-ALGOL language, and this is the basis of the KDF 9 scheme. We have not seen the need for any special structure for input–output statements; the ordinary ALGOL structure seems perfectly adequate. To this extent, therefore, we plead "not guilty." This, though, is not the whole point. Even if two implementors had agreed to use code procedures and keep within the ALGOL forms, I doubt whether, with different machines, they could write coded procedures with identical functions. Perhaps they could as far as format specifications are concerned, but some machines, like KDF 9, introduce the need for "hardware-oriented" procedures, such as those concerned with allocation of peripheral devices, which are meaningless for other machines.

There is a great diversity of input–output devices in the world today. There is no language for describing what they all do—even COBOL does not try to cope with curve plotters or knitting machines. Perhaps ALGOL is wise in saying nothing, for, as a certain Dutch professor has rightly said, "only by absolute silence can one preserve complete generality."

Mr. H. J. Richards (*IBM (U.K.) Ltd.*): Your format resembles very closely the COBOL "picture." I think the ALGOL school should at least study the work of the COBOL school for ideas in this area.

Mr. F. G. Duncan: In designing the KDF 9 formats, we have drawn mainly upon the work done for DASK. The COBOL report has not, to my knowledge and memory, provided us with any new ideas.

There must be many people working on ALGOL who have tried to get to grips with the COBOL report. I have been involved in some quite intensive work to see whether ALGOL needs to be extended to cope with so-called "commercial" problems, and I have consulted the COBOL report as part of this work.

One cannot take over the COBOL ideas into an ALGOL scheme for many reasons. In any case they would need to be extended in order to deal adequately with such notions as floating-point and significant figures, without which it is impossible to produce decently laid out results.

I sympathize with the questioner's concern that there is divergence between the ALGOL and COBOL "schools." I hope the day will come when this thoroughly artificial distinction between "scientific" and "business" programming languages is removed. It seems a long way off.

Mr. B. Randell (*Atomic Power Division, English Electric Co. Ltd.*) (*who has co-operated in the work described by Mr. Duncan*): An important feature of the system being implemented in KDF 9 ALGOL is that any user can extend the system in any way that he pleases by declaring new procedures. These procedures, whose bodies can be in ALGOL in User-code will work both on the program-testing compiler, which runs interpretively, and on the optimizing compiler, which translates ALGOL into machine code. It has been difficult enough to maintain absolute compatibility between two such different compilers, and the only way has been to remain absolutely within the rules of ALGOL 60.

Correspondence

To the Editor,

The Computer Journal.

Sir,

"Print-out of Algol Programs"

Professor E. W. Dijkstra referred, on page 126 of the July 1962 issue, to the MC Algol Flexowriter of which there are now fourteen examples in Europe. An editorial footnote refers to one at the Cambridge University Mathematical Laboratory. Your readers may be interested to know that this Observatory has a similar Flexowriter, with the same keyboard and coding, but with some additional facilities.

In considering how to extend our facilities for originating and printing Algol programs, we are interested in the IBM type 72 rotating-head electric typewriter. The construction of this machine appears to be inherently suited to punched-tape input and output, and the design has the advantage that the fount of characters can be changed in a few seconds, by simply exchanging the rotating type-head. The corresponding disadvantage is that at present a whole new type-head is necessary even if only one character is to be changed.

Since an Algol type-head is not currently offered, it will be necessary to design one. We would be pleased to hear from anyone who has suggestions about this, or who would share in sponsoring the initial cost of the necessary pattern.

Yours faithfully,

PETER FELLGETT.

Royal Observatory,
Edinburgh 9.
21 November 1962