Comment *Notes.*—(1) The matrix a is usually considered to be fixed point with its elements in the range $(-1, 1)$. Floating point will obviously do equally well but is not necessary. No provision has been made for fixed-point overflow, but this is unusual if the elements lie in a somewhat smaller range, e.g. $(-0{\cdot}1, 0{\cdot}1)$.

The vectors α, β which hold the result must be floating point and should preferably be multiple precision (double length seems enough almost always). For smallish non-pathological matrices single length should be sufficient.

(2) x is of the same type as a—i.e. single length fixed or floating point. w is of the same type as α and β, i.e. floating point, multiple precision if possible.

(3) If the eliminating element β_{r+1} is exactly zero it is replaced by ε which should be a very small number. If the near triangle has been formed fixed point, ε should be rather less than one unit in the least significant place kept.

Correspondence

Continued from p. 167

Sir,

The authors' reply:

Mr. Watt's letter raises some interesting points, to which we would like to reply.

Firstly, if it were not possible to use statements as parameters of more complex statements, this would indeed be restrictive. However, by suitably defining the class of "auxiliary statements" we can always avoid this difficulty. It is true that for languages like ALGOL and Nebula, the class of "source statements" proves less useful than in the case of more "primitive" languages such as Fortran and Mercury Autocode, where this class is comparatively large: in the former case emphasis is placed almost entirely on the class of auxiliary statements.

The first example given by Mr. Watt could be treated by means of the existing proposals were it not for a quite different kind of difficulty, which arises in connection with the definition of [GE], namely

$$[\mathrm{GE}] = [\mathrm{GE}]\,[\pm]\,[\mathrm{T}],\ [\pm\ ?]\,[\mathrm{T}]$$

This type of recursive definition cannot be used in conjunction with a forward scanning recognition routine, because it would be continually searching for a [GE]! Instead, it has to be recast thus:

$$[\mathrm{GE}] = [\pm\ ?]\,[\mathrm{GE}']$$
$$[\mathrm{GE}'] = [\mathrm{T}]\,[\pm]\,[\mathrm{GE}'],\ [\mathrm{T}]$$

With this definition of [GE] Mr. Watt's example becomes, in the notation of our January paper, as follows:

```
    statement definition: A = [GE']
    → 1 if [GE'] ≡ [T]
    let [GE'] ≡ [T] [±] [GE']
    A = [GE']
    A = [±]A + [T]
    end
1]  A = [T]
    end
```

One reason why the class of secondary statements and the class of auxiliary statements are treated exceptionally is because they are large classes and are defined in a cumulative manner. At any stage they can be regarded as complete and are used for recognizing such statements in statement definitions. There is, nevertheless, something in what Mr. Watt says, in so far as it may be desirable to treat other classes in this same cumulative fashion, and associate specific compiling routines (i.e. "statement definitions") with each member of these classes. At present the meanings of a phrase are embodied in the statement definitions of the formats which employ them (and indeed may be different in different contexts). If a phrase has several alternative forms this is reflected in the relevant statement definitions by the appearance of a multi-way switch (e.g. β_1 = category of [Y], $\rightarrow \beta_1$) or other means of discrimination. In the case of those phrases which we would like to define in a cumulative manner and which have many members, the corresponding statement definitions would become unwieldy, and it is convenient to be able to call in a routine to deal with the appropriate category of the phrase on hand. The need for this was not very apparent, however, in the study of Mercury Autocode, Fortran, or even ALGOL, but first showed up in some preliminary studies of Nebula, where an example of such a class is the "logical description statement" (see Nebula Manual, Ferranti, November 1960). We have, therefore, generalized the conception of cumulative classes to take account of this.

Yours faithfully,

R. A. Brooker, D. Morris.