CORRESPONDENCE

HELP SOUGHT

To the Editor, *The Mathematical Gazette*

DEAR SIR.—This amateur is interested in cubic residues. He has achieved some results, but does not know whether they are new or old. Dealing only with $(6k+1)$ type primes, p, he has

(1) An algorithm for the CR's (cubic residues) of all $p \equiv 1 \pmod{18}$, and all p for which $3CRp$,

(2) A short cut to the solution of $E^3 - 1 \equiv 0 \pmod{p}$,
and a number of miscellanea.

Now he needs skilled advice. Is there a professional, similarly interested and not too busy, who would volunteer? All letters will be answered.

Yours faithfully,

Flat 5, 29 *Craneswater Park*, NIGEL CRIDLAND
Portsmouth, PO4 ONX

I am sorry to have to record that Mr. Cridland died while proofs were in their last stages. Will anyone interested in this work please write to me as quickly as possible. E. A. MAXWELL

To the Editor, *The Mathematical Gazette*

THE LINEAR EQUATIONS PROBLEM

DEAR SIR.—Some thoughts on " Modern " school courses are prompted by two articles in the *Gazette* for December 1970:

In Classroom Note 233 Mr. A. K. Austin describes interviews for university mathematics courses. It appears that " traditional " candidates can solve $x^2 - 3x + 2 = 0$ to produce $x = 1$ or $x = 2$ with no clear understanding of what they have done or what it means. Mr. Austin hopes that, with modern mathematics, students may understand better what the solutions mean, and I feel sure that this is so: my concern is that they will still be able to produce the solutions.

The other article, that by Mr. Merlane on Matrix Methods, points the danger. Mr. Merlane starts by describing the reaction of pupils to the solution of simultaneous equations by premultiplication with an inverse matrix: " Why perform this rigmarole when a perfectly good method already exists?" At the end of the article the suggested way to overcome this objection appears to be that they should not be taught the " perfectly good method "!

In between, Mr. Merlane describes a first course in Linear Algebra which is lucid and illuminating. He suggests that this course would lay foundations in the fourth form for later sixth form work, and it clearly would. But why should students be denied the practical and simple method of solving simultaneous equations, because they are learning matrix algebra? Two objections are given in the article:

(*a*) " The method is not one that sheds much light on the concepts of linear equations and mappings, both of which are unifying structures in mathematics."

https://doi.org/10.2307/3612394 Published online by Cambridge University Press

If this is true it raises a point that must be faced. If a technique is useful but not very illuminating, should its use not be taught? This seems to me a dangerous proposition which could lead us to a generation unable to perform much elementary arithmetic.

(*b*) " The technique is not one that commends itself to generalisation when more complicated sets of linear equations are under consideration."

Now this I think is wrong. The direct methods of solution of simultaneous equations which are most practically useful derive from systematising the elimination method that Mr. Merlane would throw out. On the contrary, the matrix method described in some "modern" texts consists of writing an inverse matrix by use of a method which generalises to a solution involving the evaluation of n^2 determinants, a method which is certainly not practically useful.

It is true that many elegant schemes for solution are best described by triangular factorisation of matrices, and that to prepare the ground for this Mr. Merlane's linear algebra course is a useful foundation. But another useful foundation is ordinary elimination, leading as it does to the solution of triangular sets of equations at the back-substitution stage. A useful ground for later exploration might thus be sets of equations having the same solution vector (such sets are produced by elimination). The discussion has then reached the threshold of vector-space ideas, which may make it " modern " enough to be respectable? This approach also leads to the best practical method of determining the rank of a set of equations, a method whose understanding would be greatly assisted by the discussion of mappings in Mr. Merlane's article. (The ideas touched on here are clearly described in "Linear Equations" by P. M. Cohn, published by Routledge and Kegan Paul in the " Library of Mathematics " series).

In short, while greatly admiring the improvements in mathematics teaching that have developed in recent years, I am sure that school teachers should continue to teach techniques that are practically useful, seeking illumination in them when possible, and of course refusing blind drill with complicated examples.

Yours sincerely,

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Beaconside, Stafford

A. D. WOODALL

To the Editor, *The Mathematical Gazette*

NEGLECT OF ELEMENTARY METHODS

DEAR SIR.—May I protest against what appears to be an accepted doctrine in " Modern Maths. ", that *the* method of solving linear simultaneous equations is by matrix inversion? It is all very well for Mr. G. Merlane to rear his pupils confidently on a safe diet of 2×2 matrices, and to assert in his article " The use of matrix methods when solving simultaneous linear equations " (*Gazette* LIV (1970), p. 341) that " the traditional method of solving simultaneous equations has no place . . . in a modern O-level curriculum ". (I assume that he is

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https://doi.org/10.2307/3612394 Published online by Cambridge University Press