Mathematics and electrical engineers

Dear Sir—Mathematics is a language. In the same way that an Englishman in Italy with a good knowledge of Italian will quickly learn about Italy and Italians, so will an engineer versed in mathematics find a quick way to the understanding and status of engineering concepts.

Mathematics is not a conventional language for two reasons:

- A mathematician must act as an interpreter for those unversed in his language.
- Mathematics is a radically evolving language.

The second reason is fundamental and seminal to technology and science today.

We know that the gifted pupils at secondary schools are increasingly turning away from pure and applied science. They are turning to subjects of which the mathematical content is either basic arithmetic or nonexistent. The reason, I believe, stems from a difficulty with mathematics which originates in the teaching and which arises because of the dynamic aspect of mathematics as a language.

It is difficult for a teacher whose curriculum is overloaded and whose research function is nil to be dynamically involved in his subject. This does not seem to be a problem in the 'arts' subjects, since changing syllabuses would seem to be involving change of fashion rather than evolution. In 'science' subjects, which more and more have a basis of mathematics—an evolving subject—the problem is real.

Hence I do not see any way out of the present impasse, which is a positive feedback, or spiralling, process, except to accept that any teacher of a dynamic subject must be for a large part of his employment a pupil in the new techniques.

It will be argued that teachers with a real interest in their subject will, by reading and discussion, try to keep abreast of new developments, but I feel that this process is altogether too slow in the context of modern scientific development.

Mathematics is the root language of science and is, furthermore, an accepted international language; thus it is vitally important that all teachers and professional practitioners of science and applied science be kept up to date with new developments and techniques in this language.—Yours faithfully,

B. SAMWELL SMITH
27 Brangurt Road North
Kilkearn, Stirling
26th June 1968

Dear Sir—If the conclusions of G. S. Brayshaw's interesting article (June 1968 *E & P*, p. 235) are accepted, the IEE has been less than diligent in its review of the objectives of engineering education.

Dr. Brayshaw argues convincingly for an increased mathematical content in the formal education of all electrical engineers. Scrutiny of many papers published by the IEE would seem to support his opinion, for they are certainly unintelligible to a high proportion of present-day professional engineers.

On the other hand, comparison of the export achievements of Britain's electrical industry with those of competing nations suggests grave deficiencies in British engineering training of a totally different kind. Easily the most important is the area of engineering economics, from estimating, cost control, value engineering and the general understanding of management accounts to the principles of resource allocation and corporate planning. At this final stage, it is all too common to find economically inexperienced engineers duelling with technologically ignorant accountants, not infrequently to the mutual death.

Perhaps the time has come to recognise that more specialisation is inevitable; that 'scientific engineers' must have more mathematics; that sales engineers and consultants need conversational skills in foreign languages; and that most (though not all) engineers need more training in economic analyses.

We cannot disregard the known disinclination of school leavers to choose an engineering career; it is a painful truth that much of the present degree syllabus is destructively boring to just the man who could best consider the packaging of an integrated circuit, or who could report imaginatively on the economic merits of satellite communication. The trend recommended by Dr. Brayshaw would reduce even further the probability of recruiting such necessary people.

Further, should we not give more thought to the experimental engineer; to the man who determines how many sidebands can be suppressed before a circuit fails; to the one who reviews the effects of echo in long-haul telephone circuits? These people need to know the relationships propounded by mathematical theorists and the assumptions on which the calculations were based, but it is not vital that they comprehend the sophisticated procedures by which formulas are established.

As a rather irregular reader of your journal, I am not as clear as I should be about what the IEE does to confirm that the educational system does indeed encourage the skills which the engineering profession most requires. My feeling is that a broadly based survey would be useful, and that especial care is necessary that educationalists shall not be overrepresented!—Yours faithfully,

D. E. L. ILIFFE
Churchill's Farm, Stourpaine
Blandford, Dorset
10th June 1968

Engineering spotlight
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New microcircuit factory

On the 5th July 1968, the Rt. Hon. Anthony Wedgwood Benn, UK Minister of Technology, opened what is claimed to be the largest integrated-circuit research, development and manufacturing plant in Britain (and possibly in Europe). The new 96000ft^2 plant at Witham, Essex, is the main manufacturing headquarters of Marconi-Elliott Microelectronics—the company recently formed by merging the microelectronics interests of English Electric's subsidiary companies Marconi and Elliott-Automation.

The production capability of the new company is claimed to be over 5 million microcircuits per annum, production being carried out both at Witham and the company's plant at Glenrothes, Fife. By 1970, it is estimated that the company's sales could exceed £4 million.

Most of the circuits being produced in the new plant are conventional bipolar devices, but a small production area has been set aside for unipolar devices such as metal-oxide-semiconductor (m.o.s.) transistors, which are expected to make their full impact felt in the early 1970s; these devices require fewer stages in manufacture and allow much greater component densities in the final product.

Research and development work is being carried out at Witham and Glenrothes on advanced technologies such as m.o.s. circuits and new interconnection methods which enable silicon integrated circuits to be mounted on thick-film or thin-film circuit patterns. Of particular importance is the work on the 'beam-lead' interconnection technique, which could prove the best method for combining linear and digital circuits in a form of large-scale integration (l.s.i.) and which also lends itself very readily to automated production methods.

The applications laboratory at Witham is currently investigating a wide range of applications for both digital and linear microcircuits, including an automatic fare-collection system for buses, a high-fidelity amplifier and f.m. tuner, a digital clock, and an automatic photoelectric position-control system suitable for use with electric lifts.

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might have been better allocated to 'services to the profession and public', and the same might be said of the CEI subscription, but the allocation was not intended to be exact in detail, and inaccuracies in one direction were broadly balanced by those in the other.

In the absence of other questions or comment, the President put to the meeting the motion that the statement of accounts and the balance sheet be received and adopted. This was agreed.

P. Evans proposed a vote of thanks to the honorary secretaries of the local Centres, Sub-Centres and specialised Sections, the Council's representatives overseas and the honorary secretaries of Overseas Branches and Committees, which was carried by acclamation.

J. H. H. Merriman proposed a vote of thanks to the Honorary Treasurer, Sir Ben Barnett, which was accorded by acclamation.

Messrs. Pannell Fitzpatrick & Co. were reappointed as the auditors of the IEE for 1968–69.