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MATHEMATICS IN RESEARCH IN NEW ZEALAND.

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Introduction.—The reason for this paper is two-fold: to discuss a problem and to obtain information.

The problem is not new, but it is one that is becoming acute with ever-increasing use of mathematics in the sciences and in technology. It is this: how best to provide the research worker with the mathematics that he requires. In this the word research is not to be limited to imply only investigations under laboratory conditions but is to be understood to cover the whole field of problems involved in adapting and improving scientific knowledge for the attainment of desired ends.

With regard to the second point is is hoped to obtain information as to the extent and type of mathematics being used and required in research in New Zealand.

My interest in the matter arose from my endeavours to cultivate the use of statistical methods by workers in New Zealand. This aspect is being adequately cared for now. Formal instruction is available at the four colleges; but, more important, has been the establishment of the Biometrics Laboratory in the Department of Scientific and Industrial Research under the capable direction of Mr. I D. Dick.

Place of Mathematics and the Service it can Give.—Mathematics is but one—certainly a most powerful one in suitable circumstances—of the tools of the investigator in the analysis of his problem. This point is stressed since the young research worker who has some acquaintance with mathematics is liable to be carried away with the power of mathematical methods and to lose sight of his problem in a profusion of mathematics. It is necessary here, as in all things, to preserve a balance, and failure to do so may lead to distrust and disillusionment, when the fault is rather, that of the user in expecting mathematics to do his thinking for him.

In general one can say that mathematics is a language that simplifies the process of thinking and makes it more reliable. This is its principal service and it was amplified in the delivery of the paper. As it is not immediately necessary to the main purpose of the paper the points can be covered by reference to an article by T. C. Fry in the *Bell Telephone System Technical Journal*, 20, 3, 1941.

Background to the Problem in New Zealand.—Physics and engineering students reach the equivalent of S III mathematics, occasional ones going as far as honours standard, at least in part. Chemists, on the other hand, have on the whole been satisfied with less, though the demand from them is increasing. When we turn to the biologists we find that most avoid mathematics as far as possible, and the same is the case for other potential users of mathematics such as the economists, psychologists and students of education.

Thus the most we can reckon on is three years' work in mathematics (S I, S II, S III). Because of the nature of the courses for a university

degree in New Zealand, a student has to cover a range of subjects, so we find students nominating for S I mathematics who have no intention of pursuing the subject further (for example, at Victoria University College, S I, 190 and S II 60). It seems to me that serious consideration will have to be given to making the first year course more of an orientation course with less emphasis on the technical aspects than at present. In fact, I consider that S I mathematics should aim principally at presenting mathematics to the student as one of the great developments of the human intellect. Indeed, I am not so sure that in this way a better foundation might not be laid for the later work of those who will pursue the subject further.

If this view is accepted, then we shall have at most two years for the majority of science students in which to make them mathematically literate. This time will be fully occupied with what is usually regarded as "pure" mathematics and would allow of few excursions into the field of applied or quantitative mathematics. I consider that any attempt to increase the extent of such excursions would act deterimentally on the standard of the work attained, and this we can ill afford.

Where then the applicable mathematics? I would suggest that, in the main, it is best treated as a post-graduate study. This belief is fully confirmed by overseas experience. (See Nature, 158, 690, 1946.)

To meet the situation two types of courses are required:—(a) General—surveys of methods over a wide field. It may be possible in some circumstances to give these concurrently with the student's other work. The aim of such courses would not be the attainment of technical facility, but to indicate to the student where mathematics can be of assistance. A further important feature would be the instruction of the student in how to express his problem mathematically. The present mechanics (so-called applied mathematics) course enables us to treat this matter in a small way but it is too restricted. A lack of knowledge of the resources of mathematics very often leads to too great a simplification of the problem under consideration, with the result that the solution arrived at is often of very little value. (b) Special—courses giving a detailed discussion of a particular field. This work must definitely be post-graduate. Such courses would be designed to meet the needs of restricted groups of workers.

Organisation Required.—The immediate requirements can possibly be satisfied by adequate liaison between the mathematics' departments and outside organisations. As for instruction, the university could provide some of it and I am sure that suitable lecturers could be found for some topics among the members of government departments and industrial organisations. In this connection the possibility of setting up temporary lectureships for such workers is worth consideration. It would give an opportunity for the carrying out of some research in conjunction with the teaching duties.

The specialised courses could well be the training ground for a class of research worker for which there is an increasing, though from the nature of it, necessarily limited demand—the mathematical technologist—the name coined for the mathematical consultant in scientific and industrial research. Such workers would be drawn from all fields and not necessarily only from among those with a highly specialised mathematical background. The main preliminary requirements would be an aptitude for the mathematical approach and the ability to co-operate with other workers.

It may prove to be the case that the approach outlined above will not be adequate for handling the demand. In that event it might prove desirable to set up a distinct department at one or more of the university colleges. But if the demand is sufficiently large I believe the whole question should be viewed in relation to the establishment in New Zealand of a College of Technology.

Conclusion.—At present the university is being asked to perform two functions:

(i) to provide a liberal education;
(ii) to train men and women for specific occupations.

The result is, in my opinion, that it is not doing either adequately. I do not believe that the second function stated above is that of a university at all, and my object has been to endeavour to suggest how, with our present organisation, we can separate the two without prejudice to either.