PURE MATHEMATICS IN AUSTRALIA

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I. D. MACDONALD argued in this journal in 1968 that there was an inadequate number of mathematicians teaching in Australian universities who were qualified by international standards to conduct honours courses and supervise research students. Moreover the distribution of the available qualified people amongst the various branches of (pure) mathematics was unsatisfactory since many of the most vigorous areas of research were amongst the most neglected.

In support of his argument Macdonald gave the results of a survey of the number of "experts" in particular areas of mathematics who were working in Australia at that time. An expert in a field was defined to be an individual who had three papers in that field reviewed in *Mathematical Reviews*. We do not repeat here Macdonald's sound reasons for basing a survey of pure mathematics on that journal.

During recent discussions on the future of mathematics in Australia the authors carried out a similar survey and collected at the same time some related data on recent mathematical activity in this country. The results are summarised in the accompanying table.

There is an obvious trap to avoid in the interpretation of the figures. Macdonald could argue that there was little activity of international standard by showing that there was little activity of any sort; but of course we cannot argue that an increased amount of research work implies an increased amount of work of international standard. It is safer to argue from the figures that many areas, some vigorous and of central importance, continue to be neglected in Australia. Note however that young mathematicians who have begun work in recent years will not be adequately represented in the figures given. It takes three years or more from the writing of a paper to its review in *Mathematical Reviews*. Macdonald felt that this distortion was not "essential", but looking back it is clear that some did occur.

The figures may be summarised as follows. Five years after Macdonald's survey the number of experts has more than doubled (from 47 to 109), the number (70) of Australian-resident authors who were reviewed in 1972 was about two-thirds of the number of

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experts, and the number (93) of papers reviewed in 1972 was not much more than one per author on average. In all cases the work of one individual in two fields counts as the work of two people and a paper with n authors counts n times. The number of papers reviewed throughout the world in one month (January 1972) was 1224 (when papers with several authors are counted only once; but joint authorship is relatively rare in pure mathematics), about thirteen times the above figure for Australian-resident authors over twelve months. Many important areas continue to be neglected, some outstanding examples being differential geometry, algebraic topology and their applications in modern analysis. Increased interest in combinatorial theory, ring theory and functional analysis is reflected in the figures, as is the continuing strength of group theory and generalisations. In some areas the number of experts is much larger than the number of authors in 1972, suggesting a decline in current interest in the topic.

Most of the figures are so small that it would be wrong to take them too seriously. Small annual changes could produce large differences in their proportions, and of course the authors cannot guarantee total accuracy. Nevertheless the figures for 1972 are fairly typical of those for the preceding two years (not given), which encourages some confidence in them but also suggests that the rapid increase of activity in the 1960s is levelling off.

What general conclusions might be drawn? The situation does not seem as hopeless now as it did in 1968. The increased local activity, the general scarcity of employment in the profession throughout the world, even the revaluation of the Australian dollar suggest that Australia should be becoming a more attractive place for active mathematicians—provided of course that there continue to be opportunities here for them. Unfortunately those we need most (the best, of course, and representatives of important areas of research which are still neglected here) are the least attracted because of the relatively high demand for them elsewhere and the relatively great isolation they would suffer here.

While the situation is now more promising, and to some extent already improved, no one would suggest that Australia's significant contributions to mathematics have been on anything like the scale of its significant contributions to, for example, some biological sciences or radio astronomy. However reasonable this relative insignificance may have been in the past, surely every effort should be made to ensure that it does not continue into the future.

APPENDIX

Macdonald's survey considered papers reviewed up to the end of 1967; ours considered papers reviewed up to the end of 1972. The

population of Australian-resident authors on which this survey is based is slightly broader than that of Macdonald's survey. The only major difference is that it includes the staff of the Mathematics Department of the Institute of Advanced Studies at the Australian National University. In particular the population for this survey was a draft list of Australian-resident mathematicians which has been compiled recently for a forthcoming edition of the World Directory of Mathematicians.

The rules governing the conduct of the survey were the same as those outlined by Macdonald in his Appendix, except that persons without three papers reviewed in any one field were not counted as experts in any field. The category "various" was consequently omitted.

Macdonald's other comments on the pitfalls of interpreting the data remain relevant but need not be repeated here.

Subject	No. of "experts" (Macdonald, to 1967)	No. of "experts" (to December 1972)	Total no. of reviews in January 1972	No. of Aust. authors reviewed in 1972	No. of Aust. authors' papers reviewed in 1972
Logic and Foundations		1	38		
Set Theory			2		
Combinatorial Theory, Graph Theory		3	49	3	5
Order, Lattices, Ordered Algebraic Structures		1	28	2	2
General Mathematical Systems			7		
Theory of Numbers	6	11	40	3	5
Fields and Polynomials		1	10		
Commutative Associative Rings and Algebras			15	1	1
Algebraic Geometry		1	18		
Linear and Multilinear Algebra, Matrix Theory		1	19	2	4
Associative Rings and Algebras		4	51	6	6
Non-Associative Rings and Algebras	1	1	13		
Category Theory, Homological Algebra	1	2	11	2	2
Group Theory and Generalisations	12	21	80	16	24
Topological Groups and Lie Theory		4	26	2	3
Functions of Real Variables	1	5	22	1	1
Measure and Integration	4	5	38	4	4
Functions of a Complex Variable	2	3	57	2	2
Potential Theory			10		
Several Complex Variables			16		
Special Functions	1	1	17	2	2
Ordinary Differential Equations	2	3	80	1	1
Partial Differential Equations	1	2	81	2	4
Finite Differences and Functional Equations			22		

Sequences, Series, Summability	1	2	11	1	1
Approximations and Expansions		1	26	2	2
Fourier Analysis	1	5	26	5	10
Integral Transforms, Operational Calculus	3	6	10		
Integral Equations			24		
Functional Analysis	3	9	89	6	6
Operator Theory	3	2	59	2	3
Calculus of Variations, Optimal Control		1	12	1	1
Geometry	3	4	18	1	1
Convex Sets and Geometric Inequalities	1	2	17		
Differential Geometry	1	1	54	1	1
General Topology	1	2	61		
Algebraic Topology	2	4	26	2	2
Topology and Geometry of Manifolds			41		
TOTALS (Macdonald's category "various" is omitted)	47	109	1224	70	93