

We wish to purchase runs and odd nos of: Sphinx, Revue Mensuelle des Questions Recreatives. Bruxelles, 1931–39. Journal of Recreational Mathematics. 1968–, Recreational Mathematics Magazine, 1961–64. Sphinx-Oedipe, Nancy, 1906–1932. All books published in the series “Libraire du Sphinx” Bruxelles. Rouse-Ball, W. W. R. Mathematical Recreations and Essays. All editions from the first (1891) to 11th (1939). Also mathematical books of all kinds from very elementary to advanced texts. Also biographies of mathematicians and physicists. We also sell books in this field, indeed we specialise in mathematics, and will be pleased to receive your list of books wanted and to send you our current catalogue on request.

**F. E. Whitehart, Bookseller,
40 Priestfield Road, Forest Hill,
London SE23 2RS. 01-699 3225.**

PLUS is a magazine for pupils in secondary schools,

PLUS is based on a level of Mathematics up to and sometimes beyond the standard of 'O' level,

PLUS is published once a term by the M.A.

PLUS includes

- * articles on mathematics and its applications to enrich and enlarge normal classroom materials,
- * puzzles, problems and competitions,
- * a computer column showing how the computer can assist and enrich mathematics,
- * activities to pursue in a Maths Club,

PLUS is published three times a year and the annual rate of subscription is:—

£1.80 for one copy of all three issues
(60p per issue)

£15 for a pack of TEN copies of all three issues
(50p per copy per issue)

ALL prices include postage and packing

ORDERS SHOULD BE SENT TO MA HEADQUARTERS

AVAILABLE FROM HEADQUARTERS

Published by Stanley Thornes & Hulton
in co-operation with The Mathematical Association

MATHS TALK

The skills of spoken language are as important in mathematics as they are in other areas of the curriculum.
A sub-committee of the Mathematical Association has produced these excellent guidelines on Language in Primary Mathematics, with close reference to the Bullock Report.
The book is illustrated in full colour, including many children's drawings for mathematics.

SHARING MATHEMATICS WITH PARENTS

Planning School-based Events

A sub-committee of the Teaching Committee of the Mathematical Association has produced this interesting range of advice for involving parents in their children's learning of mathematics in primary and secondary schools.
The book is well illustrated with a number of black and white photographs.

Sharing Mathematics With Parents

Planning School-based Events



£2.95

Maths Talk



£3.95

Copies available from
The Mathematical Association

THE MATHEMATICAL ASSOCIATION

SUBSCRIPTION RATES FOR 1988

<u>Class</u>	<u>Service</u>
D Diploma Student	G Mathematical Gazette
F Family	M Mathematics in School
I Introduction	R Reports
L Life	
O Ordinary	
PSR Primary School	
U Under 25 or full-time student	

RULE 4.1 An Ordinary Member shall be entitled to attend and to vote at all meetings of the Association, to use the Association's Library and to receive one copy of any new Report issued during the period of membership. According to the subscription paid and the service chosen, the Member shall receive also one copy of each issue of some or all of the periodicals published by, or for, the Association and issued during the period of membership.

Full details of other classes of membership obtainable from The Executive Secretary, The Mathematical Association, 259 London Road, LEICESTER, LE2 3BE, U.K..

The following subscriptions are for one calendar year, due on 1st January, but the first subscription paid by a new member joining after 1st July in any year covers the period from the date of joining until the end of the following year.

All Members (including PSR Member Schools) receive MA News and the MA Newsletter. Members receive at no extra charge the Reports allocated to each Class of membership by the Finance & General Purposes Committee. Other publications are offered to Members at preferential prices. UK is deemed to include the United Kingdom, Channel Islands and the Isle of Man.

<u>Class/Service</u>	<u>UK Full Rate</u>	<u>UK Concessionary Rate</u>	<u>Overseas Surface Mail</u>
	£	£	£
O/GMR	31.00	29.50	31.00
O/GR or O/MR	22.00	20.50	22.00
U/GMR	19.00	-	-
U/GR or U/MR	12.00	-	-
D/GMR	17.00	-	-
D/MR	10.00	-	-
I/GMR	15.00	-	-
F/GMR	33.50	32.00	33.50
F/GR or F/MR	24.50	23.00	24.50

Additional subscription for airmail to Overseas Members.

The above UK Concessionary Rates apply only to those Members using an address in the United Kingdom who pay by means of a Direct Debit agreement, or those whose subscription is received in the Headquarters of the Association not later than 31st December of the previous year, by cheque, VISA or Access or National Giro payment.

All Members (excluding Life Members, but including PSR Member Schools) may subscribe at reduced rates to other publications provided the subscription is paid with the Membership subscription. The rates are shown below with the usual rates in square brackets. All charges are for a single copy of each issue published in the year of membership.

PLUS	£1.50	(£1.80)	MATHEMATICAL PIE	60p	(78p)
STRUGGLE	£4.00	(£4.50)	MATHS ROUND THE COUNTRY	£1.50	(£2.00)
PRISM Packs	£8.00 (Primary Supplementary Packs)				

PAYMENTS MUST BE IN POUNDS STERLING

THE MATHEMATICAL ASSOCIATION

The fundamental aim of the Mathematical Association is to promote good methods of mathematical teaching. A member receives each issue of the *Mathematical Gazette* and/or *Mathematics in School* (according to the class of membership chosen), together with any Newsletters and Reports published during the year. Intending members should ask the Executive Secretary for information and application forms.

The address of the Association and of the Honorary Treasurer and Secretaries is **259 London Road, Leicester LE2 3BE, Telephone (0533) 703 877.**

Change of address should be notified to the Membership Secretary at the Leicester office. If copies of the Association's periodicals fail to reach a member for lack of such notification, duplicate copies can be supplied only at the published price. If change of address is the result of a change of appointment, the Membership Secretary will be glad to be informed.

Subscriptions should be paid to the Hon. Treasurer.

Correspondence relating to the **Teaching Committee** should be addressed to Mr D. Bain, 23 Capstan Square, Stewart Street, London E14.

The **Library** is housed in the University Library, Leicester.

THE MATHEMATICAL GAZETTE

Editor:

Dr V. W. Bryant, Department of Pure Mathematics,
The Hicks Building, The University, Sheffield S3 7RH.

Assistant editors:

Dr D. J. Baylis, Maths Department, Trent Polytechnic, Clifton Site, Nottingham NG11 8NS
Mr G. Hoare, Dr Challoner's Grammar School, Amersham, Bucks HP6 5HA.

Material for publication should be sent to Dr Bryant.

Books for review should be sent to Dr Baylis.

Problems and solutions for the Problem corner should be sent to Mr Hoare.

Business and advertising correspondence should be addressed to the Executive Secretary at the Leicester office of the Association.

CONTENTS

Locks and master keys	<i>Anthony C. Robin</i>	1
A computer verification of a pretty mathematical result	<i>Bill Leonard and Harris S. Shultz</i>	7
What they don't teach you about integration at school	<i>A. D. Fitt</i>	11
A set of inequalities	<i>A. J. B. Ward</i>	16
New angles on an old theorem	<i>Tony Crilly and Huw Jones</i>	19
Who gets good degrees?	<i>Johnston Anderson</i>	22
Equilateral triangles and the golden ratio	<i>J. F. Rigby</i>	27
Notes 72.1–72.13		
Sine-posts: a distant view	<i>Anthony C. Robin</i>	31
Sine-posts: a close-up view	<i>Tony Crilly</i>	32
An Illustration of $(\sum r)^2 = \sum r^3$	<i>D. J. Orton</i>	32
An n -dimensional vector proof for $\sum r^2$	<i>Nick Lord</i>	33
Centre of mass by linear transformations	<i>Nick MacKinnon</i>	34
Two parodies of proofs with infinity	<i>Stephen Jones</i>	36
Formula for $a \cos \theta \pm b \sin \theta$ by diagrams or vectors	<i>Ian Cook</i>	38
Some integrals	<i>P. J. Maher, D. N. Smith and R. C. Gupta</i>	39
Summation of factorial series by the Egyptians	<i>Philip Holgate</i>	41
Magic squares	<i>Michael Cornelius</i>	43
Subdividing hypercubes	<i>Nick Lord</i>	47
Products of vectors revisited	<i>P. Glaister</i>	48
Heronian triangles are almost everywhere	<i>K. Robin McLean</i>	49
Obituary		
Edwin Arthur Maxwell	<i>Douglas Quadling</i>	51
Problem corner		53
Reviews		56

ISSN 0025-5572

Computer typeset by SB Datagraphics. Printed in Great Britain by Spottiswoode Ballantyne Printers Ltd