

ISSN: 0305-0041

MATHEMATICAL PROCEEDINGS

*of the
Cambridge Philosophical Society*

VOLUME 168 PART 1

January 2020



CAMBRIDGE
UNIVERSITY PRESS

CAMBRIDGE PHILOSOPHICAL SOCIETY

FOUNDED 1819; ROYAL CHARTER 1832

2020

President: S. CONWAY-MORRIS

Vice-Presidents: C. L-H. HUANG, R.R. HORGAN, J. WOODHOUSE

Treasurer: G. A. REID

Secretaries: (Physical) F.J. LEEPER, (Biological) D.K. SUMMERS,
(Mathematical) A. G. THOMASON

The Society publishes *Mathematical Proceedings* (until 1975 entitled *Proceedings*) and *Biological Reviews*. The publication of Transactions was suspended at the end of Volume XXIII.

Orders, which must be accompanied by payment, may be sent to any bookseller or subscription agent or direct to the publisher: Cambridge University Press, Journals Fulfillment Department, University Printing House, Shaftesbury Road, Cambridge CB2 8BS, UK, or in the USA, Canada and Mexico, Cambridge University Press, Journals Fulfillment Department, 1 Liberty Plaza, Floor 20, New York, NY 10006, USA. Japanese prices for institutions are available from Kinokuniya Company Ltd, P.O. Box 55, Chitose, Tokyo 156, Japan.

Periodicals postage is paid at New York, NY, and at additional mailing offices. POSTMASTER : send address changes in USA, Canada and Mexico to *Mathematical Proceedings*, Cambridge University Press, 1 Liberty Plaza, Floor 20, New York, NY 10006, USA.

Back numbers of *Mathematical Proceedings* and *Biological Reviews* may be obtained from the CAMBRIDGE PHILOSOPHICAL SOCIETY, 17 MILL LANE, CAMBRIDGE CB2 1RX, ENGLAND. All parts of *Mathematical Proceedings* (including indices to Vols. 1–50, 51–60, 61–70, 71–80, 81–90, 91–100, 101–110 and 111–120) and of *Biological Reviews* are available. Prices will be quoted on application. Some parts of Transactions are available from the above address. The complete set on microfilm may be obtained from Microfilm Division, E.P. Group of Companies, Bradford Road, East Ardsley, Wakefield, Yorkshire, price £77.

MATHEMATICAL PROCEEDINGS

of the

CAMBRIDGE PHILOSOPHICAL SOCIETY

edited by B. J. GREEN in conjunction with

N. BERESTYCKI

M. BRIDSON

K. FALCONER

A. GRANVILLE

M. GROSS

J. W. LUK

G. PATERNAIN

J. RASMUSSEN

B. SUDAKOV

H. WILTON

1. *Mathematical Proceedings* (ISSN 0305-0041) is published bimonthly, in January, March, May, July, September and November, in two volumes of three parts by Cambridge University Press, University Printing House, Shaftesbury Road, Cambridge CB2 8BS, UK/Cambridge University Press, 1 Liberty Plaza, Floor 20, New York, NY 10006, USA. The subscription rate (excluding VAT) (which includes delivery by air) of volumes 168 and 169 (2020), which includes print and electronic access, is £747 (US \$1226 in the USA, Canada and Mexico). The electronic-only price available to institutional subscribers is £641 (US \$1066 in the USA, Canada and Mexico). Single parts cost £130 (US \$217 in USA, Canada and Mexico) plus postage. EU subscribers (outside the UK) who are not registered for VAT should add VAT at their country's rate. VAT registered subscribers should provide their VAT registration number.

2. *Scope of the Mathematical Proceedings.* Papers which advance knowledge of mathematics, either pure or applied, will be considered by the Editorial Committee. The work must be original and not submitted to another journal. Papers should be submitted electronically to the Editor at mpeditor@hermes.cam.ac.uk in pdf form only. Papers in languages other than English should be sent only after prior consultation with the Editor, who may be contacted at the e-mail address above.

3. *Correction of proofs.* If a paper is accepted, the author will receive in due course page proofs for him to correct and return within one week. To minimize disturbance of type, when words or phrases are added in proof, others of equal length should be removed if possible. If many corrections are made in the proofs, the Council reserves the right to charge the cost.

4. Authors receive a final PDF of their paper. They may order offprints via an order form sent with the proofs. © Cambridge Philosophical Society, 2019. Printed in the United Kingdom at Bell and Bain Limited, Glasgow.

This journal is included in the Cambridge Journals Online service which can be found at <http://journals.cambridge.org>. For further information on other Press titles access <http://www.cambridge.org>.

Copying. This journal is registered with the Copyright Clearance Center, 222 Rosewood Drive, Danvers, Mass. 01923, USA. Organizations in the USA who are also registered with CCC may therefore copy material (beyond the limits permitted by sections 107 and 108 of US copyright law) subject to payment to CCC of the per-copy fee of \$16.00. Code 0305-0041/2017 \$16.00. This consent does not extend to multiple copying for promotional or commercial purposes.

Organizations authorized by the Copyright Licensing Agency may also copy material subject to the usual conditions. ISI Tear Sheet Service, 3501 Market Street, Philadelphia, Pennsylvania 19104, USA, is authorized to supply single copies of separate articles for private use only. For all other use, permission should be sought from Cambridge University Press.