

The BIOCHEMICAL JOURNAL

B London: The Biochemical Society © 1984

VOLUME 224, No. 2

1 December 1984

EDITORIAL BOARD

Chairman

C. I. Pogson (*Beckenham*)

Deputy Chairmen

J. A. Lucy (*London*)

P. J. Garlick (*Aberdeen*)

P. C. Engel (*Sheffield*)

M. D. Houslay (*Glasgow*)

K. B. M. Reid (*Oxford*)

Editorial Manager

A. G. J. Evans

Editorial Secretary

A. S. Beedle

T. ap Rees (*Cambridge*)

W. J. Brammar (*Leicester*)

J. W. Bridges (*Guildford*)

K. Brocklehurst (*London*)

M. J. Clemens (*London*)

B. A. Cooke (*London*)

N. Crawford (*London*)

P. Davies (*Rahway*)

R. T. Dean (*Uxbridge*)

J. F. Dice (*Boston*)

P. J. England (*Bristol*)

W. H. Evans (*London*)

J. E. Fothergill (*Aberdeen*)

C. Greenwood (*Norwich*)

B. A. Haddock (*Edinburgh*)

J. L. Harwood (*Cardiff*)

F. W. Hemming (*Nottingham*)

L. Hue (*Bruxelles*)

O. T. G. Jones (*Bristol*)

J. E. Kay (*Brighton*)

P. F. Knowles (*Leeds*)

P. Lund (*Oxford*)

R. H. Michell (*Birmingham*)

G. Murphy (*Cambridge*)

D. G. Nicholls (*Dundee*)

G. C. K. Roberts (*London*)

G. G. Rousseau (*Bruxelles*)

E. D. Saggerson (*London*)

A. M. Tartakoff (*Cleveland*)

K. F. Tipton (*Dublin*)

P. Tulkens (*Bruxelles*)

A. J. Turner (*Leeds*)

J. E. Walker (*Cambridge*)

R. T. Walker (*Birmingham*)

D. A. Walsh (*Davis*)

The Editorial Board includes two members nominated by the British Biophysical Society

- The Biochemical Journal is published and distributed by the Biochemical Society, and appears twice monthly.
- Editorial and Publishing Offices: The Biochemical Journal, 7 Warwick Court, London WC1R 5DP, U.K.
- Subscriptions Department: The Biochemical Society Book Depot, P.O. Box 32, Commerce Way, Colchester CO2 8HP, Essex, U.K.
- All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without the prior permission of the copyright owner.
- Copies of articles in this journal may be made in the U.S.A. for personal or internal use, or for the personal or internal use of specific clients, on the condition, however, that the copier pay the stated per-copy fee through the Copyright Clearance Center Inc. (P.O. Box 765, Schenectady, New York 12301, U.S.A.) for copying beyond that permitted by Sections 107 or 108 of the U.S. Copyright Law. This consent does not extend to other kinds of copying, such as copying for general distribution, for advertising or promotional purposes, for creating new collective works, or for resale. The Copyright Clearance Center code for this journal is 0264-6021/84/\$2.00.
- Second-class postage paid at New York, NY, U.S.A.
- U.S. Postmaster: send address changes to *Biochemical Journal*, c/o Expeditors of the Printed Word Ltd., 527 Madison Avenue, New York, NY 10022, U.S.A. (U.S. mailing agent).

AUTHORS

The *Biochemical Journal* places emphasis on the prompt publication of **Full-length Papers** (on average about 6 months after receipt), **Rapid Papers** (on average within 3 months of receipt), **Reviews** and **BJ Letters**. It is the Journal's policy to publish papers in English in all fields of biochemistry, provided that they make a sufficient contribution to biochemical knowledge. Papers may include new results obtained experimentally, descriptions of new experimental methods of biochemical importance, or new interpretations of existing results. Theoretical contributions will be considered equally with papers dealing with experimental work. All work presented should have as its aim the development of biochemical concepts rather than the mere recording of facts. Preliminary or inconclusive experiments should not be described.

Papers are accepted from non-members and members of the Biochemical Society. Prospective authors should note that the *Biochemical Journal* offers rapid publication and makes no manuscript handling charges, no page charges and no charges for plates (except colour). Fifty reprints are provided free of charge; further copies are available at modest cost.

The paragraphs below are a summarized version of information provided in the Biochemical Society's *Policy of the Journal and Instructions to Authors* [*Biochem. J.* (1984) 217, 1-26]. Copies are available from the Editorial Office.

The following types of submission are considered by the Editorial Board.

1. **Full-length Papers** (normally eight printed pages maximum)
2. **Rapid Papers** (four printed pages maximum)
3. **Letters** (two printed pages maximum)
4. **Reviews** (usually solicited)

Full-length Papers and Rapid Papers

Full-length Papers should not normally exceed eight printed pages, including figures and tables. Longer papers may be acceptable if their content justifies their length. Indeed, the Board's desire to restrict the length of papers should not lead authors to split their work into two or more shorter papers. For example, a single paper consisting justifiably of ten printed pages will

normally be considered more favourably than two papers each of six pages dealing with the same material. Authors should remember that short papers are generally published with the least delay.

All papers that can be accommodated in four pages of the Journal will be treated as **Rapid Papers**. They receive priority treatment and it is aimed for their publication to be within 3 months of receipt. However, the criteria of reviewing and the appearance of Rapid Papers in the Journal are identical with those of Full-length Papers. In order to achieve the accelerated schedule, reviewers are asked to deal with the paper within 48 h and proofs of accepted Rapid Papers are not normally supplied to authors. However, authors are given details of any editing of Rapid Papers at the same time that the typescripts are sent to the printer, with a request that any essential amendments be sent to the Editorial Secretary as soon as possible. The scientific editorial staff in the Editorial Office check the proofs to ensure that they tally exactly with the edited typescripts and make any necessary alterations indicated by the authors.

Papers submitted for publication should be addressed to the Editorial Secretary, The Biochemical Journal, 7 Warwick Court, London WC1R 5DP, U.K. Three copies of the typescript should be submitted. The typescript should bear the name and address of the person to whom correspondence (including proofs) should be sent. An additional copy of the synopsis should be enclosed. The top copy should be accompanied by the original artwork (see the Appendix to *Policy of the Journal and Instructions to Authors* for advice on the preparation of figures). Photocopies of line drawings are acceptable for the other two copies but glossy prints (not photocopies) of all the halftone figures must be provided.

It is helpful if the author encloses copies of relevant preceding papers, especially if these were not published in the *Biochemical Journal*. If the paper submitted refers to a paper 'in the press' in another journal the reviewers will not have access to this material and it is important that the author should include photocopies of the relevant typescript together with documentary evidence that it has been accepted for publication. Any reference to a 'personal communication' must be supported by documentary evi-

dence from the individual quoted showing that agreement with the quotation is given.

Before preparing papers, authors should consult a current issue of the Journal to make themselves familiar with the general format, such as the use of cross-headings, lay-out of tables and citation of references. Typescripts should be in double-spaced typing throughout (including the references and legends of tables and figures) on sheets of uniform size with wide margins.

Full-length Papers should not normally exceed 6000 words in length, and Rapid Papers must not exceed 3000 words, each inclusive of title, synopsis and references. Authors must assess what proportion of a page insertions (such as tables, figures and schemes) will occupy and reduce the number of text words accordingly at the rate of 800 words per full page of the Journal.

Authors should state under which section of the contents list they wish their paper to appear:

Proteins

Enzymes

Carbohydrates

Lipids

Nucleic acids and molecular genetics

Synthesis and degradation of macromolecules

Intermediary metabolism and metabolic control

Bioenergetics and transport

Membranes and receptors

Cell structure and function

Methods

BJ Letters and Reviews

BJ Letters are intended to provide an opportunity to discuss, criticize or expand particular points made in published work, or to present a new hypothesis. They should not be comments on general aspects of the biochemical world, nor should they be used as an alternative to a Rapid Paper. If a letter is polemical in nature, a reply may be solicited from other interested parties before its publication. Letters must not exceed 1200 words, which is approximately the equivalent of two printed pages.

Reviews will usually be solicited, although unsolicited reviews will not be considered for publication; however, prospective writers of reviews should first consult the Chairman of the Editorial Board.

SUBSCRIBERS

The *Biochemical Journal* is published and distributed by the Biochemical Society. It is published twice monthly; in 1985 eight volumes (225-232) of three parts each will appear. An Annual Index is supplied to all subscribers as soon as possible after publication of the year's volumes.

Subscription rates

For non-members of the Biochemical Society the subscription rates for 1985 are shown below.

Subscribers to the *Biochemical Journal* can subscribe additionally to *Biochemical Society Transactions* on a joint subscription, saving £15.00 (U.K. and Overseas) or \$25.00 (N. America). The methods of despatch of both publications are shown below.

Terms are cash with order (£ sterling for subscribers other than in North America or U.S. \$ equivalent at current rate of exchange) or against proforma invoice. Orders and subscriptions should be sent to the address below, or through your usual agent.

	U.K. & Overseas	U.S.A., Canada & Mexico
1 year (8 volumes)	£445	U.S. \$890
Per volume	£56	U.S. \$112
Per part	£19.50	U.S. \$40

Subscription rates for Japan are available on application.

The subscription rate for North America includes an element for airfreight service.

Advertisements

Applications for advertising space should be sent to the Advertising Department at the Society's London address. Copy is required eight weeks before publication date. Rate cards are available on request.

Microfiche

Volumes 102-224 of the *Biochemical Journal* are available on microfiche. Further details are available from the address below.

Subscription Department

The Biochemical Society Book Depot,
P.O. Box 32, Commerce Way,
Colchester CO2 8HP, Essex, U.K.

LIBRARIANS

Preliminary pages: The preliminary pages in each issue have been arranged and paginated so that they can be assembled to give a set of volume preliminary pages; pages (i) and (ii) are the volume title pages supplied with part 1 of each volume, pages (iii)-(vi), (vii)-(x) and (xi)-(xiv) are the contents pages from parts 1, 2 and 3 respectively, and pages (xv) and (xvi) are the volume author index supplied in part 3 of each volume.

INDEX OF AUTHORS

	PAGE		PAGE		PAGE
Aiken, M.	673	Hall, C.	677	Quincey, R. V.	497
Alsenz, J.	389	Hanash, S. M.	609	Raeymaekers, L.	445
Anderson, P. J.	355	Hanisch, F.-G.	581	Ragan, C. I.	525
Arnold, R. E.	497	Hartzell, C. R.	651	Rajaniemi, H. J.	467
Aster, J. C.	609	Heath, J. K.	461	Rechinsky, V. O.	645
		Hetenyi, G., Jr.	355	Regoecci, E.	505
Barritt, G. J.	423	Hill, B. C.	591	Reinhart, G. D.	541
Basu, A.	515	Hlavica, P.	415	Roguin, L. P.	535
Benedetto, C.	431	Hopper, D. J.	617	Roscher, A.	569
Bibilashvili, R. S.	645	Houston, B.	437	Roughan, P. G.	637
Bleeheh, S. S.	453	Hughes, B. P.	423	Rozovskaya, T. A.	645
Bray, R. C.	601	Hutton, J. C.	483		
Brewer, G. J.	609			Saklatvala, J.	461
Brocklehurst, K. W.	483	Islam, K.	623	Sampson, D. A.	681
Brown, B. L.	453			Sarsfield, S. J.	461
Browse, J.	637	Jansen, G. R.	681	Sauder, D. N.	505
Buonocore, V.	407			Schepens, J. T.	491
Burns, R. G.	623	Karpeisky, M. Y.	645	Schroedl, N. A.	651
		Kemp, B. E.	361	Schulz, T. F.	389
Cabrini, G.	629	Kenny, A. J.	549, 559	Senior, H. J.	453
Casey, R.	661	Khomutov, R. M.	645	Shepherd, M. G.	379
Casteels, R.	445	Kinlough-Rathbone, R. L.	399	Singer, T. P.	617
Causser, M. J.	617	Kinson, G. A.	355	Slater, T. F.	431
Collier, G.	361	Klein, P.-J.	581	Stanley, J.	661
Craig, J. C.	617	Koj, A.	505	Stanley, J. C.	667
		Kostner, G. M.	569	Stewart, J. R.	549, 559
Dalton, S.	423			Sullivan, P. A.	379
Delfino, J. M.	535	Lambris, J. D.	389	Swartz, H. M.	431
De Rosa, M.	407	Lau, S.-M.	577	Sweeney, G. D.	505
De Smedt, H.	445	Lavau, M.	685	Symons, M. C. R.	431
De Togni, P.	629	Leturque, A.	685		
Dieplinger, H.	569	Leung, T.	677	Takahashi, K.	673
Dierich, M. P.	389	Lim, L.	677	Tarusova, N. B.	645
Di Virgilio, F.	629	Livesey, S. A.	361, 371	Templeton, M. D.	379
Dixon, H. B. F.	645			Thompson, R. S.	541
Dohm, G. L.	667	MacNeil, S.	453	Thomson, A. J.	591, 601
Domoney, C.	661	Madden, M.	577	Thorpe, C.	577
Donofrio, J. C.	541	Maisel, H.	609	Tomasi, A.	431
Dormer, R. L.	473	Mantle, M.	345	Tomlinson, S.	453
		Martin, T. J.	361, 371		
Earley, F. G. P.	525	Masor, M.	681	Uhlenbruck, G.	581
Everhart, E. T.	617	McIntire, W.	617		
		McManus, B. S.	667	Veerkamp, J. H.	491
Farrar, G. H.	581	McPherson, M. A.	473	Veneziale, C. M.	541
Fenton, J. W., II	673	Metsikkö, M. K.	467	Verbist, J.	445
Fischer, J.	581	Michelangeli, V. P.	371	Vickers, J. D.	399
Forstner, G. G.	345	Munro, D. S.	453	Vita, N.	535
Forstner, J. F.	345	Mustard, J. F.	399		
				Wagenmakers, A. J. M.	491
Gambacorta, A.	407	Newsholme, E. A.	667	Walker, S. W.	453
Gardiner, S. E.	637	Nicholls, P.	591	Walz, D. A.	673
Gauldie, J.	505	Nicolaus, B.	407	Webster, R. V.	617
Gavrilovic, J.	461	Nilges, M.	431	Whately, S.	677
George, G. N.	601	Nimmo, H. G.	437	Wolf, J.	415
Giardina, P.	407			Woon, T.-C.	591
Girard, J.	685	Paladini, A. C.	535	Wuytack, F.	445
Glew, R. H.	515	Peshavaria, M.	483		
Godfrey, C.	601	Peterson, J.	591	Zajac, J. D.	361
Golly, I.	415	Pilsworth, L. M. C.	461	Zechner, R.	569
Greenwood, C.	591, 601	Poerio, E.	407		
Guerre-Millo, M.	685	Pollock, A.	453		

EDITORIAL ADVISORY PANEL

The following are the members of the *Journal's* Editorial Advisory Panel for 1984.

- G. Ailhaud (Nice)
S. Ainsworth (Sheffield)
B. Åkesson (Lund)
A. K. Allen (London)
G. Allen (Beckenham)
B. H. Anderton (London)
G. B. Ansell (Birmingham)
D. J. Anstee (Bristol)
C. Anthony (Southampton)
S. J. H. Ashcroft (Oxford)
M. Z. Atassi (Houston)
G. L. Atkins (Edinburgh)
- H. Bachelard (London)
A. Baici (Zürich)
A. J. Bailey (Langford)
F. J. Ballard (Adelaide)
J. Barber (London)
A. N. Barclay (Oxford)
M. J. Barnes (Cambridge)
A. R. Battersby (Cambridge)
H. Baum (London)
P. A. Bell (Cardiff)
D. S. Bendall (Cambridge)
J. P. Bennett (Cambridge)
M. J. Berridge (Cambridge)
G. D. Birnie (Glasgow)
P. Bohley (Hannover)
J. M. W. Bouma (Groningen)
I. Bremner (Aberdeen)
R. Brimacombe (Berlin)
M. E. Brosnan (St. John's)
S. B. Brown (Leeds)
K. R. Bruckdorfer (London)
C. J. Bruton (Cambridge)
B. Burchell (Dundee)
P. H. W. Butterworth (London)
F. L. Bygrave (Canberra)
- R. B. Cain (Canterbury)
R. D. Campbell (Oxford)
D. J. Candy (Birmingham)
D. Cassel (St. Louis)
B. Casu (Milano)
R. J. Cherry (Colchester)
J. R. Coggins (Glasgow)
G. M. W. Cook (Cambridge)
H. G. Coore (Kingston)
R. K. Craig (London)
C. Crane-Robinson (Portsmouth)
M. Crompton (London)
M. J. Crumpton (London)
G. Curzon (London)
S. Cushman (Bethesda)
- P. D. G. Dean (Cambridge)
E. De Clercq (Leuven)
H. R. de Jonge (Rotterdam)
F. De Matteis (Carshalton)
J. J. H. M. de Pont (Nijmegen)
I. Dickson (Cambridge)
R. R. Dils (Reading)
H. B. F. Dixon (Cambridge)
J. E. Dumont (Bruxelles)
- J. S. Easterby (Liverpool)
A. A. Eddy (Manchester)
D. J. Ellar (Cambridge)
- K. R. F. Elliott (Manchester)
J. Engel (Basel)
M. B. Enser (Langford)
- R. B. Fears (Epsom)
M. Fehlmann (Nice)
S. J. Ferguson (Birmingham)
A. L. Fink (Santa Cruz)
R. J. Flower (Beckenham)
S. Forsen (Lund)
D. R. Fraser (Cambridge)
R. B. Freedman (Canterbury)
I. Fridovich (Durham, NC)
- J. T. Gallagher (Manchester)
R. A. Garrett (Aarhus)
J. A. Gatehouse (Durham)
J.-M. Ghuyens (Liège)
F. Gibson (Canberra)
J. Girard (Meudon)
J. P. Goddard (Glasgow)
D. F. Goldspink (Belfast)
B. D. Gomperts (London)
T. W. Goodwin (Liverpool)
J. Gordon (Chicago)
R. J. A. Grand (Birmingham)
M. E. Grant (Manchester)
J. R. Griffiths (London)
K. Gull (Canterbury)
S. Gutteridge (Rothamsted)
- A. P. Halestrap (Bristol)
T. Hallinan (London)
B. Halliwell (London)
W. A. Hamilton (Aberdeen)
T. E. Hardingham (London)
N. Hardman (Aberdeen)
P. M. Harrison (Sheffield)
J. N. Hawthorne (Nottingham)
J. F. Head (Boston)
D. F. Heath (Manchester)
D. Heinegård (Lund)
K. Heirwegh (Leuven)
J. C. Henquin (Bruxelles)
H. A. O. Hill (Oxford)
J. G. Hoggett (York)
M. R. Hollaway (London)
U. Hopfer (Cleveland)
D. J. Hopper (Aberystwyth)
S. L. Howell (London)
J. Hughes (Cambridge)
R. C. Hughes (London)
W. C. Hülsmann (Rotterdam)
- R. F. Irvine (Cambridge)
M. Israel (Gif-sur-Yvette)
- J. Jänne (Helsinki)
J.-C. Jaton (Genève)
A. J. Jeffreys (Leicester)
W. Jessup (Uxbridge)
M. N. Jones (Manchester)
- M. A. Kerr (Dundee)
C. J. Kirk (Birmingham)
K. Kirschner (Basel)
K. I. Kivirikko (Oulu)
J. Knudsen (Odense)
J. Kondrup (København)
- T. C. Laurent (Uppsala)
P. Lazarow (New York)
D. P. Leader (Glasgow)
C. J. Leaver (Edinburgh)
F. Lederer (Paris)
A. G. Lee (Southampton)
A. R. Lehmann (Brighton)
D. M. J. Lilley (Dundee)
L. Lim (London)
U. Lindahl (Uppsala)
D. Lloyd (Cardiff)
J. B. Lloyd (Keele)
G. Lowe (Oxford)
- A. J. MacGillivray (Brighton)
A. D. B. Malcolm (London)
G. P. Mannaerts (Leuven)
B. Mannervik (Stockholm)
H. G. Mannherz (Marburg)
S. Maroux (Marseille)
D. Marsh (Göttingen)
B. R. Martin (Cambridge)
R. M. Mason (London)
R. G. Matthews (Ann Arbor)
R. J. Mayer (Nottingham)
S. G. Mayhew (Dublin)
J. D. McGivan (Bristol)
A. J. Meijer (Amsterdam)
W. T. Melvin (Aberdeen)
B. Middleton (Nottingham)
E. Milgrom (Bicêtre)
D. J. Millward (London)
A. J. G. Moir (Sheffield)
D. M. L. Morgan (Harrow)
D. B. Morton (Leicester)
J. Mowbray (London)
T. Miyazawa (Tokyo)
G. J. Mulder (Leiden)
- T. Nagatsu (Yokohama)
H. G. Nimmo (Glasgow)
I. A. Nimmo (Edinburgh)
D. H. Northcote (Cambridge)
K. R. Norum (Oslo)
- E. Oldfield (Urbana)
T. Olivecrona (Umea)
F. R. Opperdoes (Bruxelles)
J. Orly (Jerusalem)
J. H. Ottaway (Edinburgh)
- V. M. Pain (Brighton)
M. G. Parker (London)
R. M. E. Parkhouse (London)
R. N. Perham (Cambridge)
G. Pettersson (Lund)
T. Pfeuffer (Würzburg)
C. F. Phelps (London)
J. H. Phillips (Edinburgh)
G. A. Pitt (Liverpool)
L. Polgár (Budapest)
J. W. Porteous (Aberdeen)
N. C. Price (Stirling)
H. Prydz (Oslo)
K. Purvis (Oslo)
- C. I. Ragan (Southampton)
D. B. Ramsden (Birmingham)
P. J. Randle (Oxford)

Editorial Advisory Panel

- P. J. Reeds (Aberdeen)
J. Ricard (Marseille)
P. W. J. Rigby (London)
G. T. Robillard (Groningen)
S. P. Robins (Aberdeen)
D. S. Robinson (Leeds)
R. Rodnight (London)
M. S. Rose (Runcorn)
S. P. R. Rose (Milton Keynes)
B. D. Ross (Oxford)
E. V. Rowsell (Manchester)
M. G. Rumsby (York)
- M. C. Scrutton (London)
W. Sebald (Braunschweig)
J. Seelig (Basel)
P. O. Seglen (Oslo)
H. S. A. Sherratt (Newcastle upon Tyne)
C. A. Shuttleworth (Manchester)
H. Sies (Düsseldorf)
E. A. Siess (München)
R. B. Sim (Oxford)
T. P. Singer (San Francisco)
I. F. Skidmore (Ware)
K. Snell (Guildford)
H.-D. Söling (Göttingen)
A. K. Soutar (London)
- S. Spadari (Pavia)
W. Stalmans (Leuven)
D. A. Stansfield (Dundee)
J. L. Stirling (London)
P. H. Sugden (London)
D. M. Swallow (London)
- J. M. Tager (Amsterdam)
G. H. Tait (London)
C. B. Taylor (Sheffield)
J. O. Thomas (Cambridge)
A. Thomson (Lancaster)
A. R. Thomson (Harwell)
R. N. F. Thorneley (Brighton)
I. P. Trayer (Birmingham)
S. Tuček (Praha)
- T. J. C. van Berkel (Rotterdam)
D. E. Vance (Vancouver)
K. van Dam (Amsterdam)
E. J. Vandamme (Gent)
G. van den Berghe (Bruxelles)
W. J. van Venrooij (Nijmegen)
P. V. Vignais (Grenoble)
K. von Figura (Münster)
- S. G. Waley (Oxford)
D. A. Walker (Sheffield)
M. Wallis (Brighton)
P. Walter (Basel)
G. Warren (Heidelberg)
D. J. Watts (Sheffield)
I. C. West (Bodmin)
C. W. Wharton (Birmingham)
K. P. Wheeler (Brighton)
M. F. Wikström (Helsinki)
A. Williams (Canterbury)
A. R. Williamson (Greenford)
D. H. Williamson (Oxford)
B. G. Winchester (London)
H. Winkler (Innsbruck)
P. J. Winterburn (Cardiff)
J. C. Wootton (Leeds)
- A. V. Xavier (Lisboa)
- D. W. Yates (Bristol)
S. J. Yeaman (Newcastle upon Tyne)
D. A. York (Southampton)
- P. Zahler (Bern)
V. A. Zammit (Ayr)