

biochemical society

---

**TRANSACTIONS**

## **638th Meeting Reading**

colloquia

**Redesigning Crop Products for Biotechnology: Starch and Fructan**

**Comparative Aspects of Respiratory Electron Transfer Complexes**

**Genetic Approaches to Oligosaccharide Metabolism**

**Food Biotechnology**

**Proteinases**

**The Role of Enzymes in Regulating the Toxicity of Xenobiotics**

**Molecular Aspects of Fungal Sterol Biosynthesis and Inhibition**

communications

■ *Biochemical Society Transactions* (ISSN 0300-5127) is published by Portland Press Ltd on behalf of the Biochemical Society. Each issue contains the lectures, colloquia and communications presented at one of the Biochemical Society's meetings held in various parts of the U.K. and Ireland and, occasionally, in conjunction with other Societies, abroad. Submitted primary research papers are not published. Authors of lectures and colloquium contributions at Society meetings will receive instructions on the format of their article prior to the meeting; instructions for authors intending to present communications at Society meetings appear in the Society's membership journal, *The Biochemist*, and occasionally in this journal.

■ For information about the advantages of membership of the Biochemical Society, contact the Executive Secretary, The Biochemical Society, 59 Portland Place, London W1N 3AJ, U.K. (telephone 071-580 5530).

■ Editorial and publishing office: *Biochemical Society Transactions*, 59 Portland Place, London W1N 3AJ, U.K. (telephone 071-637 5873; facsimile 071-323 1136).

## Subscription rates

■ Subscriptions department: Portland Press, P.O. Box 32, Commerce Way, Colchester CO28HP, U.K. (telephone 0206-46351; facsimile 0206-549331). *Biochemical Society Transactions* is published in February, May, August and November of each year. Subscription rates for volume 19, parts 1-4 (1991):

	North America	Rest of world
Volume 19	\$195.00	£105.00
Single issues	\$33.00	£18.00

Subscribers to the *Biochemical Journal* may take a joint subscription to that journal and to *Biochemical Society Transactions*, saving \$25 (North America) or £15 (rest of world). North American subscription rates include airfreight delivery, and those for Japan include Accelerated Surface Post; other overseas locations are serviced by surface mail. Airmail delivery is available at extra cost. Back issues are available. Subscribers in Japan should send orders to Kinokuniya Company Ltd, Journal Department, P.O. Box 55, Chitose, Tokyo 156.

■ All rights reserved. Apart from any fair dealing for the purposes of research or private study, or criticism or review, as permitted under the Copyright, Designs and Patents Act, 1988, this publication may be reproduced, stored or transmitted, in any form or by any means, only with the prior permission in writing of the publishers, or in the case of reprographic reproduction in accordance with the terms of licences issued by the Copyright Licensing Agency. Inquiries concerning reproduction outside those terms should be sent to the publishers at their London address.

■ 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, NY 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 0300-5127/91/\$02.00 + 0.00.

■ Although, at the time of going to press, the information contained in this publication is believed to be correct, neither the authors nor the publisher nor the editor assume any responsibility for any errors or omissions herein contained.

■ Display advertising is accepted; information is available on request from the London office of Portland Press.

■ Second-class postage paid at Rahway, NJ, U.S.A.

■ U.S. Postmaster: send address changes to *Biochemical Society Transactions*, c/o Mercury Airfreight International Ltd, 2323 Randolph Avenue, Avenel, NJ 07001, U.S.A.

■ Typeset by Unicus Graphics Ltd, Horsham, and printed in Great Britain by Whitstable Litho Printers Ltd, Kent.

- Abadah, S.** 332S  
**Abadom, F. E.** 334S  
**Ahmann, D.** 636  
**Aitken, A.** 327S  
**Akhmaloka,** 281S  
**Andrews, A. T.** 271S, 272S  
**Angenent, G.** 565  
**Aoyama, Y.** 778  
**Armstrong, F. A.** 594  
**Arrol, S.** 304S  
**Aruoma, O. I.** 317S  
**Asenjo, J. A.** 275S  
**Ashley, R.** 254S, 255S  
**Ashton, I. P.** 320S
- Baba, A. S. H.** 309S  
**Bacon, M.** 613  
**Ball, K.** 539  
**Barber, J.** 284S, 313S  
**Bárcena, J. A.** 302S  
**Barnes, J.** 338S  
**Barrett, A. J.** 289S, 290S, 707  
**Baydoun, E. A.-H.** 245S, 250S  
**Behrend, T. L.** 649  
**Belfield, G. P.** 279S  
**Benboubetra, M.** 332S  
**Bennett, B.** 260S  
**Benson, N.** 605  
**Berka, R. M.** 681  
**Berks, B. C.** 581  
**Beynon, R. J.** 296S, 297S  
**Bises, G.** 283S  
**Blaydes, J.** 338S  
**Blom, H.** 694  
**Bloor, D.** 284S  
**Blundell, T. L.** 265S  
**Bogoyevitch, M. A.** 276S  
**Bonnett, T. C.** 605  
**Botham, K. M.** 335S  
**Bottiglieri, T.** 310S  
**Boulnois, G.** 628  
**Bourne, R. M.** 251S  
**Braganza, J. M.** 310S  
**Brandt, U.** 263S  
**Bray, R. C.** 260S  
**Brealey, C. J.** 741  
**Breton, J.** 594  
**Brett, C. T.** 244S, 245S, 250S  
**Brindley, D. N.** 321S  
**Bronze, E.** 300S
- Brouwer, A.** 731  
**Brown, J. W. S.** 340S  
**Brown, S.** 263S  
**Burke, J. F.** 260S  
**Butt, J. N.** 594  
**Butters, J. A.** 799  
**Buttery, P. J.** 309S
- Cammack, R.** 256S  
**Canela, E. I.** 323S  
**Carlenor, E.** 573  
**Carlucci, F.** 343S, 347S, 348S  
**Castro, M.** 246S  
**Cawston, T. E.** 287S, 288S  
**Centelles, J. J.** 323S  
**Chambers, T. J.** 286S  
**Chen, J.** 346S  
**Chidwick, K.** 269S  
**Chipman, J. K.** 751  
**Choi, G.** 308S  
**Chovnick, A.** 260S  
**Cinci, G.** 345S  
**Clark, I. M.** 287S  
**Clarke, A. R.** 576  
**Clarke, N. J.** 288S  
**Clarke, S. E.** 762  
**Cockle, S. M.** 327S  
**Cole, D. J.** 320S  
**Colebrook, S.** 576  
**Colthurst, D. R.** 279S  
**Connerton, I. F.** 799  
**Cooke, D.** 551  
**Cookson, E. J.** 296S  
**Cooper, C. E.** 257S, 259S  
**Coppack, S. W.** 314S  
**Cortes, A.** 576  
**Crofts, A. R.** 588  
**Cromartie, T.** 319S
- Davies, M. C.** 329S  
**Davis, S. S.** 329S  
**Deane, S. M.** 799  
**Delarge, M. H. P.** 244S, 245S, 250S  
**Denyer, K.** 547  
**Devonshire, A. L.** 755  
**Dey, P. M.** 269S  
**Di Lullo, G.** 283S  
**Dispensa, E.** 343S, 348S  
**Djabballah, H.** 291S  
**Dorado, G.** 301S  
**Dormer, R. L.** 247S
- Doyle, E. M.** 270S  
**Doyle, W. A.** 260S  
**Draye, J.-P.** 253S  
**Dunn, R.** 645  
**Durrington, P. N.** 304S
- Ebskamp, M.** 565  
**Emery, D. C.** 576  
**Engchild, J. J.** 715  
**Ennis, M. P.** 295S  
**Evans, P. J.** 317S
- Farbood, M. I.** 690  
**Farmer, M. J.** 250S  
**Faulkner, A.** 311S, 315S  
**Ferguson, S. J.** 581, 605  
**Fernandez-Valesco, J.** 588  
**Ferrer, N.** 324S  
**Filva, G.** 300S  
**Fisher, R. M.** 314S  
**Flint, D. J.** 315S  
**Forgarty, W. M.** 270S  
**Franco, R.** 323S, 324S  
**Frayn, K. N.** 314S  
**Fuchs, A.** 555  
**Fuller, S. J.** 276S, 277S
- Gao, B.** 308S  
**Garner, A.** 307S  
**Garrett, S. D.** 698  
**Gaskin, D. J. H.** 298S  
**George, S. J.** 594  
**Gibbons, G. F.** 314S  
**Gibbons, W. A.** 308S  
**Gidley, M. J.** 551  
**Gill, R.** 248S  
**Girstel, B.** 280S  
**Gladwell, R. T.** 303S  
**Glazebrook, J.** 636  
**Glucksmann, M. A.** 636  
**Glynn, B.** 246S  
**Goodenough, P. W.** 655  
**Gooding, C. M.** 698  
**Goosey, M. W.** 769  
**Grandison, A. S.** 274S  
**Grant, C. M.** 281S  
**Gyi, J. I.** 313S  
**Guerranti, R.** 344S  
**Guldur, T.** 326S
- Haggas, R. L.** 303S  
**Halliwell, B.** 317S  
**Halsall, D. J.** 576
- Hamill, J. D.** 702  
**Hanlon, S. P.** 605  
**Hann, A. C.** 318S  
**Hannah, M.** 246S  
**Hannah, S.** 294S  
**Harper, G. P.** 288S  
**Harrison, R.** 332S, 338S  
**Hart, K. W.** 576  
**Hart, R. J.** 269S  
**Hartley, A. D.** 280S  
**Harwood, J. L.** 243S, 268S, 318S, 319S, 320S  
**Hatchikian, E. C.** 594  
**Hayman, A. R.** 286S  
**Heinemeyer, W.** 724  
**Hemingway, J.** 305S  
**Hershko, A.** 726  
**Hidaka, H.** 561  
**Hilhorst, R.** 666  
**Hill, B. T.** 278S  
**Hirayama, M.** 561  
**Hirsch, H. H.** 724  
**Hitchcock, C. A.** 782  
**Hobbs, M. C.** 244S, 245S, 250S  
**Holbrook, J. J.** 576  
**Holloman, D. W.** 799  
**Holm, L.** 608  
**Hombroeckx, A.** 251S  
**Höppener, J. W. M.** 645  
**Hosking, L. K.** 278S  
**Howell, S.** 327S  
**Hu, Y.** 340S  
**Hue, L.** 261S  
**Hughes, R. K.** 260S  
**Hull, E.** 645  
**Humphreys, S. M.** 314S  
**Hutson, D. H.** 737
- Iglesias, S.** 539  
**Ingledeu, W. J.** 613  
**Ioannidis, N.** 259S  
**Irvine, G. B.** 295S  
**Illum, L.** 329S
- Jackson, J. B.** 573, 605  
**Jackson, R. M.** 576  
**Jann, B.** 623  
**Jann, K.** 623  
**Jayawardena, K. G. I.** 305S  
**Jenkins, J. A.** 655  
**John, P.** 569  
**John, R. A.** 319S

Johnston, G. 741  
 Jones, A. L. 318S  
 Joshi, B. 282S  
 Joshi-Barve, S. 282S

Takefuda, G. 539  
 Kelly, C. T. 270S  
 Kelly, S. L. 796  
 Kennedy, K. 284S  
 Ketterman, A. J. 305S, 306S  
 Kirchin, M. A. 746  
 Klaenhammer, T. R. 675  
 Knecht, E. 293S  
 Knight, C. G. 290S  
 Knox, M. 698  
 Kodama, K. H. 681  
 Kok, J. 670  
 Konijn, A. M. 317S

Larsen, R. D. 649  
 Lawler, S. E. 248S, 265S, 267S  
 Lee, K. S. 762  
 Lemieux, L. 608  
 Leoncini, R. 344S, 345S, 346S  
 Lever, T. M. 573  
 Lewis, T. 319S  
 Li, L. 539  
 Linton, E. 246S  
 Livingstone, D. R. 751  
 Loeffler, R. S. T. 799  
 López-Barea, J. 301S, 302S  
 Lowe, J. B. 649  
 Lowenstein, P. 246S  
 Lowry, P. 246S  
 Lloyd, D. 318S  
 Lluis, C. 323S  
 Lübben, M. 608  
 Luke, G. 328S  
 Lund, B. M. 698  
 Lunt, G. G. 338S  
 Lye, G. J. 275S

McCaffery, A. R. 762  
 McCann, J. J. 295S  
 McCarthy, J. E. G. 280S  
 McCarthy, J. P. 315S  
 McClean, S. 278S  
 McEwan, A. G. 60S  
 McGrath-Linden, S. J. 295S

McKee, R. A. 698  
 McKenna, N. J. 295S  
 McPherson, M. A. 247S  
 Mackenzie, A. 269S  
 Mackness, M. I. 303S, 304S, 741  
 Madgwick, S. A. 263S  
 Makinde, V. 336S  
 Mallol, J. 323S  
 Mantaounis, D. 248S, 265S, 266S, 267S  
 Marinello, E. 343S, 346S, 347S, 348S  
 Marks, R. M. 649  
 Marra, A. 636  
 Marsh, J. W. 751  
 Martin, A. 321S  
 Martin, C. 547  
 Martin, P. A. 315S  
 Martínez-Lara, E. 302S  
 Maskell, D. 631  
 Matharu, P. J. 330S  
 Maurizi, M. R. 719  
 Mayes, P. A. 325S, 326S  
 Mbafor, W. 271S  
 Mercer, E. I. 788  
 Millburn, P. 737  
 Milsom, D. W. 334S  
 Mindham, M. A. 325S  
 Moghimi, S. M. 329S  
 Molinelli, M. 343S, 347S, 348S  
 Montgomery, P. C. 331S  
 Moody, A. J. 259S, 262S, 617  
 Moore, D. J. 769  
 Moritz, R. L. 64S  
 Morris, G. M. 793  
 Mørtvedt, C. 694  
 Moxon, E. R. 631  
 Muir, I. S. 329S  
 Mulholland, F. 68S  
 Murray, D. 255S  
 Mynett, J. R. 277S  
 Mynott, C. L. 307S

Naase, M. 312S  
 Nagase, H. 71S  
 Nair, R. P. 649  
 Nicholls, P. 252S  
 Nicholson, B. H. 312S, 333S  
 Niederhauser, H. 252S

Niven, G. W. 273S  
 Nugent, P. 265S  
 Obinger, C. 252S  
 Ogata, Y. 71S  
 O'Grady, J. E. 299S, 300S  
 O'Hare, M. C. 288S  
 Orprayoon, P. 265S

Pagani, R. 343S, 344S, 345S, 346S, 347S, 348S  
 Page, A. 286S  
 Page, N. 328S  
 Pain, V. M. 282S  
 Pallett, K. E. 320S  
 Palmer, A. 293S  
 Parish, D. 249S  
 Pascual, P. 302S  
 Pazzani, C. 628  
 Peinado, J. 301S  
 Penttilä, M. 248S, 265S, 267S, 663  
 Pereira, M. M. C. 247S  
 Perry, H. J. 243S  
 Peschek, G. A. 252S  
 Persson, B. 573  
 Peters, T. J. 316S, 317S, 321S  
 Phillips, S. C. 339S, 341S, 342S  
 Pinches, S. A. 307S  
 Pitts, J. E. 248S, 265S, 266S, 267S, 663  
 Pizzichini, M. 343S, 345S, 346S, 348S  
 Pockley, A. G. 331S  
 Ponchaut, S. 253S  
 Porcelli, B. 345S  
 Portugal, J. 324S  
 Potts, J. L. 314S  
 Poverini, R. 283S  
 Powell, H. A. 698  
 Powls, R. 297S  
 Preiss, J. 539  
 Price, N. R. 759  
 Pridham, J. B. 269S  
 Pueyo, C. 301S  
 Pugh, C. E. 319S  
 Pyle, L. 274S, 275S

Quinn, D. 267S, 663  
 Raja, K. B. 316S, 317S  
 Ramzan, M. A. 296S

Rawlings, N. D. 289S, 707  
 Record, C. O. 264S  
 Reed, J. 636  
 Rees, L. 303S  
 Reuber, T. L. 636  
 Rey, M. W. 681  
 Rhoads, R. E. 282S  
 Rhodes, M. J. C. 702  
 Rich, P. R. 251S, 259S, 262S, 263S  
 Richards, W. G. 793  
 Richardson, D. J. 60S  
 Rivett, A. J. 291S, 292S, 293S  
 Rowe, J. 796  
 Robbins, P. W. 642  
 Roberts, I. 628  
 Rodriguez-Ariza, A. 301S  
 Rogers, A. T. 338S  
 Ronis, M. J. J. 746  
 Ryder, N. S. 774  
 Rydstrom, J. 573  
 Ryle, A. P. 294S

Salerno, J. C. 599  
 Salvesen, G. 71S  
 Sanchez, J. 268S  
 Saraste, M. 608  
 Sarkar, M. 64S  
 Savory, P. J. 292S  
 Savva, D. 328S, 333S  
 Sayos, J. 323S  
 Scarino, M. L. 283S  
 Scott, G. K. 285S  
 Schachter, H. 64S  
 Schiffer, H. H. 724  
 Schofield, D. 310S  
 Sharpe, M. A. 257S  
 Shergill, J. K. 256S  
 Shirazi-Beechey, S. P. 307S  
 Simeon, A. 724  
 Simkiss, K. 328S  
 Simpson, K. J. 321S  
 Simpson, R. J. 316S, 317S, 64S  
 Sirman, T. 274S  
 Smeekens, S. 56S  
 Smith, A. M. 547  
 Smith, J. M. A. 337S  
 Smith-White, B. 539  
 Sousa, A. 300S

- Spencer, A.** 702  
**Spurway, T. D.** 254S  
**Stansfield, I.** 281S  
**Stephen, A. G.** 297S  
**Stoolman, L. M.** 649  
**Strop, P.** 267S  
**Sugden, P. H.** 276S, 277S  
**Suzuki, K.** 715  
**Sweeney, G. E.** 330S  
**Sweeney, S. T.** 293S
- Tabucchi, A.** 343S, 344S, 347S, 348S  
**Tárnoky, A. L.** 333S  
**Teahon, K.** 322S  
**Teichert, U.** 724  
**Teixeira, N. A.** 299S, 300S
- Terzuoli, L.** 344S, 346S  
**Tezapsidis, N.** 249S  
**Thompson, H. M.** 303S  
**Thompson, S.** 264S  
**Thomson, A. J.** 594  
**Toribio, F.** 302S  
**Tse, C. A.** 285S  
**Tuite, M. F.** 279S, 280S, 281S  
**Turner, G. A.** 264S  
**Turner, P. C.** 339S, 340S, 341S, 342S
- Uusitalo, J.** 248S, 265S, 267S, 663
- Valerio, P.** 343S, 347S, 348S
- van der Oost, J.** 608  
**Van Hoof, F.** 253S  
**Vannoni, D.** 345S  
**Veitch, K.** 253S, 261S  
**Venkatesan, S.** 321S, 322S  
**Verhaert, R. M. D.** 666  
**Visser, A. J. W. G.** 666  
**Von Jagow, G.** 263S
- Waldron, K. W.** 250S  
**Wali, F. A.** 336S  
**Walker, C. H.** 303S, 741, 762  
**Walker, G. C.** 636  
**Warburton, M. J.** 286S  
**Ward, M.** 681
- Watson, P. F.** 796  
**Wagh, R.** 340S  
**Weiner, J. H.** 256S  
**Weisbeek, P.** 565  
**Whelan, R. D. H.** 278S  
**Wilderspin, A. F.** 298S  
**Wilks, H. M.** 576  
**Williams, C. H.** 295S  
**Williams, M.** 268S  
**Wilson, L. J.** 681  
**Winston, G. W.** 746  
**Wolf, D. H.** 724  
**Wrigglesworth, J. M.** 257S, 258S, 259S  
**Wright, J. K.** 287S
- Yoshida, Y.** 778