

biochemical society

TRANSACTIONS

658th Meeting Liverpool

colloquia

RNA Interactions: Ribozymes and Antisense
Molecular Mechanisms of Neurotransmitter Release
Function and Pharmacology of Protein Prenylation
Interaction of Photosynthesis and Respiration
Bioactive Components of Food
Mammalian Amino Acid Transporters and their Regulation
Keeping the Cell Reduced: Enzymes Influencing Redox Reactions
Biochemical Mass Spectrometry

communications

■ *Biochemical Society Transactions* (ISSN 0300-5127; USPS 003350) is published by Portland Press Ltd on behalf of the Biochemical Society. Each issue contains the lectures, colloquia and communications presented at a meeting of the Biochemical Society or one of its constituent interest groups and, occasionally, the colloquia of other scientific meetings of biochemical interest held in the U.K. or elsewhere. Submitted primary research papers are not published and authors are reminded that detailed presentation of new experimental data may prejudice its subsequent publication in precisely that same form elsewhere. Lectures and colloquium contributions are published subject to editorial acceptance and authors will be issued with instructions on the format of their article before the meeting. Authors intending to present communications at Society meetings should consult the instructions for authors which appear in the Society's membership journal, *The Biochemist*, and occasionally in this journal. Although the publication of colloquia is by invitation, organizers of scientific meetings who would be interested in publishing their colloquia presentations in the journal are invited to discuss this possibility with the Executive Editor in the first instance.

■ 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 0171-580 5530).

■ Editorial and publishing office: *Biochemical Society Transactions*, 59 Portland Place, London W1N 3AJ, U.K. (telephone 0171-637 5873; facsimile 0171-323 1136).

■ Royal Mail International, c/o Yellowstone International, 87 Burlews Court, Hackensack, NJ 07061, U.S.A.

Subscription rates

■ Subscriptions department: Portland Press, P.O. Box 32, Commerce Way, Colchester CO2 8HP, U.K. (telephone 01206-796351; facsimile 01206-799331). *Biochemical Society Transactions* is published in February, May, August and November of each year. Subscription rates for volume 24, parts 1-4 (1996):

	North America	Rest of world
Volume 24	\$253.00	£149.00
Single issues	\$66.00	£39.00

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. Air-speeded delivery is available at an extra cost of £10. Back issues are available.

■ 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 permissions granted by the copyright clearing houses such as the Copyright Licensing Agency (U.K.) or the Copyright Clearance Center (U.S.A.). The CCC item-fee code for this publication is 0300-5127/96/\$8.50+0.00. Inquiries concerning reproduction outside those terms should be sent to the publishers at the London address.

■ 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 South Hackensack, NJ, U.S.A.

■ U.S. Postmaster: send address changes to Royal Mail International, c/o Yellowstone International, 2375 Pratt Boulevard, Elk Grove Village, IL 60007-5937, U.S.A.

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

- Abayasekara, D. R. E. 366S
 Abdul-Wahab, K. 364S
 Adams, C. 412S
 Adams, D. G. 417S
 Affourtit, C. 746
 Ahmed, A. 869
 Ahmed, I. 497S
 Akhtar, N. 373S
 Albury, M. S. 746
 Altmann, K.-H. 630
 Anant, J. S. 699
 Angelini, G. D. 487S
 Anthony, N. J. 688
 Armstrong, K. 337S
 Astley, S. B. 387S, 388S
 Attwood, P. V. 469S
 Augustine, G. 666
 Austin, P. A. 402S
- Babaei, H. 377S
 Bailey, A. L. 387S, 388S
 Bailey, J. M. 435S
 Bain, M. D. 441S, 442S
 Baker, J. 452S
 Baldwin, S. A. 478S
 Ball, A. S. 378S, 455S
 Banerjee, N. 337S
 Bao, Y. 462S
 Barber, M. C. 361S
 Barbrook, A. C. 750
 Barnard, R. J. O. 653
 Barraclough, R. 340S, 341S, 351S–354S, 356S
 Bartlett, K. 457S
 Bartolome, B. 379S
 Basudev, H. 645
 Bates, A. D. 420S, 421S
 Bates, J. 499S
 Bates, T. E. 425S
 Bax, B. E. 441S, 442S
 Bax, C. M. R. 443S
 Baxter, T. 415S
 Bayliss, M. 474S
 Beattie, J. H. 408S
 Begley, I. S. 927
 Bell, C. G. H. 494S–496S
 Bell, N. J. 482S
 Belletti, S. 864
 Benfenati, F. 645
 Bennett, C. F. 623
 Benz, R. 754
 Berry, S. D. H. 490S
- Bersinger, N. A. 498S
 Betz, A. 661
 Betz, H. 666
 Beveridge, M. J. 839
 Binas, B. 371S
 Bird, P. 367S
 Black, J. C. 437S
 Blakytyn, R. 881
 Blench, I. 433S
 Bolton, M. C. 483S
 Bommert, K. 666
 Bösel, A. 464S
 Botham, K. M. 440S
 Breitman, T. R. 723
 Brenton, A. G. 474S
 Brizot, M. L. 498S
 Broadie, K. S. 639
 Brocklehurst, K. 468S, 473S
 Broomhead, G. 349S
 Brose, N. 661
 Brosnan, J. T. 488S
 Brosnan, M. E. 488S
 Brown, E. G. 401S, 477S
 Brown, W. L. 413S
 Bryan, A. J. 487S
 Bucknall, R. C. 489S
 Budd, D. C. 429S
 Bundy, R. E. 439S
 Burdon, T. G. 370S
 Burgoyne, R. D. 653
 Burke, J. M. 608
 Burrows, P. 739
 Bussolati, O. 864
 Byrne, C. R. 480S
- Calder, P. C. 814
 Camáñez Ginestar, M. P. 394S
 Caputo, M. 487S
 Carter, J. M. 482S
 Cartwright, J. L. 419S
 Castro, M. G. 423S, 497S
 Chalmers, R. A. 441S, 442S
 Chamberlain, L. H. 653
 Chambers, S. J. 380S
 Chance, M. L. 434S
 Charlton, M. P. 666
 Chatzaki, E. 443S
 Chaves, E. M. C. 439S
 Chen, D.-S. 352S
 Chen, H.-J. 354S
 Chen, H.-L. 358S
- Chen, J.-H. 436S, 438S
 Chillarón, J. 856
 Chiu, D. T.-Y. 884
 Clark, A. J. 339S, 371S
 Clark, J. B. 425S, 449S, 460S
 Clarke, A. R. 412S
 Clarke, H. L. 380S
 Clarkson, A. M. 366S
 Clarkson, S. 420S
 Clayton, P. T. 932
 Clegg, R. A. 338S
 Clinton, M. 372S
 Clunn, G. F. 446S
 Conner, M. W. 688
 Connor, K. 338S
 Cooper, C. 451S
 Cooper, C. C. 450S
 Cooper, C. E. 448S, 465S
 Corcoran, D. 359S, 364S, 365S
 Cordeiro, C. 472S
 Cousin, M. A. 430S
 Coussons, P. J. 397S
 Crabbe, M. J. C. 453S, 888
 Craig, V. A. 369S
 Creeke, P. I. 394S
 Creissen, G. P. 829
 Crews, H. M. 947
 Croft, S. 433S
 Croucher, M. J. 431S
- Dale, V. C. M. 943
 Dall'Asta, V. 864
 Dallner, G. 677
 Danks, K. 428S
 Darbre, P. D. 359S, 362S–365S
 Darchen, F. 657
 Das, I. 484S
 Davenport Jones, J. 452S
 Davey, J. 432S, 502S–504S, 718
 Davies, M. P. A. 356S
 Davies, S. 443S
 De Takats, P. G. 374S
 Dean, N. M. 623, 630
 DeBello, W. 666
 Del Villar, K. 709
 Desnoyers, L. 699
 deSolms, S. J. 688
 Dhillon, P. S. 473S
 Dihmis, W. C. 487S
- Dils, R. 362S
 Dive, C. 348S
 Dixon, L. K. 415S
 Dorin, D. 709
 Dougherty, L. J. 401S, 477S
 Dousseau, F. 657
 Dresbach, T. 666
 Duchen, M. R. 449S
 Dudley, P. 746
- Eaton, S. 457S
 Eckstein, F. 601
 Edwards, G. M. 345S
 Edwards, S. W. 489S–493S
 El Far, O. 666
 El-Shazley, H. 474S
 El-Tanani, M. K. K. 343S, 344S
 Erdman, R. A. 703
 Evans, A. M. 475S
 Evans, A. T. 377S
- Fabbro, D. 623, 630
 Fairbanks, L. D. 442S
 Fairweather-Tait, S. J. 775, 947
 Faulds, C. B. 384S, 386S
 Fearnley, I. M. 912
 Fensom, A. H. 441S
 Fenwick, G. R. 393S
 Fernig, D. G. 355S, 357S, 358S, 501S
 Field, H. 433S
 Field, M. C. 433S, 459S
 Finazzi, G. 398S
 Finch, L. M. B. 357S, 369S
 Finglas, P. M. 387S, 388S
 Fisher, M. J. 424S, 438S
 Flint, A. P. F. 366S
 Flynn, A. M. 341S
 Fonesca, S. 412S
 Fox, R. M. 452S
 Franchi-Gazzola, R. 864
 Freedman, R. B. 339S
 Furniss, C. S. M. 382S
- Gacesa, P. 404S–407S
 Gallagher, C. J. 443S
 Gallagher, J. T. 355S
 Gallon, J. R. 401S, 475S, 477S

- Galzie, Z. 501S
 Games, D. E. 474S, 475S
 Games, M. P. L. 475S
 Ganea, E. 881
 Garcia-Conesa, M. T. 379S
 Garrod, D. R. 346S
 Gaskell, R. M. 414S
 Gasmi, L. 491S
 Gazzola, G. C. 864
 Geiger, T. 623, 630
 Ghilchick, M. 337S
 Gibbs, J. B. 688
 Gibson, I. 409S
 Gilchrist, D. S. 421S
 Ginger, M. L. 434S
 Glenn, D. E. 653
 Glenn, M. A. 414S
 Goad, L. J. 434S
 Goberdhan, N. 348S
 Godfrey, R. 432S
 Goldberg, J. B. 407S
 Goldfarb, P. 375S, 376S
 Golmohammadi, R. 412S
 Goodall, A. R. 427S
 Goode, D. 453S
 Gordge, P. C. 338S
 Gordon, K. E. 371S
 Govan, J. R. W. 404S, 406S
 Graham, A. 396S, 467S
 Graham, S. L. 688
 Green, B. N. 917
 Green, C. D. 343S, 344S
 Green, J. A. 410S
 Griffiths, S. 383S
 Gul, S. 473S
 Gumpel, N. 733
- Haff, L. A.** 901
Harding, J. J. 881
Hall, L. M. 416S
Hamilton, A. D. 692
Hankin, S. 418S
Hanson, P. J. 480S
Harding, J. J. 881
Harris, F. M. 474S
Harris, S. 356S
Hart, C. A. 492S
Hartman, G. D. 688
Harvey, D. J. 905, 917
Häusler, R. E. 757
Heal, R. D. 479S
Heerkens, E. 368S
- Held, B.** 430S
Heldt, H. W. 754
Henry, J.-P. 657
Hertog, M. G. L. 785
Hesketh, J. E. 408S
Hess, E. J. 670
Hickman, J. A. 347S
Hill, H. R. 413S
Hill, S. 743
Hille, R. 456S
Hoang, V. M. 471S
Hofmann, K. 661
Hollman, P. C. H. 785
Holmes, H. C. 350S
Hooper, N. M. 444S, 470S
Howe, C. J. 750
Huang, L. 456S
Hughes, A. D. 446S
Hughes, D. A. 387S–389S
Hughes, M. 502S
Hundal, H. S. 869
Hunt, J. M. 666
Hunt, J. V. 397S
Huppe, H. C. 767
Hurst, H. 430S
Hurst, R. D. 460S
Hutter, J. A. 487S
Hyde, R. J. 470S
- Iles, R. A.** 350S
Inglese, J. 714
Irving, G. 377S
- Jackson, B.** 440S
Jackson, M. J. 485S, 486S
Jacob, T. J. C. 423S
Jacoby, J. 397S
James, H. A. 409S
James, R. W. 454S
Jenkins, N. 339S
Jenner, H. 743
Jensen, O. N. 893
Jervis, L. 395S, 403S
Johannes, L. 657
Johnson, A. W. 932
Johnson, I. T. 381S, 824
Joliot, P. 398S
Jones, A. 475S
Jones, A. K. 440S
Jones, D. 416S
Jones, G. D. 455S
Jünemann, S. 400S
- Kang, S.** 445S
Kanner, B. I. 843
Karas, M. 897
Katan, M. B. 785, 800
Ke, Y. 354S
Keelan, J. 425S
Kemp, P. A. 339S
Kerr, D. J. 374S
Khan, N. S. 484S
Khogali, S. E. O. 869
Kibble, A. V. 653
Kilberg, M. S. 839
Kilgour, E. 360S
Kilty, I. C. 351S
Kind, A. L. 369S
Kinsella, A. R. 501S
Klinowska, T. C. M. 349S
Knorpp, C. 743
Knowles, R. G. 483S, 875
Koblan, K. S. 688
Kohl, N. E. 688
Korotkov, E. 422S
Kosmeijer-Schull, T. G. 800
Kotecha, J. A. 458S
Krömer, S. 761
Kroon, P. A. 384S
Kruppa, G. H. 943
Kubiseski, T. J. 458S
Küster, B. 905
Kwon, H. M. 853
- Ladds, G.** 502S, 504S
Lambert, N. 380S, 461S
Langridge, J. I. 474S
Larsen, C. 363S
Latunde-Dada, G. O. 505S, 506S
Lea, P. J. 757
Leach, G. R. 746
Leaver, C. 743
Lee, H. A. 394S
Lee, H. J. 447S
Lee, R. 435S
Leegood, R. C. 757
Lewis, M. E. 453S
Li, D. 475S
Li, P. 357S
Lian, L.-Y. 447S
Liljas, L. 412S
Lim, P. 392S
Lima, V. L. M. 439S
Linstead, D. 373S
Linton, E. A. 497S
- Liu, Q.-M.** 342S
Lloyd, B. H. 340S
Lomas, L. O. 437S, 476S
Low, S. Y. 869
Lumbreras, V. 733
Lymn, J. S. 446S
- MacLaren, A.-P.** 372S
MacLeod, C. L. 846
Maden, B. E. H. 466S
Maier, E. 754
Malandro, M. S. 839
Maltese, W. A. 703
Mann, M. 893, 943
Mannervik, B. 878
Manson, M. M. 380S
Martin, A. 374S
Massari, S. 464S
Mathews, F. S. 456S
McArdle, A. 485S
McBride, D. 372S
McCurrie, J. R. 377S
McDowall, I. L. 424S
McDowell, H. E. 869
McGivan, J. D. 479S, 481S, 837
McKay, R. 623
McKee, K. 811
McLauchlan, W. R. 385S
McLaughlin, M. 429S
McLennan, A. G. 417S–419S, 491S
Mehta, P. P. 670
Meier-Augenstein, W. 927
Metcalf, A. D. 347S
Meyers, E. 417S
Millar, A. J. 411S
Miller, N. J. 790
Miller, W. R. 338S
Mills, J. D. 399S, 402S
Mills, K. 932
Mills, K. I. 409S
Miraglia, L. 623
Mitsuzawa, H. 709
Monia, B. P. 630
Monteiro, H. P. 884
Moore, A. L. 746
Moore, J. V. 368S
Mora, C. 856
Morgan, A. 653
Morgan, M. R. A. 394S
Morris, P. 403S
Mortensen, P. 893

- Moulding, D. A. 492S
Müller, M. 623, 630
Mullineaux, P. M. 829
Murphy, C. 463S
Murray, J. 412S
Musk, S. R. R. 381S
- Naven, T. J. P. 905
Neal, G. 380S
Nedbal, W. 615
Nesaretnam, K. 362S
Neubauer, G. 893
Newsholme, P. 463S
Newton, R. P. 474S, 938
Nicholas, K. 367S
Nicholls, D. G. 429S, 430S
Nicholls, J. 399S
Nicholls, P. 451S
Nicholson, B. 481S
Nicklin, P. 630
Nixon, P. J. 739
Noble, M. 468S
Novak, D. A. 839
- O'Reilly, J. 390S–392S
O'Sullivan, D. 488S
O'Connor, V. 666
Oates, A. J. 353S
Oliff, A. 688
Oliver, R. W. A. 917
Omer, C. A. 688
Ondárroa, M. 398S
Owen, J. S. 396S, 439S, 454S
Owen, L. M. W. 947
- Packer, J. C. L. 750
Palacín, M. 856
Panagiotopoulou, A. 448S
Parish, D. C. 337S
Parkin, E. T. 444S
Parmryd, I. 677
Patel, A. 927
Patel, D. R. 431S
Patel, M. K. 446S
Pazouki, S. 368S
Peerless, A. C. J. 387S, 388S
Pellegrini, L. 666
Pendleton, N. 368S
Pennington, S. R. 499S, 500S
Penrice, J. 448S
- Perachiotti, A. 359S, 364S
Perin, I. 451S
Perone, M. J. 497S
Peschek, G. A. 729
Peuchen, S. 449S
Pezeshk, A. 465S
Philp, J. A. C. 370S
Phoenix, D. A. 422S
Pinder, A. C. 388S, 389S
Pinitglang, S. 468S
Plitzanopoulou, P. 390S
Plumb, G. W. 380S
Podtelejnikov, A. V. 893
Pogson, C. I. 483S
Polwart, T. 399S
Ponces Freire, A. 472S
Poston, G. J. 501S
Poulain, B. 657
Poulet, P. 709
Powell, M. 469S
Powls, R. 436S
Powner, D. 503S
Pratt, J. R. 746
Premont, R. T. 714
Prescott, M. C. 476S
Price, K. R. 393S, 394S
Pullen, R. G. L. 452S
Purton, S. 733
- Quayle, J. A. 489S, 493S
- Rahmoune, H. 355S
Ralley, L. 733
Rando, R. R. 682
Rauscher, A. M. 947
Reed, M. J. 337S
Rees, H. H. 436S–438S, 476S
Rennie, M. J. 869, 927
Restall, C. J. 474S
Reumann, S. 754
Reynolds, J. L. 374S
Rhodes, M. J. C. 393S, 394S
Rice-Evans, C. A. 790
Rich, P. R. 398S, 400S
Riddell, D. R. 454S
Ridgway, T. 391S
Riley, P. R. 366S
Rob, A. 378S, 455S
Robinson, N. 709
Ross, I. S. 402S
Rossi, P. A. 864
Rotoli, B. M. 864
- Rowe, J. M. 423S
Ruddell, C. J. 340S, 410S
Rudland, P. S. 340S, 341S, 351S, 353S–358S
Ruiz, R. G. 393S
Runswick, S. K. 346S
Russell, N. J. 404S–406S
Ryden, P. 384S
- Sala, R. 864
Salter, M. 483S
Sanders, T. A. B. 771
Sanderson, J. 385S
Sansom, C. E. 471S
Sattler, I. 709
Sazanov, L. A. 739
Scheibe, R. 761
Schnieke, A. 369S
Schor, A. M. 368S
Schweizer, F. 666
Scott, A. 369S
Scott, D. J. 412S
Scott, W. G. 604
Scrimgeour, C. M. 927
Scrutton, N. S. 447S, 456S
Sczakiel, G. 615
Seabra, M. C. 699
Sebti, S. M. 692
Sharma, G. 375S
Sharpe, M. 451S
Shaw, D. 367S
Sheikh, S. 454S
Sheldrick, E. L. 366S
Shevchenko, A. I. 893
Shevchenko, A. N. 893
Simmonds, H. A. 442S
Simon, T. 435S
Simpson, K. J. 367S
Sinclair, M. A. 500S
Skamarauskas, J. T. 397S
Smirnov, I. P. 901
Smith, J. A. 342S, 358S, 501S
Smith, T. 381S
Smither, R. L. 368S
Snell, K. 483S
Snodgrass, G. J. A. I. 350S
Southon, S. 387S, 388S
Speir, J. P. 943
Springett, R. J. 448S
Stacey, C. C. 943
Stephen, R. 365S
- Stern, A. 884
Stevenson, J. 399S
Stockley, P. G. 412S, 413S
Stonehouse, N. J. 412S
Straghan, E. 375S
Streuli, C. H. 345S–349S
Suckling, K. E. 440S
Suleiman, M.-S. 482S, 487S
Symons, M. R. C. 465S
- Takahashi, N. 723
Talalay, P. 806
Tam, S.-C. 408S
Tamanoi, F. 709
Tatnell, P. J. 404S–407S
Taylor, P. D. 455S
Taylor, P. M. 869
Telemenakis, I. 661
Thomas, E. W. 468S, 473S
Tidd, D. M. 410S, 619
Torres, J. 450S, 465S
Travers, M. T. 361S
Tucker, G. 391S
Tuncer, M. 378S, 455S
Turnbull, J. E. 355S
Turner, A. J. 444S, 470S, 471S
Turner, M. 733
Turner, N. A. 426S
Turner, P. C. 414S, 415S
Turpin, D. H. 767
Twomey, C. M. 409S
- Uda, N. 811
Uggeri, J. 864
Urano, J. 709
Urgert, R. 800
- Valegård, K. 412S
Valtorta, E. 645
van den Worm, S. 412S
Vasconcelos, M. H. 408S
Vaughan, P. F. T. 426S–428S
Veal, E. A. 486S
Velasco, M. 811
Verma, C. 468S, 473S
Visigalli, R. 864
Vorm, O. 893
- Wainwright, G. 476S

- Wainwright, L. J.** 459S
Wakelam, M. J. O. 373S, 374S
Walker, J. E. 912
Walker, J. H. 426S–428S
Walker, R. 780
Walker, V. E. 423S
Wallace, R. 371S
Walton, D. J. 458S
Walton, T. J. 474S, 475S
Wang, B. 461S
Wang, H. 383S
Ward, C. P. 441S
Wargovich, M. J. 811
Watson, C. J. 370S–372S
Watson, F. 489S
- Watt, P. W.** 927
Webster, S. G. 476S
Weinglass, A. B. 478S
Wells, M. 369S
West, G. 391S
White, F. S. 493S
White, M. R. H. 411S
Whitehouse, D. G. 746
Whittle, B. J. R. 480S
Wilde, C. J. 357S, 369S
Wilford, F. H. 345S
Wilkins, A. 474S
Wilkinson, A. P. 394S
Wilkinson, M. C. 342S, 415S
Williams, D. R. 438S
- Williams, T. M.** 688
Williamson, G. 379S, 380S, 382S–386S, 461S, 462S
Wilm, M. 893, 943
Wilson, A. L. 703
Wilson, E. K. 456S
Wilson, M. C. 670
Wilson, M. T. 378S, 450S, 455S, 465S
Winning, B. 743
Winterø, A. K. 418S
Wiseman, A. 375S, 376S
Wiseman, H. 390S–392S, 795
Withers, S. E. 338S
- Wollman, F.-A.** 398S
Wood, B. 416S
Wood, C. D. 411S
Wood, C. K. 746
Wood, E. J. 445S
Wood, J. L. 467S
Woods, C. 811
Wrigglesworth, J. M. 464S
Wright, A. J. A. 387S, 388S
Wu, M. 413S
- Zhang, Y.** 806
Zito, F. 398S