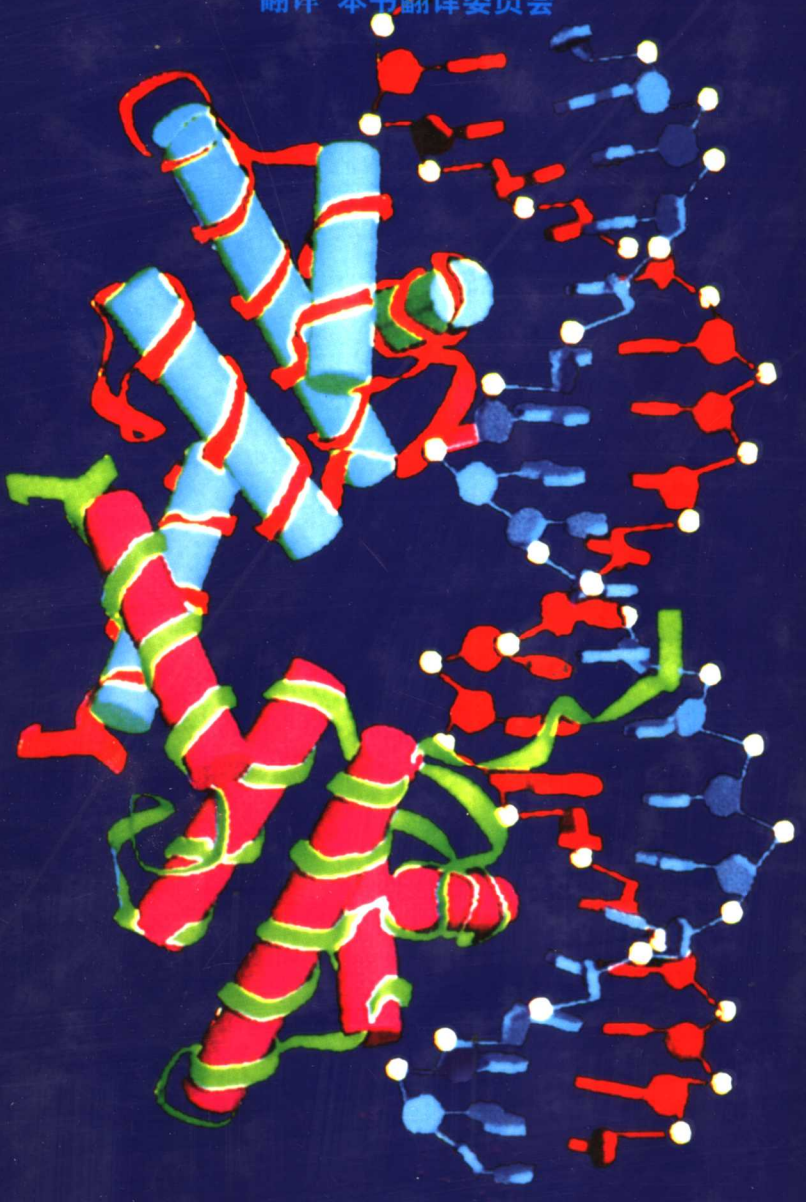
英汉分子生物学百科辞典

主编 约翰·肯德鲁爵士 执行主编 埃莉诺·劳伦斯

翻译 本书翻译委员会



上海科学技术出版社

图书在版编目（CIP）数据

英汉分子生物学百科辞典／（英）肯德鲁著；《英汉分子生物学百科辞典》翻译委员会译．—上海：上海科学技术出版社，2004.8
ISBN 7-5323-7134-4

Ⅰ.英… Ⅱ.①肯…②英… Ⅲ.分子生物学—词典—英、汉 Ⅳ.Q7-61

中国版本图书馆 CIP 数据核字（2003）第 059226 号

世纪出版集团
上海科学技术出版社 出版发行
（上海瑞金二路 450 号 邮政编码 200020）
新华书店上海发行所经销
上海新华印刷有限公司印刷
开本 850×1168 1/16 字数 2 940 000
印张 68.75 插页 8
2004 年 8 月第 1 版
2004 年 8 月第 1 次印刷
印数 1-3000
定价：230.00 元

作 者 名 单

主编

SIR JOHN KENDREW *The Guildhall, 4 Church Lane, Linton, Cambridge CB1 6JX, UK*

执行主编

ELEANOR LAWRENCE *56 Montrose Avenue, Whitton, Twickenham TW2 6HB, UK*

编委会

E. A. BARNARD *Molecular Neurobiology Unit, Royal Free Hospital School of Medicine, Rowland Hill Street, London NW3 2PF, UK* (分子神经生物学)

A. C. BLOOMER *MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH, UK* (结构生物学)

K. E. DAVIES *Molecular Genetics Group, Institute of Molecular Medicine, John Radcliffe Hospital, Oxford OX3 9DU, UK* (分子药物)

S. P. HUNT *Division of Neurobiology, MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH, UK* (分子神经生物学)

R. KEYNES *Department of Anatomy, University of Cambridge, Downing Street, Cambridge CB2 3DY, UK* (发育生物学)

T. H. RABBITTS *Clinical Oncology & Radiotherapeutics Unit, MRC Centre, Hills Road, Cambridge CB2 2QH, UK* (分子免疫学)

P. H. RUBERY *Department of Biochemistry, University of Cambridge, Tennis Court Road, Cambridge CB2 1QW, UK* (分子植物学)

M. F. TUITE *Biological Laboratory, The University, Canterbury, Kent CT2 7NJ, UK* (分子遗传学)

C. WATTS *Department of Biochemistry, University of Dundee, Dundee DD1 4HN, UK* (细胞生物学)

SIR DAVID J. WEATHERALL *Nuffield Department of Clinical Medicine, John Radcliffe Hospital, Headington, Oxford OX3 9DU, UK* (分子药物)

R. A. H. WHITE *Department of Anatomy, University of Cambridge, Downing Street, Cambridge CB2 3DY, UK* (发育生物学)

撰稿人

H.-W. ACKERMANN *Department of Microbiology, Faculty of Medicine, Laval University, Quebec, P. Q. Canada G1K 7P4*

M. E. AKAM *Wellcome/CRC Institute, Tennis Court Road, Cambridge CB2 1QR, UK*

L. A. AMOS *MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH, UK*

S.-I. AOTA *Laboratory of Developmental Biology, NIDR, NIH, Bethesda, MD 20892, USA*

J. ARMSTRONG *School of Biological Sciences, University of Sussex, Falmer, Brighton BN1 9QG, UK*

M. ASHBURNER *Department of Genetics, University of Cambridge, Downing St, Cambridge CB2 3EH, UK*

B. M. AUSTEN *Department of Surgery, St George's Hospital Medical School, Cranmer Terrace, London SW17 ORE, UK*

R. J. BAER *Department of Microbiology, University of Texas Southern Medical Center, 5323 Harry Hines Blvd, Dallas, TX 75235, USA*

J. P. BALDWIN *Liverpool John Moore's University, School of Biomolecular Sciences, Byrom Street, Liverpool L3 3AF, UK*

A. N. BARCLAY *MRC Cellular Immunology Unit, Sir William Dunn School of Pathology, University of Oxford, South Parks Road, Oxford OX1 3RE, UK*

E. A. BARNARD *Molecular Neurobiology Unit, Royal*

Free Hospital Medical School, Rowland Hill Street, London NW3 2PF, UK

Z. I. BASHIR *Department of Pharmacology, The Medical School, University of Birmingham, Edgbaston, Birmingham B15 2TT, UK*

D. BAULCOMBE *The Sainsbury Laboratory, John Innes Centre, Norwich Research Park, Colney, Norwich NR4 7UH, UK*

K. B. BECKMAN *Division of Biochemistry and Molecular Biology, 401 Barker Hall, University of California, Berkeley, CA 94720, USA*

G. P. BELFIELD *Biological Laboratory, University of Kent, Canterbury, Kent CT2 7NJ, UK*

D. S. BENDALL *Department of Biochemistry, University of Cambridge, Tennis Court Road, Cambridge CB2 1QW, UK*

C. BEREK *Deutsches Rheuma Forschungs Zentrum, Forschungslaboratorium Haus 10, Nordufer 20, 1000 Berlin 65, Germany*

A. BETZ *MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH, UK*

A. P. BIRD *Institute of Cell and Molecular Biology, University of Edinburgh, King's Buildings, Mayfield Road, Edinburgh EN9 3JR, UK*

N. J. M. BIRDSALL *National Institute for Medical Research, Mill Hill, London NW7 1AA, UK*

A. C. BLOOMER *MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH, UK*

T. BOEHM *Klinikum der Albert-Ludwigs-Universität, Abt Innere Medizin I, Hugstetterstrasse 55, D7800 Freiburg, Germany*

P. BORST *Division of Molecular Biology, Netherlands Cancer Institute, Plesmanlaan 121, 1066 CX Amsterdam, The Netherlands*

P. BOSSIER *Laboratorio de Genetica Molecular, Instituto Gulbenkian de Ciencia, Rue de Quinta Grande, Apartado 14, 2781 Oeiras Codex, Portugal*

D. J. BOWLES *Centre for Plant Biochemistry and Biotechnology, University of Leeds, Leeds LS2 9JT, UK*

M. D. BRAND *Department of Biochemistry, University of Cambridge, Tennis Court Road, Cambridge CB2 1QW, UK*

G. BRICOGNE *MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH, UK*

A. J. P. BROWN *Department of Molecular & Cell Biology, University of Aberdeen, Marischal College, Aberdeen AB9 1AS, UK*

T. A. BROWN *Department of Biochemistry & Applied Molecular Biology, UMIST, PO Box 88, Manchester M60 1QD, UK*

G. BURNSTOCK *Department of Anatomy & Developmental Biology, University College London, Gower Street, London WC1E 6BT, UK*

S. J. W. BUSBY *School of Biochemistry, University of Birmingham, PO Box 363, Birmingham B15 2TT, UK*

V. S. BUTT *Department of Plant Sciences, University of Oxford, Parks Road, Oxford OX1 3PF, UK*

B. BYTH *Department of Genetics, Hospital for Sick Children, 555 University Avenue, Toronto, Ontario, Canada M5G 1X8*

M. CAMBRAY-DEAKIN *School of Biological Sciences, University of Sheffield, Sheffield S10 2TN, UK*

R. CAMMACK *Division of Life Sciences, King's College, University of London, Campden Hill Road, London W8 7AH, UK*

M. J. CARDEN *Biological Laboratory, University of Kent, Canterbury, Kent CT2 7NJ, UK*

R. W. CARRELL *Department of Haematology, University of Cambridge Clinical School, MRC Centre, Hills Road, Cambridge CB2 2QH, UK*

V. K. K. CHATTERJEE *Department of Medicine, University of Cambridge, Addenbrooke's Hospital, Hills Road, Cambridge CB2 2QQ, UK*

M. CHURCHILL *Department of Cell and Structural Biology, 506 Morrill Hall, 505 S. Goodwin Avenue, Urbana, IL 61801, USA*

D. CLARK *Bldg 5, Room 204, Laboratory of Molecular Biology, NIDDK, NIH, 9000 Rockville Pike, Bethes-*

da, MD 20892, USA

F. A. L. CLOWES *Department of Plant Sciences, University of Oxford, South Parks Road, Oxford OX1 3PF, UK*

S. P. COBBOLD *Sir William Dunn School of Pathology, University of Oxford, South Parks Road, Oxford, OX1 3RE, UK*

P. T. W. COHEN *MRC Protein Phosphorylation Unit, Department of Biochemistry, The University, Dundee DD1 4HN, UK*

G. L. COLLINGRIDGE *Department of Pharmacology, The Medical School, University of Birmingham, Edgbaston, Birmingham B15 2TT, UK*

A. COLMAN *Pharmaceutical Proteins Ltd, Roslin, Midlothian EH25 9PP, UK*

D. COLTHURST *Biological Laboratory, University of Kent, Canterbury, Kent CT2 7NJ, UK*

H. COOKE *MRC Human Genetics Unit, Western General Hospital, Crewe Road, Edinburgh EH4 2XU, UK*

A. R. COULSON *MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH, UK*

G. L. DANIELS *MRC Blood Group Unit, Wolfson House, University College London, 4 Stephenson Way, London NW1 2HE, UK*

K. E. DAVIES *Molecular Genetics Group, Institute of Molecular Medicine, John Radcliffe Hospital, Oxford OX3 9DU, UK*

S. D. DAVIES *Division of Neurobiology, MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH, UK*

P. DE MEYTS *Hagedorn Research Laboratory, Niels Steensens Vej 6, DK-2820 Gentofte, Denmark*

T. M. DEXTER *Kay Kendall Laboratory, Paterson Institute for Cancer Research, Christie Hospital, Wilmslow Road, Manchester M20 9BX, UK*

G. DIAKUN *SERC Daresbury Laboratory, Daresbury, Warrington, Cheshire WA4 4AD, UK*

N. J. DIMMOCK *Department of Biological Sciences, University of Warwick, Coventry CV4 7AL, UK*

C. DINGWALL *Wellcome/CRC Institute, Tennis Court Road, Cambridge CB2 1QR, UK*

H. B. F. DIXON *Department of Biochemistry, University of Cambridge, Tennis Court Road, Cambridge CB2 1QW, UK*

M. B. A. DJAMGOZ *Neurobiology Group, Department of Biology, Imperial College of Science, Technology and Medicine, Prince Consort Road, London SW7 2BB, UK*

J. E. G. DOWNING *Neurobiology Group, Department of Biology, Imperial College of Science, Technology and Medicine, Prince Consort Road, London SW7 2BB, UK*

R. R. EADY *Nitrogen Fixation Laboratory, AFRC Institute of Plant Science Research, University of Sussex, Brighton BN1 9RQ, UK*

F. EBLING *Department of Anatomy, University of Cambridge, Downing Street, Cambridge CB2 3DY, UK*

R. EGEL *Department of Genetics, Institute of Molecular Biology, University of Copenhagen, Øster Farimagsgade 2A, DK-1353 Copenhagen K, Denmark*

R. J. ELLIS *Department of Biological Sciences, University of Warwick, Coventry CV4 7AL, UK*

H. EPSTEIN *Department of Anatomy, University of Cambridge, Downing Street, Cambridge CB2 3DY, UK*

E. M. EVANS *HUGO Europe, 1 Park Square West, London NW1 4LJ, UK*

M. EVANS *Wellcome/CRC Institute, Tennis Court Road, Cambridge CB2 1QR, UK*

P. A. EVANS *Department of Biochemistry, University of Cambridge, Tennis Court Road, Cambridge CB2 1QW, UK*

R. FARQUHAR *Discovery Biology, Pfizer Central Research, Sandwich, Kent CT13 9NJ, UK*

A. R. FARUQI *MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH, UK*

M. FERGUSON *Department of Biochemistry, The University, Dundee DD1 4HN, UK*

C. K. FFRENCH-CONSTANT *Wellcome/CRC Institute, Tennis Court Road, Cambridge CB2 1QR, UK*

4 作者名单

J. R. S. FINCHAM *20 Greenbank Road, Edinburgh EH10 5RY, UK*

D. J. FINNEGAN *Institute of Cell & Molecular Biology, University of Edinburgh, King's Buildings, Mayfield Road, Edinburgh EH9 3JR, UK*

A. FLAVELL *Department of Biochemistry, University of Dundee, Dundee DD1 4HN, UK*

T. P. FLEMING *Department of Biology, Biomedical Sciences Building, University of Southampton, Southampton SO9 3TU, UK*

S. P. FRASER *Neurobiology Group, Department of Biology, Imperial College of Science, Technology and Medicine, Prince Consort Road, London SW7 2BB, UK*

R. B. FREEDMAN *Biological Laboratory, University of Kent, Canterbury, Kent CT2 7NJ, UK*

R. FUCHS *EMBL, Meyerhofstrasse 1, D-6900 Heidelberg, Germany*

D. A. GALBRAITH *The Durrell Institute of Conservation & Ecology, University of Kent, Canterbury, Kent CT2 7NX, UK*

J. GAMBLE *Biological Laboratory, University of Kent, Canterbury, Kent CT2 7NJ, UK*

R. GIBBONS *Institute of Molecular Medicine, John Radcliffe Hospital, Oxford QX3 9DU, UK*

P. GILL *Central Research and Support Establishment, Home Office Forensic Science Service, Aldermaston, Reading RG7 4PN, UK*

B. D. GOMPERTS *Department of Physiology, University College London, Rockefeller Building, University Street, London WC1E 6JJ, UK*

N. M. GREEN *Laboratory of Protein Structure, National Institute for Medical Research, Mill Hill, London NW7 1AA, UK*

J. M. GRIENENBERGER *Institut de Biologie Moléculaire des Plantes du CNRS, 12 rue du Général Zimmer, 67084 Strasbourg Cedex, France*

K. GULL *Department of Biochemistry & Molecular Biology, University of Manchester, Stopford Building, Oxford Road, Manchester M13 9PT, UK*

W. J. GULLICK *ICRF Molecular Oncology Group, Hammersmith Hospital, Du Cane Road, London W12 0HS, UK*

S. E. HALFORD *Department of Biochemistry, University of Bristol Medical School, University Walk, Bristol BS8 1TD, UK*

A. HALL *Chester Beatty Laboratories, Institute of Cancer Research, Fulham Road, London SW3 6JB, UK*

D. G. HARDIE *Department of Biochemistry, University of Dundee, Dundee DD1 4HN, UK*

K. G. HARDY *Glaxo Institute of Molecular Biology SA, 46 route des Acacias, 1227 Carouge, Geneva, Switzerland*

A. D. HARTLEY *Section of Cell Growth, Regulation and Oncogenesis, Box 3686, Duke Comprehensive Cancer Center, Durham, NC 27710, USA*

D. A. HARTLEY *Department of Biochemistry, Imperial College of Science, Technology and Medicine, London SW7 2AZ, UK*

A. J. HARWOOD *MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH, UK*

R. T. HAY *Department of Biochemistry & Microbiology, University of St Andrews, St Andrews, Fife K16 9AL, UK*

G. L. HAZELBAUER *Department of Biochemistry & Biophysics, Washington State University, Pullman, WA 99164-4660, USA*

M. HAZELWOOD *Department of Immunology, The Medical School, University of Birmingham, Birmingham B15 2TT, UK*

J. K. HEATH *Department of Biochemistry, University of Oxford, South Parks Road, Oxford OX1 3QU, UK*

P. HEDDEN *Department of Agricultural Science, University of Bristol, AFRC Institute of Arable Crops Research, Long Ashton Research Station, Bristol BS18 9AF, UK*

S. HEKIMI *Department of Biology, McGill University, 1205 Dr Penfield Avenue, Montreal PQ, Canada H3A 1B1*

J. M. HENLEY *Department of Pharmacology, Universi-*

ty of Birmingham, Birmingham B15 2TT, UK

A. G. HEPBURN *PO Box 580, Verplanck, NY 10596, USA*

M. HIRST *Molecular Genetics Group, Institute of Molecular Medicine, John Radcliffe Hospital, Oxford OX3 9DU, UK*

T. R. HIRST *Biological Laboratory, University of Kent, Canterbury, Kent CT2 7NJ, UK*

M. HOBART *Mechanisms in Immunopathology Unit, MRC Centre, Hills Road, Cambridge CB2 2QH, UK*

J. J. HOLBROOK *Department of Biochemistry, University of Bristol Medical School, University Walk, Bristol BS8 1TD, UK*

N. HOLDER *Developmental Biology Research Centre, Randall Institute, Division of Biomolecular Sciences, King's College London, 26-29 Drury Lane, London WC2B 5RL, UK*

P. W. H. HOLLAND *Department of Zoology, University of Oxford, South Parks Road, Oxford OX1 3PS, UK*

J. HOPE *Institute for Animal Health, AFRC & MRC Neuropathogenesis Unit, Ogston Building, West Mains Road, Edinburgh EH9 3JF, UK*

N. D. HOPWOOD *Wellcome/CRC Institute, Cambridge CB2 1QR* * *Present address Cambridge Wellcome Unit for the History of Medicine, University of Cambridge, Free School Lane, Cambridge CB2 3RH, UK*

M. A. HORTON *ICRF Haemopoiesis Research Group, St Bartholomew's Hospital, London EC1A 7BE, UK*

C. J. HOWE *Biochemistry Department, University of Cambridge, Cambridge CB2 1QW, UK*

C. H. V. HOYLE *Department of Anatomy & Developmental Biology, University College London, Gower Street, London WC1E 6BT, UK*

R. HULL *John Innes Institute, Colney Lane, Norwich NR4 7UH, UK*

S. P. HUNT *Division of Neurobiology, MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 3QH, UK*

T. HUNT *ICRF Clare Hall Laboratories, South Mimms, Herts EN6 3LD, UK*

J. C. HUNTER *Parke-Davis Neuroscience Research Centre, Addenbrooke's Hospital, Cambridge CB2 2QB, UK*

D. A. JACKSON *Sir William Dunn School of Pathology, University of Oxford, South Parks Road, Oxford OX1 3RE, UK*

M. B. JACKSON *Department of Agricultural Science, University of Bristol, AFRC Institute of Arable Crops Research, Long Ashton Research Station, Bristol BS18 9AF, UK*

H. T. JACOBS *Institute of Genetics, University of Glasgow, Church Street, Glasgow G11 5JS, UK*

R. JEFFERIS *Department of Immunology, The Medical School, University of Birmingham, Birmingham B15 2TT, UK*

P. JEFFS *Department of Anatomy, University of Cambridge, Downing Street, Cambridge CB2 3DY, UK*

R. JENKINS *Division of Neurobiology, MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH, UK*

A. JOHNSON *Department of Anatomy, University of Cambridge, Downing Street, Cambridge CB2 3DY, UK*

M. H. JOHNSON *Department of Anatomy, University of Cambridge, Downing Street, Cambridge CB2 3DY, UK*

A. W. B. JOHNSTON *School of Biological Sciences, University of East Anglia, Norwich NR4 7TJ, UK*

SIR JOHN KENDREW *The Guildhall, 4 Church Lane, Linton, Cambridge CB1 6JX, UK*

J. KENDRICK-JONES *MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH, UK*

R. KEYNES *Department of Anatomy, University of Cambridge, Downing Street, Cambridge CB2 3DY, UK*

A. E. KNIGHT *MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH, UK*

N. S. KRAUZEWICZ *Department of Virology, Royal Postgraduate Medical School, Hammersmith Hospital,*

Du Cane Road, London W12 0HS, UK

J. M. LACKIE *Yamanouchi Research Institute, Littlemore Hospital, Sandford Road, Littlemore, Oxford OX4 4XN, UK*

R. A. LAKE *St Mary's Hospital Medical School, Department of Immunology, Wright-Fleming Institute, London W2 1PG, UK*

S. J. LAMBERT *Liverpool John Moore's University, School of Biomolecular Sciences, Byrom Street, Liverpool L3 3AF, UK*

E. M. LASATER *Departments of Physiology & Ophthalmology, University of Utah, Salt Lake City, UT 84108, USA*

R. LASKEY *Wellcome/CRC Institute, Tennis Court Road, Cambridge CB2 1QR, UK*

D. S. LATCHMAN *Division of Molecular Pathology, University College & Middlesex School of Medicine, University College London, The Windeyer Building, Cleveland Street, London W1P 6DB, UK*

M.-P. LEFRANC *Laboratoire d'immunogénétique Moléculaire, URA CNRS 1191, Université Montpellier II, Place Eugénie Bataillon, CPO12, 34095 Montpellier, Cedex 5, France*

A. M. LESK *Department of Haematology, University of Cambridge Clinical School, MRC Centre, Hills Road, Cambridge CB2 2QH, UK*

J. H. LEWIS *ICRF Developmental Biology Unit, Department of Zoology, South Parks Road, Oxford OX1 3PS, UK*

J. LUCOCQ *Anatomisches Institute, Universität Bern, CH-3000, Bern 9, Switzerland*

A. G. S. LUMSDEN *Division of Anatomy and Cell Biology, UMDS, Guy's Hospital, London Bridge, London SE1 9RT, UK*

J. P. LUZIO *Department of Clinical Biochemistry, University of Cambridge, Addenbrooke's Hospital, Hills Road, Cambridge CB2 2QR, UK*

M. F. LYON *MRC Radiobiology Unit, Chilton, Didcot OX11 0RD, UK*

J. F. McBLANE *Building 2, Room 304, NIDDKD, NIH, Bethesda, MD 20892, USA*

J. E. G. McCARTHY *Department of Gene Expression, Gesellschaft für Biotechnologie Forschung mbH, Mascheroder Weg 1, W-3300 Braunschweig, Germany*

J. R. McINTOSH *Department of Cellular and Developmental Biology, University of Colorado, Boulder, CO 80309-0347, USA*

S. K. MACIVER *MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH, UK*

I. MacLENNAN *Department of Immunology, University Medical School, Edgbaston, Birmingham B15 2TT, UK*

P. A. McNAUGHTON *Department of Physiology, King's College London, The Strand, London WC2R 2LS, UK*

A. I. MAGEE *Laboratory of Eukaryotic Molecular Genetics, National Institute for Medical Research, Mill Hill, London NW7 1AA, UK*

M. MARSH *MRC Laboratory for Molecular Cell Biology, University College London, Gower Street, London WC1E 6BT, UK*

C. MARTIN *The John Innes Institute, Norwich Research Park, Colney, Norwich NR4 7UH, UK*

J. MARTIN *Department of Molecular Biology and Biotechnology, University of Sheffield, PO Box 594, Sheffield S10 2UH, UK*

A. MARTINEZ ARIAS *Department of Zoology, University of Cambridge, Downing Street, Cambridge CB2 3EJ, UK*

E. J. MELLOR *Department of Biochemistry, University of Oxford, South Parks Road, Oxford OX1 3RA, UK*

L. MENGLE-GAW *Monsanto Company, 700 Chesterfield Village Parkway, Chesterfield, MO 63198, USA*

M. J. MERRICK *Nitrogen Fixation Laboratory, AFRC Institute of Plant Science Research, University of Sussex, Brighton BN1 9RQ, UK*

R. H. MICHELL *School of Biochemistry, University of Birmingham, Edgbaston, Birmingham B15 2TT, UK*

G. MOLINEUX *Kay Kendall Laboratory, Paterson Insti-*

tute for Cancer Research, Christie Hospital, Wilmslow Road, Manchester M20 9BX, UK

P. MORANDINI *MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH, UK*

D. MORAS *Institut de Biologie Moléculaire et Cellulaire du CNRS, 15 rue René Descartes, 67084 Strasbourg Cedex, France*

N. E. MURRAY *Institute of Cell & Molecular Biology, University of Edinburgh, King's Buildings, Mayfield Road, Edinburgh EH9 3JR, UK*

L. H. NAYLOR *Biological Laboratory, University of Kent, Canterbury, Kent CT2 7NJ, UK*

S. NEIDLE *Institute of Cancer Research, CRC Biomolecular Structure Unit, Cotswold Road, Sutton, Surrey SM2 5NG, UK*

M. S. NEUBERGER *MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH, UK*

D. H. NORTHCOTE *The Master's Lodge, Sidney Sussex College, Cambridge CB2 3HU, UK*

M. OSMOND *Department of Anatomy, University of Cambridge, Downing Street, Cambridge CB2 3DY, UK*

P. J. PARKER *ICRF, PO Box 123, Lincoln's Inn Fields, London WC2A 3PX, UK*

J. M. PARRY *School of Biological Sciences, University College Swansea, Singleton Park, Swansea SA2 8PP, UK*

D. PENNY *Molecular Genetics Unit, Massey University, Private Bag, Palmerston North, New Zealand*

S. PICKERING *Department of Anatomy, University of Cambridge, Downing Street, Cambridge CB2 3DY, UK*

P. W. PIPER *Department of Biochemistry and Molecular Biology, University College London, Gower Street, London WC1E 6BT, UK*

D. J. PORTEOUS *Molecular Genetics Group, MRC Human Genetics Unit, Western General Hospital, Crewe Road, Edinburgh EH4 2XU, UK*

A. POTERSZMAN *Institut Biologie Moléculaire et Cellulaire du CNRS, 15 rue René Descartes, 67084 Strasbourg Cedex, France*

S. POVEY *MRC Human Biochemical Genetics Unit, University College London, Wolfson House, 4 Stephenson Way, London NW1 2HE, UK*

D. POYNER *Pharmaceutical Sciences, Aston University, Aston Triangle, Birmingham B4 7ET, UK*

H. PRATT *Department of Anatomy, University of Cambridge, Downing Street, Cambridge CB2 3DY, UK*

C. G. PROUD *Department of Biochemistry, University of Bristol Medical School, University Walk, Bristol BS8 1TD, UK*

R. QUINLAN *Department of Biochemistry, University of Dundee, Dundee DD1 4HN, UK*

P. H. RABBITTS *Clinical Oncology & Radiotherapeutics Unit, MRC Centre, Hills Road, Cambridge CB2 2QH, UK*

P. B. RAINEY *Department of Plant Sciences, University of Oxford, South Parks Road, Oxford OX1 3RB, UK*

G. A. REID *Institute of Cell & Molecular Biology, University of Edinburgh, Mayfield Road, Edinburgh EH9 3JR, UK*

W. REIK *Department of Molecular Embryology, AFRC Institute of Animal Physiology & Genetics Research, Babraham, Cambridge CB2 4AT, UK*

C. D. REYNOLDS *School of Science and Technology, Liverpool John Moore's University, Byrom Street, Liverpool L3 3AF, UK*

G. P. REYNOLDS *Department of Biomedical Science, University of Sheffield, Sheffield S10 2TN, UK*

D. RHODES *MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH, UK*

A. J. RIVETT *Department of Biochemistry, University of Leicester, Leicester LE1 7RH, UK*

M. S. ROBINSON *Department of Clinical Biochemistry, University of Cambridge, Addenbrooke's Hospital, Hills Road, Cambridge CB2 2QR, UK*

J. H. ROGERS *Physiological Laboratory, Downing Street, Cambridge CB2 3EG, UK*

8 作者名单

J. H. ROTHMAN *Department of Biochemistry, University of Wisconsin-Madison, 420 Henry Mall, Madison, WI 53706-1569, USA*

T. ROWE *MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH, UK*

N. J. P. RYBA *NIDR, National Institutes of Health, 9000 Rockville Pike, Bethesda, MD 20892, USA*

H. SAKANO *Department of Molecular and Cell Biology, Division of Immunology, University of California, Berkeley, CA 94720, USA*

J. R. SAUNDERS *Department of Genetics & Microbiology, The University, PO Box 147, Liverpool L69 3BX, UK*

P. J. SCAMBLER *Molecular Medicine Unit, Institute of Child Health, 30 Guildford Street, London WC1N 1EH, UK*

J. W. R. SCHWABE *MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH, UK*

S. SCOTT-DREW *Wellcome/CRC Institute, Tennis Court Road, Cambridge CB2 1QR, UK*

W. V. SHAW *Department of Biochemistry, University of Leicester, Leicester LE1 7RH, UK*

J. SLACK *ICRF Developmental Biology Unit, Department of Zoology, University of Oxford, South Parks Road, Oxford OX1 3PS, UK*

H. SMITH *Department of Botany, Adrian Building, University of Leicester, Leicester LE1 7RH, UK*

J. C. SMITH *Laboratory of Developmental Biology, National Institute for Medical Research, Mill Hill, London NW7 1AA, UK*

P. R. SMITH *Department of Virology, Royal Postgraduate Medical School, Hammersmith Hospital, Du Cane Road, London W12 0HS, UK*

A. K. SOUTAR *MRC Lipoprotein Team, Royal Postgraduate Medical School, Hammersmith Hospital, Du Cane Road, London W12 0HS, UK*

K. A. STACEY *Biological Laboratory, University of Kent, Canterbury, Kent CT2 7NJ, UK*

R. STADEN *MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH, UK*

I. STANSFIELD *Biological Laboratory, University of Kent, Canterbury, Kent CT2 7NJ, UK*

F. A. STEPHENSON *School of Pharmacy, 29-39 Brunswick Square, London WC1N 1AX, UK*

C. D. STERN *Department of Human Anatomy, University of Oxford, South Parks Road, Oxford OX1 3QX, UK*

R. W. STODDART *Department of Pathological Sciences, University of Manchester, Stopford Building, Oxford Road, Manchester M13 9PT, UK*

P. STOEHR *EMBL, Meyerhofstrasse, 1, D-6900 Heidelberg, Germany*

K. M. SULLIVAN *Home Office Forensic Service Research and Support Establishment, Aldermaston, Reading RG7 4PN, UK*

M. SUZUKI *MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH, UK*

J. TAME *Department of Chemistry, University of York, Heslington, York YO1 5DD, UK*

D. TANNAHILL *Department of Anatomy, University of Cambridge, Downing Street, Cambridge CB2 3DY, UK*

N. K. TANNER *GENSET, 1 Passage Etienne Delaunay, 75011 Paris, France*

P. E. R. TATHAM *Department of Physiology, University College London, Rockefeller Building, University Street, London WC1E 6JJ, UK*

E. TERZAGHI *Molecular Genetics Unit, Massey University, Private Bag, Palmerston North, New Zealand*

J. THOMAS *Department of Biochemistry, University of Dundee, Dundee DD1 4HN, UK*

P. TIPPETT *MRC Blood Group Unit, Wolfson House, University College London, 4 Stephenson Way, London NW1 2HE, UK*

A. TRAMONTANO *Istituto di Richerche di Biologia Molecolare, Via Pontina Km 30 600, 00400 Pomezia, Rome, Italy*

M. F. TUITE *Biological Laboratory, University of Kent, Canterbury, Kent CT2 7NJ, UK*

H. VAN DEN BERGHE *Centre for Human Genetics, University of Leuven, Campus Gasthuisberg, Herestraat, B-3000 Leuven, Belgium*

V. VAN HEYNINGEN *MRC Human Genetics Unit, Western General Hospital, Crewe Road, Edinburgh EH4 2XU, UK*

R. VILE *ICRF, PO Box 123, Lincoln's Inn Fields, London WC2A 3PX, UK*

A. WALMSLEY *Department of Molecular Biology & Biotechnology, University of Sheffield, PO Box 594, Sheffield S10 2UH, UK*

F. S. WALSH *Department of Experimental Pathology, UMDS, Guy's Hospital, London Bridge, London SE1 9RT, UK*

J. WALTHO *Department of Molecular Biology and Biotechnology, University of Sheffield, PO Box 594, Sheffield S10 2UH, UK*

G. WARREN *Cell Biology Laboratories, ICRF, PO Box 123, Lincoln's Inn Fields, London WC2A 3PX, UK*

C. WATTS *Department of Biochemistry, University of Dundee, Dundee DD1 4HN, UK*

SIR DAVID J. WEATHERALL *Nuffield Department of Clinical Medicine, John Radcliffe Hospital, Headington, Oxford OX3 9DU, UK*

M. WEST *Department of Biochemistry, University of Dundee, Dundee DD1 4HN, UK*

R. A. H. WHITE *Department of Anatomy, University of Cambridge, Downing Street, Cambridge CB2 3DY, UK*

The late M. WILCOX *MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH, UK*

A. WILKIE *Institute of Molecular Medicine, John Radcliffe Hospital, Oxford OX3 9DU, UK*

G. G. WILSON *Department of Pharmacology, University of Leeds, Woodhouse Lane, Leeds LS2 9JT, UK*

S. W. WILSON *Developmental Biology Research Centre, Randall Institute, Division of Biomedical Sciences, King's College London, 26-29 Drury Lane, London WC2B 5RL, UK*

R. D. WOOD *ICRF, Clare Hall Laboratories, South Mimms, Herts EN6 3LD, UK*

D. WRAY *Department of Pharmacology, University of Leeds, Woodhouse Lane, Leeds LS2 9JT, UK*

C. C. WYLIE *Wellcome/CRC Institute, Tennis Court Road, Cambridge CB2 1QR, UK*

K. M. YAMADA *Laboratory of Developmental Biology, NIDR, NIH, Bethesda, MD 20892, USA*

致　谢

衷心感谢有关的作者和出版社惠允使用下列资料。
完整的文献细节在相关的条目中给出。

图 A15：from Watson *et al.* *The Molecular Biology of the Gene.* © 1987 by the Benjamin/Cummings Publishing Company, Inc.

图 B16、B19、B26、G49、M3、M17：from *Nature.* © Macmillan Magazines, Ltd.

图 C4：Fig. 18 from White, Southgate, Thomson & Brenner (1986) The structure of the nervous system of the nematode *Caenorhabditis elegans.* *The Philosophical Transactions of the Royal Society of London.* **B314**, 1-340, by permission of the Royal Society of London.

图 A35、C5、P60：from *Science.* © The American Association for the Advancement of Science.

图 C43*a*、*b*, N36*b*、*c*、*e*、*f*：reproduced from the *Journal of Cell Biology* by copyright permission of the Rockefeller University Press.

图 C7：from *FEBS Letters*, by permission of Elsevier Science. © The Federation of European Biochemical Societies.

图 C48、M28、S10、X2：from *Trends in Genetics.* by permission of Elsevier Science.

图 R29：from *Trends in Biochemical Science*, by permission of Elsevier Science.

图 C43、D37、H12：from *Cell.* © Cell Press.

图 N24、N25、N26、N27：from *Biochemistry.* © American Chemical Society.

图 H4、N23、P62、S8：from *Journal of Molecular Biology.* © Academic Press Ltd.

图 C31：from Cook & Stoddart (1973) *Surface Carbohydrates of the Eukaryotic Cell.* © 1973 by Academic Press Ltd.

图 M41、M42：from Huxley, A. H. (1983) *Molecular Basis of Contraction in Cross-striated Muscles and Relevance to Motile Mechanisms.* *Muscle and Nonmuscle Motility.* © 1983 by Academic Press, Inc.

图 Z3：(drawn by S Kimmel) from Kimmel *et al.* (1991) *Cell-cell Interactions in Early Development* (Wiley-Liss). © Wiley-Liss.

图 B7、B15：from (Neidhart, F. C., Ed.) *Escherichia coli and Salmonella typhimurium: Cellular and Molecular Biology.* © 1987 American Society for Microbiology.

图 N17：from *Neuron.* © 1989 by Cell Press.

图 C9、L6：from *Annual Review of Biochemistry* vols 55 & 58. © 1986 & 1989 Annual Reviews Inc.

图 A49、N38、R20：from *The EMBO Journal* by permission of Oxford University Press. © EMBO/Oxford University Press.

图 X8：from Levitan & Kaczmarek (1991) *The Neuron: Cell and Molecular Biology* (Oxford University Press) by permission of Oxford University Press.

图 B24、N39：from Saenger (1984) *Principles of Nucleic Acid Structure* (Springer-Verlag, New York). © Springer-Verlag.

图 A55、D36、M50、P5、V4，图版 8*e*：from *Development.* © Company of Biologists Ltd.

图 C27、H13、M24：from *BioEssays.* © ICSU Press.

图 C26：from *Journal of Cell Science, Supplement.* © 1986 Company of Biologists Ltd.

图 C39：from *Molecular and General Genetics*, Springer International. © Springer-Verlag Berlin Heidelberg.

图 P12、P14：from Alberts *et al.* (1989) *Molecular Biology of the Cell* 2nd edn (Garland Publishing Company, Inc). © Alberts *et al.*

图 P28：from *Photochemistry & Photobiology*. © American Society for Photobiology.

图 B14：from *Current Biology*. © 1991 Current Biology.

图 P62*d*：from *Current Opinion in Structural Biology*. © Current Opinion in Structural Biology.

图 L8、V6：from *Current Opinion in Neurobiology*. © Current Opinion in Neurobiology.

图 G10、G23、R35：from Singer & Berg (1991) *Genes and Genomes* (University Science Books). © 1991 University Science Books.

图 V5：from *Journal of Neurobiology*. © 1990 by John Wiley & Sons Inc.

图 C1、C2：from *Developmental Biology*. © 1977, 1983 Academic Press, Inc.

图 M27、N14、R20*a*：from *Nucleic Acids Research* (IRL Press), by permission of Oxford University Press.

图 M9、M10、M11：from Evans & Graham (1989) *Membrane Structure & Function* (IRL Press) by permission of Oxford University Press, 1989.

图 B4：from *Canadian Journal of Microbiology*. © National Research Council of Canada 1988. All rights reserved.

图 N9：from *Neuroscience*. © 1988 IBRO.

图 N10：from *Developmental Brain Research*, by permission of Elsevier Science.

图 D25、D27、D30. © British Crown Copyright, 1991.

图 A43：from *The New Biologist*. © 1992 W. B. Saunders, Philadelphia.

图 H3：from Perutz (1990) *Mechanism of cooperativity and allosteric regulation in proteins* (Cambridge University Press). © Miss Vivien Perutz and Dr. R. N. Perutz, 1989, 1990.

图 H5：from Fermi & Perutz (1981) *Atlas of Molecular Structures in Biology: Haemoglobin & Myoglobin* (Clarendon Press), by permission of Oxford University Press 1981.

图 I36：from *Diabetes*. © American Diabetes Association.

图 E13：from *Genetics*. © 1964 by the Genetics Society of America.

图 M49：from Lash & Whittaker (ed.) (1974) *Concepts of Development*. © 1974 Sinauer Associates, Inc., Sunderland, MA.

图 A37：from *Control of Virus Diseases*, Society of General Microbiology Symposium **45**, 1990, by permission of the Society for General Microbiology.

图 M26：from *Gene*, by permission of Elsevier Science.

图 N13：from *European Journal of Biochemistry*, by permission of Elsevier Science.

图 H7：from Branden & Tooze (1991) *Introduction to Protein Structure*. © Garland Publishing Company, Inc.

图 R20*c*：from *Journal of Biological Chemistry*, © American Society for Biochemistry and Molecular Biology, Inc. 1990.

图版 7 (*a*、*b*、*c*、*d*) © Scripps Clinic and Research Foundation.

图 C10、C50、C81、C82、E2、E8、F2、H6、K5、L1、L5、M51、P63、S6、S35、T49、U1 以及图版 3、4、5、6 (*b* & *c*) courtesy of A. M. Lesk.

中国科学院上海生物化学与细胞生物学研究所
《英汉分子生物学辞典》
翻译委员会名单

主任委员 龚祖埙

副主任委员 张友尚　王克夷　祁国荣

委　　员 （按姓氏笔画为序排列）

丁达夫　甘人宝　冯佑民　刘定干　刘望夷　李　潇
陆长德　张永莲　张组传　陈江野　杜雨苍　宋建国
吴祥甫　吴家睿　邹永水　周元聪　金由辛　郑仲承
胡红雨　洪国藩　赵辅昆　敖世州　戚正武　夏其昌
龚蓁蓁　景乃禾

英文版前言

分子生物学起始于20世纪30年代,但主要的突破是在50年代。分子生物学在目前看起来与实际应用尚有一段距离,但随着快速的发展,在遗传学、在发育和细胞功能的分子基础、在诸如DNA和蛋白质的大分子结构方面的这些突破变得愈来愈广地和应用领域如医学、药物学、农业和工业生物技术有关。它们显得特别有价值并快速引导着重大的应用,例如基因治疗、药物设计、作物遗传性状的改良、重要化合物的合成等。这些应用成果使得分子生物领域内的先驱者大为惊奇。他们一直以为,他们的研究仅仅为了对未知事物作出解释。分子生物学的实际应用也愈来愈多地由医学、农业和工业的人士参与,他们要求了解分子生物学的原则和进展,提高阅读有关文献的能力。非本领域出身的更广泛人群,需要专门术语——行话的帮助以及分子生物学原则的指导。诚然,就如在其他的激增的科学分支内一样,即使本学科内,专业的分子生物学家有时也会发现自己不懂的行话,他们必须阅读自己领域之外的文献。

在19世纪,对大多数科学家来说,都有可能应用一种只要能够阅读日常报纸的任何人都能懂的语言来撰写他们的研究。啊! 时光不再。《自然》和《科学》的最新出版物内,有多少比例,科学家或非专业的人们能够懂? 每一个活跃的科学家都在发明自己个人的行话,分子生物学也并不例外。诚然,行话在其被发明之后,也被输出和输入。"克隆",从经典的植物学引进到分子生物学,现在重新被输出,已变成公众广泛应用的一个时髦术语,虽然应用得并不全部合适。相反,"下游"、"上游"、"伴侣",甚至"诱导"等术语在分子生物学中都含有与日常生活十分不同的意义。

本书的目的是帮助本领域内外的人士了解分子生物学的方法、概念和发现,即使他们最初对本领域内全部或部分的行话是无知的。这是一部百科全书,而不仅仅是一本字典,也就是说,本书作者并不简单地满足于把词汇的定义按字典型进行排列,虽然这种定义可以从本书中大量地找到。作者力求,而这更重要,对大多数论题,例如蛋白质合成、膜的行为或基因操作等,提供一个概观,使领域之外的人士能够了解感兴趣的或与自己专业活动有关的论题。为此,本书内容有两部分,即长条目(比较类似百科全书型)和短条目(比较类似字典型)混合组成。本书内还有丰富的交叉参考,并含有大量的图表,以帮助在不同论题间的穿梭。本书所有作者均是活跃的研究者,他们在自己领域内都作出过重大的贡献,因而对他们所选定的论题都具有第一手的知识。编者希望,本书的这些特点使得它对于那些需要了解分子生物学概念的人们,对于他们的工作是有价值的。

约翰·肯德鲁

剑桥 1994

龚祖埙 译

英文版导言

《英汉分子生物学百科辞典》(*Encyclopedia of Molecular Biology*)的目的是为分子生物学本身的核心论题提供一个全面、综合、简明的参考来源,同时本书也包括分子生物学曾为之作出巨大贡献的其他领域的一般背景材料。因此尽可能在一本书中向所有的生物学专家和生物学专业的学生以及相关领域(如医学)的专家和学生提供可以理解的完整的参考资料。本书宽广的涉及面使非生物专业的读者也能方便地找到有关当前分子生物学进展的信息。

本书共含有5 500多条长度不等的条目,以字母先后安排顺序。名字前的数字、希腊字母和构象字母在排列时不予考虑。例如,β-半乳糖苷酶(β-galactosidase)被安排在G项,N-乙酰半乳糖胺(*N*-acetylgalactosamine)被安排在A项。条目中共有217条命题经过挑选的长的综述条目,同时还有4 000余条目前广泛应用的较短的专业术语的定义。关键词还包含有通用的缩写词、同义词和指导读者寻找相应条目的交叉参考条目。整书的不带定义的标准缩写词列于第9～10页。

具有综述性质的条目目录除以字母排列外,还按相关领域分类,列于本书的第5～7页。在每条条目内,能提供补充材料或基础材料的交叉条目将以小的大写字母列出,在每条条目的最后,还以小的大写字母列出补充交叉条目(译者注:这些小的大写字母在中文书中均以黑体字标出)。

所有长条目和许多短条目还附有参考书目,这些参考书目是为了使读者能进入有关文献,但不作为完整的文献目录而列出。

埃莉诺·劳伦斯

龚祖埙　译

中文版前言

不能否认,20世纪生命科学之所以取得如此令人瞩目的飞速发展和巨大成就,与分子生物学这一分支学科的建立及研究进展有密切的联系。

生物的多样性,生命现象的复杂性,使得生命科学的研究长期处于宏观或微观(细胞、组织)形态描述的水平。随着大量现代技术的发明和应用,新发现、新概念、新见解不断涌现,使得一些生命现象目前已能在分子水平上进行阐述和解释。分子生物学作为一门独立的分支学科,不仅在最近数十年间得到飞速的发展,而且与细胞生物学、分子遗传学、发育生物学、神经科学和生物工程等学科相互交叉和渗透,目前已很难分清这些生命科学分支学科之间的边缘界限,分子生物学的概念和技术也渗入到一些本来比较传统的生命科学学科之中,如动物学、植物学、比较生物学和古生物学等。

新中国成立后,我国前辈科学家曾在分子生物学领域做出了杰出的贡献,如牛结晶胰岛素和酵母丙氨酸tRNA分子的人工合成等,并且培养了一批卓有成就的研究骨干和学术带头人。改革开放以后,大批年轻学者纷纷出国学习和进修,把一些先进的理念和技术带回祖国,使得我国在分子生物学研究方面与国际水平的差距有所缩小。但总体而言,我国分子生物学的研究水平和国际水平仍有一定的差距。

由诺贝尔奖获得者肯德鲁博士主编、本领域杰出研究者撰写的 *Encyclopedia of Molecular Biology*,内容丰富,覆盖面广,条理清晰,信息量大。共有条目5 500多条,从基础理论到科学概念,从研究技术到名词解释,均有详尽和精湛的阐述。这是一本不可多得的参考书。参与此书翻译的有中国科学院上海生物化学与细胞生物学研究所的数十位专家及博士研究生。参与本书编辑校对工作的还有李茂深先生和曹京凤女士等。

肯德鲁博士于1996年来中国访问。在访问中国科学院上海生物化学研究所期间,他曾答应为本书中译本作序,但他在返国后不久即不幸因病去世,因而他为本书中译本作序的愿望未能完成。在此我们对肯德鲁博士在科学上的杰出贡献以及为发展中国与国际同行之间的学术交流所做出的努力表示敬意,并对他的逝世表示深切哀悼。

我们相信,所有从事生命科学研究的专家、学者、学生以及农学和医学研究和教学工作者均能从本书的出版中有所获益。

龚祖埙

2002年6月