

P&S BIOMEDICAL

SCIENCES SYMPOSIA

CELL BIOLOGY OF THE MAJOR HISTOCOMPATIBILITY COMPLEX

Edited by

BENVENUTO PERNIS HENRY J. VOGEL

CELL BIOLOGY OF THE MAJOR HISTOCOMPATIBILITY COMPLEX



P & S BIOMEDICAL SCIENCES SYMPOSIA Series

HENRY J. VOGEL, Editor

College of Physicians and Surgeons Columbia University New York, New York

Henry J. Vogel (Editor). Nucleic Acid-Protein Recognition, 1977

- Arthur Karlin, Virginia M. Tennyson, and Henry J. Vogel (Editors). Neuronal Information Transfer, 1978
- Benvenuto Pernis and Henry J. Vogel (Editors). Cells of Immunoglobulin Synthesis, 1979
- Benvenuto Pernis and Henry J. Vogel (Editors). Regulatory T Lymphocytes, 1980
- Georgiana Jagiello and Henry J. Vogel (Editors). Bioregulators of Reproduction, 1981
- Hymie L. Nossel and Henry J. Vogel (Editors). Pathobiology of the Endothelial Cell, 1982
- I. Bernard Weinstein and Henry J. Vogel (Editors). Genes and Proteins in Oncogenesis, 1983
- Harold S. Ginsberg and Henry J. Vogel (Editors). Transfer and Expression of Eukaryotic Genes, 1984
- Benvenuto Pernis and Henry J. Vogel (Editors). Cell Biology of the Major Histocompatibility Complex, 1985

CELL BIOLOGY OF THE MAJOR HISTOCOMPATIBILITY COMPLEX

Edited by BENVENUTO PERNIS HENRY J. VOGEL

College of Physicians and Surgeons Columbia University New York, New York



ACADEMIC PRESS, INC.

Harcourt Brace Jovanovich, Publishers

Orlando San Diego New York Austin London Montreal Sydney Tokyo Toronto COPYRIGHT © 1985 BY ACADEMIC PRESS, INC. ALL RIGHTS RESERVED. NO PART OF THIS PUBLICATION MAY BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPY, RECORDING, OR ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT PERMISSION IN WRITING FROM THE PUBLISHER.

ACADEMIC PRESS, INC. Orlando, Florida 32887

United Kingdom Edition published by ACADEMIC PRESS INC. (LONDON) LTD. 24-28 Oval Road, London NW1 7DX

Library of Congress Cataloging in Publication Data Main entry under title:

Cell biology of the major histocompatibility complex.

Proceedings of the 9th meeting of the P & S Biomedical Sciences Symposia, held at Arden House on the Harriman Campus of Columbia University, June 8-10, 1984; sponsored by the College of Physicians and Surgeons.

Includes index.

 Histocompatibility antigens-Congresses.
Pernis, Benvenuto. II. Vogel, Henry J. (Henry James), Date. III. Columbia University. College of Physicians and Surgeons. [DNLM: 1. Histocompatibility Antigens-immunology-congresses. 2. Lymphocytesimmunology-congresses. 3. Major Histocompatibility Complex-congresses. WO 680 C393 1984] QR184.3.C45 1985 616.07'9 85-13379 ISBN 0-12-550870-0 (alk. paper) ISBN 0-12-550871-9 (paperback)

PRINTED IN THE UNITED STATES OF AMERICA

85 86 87 88 9 8 7 6 5 4 3 2 1

Contents

| List of Participants | xiii |
|----------------------|------|
| Preface | xxi |
| | |
| | |

OPENING ADDRESS

The Biological Significance of the Antigens of the Major Histocompatibility Complex

BARUJ BENACERRAF AND KENNETH L. ROCK

| Introduction | 3 |
|---|----|
| The Selective Expansion of Thymocytes with Receptors for Self-Ia | 4 |
| The Origin of Alloreactivity | 7 |
| The Interaction between Class II MHC Molecules and Antigen: A Basis for the | |
| Specificity of Ir Gene-Controlled Phenomena | 8 |
| References | 13 |

PART I. THE STRUCTURE OF MHC MOLECULES: IMPLICATIONS FOR FUNCTIONS

Human Histocompatibility Antigens: Genes and Proteins

JACK L. STROMINGER

| Text | 17 |
|------------|----|
| References | 24 |
| | |

New Approaches and Results in Cloning of the Human Major Histocompatibility Complex

RAKESH SRIVASTAVA, BARRY W. DUCEMAN, P. A. BIRO, MICHAEL J. CHORNEY, ASHWANI SOOD, DANIEL S. GREENSPAN, JULIAN PAN, AND SHERMAN M. WEISSMAN

| Text |
|------------|
| References |

27 34

Cloning at a Distance with a Circularization Technique

| FR | ANCIS S. COLLINS AND SHERMAN M. WEISSMAN | |
|------------------|---|----------|
| Text Referenc | es | 37 40 |
| | ts of the Murine Major Histocompatibility Complex: Iral Analysis of <i>in Vivo</i> and <i>in Vitro</i> H-2K ^b Variants | |
| SC | A. ZEFF, S. S. GEIER, J. GOPAS, J. GELIEBTER, D. H. CHULZE, L. R. PEASE, G. M. PFAFFENBACH, P. PONTAROTTI, MASHIMO, D. A. McGOVERN, AND S. G. NATHENSON | |
| Introduct | tion | 41 |
| In Vivo N | 1HC Mutants | 43 |
| In Vitro N | MHC Mutants | 45 |
| Referenc | es | 49 |
| . 0 | eny of MHC Class I and Class II Molecules Identified by Reactive Xenoantisera | |
| | | |

JIM KAUFMAN, MARTIN FLAJNIK, AND LOUIS DU PASQUIER

| Introduction | 51 |
|------------------------|----|
| Results and Discussion | 52 |
| References | 58 |

Organization of the Genes of the H-2 Complex

MICHAEL STEINMETZ

| Introduction | 61 |
|---|----|
| Genetic Map of the Major Histocompatibility Complex | 61 |
| A Large Number of Class I Genes | 62 |
| A Chromosome Walk in the <i>I</i> Region | 63 |
| Variable or Conserved Chromosomal Tracts | 66 |
| Future | 69 |
| References | 70 |

Membrane Expression and Function of MHC Class I Antigens with Truncated or Altered Cytoplasmic Tails

MARTHA C. ZUNIGA AND LEROY HOOD

| Strategies of in Vitro Mutagenesis | 75 |
|--|----|
| Cytoplasmic Tail Sequences Required for Expression of a Functional MHC | |
| Molecule on the Cell Surface | 75 |
| Does the Cytoplasmic Tail Have a Role in the Lateral Mobility of the MHC | |
| Molecule on the Cell Membrane? | 76 |

vi

| CONTENTS | vii |
|---|----------------------|
| Effect of the Cytoplasmic Tail on the Internalization of the MHC Molecule Conclusions References | 77 77 78 |
| A Gene Conversion Event in the $I-A\beta^b$ Gene Alters the Self-I-A Restricted T-Cell Repertoire of B6.C- $H-2^{bm12}$ Mice | |
| PAULA S. HOCHMAN, GEORG WIDERA, RICHARD A. FLAVELL, AND BRIGITTE T. HUBER | |
| Introduction The Role of Ia Epitopes in Conferring Specificity for the Immune Response to Nominal Antigen Discussion References | 81 84 92 94 |
| Evolution of H-2 Genes on t Chromosomes | |
| JAN KLEIN, DEAN NIŽETIĆ, MLADEN GOLUBIĆ, ZLATKO DEMBIĆ, AND FELIPE FIGUEROA | |
| Text References | 97 105 |
| PART II. ALTERNATE FORMS OF MHC MOLECULES | |

Expression of a Secreted Form of the MHC Class I Antigen

YVES BARRA, KENICHI TANAKA, WENDY DAVIDSON, GEORGE KHOURY, AND GILBERT JAY

| Text | 109 |
|------------|-----|
| References | 120 |

Alternative Splicing in the H-2 Multigene Family

CATHERINE TRANSY, JEAN-LOUIS LALANNE, MADELEINE COCHET, SYLVAIN GUÉRIN, GABRIEL GACHELIN, AND PHILIPPE KOURILSKY

Introduction 121 The pH-2^d-33 and pH-2^d-24 cDNA Clones 122 Demonstration of Alternate Splicing in the 5' Moiety of the $H-2K^d$ Gene 124 The "33" and "24" Transcripts Are Made in a Variety of Tissues of DBA/2 Mice 124 Alternate Splicing in the 5' Moiety of *H*-2K Genes in Other Haplotypes 124 Alternative Splicing in the 3' Region of the $H-2K^d$ Gene 125 125Alternative Splicing in the Q10 Gene Alternative Splicing in Other Class I Genes 126 Evolution of Class I Genes through Mutations Altering Splicing Events 126

| Potential for Alternative Splicing in Class I Genes | 127 |
|---|-----|
| What Determines Alternate Splicing? | 128 |
| Possible Significance of Alternative Splicing | 128 |
| References | 129 |

PART III. MHC BIOSYNTHESIS, INTRACELLULAR TRANSPORT, AND MEMBRANE EXPRESSION

Manipulation of Glycans on Antigens of the Major Histocompatibility Complex

HIDDE PLOEGH AND ULRIKE FUHRMANN

| Introduction | 133 |
|--|-----|
| Inhibitors of N-Linked Glycan Processing | 134 |
| Carbohydrates and Membrane Recycling | 137 |
| Biosynthesis of MHC Products | 139 |
| Experiments | 140 |
| Results | 141 |
| Recycling of MHC Antigens | 148 |
| Discussion | 148 |
| References | 150 |

Dynamics of MHC Molecules in Lymphoid Cells: Facts and Speculations

BENVENUTO PERNIS AND DORIS B. TSE

| Introduction | 153 |
|--|-----|
| Evidence for Recycling of Class I MHC in Activated T Lymphocytes | 154 |
| Intracellular MHC Molecules in Nonlymphoid Cells | 157 |
| The Effect of Anti-MHC Antibodies | 158 |
| Intracellular Non-MHC Antigens in Human Activated T-Lymphoid Cells | 161 |
| Conclusion | 163 |
| References | 164 |

Internalization of Histocompatibility Antigens Studied by Flow Cytometry

CHARLES R. CANTOR, DORIS B. TSE, JOAN McDOWELL, ROBERT MURPHY, AND BENVENUTO PERNIS

| Introduction | 165 |
|---|-----|
| Dual Fluorescence Studies of MHC Internalization | 166 |
| Single Fluorescence Technique for MHC Internalization | 168 |
| Discussion | 170 |
| References | 171 |
| | |

viii

Evidence for a Second Receptor-Like Molecule in a Human T-Cell Leukemia

YURI BUSHKIN, HENRY G. KUNKEL, BENVENUTO PERNIS, AND CHANG-YI WANG

| Introduction | 173 |
|-----------------------|-----|
| Materials and Methods | 174 |
| Results | 175 |
| Discussion | 179 |
| References | 183 |

Endocytosis of MHC Molecules Evaluated by Specifically Targeted Liposomes

LEE D. LESERMAN, PATRICK MACHY, ALEMSEGED TRUNEH, AND MARTHA C. ZUNIGA

| Specific Liposome-Mediated Drug Delivery | 185 |
|---|-----|
| Endocytosis and Its Pharmacologic Control | 186 |
| Possible Mechanisms for Differential Endocytosis | 187 |
| Control of Endocytosis Studied by Transfected and Variant Cells | 188 |
| Liposomes for Negative and Positive Selection | 191 |
| Conclusions | 192 |
| References | 193 |

The Mechanism of Intracellular Transport and Surface Expression of MHC Antigens

CHRISTINE KINNON AND MICHAEL J. OWEN

| Introduction | 195 |
|-------------------------|-----|
| Results and Discussion | 198 |
| Summary and Conclusions | 213 |
| References | 214 |

PART IV. HOMOLOGUES OF CLASS I MHC MOLECULES

Class I Genes: What Do They All Do?

EDWARD A. BOYSE

| Text | 219 |
|------------|-------|
| References | . 222 |

. . .

Tla: Aspects of Its Expression in Normal and Malignant Cells

EDWARD A. BOYSE

| TL ⁺ and TL ⁻ Genotypes | 223 |
|---|-----|
| Normal Differentiation | 224 |
| Leukemogenesis | 225 |
| References | 226 |

The Qa Series of Antigens

LORRAINE FLAHERTY, MARGARET KARL, AND KATHLEEN DIBIASE

| Introduction | 229 |
|---------------------------|-----|
| Genetics | 230 |
| Other Characteristics | 232 |
| Modulation Studies | 232 |
| Molecular Genetic Studies | 234 |
| Qa-2 Function | 235 |
| References | 236 |

Expression of Structurally Diverse Qa-2-Encoded Molecules on the Surface of Cloned Cytotoxic T Lymphocytes

| DAVID H. | SHERMAN, | DAVID | М. | KRANZ, | AND | HERMAN N. | EISEN |
|----------|----------|-------|----|--------|-----|-----------|-------|
| | | | | | | | |

| Text | 239 |
|------------|-----|
| References | 247 |

TLymI, a Lymphoid Stage-Specific Transforming Gene, Shares Homology with *MHCI*-Encoded Genes

M. A. LANE, H. A. F. STEPHENS, K. M. DOHERTY, AND M. TOBIN

| Text | 249 |
|------------|-----|
| References | 254 |

PART V. ASSOCIATION OF MHC WITH ANTIGENS

Quantitative Variation in Ia and Non-Ia B-Cell Surface Molecules Regulates T-Cell : B-Cell Interactions

CHARLES A. JANEWAY, JR., KIM BOTTOMLY, BARRY JONES, MICHAEL KATZ, JONATHAN KAYE, GRACE SU, AND JOHN TITE

| Introduction | 259 |
|--------------|-----|
| Results | 261 |
| Discussion | 269 |
| References | 271 |

Х

| Histocompatibility Molecules as Immune Response Gene Products | |
|---|--------------------------|
| RONALD H. SCHWARTZ, LOUIS A. MATIS, AND ZDENKO KOVAC | |
| Text References | 273 281 |
| Molecular Nature of T-Cell Recognition of Antigen | |
| PAUL M. ALLEN AND EMIL R. UNANUE | |
| Antigen Processing Studies of Lysozyme References | 283 284 287 |
| Clonotypic Markers Expressed on a Murine T-Cell Hybridoma Recognizing Foreign Antigen in Association with Murine and Human Ia Antigen | |
| CONSTANTIN A. BONA AND STANLEY J. WATERS | |
| Introduction Conclusion References | 289 296 297 |
| Cytolytic T Cells Recognize Conformational Determinants of H-2 K Antigens in Influenza A-Infected Cells | |
| SUNE KVIST, BERND ARNOLD, AND HANS-GERHARD BURGERT | |
| Introduction Results Discussion References | 299 300 306 308 |

Index

311

This page intentionally left blank

List of Participants

- AL-HAIDERI, MAYSOON T., Department of Pathology, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- ALLEN, PAUL M., Department of Pathology, Harvard Medical School, Boston, Massachusetts 02115
- AL SEDAIRY, S. T., Department of Pathology, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- AL SEDAIRY, W. M., Department of Pathology, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- ANDERSON, DEBORAH J., Dana-Farber Cancer Institute, Harvard Medical School, Boston, Massachusetts 02115
- ARNOLD, BERND, German Cancer Research Center, D-6900 Heidelberg, Federal Republic of Germany
- BAILEY-BRAXTON, DENISE, Department of Pathology, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- BARRA, YVES, Laboratory of Molecular Virology, National Cancer Institute, National Institutes of Health, Bethesda, Maryland 20205
- BAYLEY, HAGAN, Department of Biochemistry and Molecular Biophysics, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- BENACERRAF, BARUJ, Department of Pathology, Harvard Medical School, Boston, Massachusetts 02115
- BERGER, CAROLE L., Departments of Dermatology and Pathology, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- BIKOFF, ELIZABETH K., Department of Microbiology, Mt. Sinai School of Medicine, New York, New York 10029
- BIRO, P. A., Dana-Farber Cancer Institute, Harvard Medical School, Boston, Massachusetts 02115
- BONA, CONSTANTIN A., Department of Microbiology, Mt. Sinai School of Medicine, New York, New York 10029
- BONAGURA, VINCENT R., Departments of Pediatrics and Microbiology, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- BOTTOMLY, KIM, Howard Hughes Medical Institute, Yale University School of Medicine, New Haven, Connecticut 06510
- BOYER, CINDA M., Division of Immunology, Duke University Medical Center, Durham, North Carolina 27710
- BOYSE, EDWARD A., Memorial Sloan-Kettering Cancer Center, New York, New York 10021
- BUCHHAGEN, DOROTHY L., Department of Microbiology and Immunology, Down-

state Medical Center, State University of New York, New York, New York 11203

- BURGERT, HANS-GERHARD, EUROPEAN Molecular Biology Laboratory, D-6900 Heidelberg, Federal Republic of Germany
- BURNETT, ROGER M., Department of Biochemistry and Molecular Biophysics, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- BUSHKIN, YURI, Laboratory of Molecular Immunology, Memorial Sloan-Kettering Cancer Center, New York, New York 10021
- BUTLER, VINCENT P., Department of Medicine, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- CANTOR, CHARLES R., Department of Human Genetics and Development, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- CARLINO, JOSEPH, Department of Pathology, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- CARRIER, CARMELITA, Department of Pathology, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- CHEN, CHANG-YAN, Department of Pathology, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- CHESS, LEONARD, Department of Medicine, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- CHORNEY, MICHAEL J., Department of Human Genetics, Yale University School of Medicine, New Haven, Connecticut 06510
- CLEVELAND, W. LOUIS, Department of Microbiology, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- COCHET, MADELEINE, Institut Pasteur, 75724 Paris Cédex 15, France
- COLIGAN, JOHN E., Laboratory of Immunogenetics, National Institute of Allergy and Infectious Diseases, National Institutes of Health, Bethesda, Maryland 20205
- Collins, Francis S., Department of Medicine, University of Michigan Medical School, Ann Arbor, Michigan 48109
- CONE, ROBERT, Department of Pathology, Yale University School of Medicine, New Haven, Connecticut 06510
- DAVIDSON, WENDY, Laboratory of Molecular Virology, National Cancer Institute, National Institutes of Health, Bethesda, Maryland 20205
- DEMBIĆ, ZLATKO, Abteilung Immungenetik, Max-Planck-Institut für Biologie, D-7400 Tübingen, Federal Republic of Germany
- DE ROSA, CAROLYN M., Department of Pathology, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- DIBIASE, KATHLEEN, Wadsworth Center for Laboratories and Research, New York State Department of Health, Albany, New York 12201
- DOHERTY, K. M., Laboratory of Molecular Immunobiology, Dana-Farber Cancer Institute, Harvard Medical School, Boston, Massachusetts 02115
- DOHERTY, PAUL, National Cancer Institute, National Institutes of Health, Bethesda, Maryland 20205

- DUCEMAN, BARRY W., Department of Human Genetics, Yale University School of Medicine, New Haven, Connecticut 06510
- Du Pasquier, Louis, Basel Institute for Immunology, CH-4005 Basel, Switzerland
- EDELSON, RICHARD L., Department of Dermatology, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- EISEN, HERMAN N., Department of Biology, and Center for Cancer Research, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139
- FARREL, MICHAEL P., Dana-Farber Cancer Institute, Harvard Medical School, Boston, Massachusetts 02115
- FIGUEROA, FELIPE, Abteilung Immungenetik, Max-Planck-Institut für Biologie, D-7400 Tübingen, Federal Republic of Germany
- FLAHERTY, LORRAINE, Wadsworth Center for Laboratories and Research, New York State Department of Health, Albany, New York 12201
- FLAJNIK, MARTIN, Basel Institute for Immunology, CH-4005 Basel, Switzerland
- FLAVELL, RICHARD A., Biogen Research Corporation, Cambridge, Massachusetts 02142
- FREEMAN, GORDON, Dana-Farber Cancer Institute, Harvard Medical School, Boston, Massachusetts 02115
- FUHRMANN, ULRIKE, Institut für Genetik, Universität zu Köln, Cologne, Federal Republic of Germany
- GACHELIN, GABRIEL, Institut Pasteur, 75724 Paris Cédex 15, France
- GEIER, S. S., Departments of Cell Biology and Microbiology and Immunology, Albert Einstein College of Medicine, Bronx, New York 10461
- GELIEBTER, J., Departments of Cell Biology and Microbiology and Immunology, Albert Einstein College of Medicine, Bronx, New York 10461
- GINSBERG, HAROLD S., Department of Microbiology, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- GIPHART, MARIUS, Department of Immunohematology, University Hospital, 2333 AA Leiden, The Netherlands
- GODFREY, MAURICE, Department of Pathology, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- GODMAN, GABRIEL C., Department of Pathology, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- GOLUBIĆ, MLADEN, Abteilung Immungenetik, Max-Planck-Institut für Biologie, D-7400 Tübingen, Federal Republic of Germany
- GOPAS, J., Departments of Cell Biology and Microbiology and Immunology, Albert Einstein College of Medicine, Bronx, New York 10461
- GREATON, CYNTHIA J., Department of Pathology, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- GREATON, JAMES P., Department of Pathology, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- GREENSPAN, DANIEL S., Department of Human Genetics, Yale University School of Medicine, New Haven, Connecticut 06510

- GUÉRIN, SYLVAIN, Institut Pasteur, 75724 Paris Cédex 15, France
- HALL, JOHN L., Department of Biochemistry, New York University Medical Center, New York, New York 10016
- HANNA, EDGAR E., Laboratory of Molecular Genetics, National Institutes of Health, Bethesda, Maryland 20205
- HAYS, ARTHUR P., Department of Pathology, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- HOCHMAN, PAULA S., Cancer Research Center, and Department of Pathology, Tufts University School of Medicine, Boston, Massachusetts 02111
- HOFFMAN, MICHAEL K., Sloan-Kettering Institute for Cancer Research, New York, New York 10021
- HOOD, LEROY, Division of Biology, California Institute of Technology, Pasadena, California 91125
- HUBER, BRIGITTE T., Cancer Research Center, and Department of Pathology, Tufts University School of Medicine, Boston, Massachusetts 02111
- JANEWAY, CHARLES A., JR., Howard Hughes Medical Institute, Yale University School of Medicine, New Haven, Connecticut 06510
- JAY, GILBERT, Laboratory of Molecular Virology, National Cancer Institute, National Institutes of Health, Bethesda, Maryland 20205
- JIANG, SU I., Department of Pathology, Downstate Medical Center, State University of New York, New York, New York 11203
- JOHNSON, WILLIAM G., Department of Neurology, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- JONES, BARRY, Howard Hughes Medical Institute, Yale University School of Medicine, New Haven, Connecticut 06510
- KABAT, ELVIN A., Department of Microbiology, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- KARL, MARGARET, Wadsworth Center for Laboratories and Research, New York State Department of Health, Albany, New York 11201
- KATZ, MICHAEL, Howard Hughes Medical Institute, Yale University School of Medicine, New Haven, Connecticut 06510
- KAUFMAN, JAMES F., Basel Institute for Immunology, CH-4005 Basel, Switzerland
- KAYE, JONATHAN, Department of Pathology, Yale University School of Medicine, New Haven, Connecticut 06510
- KHOURY, GEORGE, Laboratory of Molecular Virology, National Cancer Institute, National Institutes of Health, Bethesda, Maryland 20205
- KING, WALTER, Department of Urology, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- KINNON, CHRISTINE, Division of Biology, California Institute of Technology, Pasadena, California 91125
- KLEIN, JAN, Abteilung Immungenetik, Max-Planck-Institut für Biologie, D-7400 Tübingen, Federal Republic of Germany
- KNOBLER, ROBERT, Department of Dermatology, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- KNOWLES, ROBERT W., Sloan-Kettering Institute for Cancer Research, New York, New York 10021

KOURILSKY, PHILIPPE, Institut Pasteur, 75724 Paris Cédex 15, France

- KOVAC, ZDENKO, Laboratory of Immunology, National Institute of Allergy and Infectious Diseases, and National Cancer Institute, National Institutes of Health, Bethesda, Maryland 20205
- Kowal, Czeslawa H., Department of Pathology, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- KRANZ, DAVID M., Department of Biology and Center for Cancer Research, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139
- KUNG, PATRICK C., Centocor, Inc., Malvern, Pennsylvania 19355
- KVIST, SUNE, Swiss Institute for Experimental Cancer Research, CH-1066 Epalinges, s/Lausanne, Switzerland
- LALANNE, JEAN-LOUIS, Institut Pasteur, 75724 Paris Cédex 15, France
- LANE, MARY-ANN, Department of Pathology, and Laboratory of Molecular Immunobiology, Dana-Farber Cancer Institute, Harvard Medical School, Boston, Massachusetts 02115
- LAU, HENRY T., Department of Surgery, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- LEE, JANET S., Memorial Sloan-Kettering Cancer Center, New York, New York 10021
- LESERMAN, LEE D., Centre d'Immunologie I.N.S.E.R.M. C.N.R.S. de Marseille Luminy, 13288 Marseille Cédex 9, France
- LITTMAN, DAN R., Institute of Cancer Research, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- LIU, ZHUORU, Department of Pathology, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- LODISH, HARVEY, Whitehead Institute for Biomedical Research, Cambridge, Massachusetts 02142
- LOPEZ, CECILIA ANG, Department of Pathology, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- LYNCH, DAVID H., National Institutes of Health, Bethesda, Maryland 20205
- McDevitt, Hugh O., Department of Medical Microbiology, Stanford University School of Medicine, Stanford, California 94305
- McDowell, JOAN, Comprehensive Cancer Center, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- McGOVERN, D. A., Departments of Cell Biology and Microbiology and Immunology, Albert Einstein College of Medicine, Bronx, New York 10461
- MACHY, PATRICK, Centre d'Immunologie I.N.S.E.R.M. C.N.R.S. de Marseille Luminy, 13288 Marseille Cédex 9, France
- MASHIMO, H., Departments of Cell Biology and Microbiology and Immunology, Albert Einstein College of Medicine, Bronx, New York 10461
- MATIS, LOUIS A., Medicine Branch, National Cancer Institute, National Institutes of Health, Bethesda, Maryland 20205
- MUNK, GARY, Department of Pathology, College of Physicians and Surgeons, Columbia University, New York, New York 10032
- MURPHY, ROBERT, Department of Biological Sciences, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213