

INFECTION AND IMMUNITY

VOLUME 59 • MAY 1991 • NUMBER 5

Vincent A. Fischetti, *Editor in Chief* (1994)
Rockefeller University
New York, N.Y.

Roy Curtiss III, *Editor* (1995)
Washington University
St. Louis, Mo.

Barry I. Eisenstein, *Editor* (1994)
University of Michigan Medical School
Ann Arbor, Mich.

Stanley Falkow, *Editor* (1995)
Stanford University School of
Medicine
Stanford, Calif.

Dexter H. Howard, *Editor* (1991)
University of California
Los Angeles, Calif.

Stephen H. Leppla, *Editor* (1991)
National Institute of Dental Research
Bethesda, Md.

Jerry R. McGhee, *Editor* (1994)
University of Alabama
Birmingham, Ala.

Carol A. Nancy, *Editor* (1995)
Walter Reed Army Institute of Research
Rockville, Md.

Staffan Normark, *Editor* (1995)
Washington University School of
Medicine
St. Louis, Mo.

EDITORIAL BOARD

Soman N. Abraham (1991)
John F. Alderete (1991)
Sandra K. Armstrong (1993)
Joseph T. Barbieri (1992)
Alan G. Barbour (1992)
Joel B. Baseman (1991)
Philip J. Bassford, Jr. (1993)
Robert E. Baughn (1993)
Patrick Bavoil (1993)
Blaine L. Beaman (1991)
Gary K. Best (1991)
Jenefer Blackwell (1991)
Martin J. Blaser (1992)
Arnold S. Bleiweis (1993)
Gregory A. Bohach (1993)
David E. Briles (1991)
Robert R. Brubaker (1993)
Drusilla L. Burns (1991)
Gerald Byrne (1991)
Richard A. Calderone (1993)
Harlan Caldwell (1993)
Priscilla A. Campbell (1993)
Janne G. Cannon (1993)
Gail H. Cassell (1993)
Bruce Chassy (1993)
Ambrose Cheung (1993)
Nicholas P. Cianciotto (1993)
John O. Cisar (1991)
Virginia L. Clark (1992)
William B. Clark (1991)
Josephine Clark-Curtiss (1993)
P. Patrick Cleary (1993)
Steven Clegg (1993)
Don B. Clewell (1993)
Myron S. Cohen (1993)
Paul S. Cohen (1993)
Frank M. Collins (1992)
Guy Cornelis (1993)
Rebecca Cox (1993)
Jorge H. Crosa (1991)
Jim E. Cutler (1993)
Charles J. Czuprynski (1992)
George S. Deepe, Jr. (1992)
Judith E. Domer (1992)

Arthur Donohue-Rolfe (1992)
Gordon Dougan (1991)
Lawrence A. Dreyfus (1993)
Roman Dziarski (1993)
Robert A. Eisenberg (1993)
Toby K. Eisenstein (1993)
John H. Eldridge (1992)
Charles O. Elson (1992)
N. Cary Engleberg (1992)
Joseph C. Fantone III (1993)
Ronald Fayer (1992)
Joseph J. Ferretti (1992)
Dara W. Frank (1993)
Rolf G. Freter (1993)
Ronald J. Gibbons (1991)
Janet R. Gilsdorf (1993)
Mae Go (1993)
William E. Goldman (1992)
Emil Gotschlich (1991)
Patricia Guerry-Kopeccko (1993)
Donald G. Guiney (1992)
Paul Gulig (1993)
Constantine G. Haidaris (1992)
Thomas L. Hale (1993)
Jane L. Halpern (1993)
Shigeyuki Hamada (1993)
Eric J. Hansen (1992)
David L. Hasty (1991)
Fred Heffron (1993)
David Hentges (1991)
Erik Hewlett (1993)
James B. Hicks (1991)
Jacques R. Hiernaux (1991)
Paul S. Hoffman (1991)
Anne Morris Hooke (1992)
Ralph R. Isberg (1993)
William R. Jacobs, Jr. (1993)
William Johnson (1991)
Stefan H. E. Kaufmann (1992)
Paul M. Kaye (1991)
Mogens Kilian (1993)
Hiroshi Kiyono (1992)
Dennis J. Kopeccko (1992)
Malak Kotb (1991)

Thomas R. Kozel (1991)
Arnold Kreger (1992)
Stephen Lory (1993)
Carl F. Marrs (1993)
Anthony Maurelli (1993)
Floyd C. McIntire (1991)
John Mekalanos (1992)
Eleanor S. Metcalf (1992)
Suzanne M. Michalek (1992)
Michael L. Misfeldt (1991)
David C. Morrison (1992)
Steve L. Moseley (1993)
Richard Moxon (1993)
Antony J. Muktada (1993)
Martha H. Mulks (1992)
Robert S. Munford (1992)
Robert S. Munson (1992)
Juneann W. Murphy (1993)
Thalia I. Nicas (1992)
Hiroshi Nikaïdo (1992)
Alison O'Brien (1992)
Dennis E. Ohman (1992)
Andrew B. Onderdonk (1993)
Paul Orndorff (1993)
Jeffrey Parsonnet (1992)
Shelley M. Payne (1991)
Kenneth Peterson (1993)
William A. Petri, Jr. (1993)
Gerald B. Pier (1992)
Matthew Pollack (1992)
Daniel A. Portnoy (1992)
Richard A. Proctor (1993)
Justin D. Radolf (1993)
Reuben Ramphal (1991)
Jonathan I. Ravdin (1992)
Neil E. Reiner (1991)
Richard F. Rest (1993)
Judith C. Rhodes (1992)
Donald Robertson (1993)
Domenico Romeo (1991)
Sara W. Rothman (1993)
Roy R. B. Russell (1992)
R. Bradley Sack (1992)

Catharine Saelinger (1993)
Philippe J. Sansonetti (1992)
Charles F. Schachte (1991)
Stewart Scherer (1991)
Patrick Schlievert (1993)
June R. Scott (1993)
Thomas M. Shinnick (1991)
Howard A. Shuman (1992)
Richard P. Silver (1992)
W. A. Simpson (1991)
Emil Skamene (1991)
Jack D. Sobel (1993)
P. Frederick Sparling (1993)
Walter E. Stamm (1993)
George Stewart (1993)
Susan C. Straley (1992)
Barnet M. Sultzer (1991)
Catharina Svanborg (1993)
John L. Swanson (1993)
Martin A. Taubman (1993)
Diane W. Taylor (1993)
Ronald K. Taylor (1991)
John Thompson (1993)
Michael R. Thompson (1993)
Elaine Tuomanen (1993)
Rodney K. Tweten (1993)
Ivo van de Rijn (1993)
Thomas E. Van Dyke (1992)
Jan D. A. van Embden (1991)
Johannes van Houte (1991)
Michael L. Vasil (1993)
Peter D. Walzer (1992)
Peter A. Ward (1991)
Rodney Welch (1993)
Tracy D. Wilkins (1993)
Dwight Williams (1993)
Peter H. Williams (1993)
Herbert H. Winkler (1992)
Marcia K. Wolf (1993)
Patricia L. Worsham (1993)
Priscilla B. Wyrick (1993)
Douglas B. Young (1991)
Elizabeth J. Ziegler (1991)

Barbara H. Iglewski, *Chairman, Publications Board*

Linda M. Illig, *Director, Journals*

Jack Kenney, *Production Editor*

Infection and Immunity (ISSN 0019-9567), a publication of the American Society for Microbiology, 1325 Massachusetts Ave., N.W., Washington, DC 20005-4171, is devoted to the advancement and dissemination of fundamental knowledge concerning: (i) infections caused by pathogenic bacteria, fungi, and unicellular parasites; (ii) the ecology and epidemiology of pathogenic microbes; (iii) virulence factors, such as toxins and microbial surface structures; (iv) nonspecific factors in host resistance and susceptibility to infection; and (v) immunology of microbial infection. Instructions to authors are published in the January issue each year; reprints are available from the editors and the Journals Division. *Infection and Immunity* is published monthly, one volume per year. The nonmember subscription prices are \$350 (U.S. and Canada) and \$390 (foreign; air drop shipping) per year; single copies are \$40. The member subscription prices are \$45 (U.S. and Canada) and \$85 (foreign; air drop shipping) per year; single copies are \$10. Correspondence relating to subscriptions, reprints, defective copies, availability of back issues, lost or late proofs, disposition of submitted manuscripts, and general editorial matters should be directed to the ASM Journals Division, 1325 Massachusetts Ave., N.W., Washington, DC 20005-4171 (phone: 202 737-3600).

Claims for missing issues from residents of the United States, Canada, and Mexico must be submitted within 3 months after publication of the issues; residents of all other countries must submit claims within 6 months of publication of the issues. Claims for issues missing because of failure to report an address change or for issues "missing from files" will not be allowed.

Second class postage paid at Washington, DC 20005, and at additional mailing offices.

POSTMASTER: Send address changes to *Infection and Immunity*, ASM, 1325 Massachusetts Ave., N.W., Washington, DC 20005-4171. Made in the United States of America. Printed on acid-free paper.

Copyright © 1991, American Society for Microbiology.

日本：価格は外貨表示とは関係なく円建。

All Rights Reserved.

The code at the top of the first page of an article in this journal indicates the copyright owner's consent that copies of the article may be made for personal use or for personal use of specific clients. This consent is given on the condition, however, that the copier pay the stated per-copy fee through the Copyright Clearance Center, Inc., 21 Congress St., Salem, MA 01970, for copying beyond that permitted by Sections 107 and 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.

Author Index

- Aitken, Alastair, 1599
Alam, Khorsheed, 1864
Albert, M. John, 1864
Ansaruzzaman, M., 1864
Araujo, Fausto G., 1614
Athamna, Abed, 1673
- Baldwin, Tom J., 1599
Balish, Edward, 1785
Barile, Michael F., 1683
Barnea, A., 1667
Beecher, Douglas J., 1778
Bermudez, Luiz E., 1697
Bettelheim, Karl, 1864
Bleiweis, A. S., 1803
Bloom, Barry R., 1755
Bonnin, A., 1703
Brady, L. J., 1803
Brassart, Dominique, 1605
Brennan, Patrick J., 1755
Briand, J. P., 1846
Brown, Julia A., 1772
Burton, James, 1818
- Calderone, Richard A., 1832
Camerlynck, P., 1703
Campbell, Douglas, 1853
Caparon, Michael G., 1811
Cappelli, D., 1795
Case, Stephen E., 1585
Chalifour, Robert, 1690
Chan, John, 1755
Chang, Sandra P., 1585
Charles, Ian G., 1627
Chatfield, Steve N., 1627
Cheers, Christina, 1790
Chen, Jen-Yang, 1656
Chia, Jean-San, 1656
Coleman, Trey, 1716
Courtney, Harry S., 1661
Crowle, Alfred J., 1823
Crowley, P. J., 1803
Cunningham, Thomas M., 1683
Cutler, Jim E., 1832
- Dahl, Rolf, 1823
Denis, Michel, 1853, 1857
Dubremetz, J. F., 1703
Dutton, Guy G. S., 1673
- Ebersole, J. L., 1795
Eissenberg, Linda Groppe, 1639
Enkel, Holly, 1697
- Fairweather, Neil F., 1627
Fan, Xuedong, 1755
Faruque, Shah M., 1864
Feldman, Robert, 1690
Fierer, Joshua, 1860
Fitzgerald, Thomas J., 1869
Froberg, M. Kent, 1869
- Gamian, Andrzej, 1690
Gangloff, Sophie, 1620
Goebel, W., 1846
Goldman, William E., 1639
Golin, J. E., 1762
Golliard, Mireille, 1605
Grass, Susan, 1716
Gregg, Evan O., 1853
Griffioen, Arjan W., 1839
Guiney, Donald, 1860
Guzmán, Carlos A., 1739
- Haider, Khaleda, 1864
Hahn, Liang-Jiunn, 1656
Harvey, Shaun, 1872
Harwood, Julia, 1860
Hashiro, Carol, 1585
Hasty, David L., 1661
Hellio, Raymond, 1723
Hidore, Michelle R., 1747
Hsu, Tsuey-Ying, 1656
Hui, George S. N., 1585
Hunter, Shirley W., 1755
- Islam, Moyenu, 1864
- Janssens-Korpela, Pirkko, 1839
Jennings, Harold J., 1690
- Kanbe, Toshio, 1832
Karpas, Arthur A., 1683
Kasper, Dennis L., 1690
Keisari, Yona, 1673
Kelly, C., 1803
Kelly, David, 1872
Kern, P., 1846
- Klein, Jean-Paul, 1620
Knutton, Stuart, 1599
Kotani, Shozo, 1585
Krause, Martin, 1860
Kusumoto, Shoichi, 1585
Kwon-Chung, K. J., 1762
- Lee, S. F., 1803
LeFebvre, Rance B., 1772
Lehner, T., 1803
Lepoivre, Yves, 1620
Leslie, Dario L., 1872
Li, Ren-Kai, 1832
- Ma, J. K.-C., 1803
Macmillan, James D., 1778
Makoff, Andrew J., 1627
Markowitz, Simcha, 1673
May, Mary H., 1823
McCabe, Robert, 1633
Meagher, Stephen, 1633
Michon, Francis, 1690
Montanaro, Jacqueline, 1864
Mounier, Joëlle, 1723
Muller, S., 1846
Mullins, Brian, 1633
Munson, Robert, Jr., 1716
Murphy, Juneann W., 1747
M'Zoughi, Ridha, 1620
- Nabavi, Nasrin, 1747
Neeser, Jean-Richard, 1605
- Ofek, Itzhak, 1673
Ogier, Joëlle A., 1620
Olsén, Arne, 1811
Olson, Lyn D., 1683
Oropeza-Wekerle, R. L., 1846
- Pan, Ming Jeng, 1772
Pinto, M., 1667
Pozsgay, Vince, 1690
Prevost, Marie Christine, 1723
Probst, Peter S., 1683
- Ribeiro, Jose M. C., 1592
Rijkers, Ger T., 1839
Rodgers, Brian C., 1627
Rohde, Manfred, 1739
Ross, Elise, 1823
- Salkowski, Cindy A., 1785
Sandoval, M.-N., 1795
Sansonetti, Philippe J., 1723
Schöller, Marie, 1620
Schreiber, Robert D., 1709
Scott, June R., 1811
Shane, Stephanie W., 1683
Sharon, Nathan, 1673
Shiba, Tetsuo, 1585
Siddiqui, Wasim A., 1585
Skea, Danna L., 1733
Slater, Debbie E., 1627
Sonleitner, Frank, 1747
Stanley, E. R., 1790
Steffen, M. J., 1795
Stephens, David S., 1811
Sun, D., 1846
- Tam, Leslie Q., 1585
Teng, Lee-Jene, 1656
Theodos, Cynthia M., 1592
Timmis, Kenneth N., 1739
Titball, Richard W., 1872
Titus, Richard G., 1592
Turco, Jenifer, 1647
Tzipori, Saul, 1864
- Unanue, Emil R., 1709
Underdown, Brian J., 1733
- Vasselon, Thierry, 1723
- Wadsworth, Elsa, 1832
Walker, Mark J., 1739
Ward, William, 1599
Wessels, Michael, 1690
West, Janet L., 1639
Wherry, Janice C., 1709
Wickes, B. L., 1762
Williams, Peter H., 1599
Winkler, Herbert H., 1647
Woltz, Arlette, 1605
Wood, Stephen G., 1818
Woods, Jon P., 1639
- Yang, Czau-Siung, 1656
Young, Lowell S., 1697
- Zegers, Ben J. M., 1839
Zehavi-Willner, T., 1667
Zhan, Y. F., 1790

1991



ICAAC YOUNG INVESTIGATOR AWARDS Call for Nominations

1991 ICAAC Young Investigator Awards: Eligibility and Nominations

The Young Investigator Awards were established in 1983 for the Interscience Conference on Antimicrobial Agents and Chemotherapy (ICAAC) under the sponsorship of Merck Sharp & Dohme. The awards are made annually to four individuals. The deadline for nominations for awards to be presented at the 1991 ICAAC in Chicago, Illinois, is 1 April 1991.

Purpose. To recognize and reward young investigators for excellence in research in the broad areas of microbiology and infectious diseases. A monetary award is provided to support attendance at ICAAC and other endeavors enhancing the educational background of the individual.

Eligibility. *Pre- and postdoctoral students and fellows in microbiology and infectious disease fields*, including those not more than 18 months post-training, who have performed significant research in North America. Research eligible for evaluation is limited to the study and understanding of microbiology, infectious diseases, or any of the sciences associated with the discovery and application of chemotherapeutic agents.

Nominations. Individuals may be nominated by an active member of ASM, and nominations are invited from all qualified fellows. Nominations should include a complete nomination form which provides a biographical sketch of the nominee, a

summary appraisal of his or her research, and a list of his or her most pertinent publications. Nomination forms can be obtained from ASM Headquarters (see below).

Supporting letters from appropriate individuals in the field, if possible from more than one institution, are desirable.

Award process. Awardees will be selected by the award committee on the basis of research potential and quality.

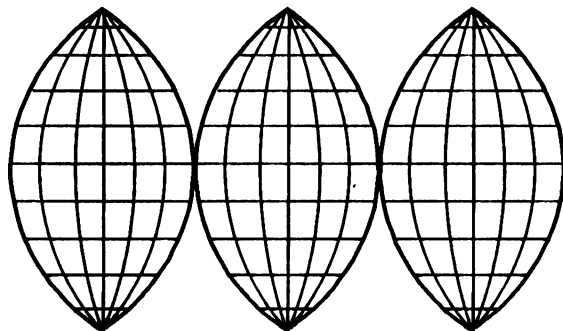
Award. Each young investigator selected will receive a monetary award and a plaque or scroll. Four awards will be made each year. The number of awards will be reviewed annually by the committee. Awards will be presented by the President of ASM and the Chair of the ICAAC Committee at the annual ICAAC meeting. Awardees and their mentors will be honored at a private dinner hosted by the sponsor, Merck Sharp & Dohme, and their names will be published in "ASM News."

Submission procedure. Submit four copies of the completed nomination form and four copies of supporting letters by 1 April 1991 to Carol A. Colgan, Awards Committee, American Society for Microbiology, 1325 Massachusetts Ave, NW, Washington, DC 20005.

Supported by a grant from

MSD
MERCK
SHARP &
DOHME

4th INTERNATIONAL SYMPOSIUM ON LEGIONELLA



ASM CONFERENCE

January 26-29, 1992

Orlando, Florida

This international symposium is a premier meeting for exchange of current information on *Legionella*. It covers a broad spectrum of topics, including:

- Cellular immune responses
- Clinical and laboratory diagnosis
- Genetics
- Molecular subtyping
- Environmental detection
- Interaction with protozoa
- Epidemiology
- Control measures

For information, contact ASM Meetings:

1325 Massachusetts Ave., N.W., Washington, D.C. 20005

Tel: (202) 737-3600

Fax: (202) 737-0322

Supported in part by:

**The Environmental Protection Agency, Environmental Systems Laboratory, Cincinnati, Ohio
and Centers for Disease Control, Atlanta, Georgia**