

INFECTION AND IMMUNITY

VOLUME 50 • OCTOBER 1985 • NUMBER 1

J. W. Shands, Jr., *Editor in Chief* (1989)
University of Florida, Gainesville

Phillip J. Baker, *Editor* (1990)
*National Institute of Allergy and
Infectious Diseases
Bethesda, Md.*

Edwin H. Beachey, *Editor* (1988)
*VA Medical Center
Memphis, Tenn.*

Peter F. Bonventre, *Editor* (1989)
*University of Cincinnati
Cincinnati, Ohio*

Roy Curtiss III, *Editor* (1990)
*Washington University
St. Louis, Mo.*

Arthur G. Johnson, *Editor* (1986)
University of Minnesota, Duluth

Stephan E. Mergenhagen, *Editor* (1989)
*National Institute of Dental Research
Bethesda, Md.*

EDITORIAL BOARD

Leonard C. Altman (1986)
Michael A. Apicella (1985)
Roland Arnold (1987)
Joel B. Baseman (1985)
Robert E. Baughn (1987)
Arnold S. Bleiweis (1987)
William H. Bowen (1985)
Robert R. Brubaker (1986)
Ward Bullock, Jr. (1985)
Charles Carpenter (1985)
Bruce Chassy (1987)
John O. Cisar (1985)
John Clements (1985)
Don B. Clewell (1987)
Myron S. Cohen (1987)
R. John Collier (1987)
Jim E. Cutler (1987)
Judith E. Damer (1986)
James L. Duncan (1985)
Dennis Dwyer (1987)
Roman Dziarski (1987)
Robert A. Eisenberg (1987)
Barry Eisenstein (1985)
Toby K. Eisenstein (1987)
Peter Elsbach (1986)
Stanley Falkow (1985)
John J. Farrar (1985)
John C. Feeley (1985)
John R. Finerty (1987)
Robert Fitzgerald (1986)

Samuel B. Formal (1986)
John Gallin (1985)
Peter Gemski (1985)
Robert Genco (1985)
Ronald J. Gibbons (1985)
Mayer B. Goren (1985)
Harry Greenberg (1985)
Frank Griffin (1987)
Richard Guerrant (1986)
Carlton L. Gyles (1985)
Thomas L. Hale (1987)
Edgar Hanna (1987)
Eric J. Hansen (1986)
David Hentges (1985)
Martin S. Hirsch (1985)
Randall K. Holmes (1986)
Marcus A. Horwitz (1987)
Dexter H. Howard (1987)
Barbara Iglewski (1986)
Richard E. Isaacson (1987)
Howard M. Johnson (1985)
Russell C. Johnson (1985)
William Johnson (1985)
Dennis L. Kasper (1985)
David F. Keren (1985)
F. Kierszenbaum (1987)
Paul Kolenbrander (1986)
Julius P. Kreier (1986)
Maurice J. Lefford (1987)
Thomas Lehner (1986)

Stephen H. Leppla (1985)
John Mansfield (1985)
Zell A. McGee (1985)
Jerry R. McGhee (1985)
Douglas D. McGregor (1985)
Floyd C. McIntire (1985)
Monte Meltzer (1986)
Jiri Mestecky (1986)
J. Gabriel Michael (1986)
Page Morahan (1985)
Frederick A. Murphy (1985)
Henry W. Murray (1986)
Carol A. Nancy (1987)
Robert J. North (1985)
Alison O'Brien (1985)
Itzhak Ofek (1986)
Andrew B. Onderdonk (1987)
Roy C. Page (1985)
Chik H. Pai (1985)
Monique Parant (1987)
Nathaniel F. Pierce (1986)
Matthew Pollack (1986)
Ruth Rappaport (1986)
John B. Robbins (1986)
Donald Robertson (1987)
Burton Rosan (1986)
Stephen W. Russell (1985)
Catherine Saelling (1987)
Dwayne C. Savage (1987)
Edward J. St. Martin (1985)

Irving E. Salit (1986)
Charles F. Schachtele (1985)
Julius Schachter (1986)
Gary K. Schoolnik (1987)
Jerome L. Schulman (1985)
June R. Scott (1987)
Alan Sher (1987)
Gerald D. Shockman (1986)
Phillip D. Smith (1985)
Ralph Snyderman (1985)
Maggie So (1986)
P. Frederick Sparling (1987)
J. G. Stevens (1985)
Barnet M. Sultzer (1985)
Catharina Svanborg-Edén (1985)
John L. Swanson (1987)
Diane Taylor (1987)
K. N. Timmis (1987)
Ivo van de Rijn (1987)
Johannes van Houte (1985)
Jan T. Vilcek (1985)
Stefanie Vogel (1985)
Peter A. Ward (1985)
William P. Weidanz (1987)
P. H. Williams (1987)
Jerry A. Winkelstein (1987)
Herbert H. Winkler (1986)
Wendell D. Zollinger (1985)

Helen R. Whiteley, *Chairman, Publications Board*

Linda M. Illig, *Managing Editor, Journals*

Thomas M. Rogers, *Production Editor*

Infection and Immunity (ISSN 0019-9567), a publication of the American Society for Microbiology, 1913 I St., NW, Washington, DC 20006, 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 Publications Department. *Infection and Immunity* is published monthly, and the twelve numbers are divided into four volumes per year. The nonmember subscription price is \$249 per year; single copies are \$21. The member subscription price is \$37 (foreign, \$49 [surface rate]) per year; single copies are \$7. 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 Publications Department, 1913 I St., NW, Washington, DC 20006 (phone: 202 833-9680).

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 20006, and at additional mailing offices.

POSTMASTER: Send address changes to *Infection and Immunity*, ASM, 1913 I St., NW, Washington, DC 20006.

Made in the United States of America.

Copyright © 1985, American Society for Microbiology.

All Rights Reserved.

日本：価格は外貨表示とは関係なく円建。

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

- Áhrén, Christina M., 255
Afcchain, Daniel, 136
Amano, Shigeru, 262
Apicella, Michael A., 9, 15
Arbuthnott, John P., 304
Artrip, Sharon G., 213
- Barnwell, John W., 58
Bellanti, Joseph A., 324
Bemis, David A., 35
Bistoni, Francesco, 297
Boccanera, Maria, 297
Bonham, Lynn, 317
Bonmassar, Enzo, 297
Bonventre, Peter F., 160, 169
Bowden, Christopher, 116
Bradbury, Wayne C., 284
Bullock, Ward E., 183
Burnham, Jeffrey C., 82
Burstein, Robert, 123
Bushell, Gillian, 102
- Campagnari, Anthony, 9
Cannat, Arlette, 310
Capron, Andre, 136
Carter, Richard, 102
Cassone, Antonio, 297
Cerquetti, M. Christina, 324
Chedid, Louis, 146
Chubb, Ann P., 190, 199
Chudwin, David S., 213
Clegg, Steven, 338
Clements, John D., 317
Clyde, Wallace A., Jr., 292
Cochrane, Alan H., 58
Cohen, Paul S., 152
Collier, Albert M., 292
Collins, William E., 58
Cownley, Kevin, 190, 199
Crowle, Alfred J., 1
Cryz, S. J., Jr., 225
- de Azavedo, Joyce C. S., 304
Deepe, George S., Jr., 183
Degnan, Peter J., 324
Douvas, George S., 1
Doyle, R. J., 336
Drutz, David J., 97
Dudas, Kathleen C., 9
Duhring, John L., 82
DuPont, Herbert L., 62
Durack, David T., 22
Dykes, Colin W., 279
- El-Morshidy, Sawsan, 317
Engert, Richard F., 43, 328
- Ferrante, Antonio, 243
- Foster, Timothy J., 304
Fox, A., 320
Fürer, E., 225
- Garber, N., 336
Genco, Robert J., 123
Germanier, R., 225
Goebel, W., 271
Graves, Patricia M., 102
- Hacker, J., 271
Halliday, Ishbel J., 279
Hanazawa, Shigemasu, 262
Hansen, Eric J., 207, 236
Harford, Stephen, 279
Harrison, J., 320
Hartigan, Patrick J., 304
Hatcher, Victor B., 218
Higashitsutsumi, Minoru, 322
Hirayama, Toshiya, 142
Hirofuji, Takao, 27
Hobden, Adrian N., 279
Holmans, Priscilla L., 236
Holmgren, Jan, 243
Honda, Takeshi, 322
Hooke, Anne Morris, 324
Houghten, Richard A., 328
Hu, Ping C., 292
Huang, Chien-hui, 292
Huang, Yuan-sheng, 292
Huguet, Marie-F., 310
- Ito, Masahiko, 333
- Jerrells, Thomas R., 175
Johnson, Philip C., 62
Jolivet, Michel, 146
Jonak-Urbanczyk, Judith T., 123
- Kakimoto, Kiichi, 27
Kato, Iwao, 142
Kato, Tetsuo, 231
Kidson, Chev, 102
Kitano, Shigeo, 262
Klipstein, Frederick A., 43, 328
Klotz, Stephen A., 97
Kobisch, Marylene, 190
Koga, Toshitaka, 27
König, W., 271
Korenblit, Allen, 213
Kotani, Shozo, 27
Kreiswirth, Barry N., 304
Kuramitsu, Howard K., 130
Kuusela, Pentti, 77
- Lam, J. S., 336
- Lange, Werner, 146
Laux, David C., 152
Lee, Nicole, 116
Lemesre, Jean-Loup, 136
Levitt, Mindy A., 218
Ljungström, Inger, 243
Loftus, Theresa A., 236
Looker, Douglas L., 1
Lowe, Karin L., 317
Lowy, Franklin D., 218
Luster, Michael I., 91
- Marconi, Pierfrancesco, 297
Masihi, K. Noel, 146
Matsuda, Futami, 142
Mattingly, Stephen J., 107
McAdam, K. P. W. J., 73
Mills, S. Dawn, 284
Miwatani, Toshio, 322
Miyoshi, Takehito, 262
Montaraz, Juan A., 190, 199
Morgan, Donna R., 62
Murphy, Juneann W., 50
Murphy, Timothy F., 9, 15
Myhre, Erling B., 77
Mylotte, Joseph M., 9
- Nabavi, Nasrin, 50
Naito, Yuko, 231
Nakada, Kohjin, 262
Nealon, Timothy J., 107
Nevola, Joseph J., 152
Nickol, Allen D., 160, 169
Niederbuhl, Carol J., 66
Nilsen, Lia J., 130
Nishimura, Toshiaki, 322
Noda, Masatoshi, 142
Novick, Richard P., 304
Novotny, Pavel, 190, 199
Nussenzweig, Ruth S., 58
- Ogawa, Sharon K., 218
Ohkuni, Hisashi, 27
Ohmori, Yoshihiro, 262
Okada, Hidechika, 27
Okada, Noriko, 27
Okuda, Katsuji, 231
O'Reilly, Mary, 304
- Pavia, Charles S., 66
Penner, John L., 284
Perfect, John R., 22
Perry, Dennis, 130
Persi, Marguerite A., 82
Pruckler, Janet, 338
Pung, Oscar J., 91
Purcell, Bret K., 338
- Rabesandratana, Herisoa, 310
Rao, Sudha, 213
Read, Melanie J., 279
Rest, Richard F., 116
Rice, Peter, 9
Rizvi, Farrukh S., 136
Rohde-Schulz, Beate, 146
Rojas, Rafael A., 324
- Sadigursky, Moyses, 136
Saisho, Koichiro, 27
Santoro, Ferruccio, 136
Sato, Minoru, 322
Satterwhite, Terry K., 62
Saul, Allan, 102
Scaringi, Lucia, 297
Scheffer, J., 271
Schenk, Eric A., 43
Schiffman, Gerald, 213
Serre, Arlette, 310
Sharon, N., 336
Shohet, D., 336
Short, Helen, 43
Soldau, Katrin, 73
Sordelli, Daniel O., 324
Stocker, Bruce A. D., 152
Sumiyoshi, Akinobu, 27
Svennerholm, Ann-Mari, 243, 255
- Takazoe, Ichiro, 231
Taylor, Caroline L., 183
Thijssen, Henricus M. W. M., 250
Tissi, Luciana, 297
Tobias, Peter S., 73
Toews, Galen B., 207
Tucker, Anne N., 91
- Ulevitch, Richard J., 73
- Vandenbroucke-Grauls, Christina M. J. E., 250
Vartio, Tapio, 77
Vatter, Albert E., 1
Vendrell, Jean-P., 310
Verhoef, Jan, 250
Vial, Wayne C., 207
Vore, Stephen J., 91
Vuento, Matti, 77
- Watanabe, Kenji, 27
Wilson, Mark E., 123
Wilson, Scott A., 35
Wood, Lindsey V., 62
- Yurberg, Emily R., 218
- Zajic, James E., 97

1986 Full Membership — American Society for Microbiology

1913 I St., NW, Washington, DC 20006

The Society welcomes to full membership any person who is interested in its objects, and who holds a bachelor's degree in microbiology or a related field (or who has had training and experience equivalent to that represented by a bachelor's degree).

The minimum annual membership assessment is \$61, which includes a general membership fee, *ASM News*, and \$43 toward subscriptions to the Society's scientific journals. The Society publishes nine scientific journals (listed below). Members may subscribe to one or more of these journals at special member rates; \$43 of the minimum dues payment of \$61 may be credited towards journal subscriptions. In addition, the Society publishes the monthly *ASM News*, which is sent to all members and contains news and announcements of interest to all microbiologists.

Memberships are initiated and renewed as of January each year. Unless there are directions to the contrary, membership nominations received prior to November 1 will be credited to the current year, and back issues of the selected publications for the current year will be furnished. Nominations received after November 1 will become effective the following January.

First name _____ Initial _____ Last Name _____
 Address _____

 City _____ State _____ Zip Code _____
 Area Code _____
 Phone No. _____ Yr. Birth _____ Sex _____
 Highest Degree _____ Year _____ Major _____
 Granting Institution _____
 Position _____ Experience _____
 Signature of Nominee _____

* If you are not associated with an ASM nominating member, you can still send in this form and we will contact you. Nominated by _____

(Signature of Society member)

I. 1. Journals may be subscribed to at the following rates. Please enter the higher rate (column B) if you reside *outside* the U.S. and its possessions.

	A	B	
	<input type="checkbox"/>	<input type="checkbox"/>	
Journal of Bacteriology (JB)	\$41	\$54	_____
Antimicrobial Agents and Chemotherapy (AA)	\$35	\$49	_____
Applied and Environmental Microbiology (AE)	\$35	\$49	_____
International Journal of Systematic Bacteriology (IJ)	\$35	\$35	_____
Journal of Virology (JV)	\$41	\$54	_____
Journal of Clinical Microbiology (JC)	\$35	\$49	_____
Microbiological Reviews (MR)	\$18	\$29	_____
Infection and Immunity (IA)	\$41	\$54	_____
Molecular and Cellular Biology (CB)	\$41	\$54	_____
2. Membership Fee (includes <i>ASM News</i>)	\$	18.00	_____
3. Total dues and journals from lines 1 and 2 (MINIMUM PAYMENT \$57)	\$	_____	_____

II. Check this block if you prefer to receive only *ASM News* and remit \$61.

RATES ARE FOR 1986 ONLY

Please enclose payment with application.

Prices are listed in U.S. dollars. Due to currency exchange difficulties and cost, foreign applicants in countries except Canada must remit in U.S. dollars by check or draft (payable to ASM) drawn on a U.S. bank located within the continental United States. Applicants from Canada may use checks drawn on Canadian banks, but remittance must be made in U.S. dollars.

1986 Student Membership — American Society for Microbiology

1913 I St., NW, Washington, DC 20006

Any regularly matriculated student majoring in microbiology or a related field is eligible for election as a Student Member. Student Members have all privileges of membership except the right to vote and hold office in the Society.

Student Members receive the monthly *ASM News* and are entitled to subscribe to the Society's journals at member rates.

Memberships are initiated and renewed in January of each year. Unless there are directions to the contrary, membership nominations received prior to November 1 will be credited to the current year, and back issues of the selected publications for the current year will be furnished if available. Nominations received after November 1 will become effective the following January.

NAME _____
 ADDRESS _____

 City _____ State _____ Zip Code _____
 Phone No. _____ Highest Degree _____
 Yr. of Birth _____ Sex _____
 School _____
 Major field of study _____
 Signature of Nominee _____
 Signature of chairman of major dept. _____
 * Nominated by: (1) _____

* If the department chairman is a member of the Society, a nominating signature is not required. If you are not associated with an ASM nominating member, you can still send in this form and we will contact you.

1. Journals may be subscribed to at the following rates. Please enter the higher rate (column B) if you reside *outside* the U.S. and its possessions.

	A	B	
Journal of Bacteriology (JB)	\$41	\$54	_____
Antimicrobial Agents and Chemotherapy (AA)	\$35	\$49	_____
Applied and Environmental Microbiology (AE)	\$35	\$49	_____
International Journal of Systematic Bacteriology (IJ)	\$35	\$35	_____
Journal of Virology (JV)	\$41	\$54	_____
Journal of Clinical Microbiology (JC)	\$35	\$49	_____
Microbiological Reviews (MR)	\$18	\$29	_____
Infection and Immunity (IA)	\$41	\$54	_____
Molecular and Cellular Biology (CB)	\$41	\$54	_____
2. Dues (includes <i>ASM News</i>)	\$	10.00	_____
3. TOTAL and Remit	\$	_____	_____

RATES ARE FOR 1986 ONLY

Please enclose payment with application.

Prices are listed in U.S. dollars. Due to currency exchange difficulties and cost, foreign applicants in countries except Canada must remit in U.S. dollars by check or draft (payable to ASM) drawn on a U.S. bank located within the continental United States. Applicants from Canada may use checks drawn on Canadian banks, but remittance must be made in U.S. dollars.