

EDITOR IN CHIEF (2016)

Harold L. Drake
University of Bayreuth

EDITORS

Axel A. Brakhage, *Editor* (2016)
HKI and University of Jena

Michael G. Bramucci, *Editor* (2016)
DuPont Experimental Station

Daniel Cullen, *Editor* (2017)
USDA Forest Products Laboratory

Lone Gram, *Editor* (2016)
Technical University of Denmark

Mansel W. Griffiths, *Editor* (2015)
University of Guelph

Maia Kivisaar, *Editor* (2017)
Tartu University

Joel E. Kostka, *Editor* (2016)
Georgia Institute of Technology

Shuang-Jiang Liu, *Editor* (2016)
Chinese Academy of Sciences

Frank E. Löffler, *Editor* (2013)
University of Tennessee

Charles R. Lovell, *Editor* (2015)
University of South Carolina

George T. Macfarlane, *Editor* (2016)
University of Dundee

Esperanza Martínez-Romero, *Editor* (2016)
Universidad Nacional Autónoma de México

Volker Müller, *Minireview Editor* (2014)
Goethe University Frankfurt am Main

Rebecca E. Parales, *Editor* (2016)
University of California—Davis

Matthew R. Parsek, *Cover Editor* (2014)
University of Washington

M. Julia Pettinari, *Editor* (2016)
University of Buenos Aires

Donald W. Schaffner, *Editor* (2015)
Rutgers, The State University of New Jersey

Janet L. Schottel, *Editor* (2013)
University of Minnesota

Alfred M. Spormann, *Editor* (2016)
Stanford University

Gerrit Voordouw, *Editor* (2017)
University of Calgary

Marylynn V. Yates, *Editor* (2014)
University of California—Riverside

Jizhong Zhou, *Editor* (2013)
University of Oklahoma

Thomas E. Shenk, *Chairman, Publications Board*

Barbara M. Goldman, *Director, Journals*

Barbara S. Slinker, *Production Editor*

Stephanie L. D'Agostino, *Assistant Production Editor*

Michael E. Lerman, *Assistant Production Editor*

EDITORIAL BOARD

Luis A. Actis (2014)

Eric Altermann (2012)

Rustam Aminov (2013)

Gary Andersen (2013)

Matthew Arduino (2013)

Brian Austin (2013)

Beate Averhoff (2013)

Abdu Azad (2013)

Andrea Azcarate-Peril (2012)

Charles Bacon (2012)

Michael Bagdasarian (2012)

Alan Bakalinsky (2013)

Petr Baldrian (2013)

József Baranyi (2013)

Florian Bauer (2012)

Gwyn A. Beattie (2014)

Sebastian Behrens (2012)

Harry Beller (2012)

Peter L. Bergquist (2012)

Tom Besser (2013)

Arvind A. Bhagwat (2012)

Valeria Bianciotto (2012)

Linda Bisson (2013)

Indranil Biswas (2012)

K. Johanna Bjorkroth (2013)

Christopher Blackwood (2013)

Rafael Blasco (2013)

Melanie Blokesch (2013)

Paul Bodelier (2012)

Harry Boer (2012)

Eckhard Boles (2012)

Violaine Bonnefoy (2013)

Robert Bonomo (2013)

Kathryn J. Boor (2013)

Katherine A. Borkovich (2012)

James Borneman (2014)

Kostas Bourtzis (2012)

Gesche Braker (2014)

Byron Brehm-Stecher (2013)

Frederick Breidt, Jr. (2013)

Harry Brumer (2014)

Alison Buchan (2014)

Robert Buchanan (2012)

Daniel H. Buckley (2014)

H. J. Busscher (2013)

Mark P. Buttner (2012)

Murulee Byappanahalli (2012)

Douglas R. Call (2013)

Terri A. Camesano (2012)

Jinru Chen (2014)

Shicheng Chen (2014)

Wilfred Chen (2012)

Yi Chen (2014)

Yuhuan Chen (2012)

Michael L. Chikindas (2013)

Kuang-Ren Chung (2014)

Jeffrey D. Cirillo (2014)

Luca Coccolin (2013)

Michael T. Collins (2013)

Doug Cossar (2012)

James M. Cregg (2012)

Patricia Cruz (2013)

Rolf Daniel (2012)

Steven L. Daniel (2014)

Michelle Danyluk (2013)

Atin R. Datta (2013)

Zixin Deng (2013)

Angelo DePaola, Jr. (2012)

Ronald P. de Vries (2014)

Thomas DiChristina (2012)

Francisco Diez-Gonzalez (2013)

Alan DiSpirito (2014)

Daniel P. Dougherty (2012)

Doris d'Souza (2014)

Nicole Dubilier (2013)

Siobain Duffy (2013)

Jonathan Dworkin (2014)

Daniel C. Eastwood (2014)

Leo Eberl (2014)

Elizabeth Edwards (2013)

Christopher Elkins (2014)

Marie Elliot (2014)

K.-D. Entian (2013)

Slava Epstein (2013)

Daniilo Ercolini (2012)

Joseph O. Falkinham III (2013)

Matthew W. Fields (2014)

Martin Filion (2012)

Steven E. Finkel (2013)

Steven Foley (2014)

Herbert L. Fredrickson (2013)

Michael Friedrich (2012)

Rebecca Gast (2014)

Beilei Ge (2013)

Elke Genersch (2012)

Terry Joe Gentry (2014)

Manuela Giovannetti (2012)

Emanuel Goldman (2013)

Mark Gomelsky (2014)

Ramon Gonzalez (2013)

Heidi Goodrich-Blair (2012)

Lawrence Goodridge (2012)

Joerg Graf (2014)

Irene R. Grant (2013)

Stefan J. Green (2014)

Leslie Gregg-Jolly (2014)

Jean Guard-Bouldin (2013)

John Gustafson (2012)

Ken Hammel (2012)

Hauke Harms (2013)

Steven Harris (2014)

Valerie J. (Jody) Harwood (2012)

Terry C. Hazen (2013)

Ji-Zheng He (2014)

Qiang He (2013)

Zhili He (2013)

Brian Hedlund (2014)

Hermann J. Heipieper (2014)

Ute Hentschel (2012)

Andrew Holmes (2013)

Dallas G. Hoover (2012)

David J. Hopper (2013)

Marcus A. Horn (2014)

Hong-Ying Hu (2013)

John Andrew Hudson (2014)

Hor-Gil Hur (2012)

Fumio Inagaki (2013)

Douglas Inglis (2012)

Ralph Jack (2012)

Janet K. Jansson (2013)

Lee-Ann Jaykus (2012)

Tom Jeffries (2014)

Kristen Jellison (2012)

Paul R. Jensen (2014)

Ian Jenson (2014)

Nianzhi Jiao (2014)

Yves Jouanneau (2012)

Juan Luis Jurat-Fuentes (2012)

Matthias Kaestner (2013)

Levente Karaffa (2012)

Boran Kartal (2014)

Daniel Kearns (2013)

James E. Keen (2013)

John J. Kelly (2012)

Robert M. Kelly (2014)

William Kenealy (2012)

Angela Kent (2013)

Philip J. Kersten (2013)

James Kirby (2013)

Mary Jo Kirisits (2013)

Martin G. Klotz (2014)

Kalmia E. Kniel (2014)

Rob Knight (2013)

Steffen Kolb (2014)

Konstantinos Konstantinidis (2012)

Balasubrahmanyam Kottapalli (2014)

George Kowalchuk (2012)

Lee Krumholz (2012)

Indira Kudva (2013)

Ursula Kües (2013)

Kirsten Kuesel (2013)

Timothy M. LaPara (2012)

Laurie LaPat-Polasko (2012)

Gisèle LaPointe (2013)

Luis Larrondo (2014)

Brian Lefebvre (2013)

Jeffrey T. LeJeune (2012)

Johan Leveau (2012)

Tine Rask Licht (2014)

Nic D. Lindley (2013)

John T. Lisle (2012)

Wen-Tso Liu (2013)

Xueduan Liu (2013)

Alexander Loy (2014)

Yahai Lu (2013)

Petra Luber (2014)

Tillman Lueders (2012)

Yanhe Ma (2013)

Sandra Macfarlane (2014)

Robert Mach (2012)

Eugene Madsen (2012)

Jon Magnuson (2013)

Mike Manefield (2014)

Helene Marquis (2012)

Phyllis A. W. Martin (2014)

Jan Martinussen (2014)

Emma Master (2012)

Timothy E. Mattes (2014)

Harold D. May (2013)

Robert McLean (2012)

Katherine McMahon (2012)

Brian McSpadden-Gardener (2013)

Rainer Meckenstock (2012)

Rick Meinersmann (2012)

John Scott Meschke (2014)

Patricia D. Millner (2012)

Donald K. Milton (2012)

Jamal Mohamed (2012)

Melanie Mormile (2013)

Jochen Mueller (2012)

Yuji Nagata (2012)

István Nagy (2013)

Cindy H. Nakatsu (2013)

Josh D. Neufeld (2014)

Walter G. Niehaus, Jr. (2013)

Brendan A. Niemira (2012)

Hideaki Nojiri (2012)

Norbert Nowotny (2012)

Kevin P. O'Connell (2014)

Julie Olson (2012)

Ronald S. Oremland (2012)

Mark Osborn (2013)

Konstantinos Papadimitriou (2013)

Jakob Pernthaler (2012)

Gregg Pettis (2014)

Laurent Philippot (2014)

Flynn Picardal (2013)

Carmen Pin (2012)

James L. Pinckney (2014)

Antonio G. Pisabarro (2014)

Mircea Podar (2014)

Anton F. Post (2013)

Rolf Prade (2012)

Maria Prieto (2012)

Jim I. Prosser (2014)

Cheryl L. Quinn (2012)

John P. Quinn (2012)

Ralf Rabus (2014)

Michael Rappé (2012)

Bernd Rehm (2012)

Gregor Reid (2012)

Jorge Rodrigues (2013)

Margie Romine (2014)

Michael J. Sadowsky (2013)

Daåd A. Saffarini (2014)

Badal C. Saha (2013)

Maria Sandkvist (2012)

Robert Sanford (2012)

Sima Sariaslani (2012)

Mahfuzur Sarker (2013)

Brian Sauders (2013)

Patrick D. Schloss (2012)

Monika Schmoll (2014)

Lynne Sehulster (2013)

Bernhard Seiboth (2014)

EDITORIAL BOARD (continued)

- | | | | |
|-------------------------------------|---------------------------------------|---------------------------------------|------------------------------------|
| Verena Seidl (2012) | Roger Stephan (2014) | Irene Wagner-Döbler (2014) | Hong-sheng Wu (2012) |
| Jeremy D. Semrau (2014) | Brian Stevenson (2013) | Aljoscha Wahl (2012) | Chuanwu Xi (2014) |
| Gordon Shephard (2013) | John Stolz (2013) | Judy D. Wall (2012) | Lihua Xiao (2012) |
| Stefan Sievert (2012) | Wolfgang Streit (2012) | Aijie Wang (2013) | Jagjit Yadav (2014) |
| Mark Silby (2012) | Joseph Sturino (2013) | Peng G. Wang (2012) | S. Steve Yan (2013) |
| Simon D. Silver (2014) | Marcelino Suzuki (2013) | Todd Ward (2013) | Ming Yang (2013) |
| Pascal Simonet (2012) | Cristina Takacs-Vesbach (2012) | Keith Warriner (2014) | Chris Yeager (2013) |
| Mitch Singer (2014) | Ken Takai (2013) | Bart Weimer (2013) | Suleyman Yildirim (2014) |
| Randall S. Singer (2012) | Ralph Tanner (2014) | Helge Weingart (2012) | Jill Zeilstra-Ryalls (2014) |
| Brajesh Singh (2013) | Gerald W. Tannock (2014) | Alan Welman (2012) | Karsten Zengler (2014) |
| Kaarina Sivonen (2014) | Andreas Teske (2012) | Irene Wesley (2012) | Chuanlun Zhang (2012) |
| Panos Skandamis (2013) | Michael G. Thomas (2012) | Marvin Whiteley (2013) | Qijing Zhang (2014) |
| Evan Skowronski (2012) | Nicolas Toro Garcia (2014) | Giovanni Widmer (2013) | Yu-Zhong Zhang (2014) |
| Joan L. Slonczewski (2014) | Effie Tsakalidou (2013) | Steve Wilhelm (2012) | Yong-Guan Zhu (2013) |
| John Spear (2013) | Masataka Tsuda (2012) | Charles F. Wimpee (2014) | Erik Zinser (2013) |
| Andrew Spiers (2013) | Wouter van der Star (2014) | Regina-Michaela Wittich (2014) | Erwin G. Zoetendal (2012) |
| Eric Stabb (2013) | Paul van der Wielen (2014) | K. Eric Wommack (2012) | Angeles Zorreguieta (2013) |
| Alfons J. M. Stams (2013) | Alain Vertes (2013) | Thomas K. Wood (2014) | Peter Alan Zuber (2014) |
| Lisa Stein (2013) | Adrián A. Vojnov (2013) | Randy Worobo (2013) | |
| Alexander Steinbüchel (2014) | Carmen Wachter (2013) | | |

Applied and Environmental Microbiology (ISSN 0099-2240), a publication of the American Society for Microbiology (ASM), 1752 N St., N.W., Washington, DC 20036-2904, is devoted to the advancement and dissemination of applied knowledge as well as ecological knowledge, both applied and fundamental, concerning microorganisms. Instructions to authors are no longer published in the first issue of the year but can be found at <http://aem.asm.org/site/misc/ifora.xhtml> and are updated throughout the year; reprints are available online and from the Journals Department. *Applied and Environmental Microbiology* is published twice monthly, one volume per year. Nonmember print subscription prices (per year) are: \$1,590, U.S.; \$1,685, Canada (plus 5% GST, or 13% HST where applicable); \$1,712, Europe; \$1,754, Latin America; \$1,759, rest of world. Member print subscription prices (per year) are: \$196, U.S.; \$319, Canada (plus 5% GST, or 13% HST where applicable); \$318, Europe; \$360, Latin America; \$365, rest of world. Single copies are: \$100, nonmember; \$50, member (Canadians add 5% GST, or 13% HST where applicable). For prices of electronic versions, contact the Subscriptions Unit, ASM. Correspondence relating to subscriptions, defective copies, missing issues, and availability of back issues should be directed to the Subscriptions Unit, ASM; correspondence relating to reprint orders should be directed to the Reprint Order Unit, ASM; and correspondence relating to disposition of submitted manuscripts, proofs, and general editorial matters should be directed to the Journals Department, American Society for Microbiology, 1752 N St., N.W., Washington, DC 20036-2904. Phone: (205) 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.

Periodicals postage paid at Washington, DC 20036, and at additional mailing offices.

POSTMASTER: Send address changes to *Applied and Environmental Microbiology*, ASM, 1752 N St., N.W., Washington, DC 20036-2904.

Made in the United States of America. Printed on acid-free paper. doi:10.1128/AEM.78.15.2012 CODEN: AEMIDF

Copyright © 2012, American Society for Microbiology. All Rights Reserved.

The code at the bottom 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., 222 Rosewood Drive, Danvers, MA 01923, 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.