

Volume 248
January-March
1989

The Journal of PHARMACOLOGY AND EXPERIMENTAL THERAPEUTICS

A Publication of The American Society
for Pharmacology and Experimental Therapeutics

Founded by John J. Abel 1909

EDITOR

Eva King Killam

ASSISTANT EDITOR

Mannfred A. Hollinger

EDITORS FOR SPECIFIC FIELDS

Analgesia and Drug Abuse

William L. Dewey
Billy Martin

Autonomic Pharmacology

Robert R. Ruffolo, Jr.
Robert E. Stitzel

Behavioral Pharmacology

John A. Harvey

Cardiovascular Pharmacology

Leslie E. Bailey
Henry R. Besch, Jr.
Theodore M. Brody
Sue Piper Duckles

Cell Pharmacology

Toshio Narahashi
Ronald P. Rubin
George B. Weiss

Chemotherapy

H. George Mandel

Developmental Pharmacology

Bernard L. Mirkin

Drug Metabolism and Disposition

Edward Bresnick
Jordan L. Holtzman

Endocrine Pharmacology

Paula H. Stern

Gastrointestinal Pharmacology

Thomas F. Burks

Immunopharmacology

Sydney Spector

Neuropharmacology

Edmund G. Anderson
David B. Bylund
S. J. Enna
Charles O. Rutledge

Prostaglandins and Leukotrienes

Guy C. Le Breton
John C. McGiff

Pulmonary Pharmacology

Mannfred A. Hollinger

Renal Pharmacology

William O. Berndt

Toxicology

Curtis D. Klaassen

EDITORIAL ADVISORY BOARD

Margaret Acara
Martin W. Adler
Edson X. Albuquerque
Julius C. Allen
James B. Appel
Lewis Aronow
William D. Atchison
Albert J. Azaró
Robert L. Balster
Paul Bass
Michael A. Beaven
Donald M. Bers
John A. Bevan
C. Paul Bianchi
David A. Blake
Alan S. Bloom
Floyd E. Bloom
Peter G. Bradford
Carl K. Buckner
Theodore J. Cicero
Doris H. Clouet
Marlene L. Cohen
Charles R. Craig
Luigi X. Cubeddu
E. E. Daniel
William C. de Groat
Louis Diamond
Gerald F. DiBona
Robert J. Dinerstein
Walter R. Dixon
J. W. Downie
Linda Dykstra

Hugh L. Evans
Jerry M. Farley
Harold Feinberg
Gregory D. Fink
Stephen K. Fisher
Garret A. FitzGerald
Ray W. Fuller
Timothy S. Gaginella
Gerard L. Gebber
James W. Gibb
C. Norman Gillis
Shri N. Giri
Frank R. Goodman
Thomas P. Green
Garrett J. Gross
R. Adron Harris
Richard J. Head
J. Paul Hieble
Stephen G. Holtzman
Jerry B. Hook
E. H. Jeffery
Robert M. Joy
Alain F. Junod
George J. Kaloyanides
Alexander G. Karczmar
Terry Kenakin
Conan Kornetsky
Edwin A. Kroeger
David D. Ku
Suzanne G. Laychock
Tony J.-F. Lee

Roberto Levi
George E. Lindenmayer
Horace H. Loh
Benedict R. Lucchesi
K. U. Malik
Thomas A. McCalden
Robert B. McCall
Donald E. McMillan
W. H. Morse
Hasan Mukhtar
Kevin Mullane
L. Charles Murrin
Jose M. Musacchio
Allen H. Neims
Jon A. Norman
Robert F. O'Dea
Achilles J. Pappano
Leslie V. Parise
Gavril W. Pasternak
William A. Pettinger
Larissa A. Pohorecky
Garth Powis
Donald V. Priola
Russell A. Prough
David Raeburn
Arthur Raines
C. R. Ross
Arnold Schwartz
Lewis S. Seiden
Paul J. Silver
David J. Smith

Roger P. Smith
Roger D. Speakman
Janice L. Stickney
John L. Sutko
Boris Tabakoff
A. E. Takemori
David A. Taylor
Robert E. Ten Eick
Thomas R. Tephly
Richard E. Tessel
Martin J. M. C. Thoolen
Pieter B. M. W. M. Timmermans
Myron L. Toews
Theodore J. Torphy
U. Trendelenburg
Norman J. Uretsky
Paul M. Vanhoutte
Ralph Vinegar
Larry A. Walker
Martin A. Wasserman
R. Clinton Webb
I. M. Weiner
Richard M. Welch
Grant R. Wilkinson
Michael Williams
Martin M. Winbury
Raymond J. Winquist
Barry B. Wolfe
Henry I. Yamamura
Ben G. Zimmerman

BOARD OF PUBLICATIONS TRUSTEES

William W. Fleming, *Chairman*; James A. Bain, Joseph R. Bianchine, Joel G. Hardman, Eva King Killam, Horace Loh, Jerry R. Mitchell, Marcus M. Reidenberg, Irving I. A. Tabachnick, Palmer W. Taylor, Vincent G. Zandori

EXECUTIVE OFFICER OF THE SOCIETY

Kay A. Croker

THE JOURNAL OF PHARMACOLOGY AND EXPERIMENTAL THERAPEUTICS (ISSN 0022-3565) is an official publication of The American Society for Pharmacology and Experimental Therapeutics and is published monthly by Williams & Wilkins, 428 E. Preston Street, Baltimore, MD 21202-3993. Second class postage paid at Baltimore, MD and at additional mailing offices. POSTMASTER: Send address changes to THE JOURNAL OF PHARMACOLOGY AND EXPERIMENTAL THERAPEUTICS, 428 E. Preston St., Baltimore, MD 21202-3993. Indexed by *Current Contents* and *Index Medicus*. Subscription rates \$150.00 (\$205.00 foreign, \$302 Japan); institutions \$240.00 (\$295 foreign, \$392.00 Japan) single copy \$16.00 (\$20.00 foreign). (Japanese rates include air freight.) Prices are subject to change. Copyright © 1989 by The American Society for Pharmacology and Experimental Therapeutics.

PUBLIC HEALTH LABORATORIES
NEW YORK CITY DEPT. OF HEALTH
455 First Avenue

Kuzio Ka, 5/31/91, \$12.00

The Journal of PHARMACOLOGY AND EXPERIMENTAL THERAPEUTICS

A Publication of The American Society
for Pharmacology and Experimental Therapeutics

Founded by John J. Abel 1909

EDITOR

Eva King Killam

ASSISTANT EDITOR

Mannfred A. Hollinger

EDITORS FOR SPECIFIC FIELDS

Analgesia and Drug Abuse

William L. Dewey
Billy Martin

Autonomic Pharmacology

Robert R. Ruffolo, Jr.
Robert E. Stitzel

Behavioral Pharmacology

John A. Harvey

Cardiovascular Pharmacology

Leslie E. Bailey
Henry R. Besch, Jr.
Theodore M. Brody
Sue Piper Duckles

Cell Pharmacology

Toshio Narahashi
Ronald P. Rubin
George B. Weiss

Chemotherapy

H. George Mandel

Developmental Pharmacology

Bernard L. Mirkin

Drug Metabolism and Disposition

Edward Bresnick
Jordan L. Holtzman

Endocrine Pharmacology

Paula H. Stern

Gastrointestinal Pharmacology

Thomas F. Burks

Immunopharmacology

Sydney Spector

Neuropharmacology

Edmund G. Anderson
David B. Bylund
S. J. Enna
Charles O. Rutledge

Prostaglandins and Leukotrienes

Guy C. Le Breton
John C. McGiff

Pulmonary Pharmacology

Mannfred A. Hollinger

Renal Pharmacology

William O. Berndt

Toxicology

Curtis D. Klaassen

EDITORIAL ADVISORY BOARD

Margaret Acara
Martin W. Adler
Edson X. Albuquerque
Julius C. Allen
James B. Appel
Lewis Aronow
William D. Atchison
Albert J. Azzaro
Robert L. Balster
Paul Bass
Michael A. Beaven
Donald M. Bers
John A. Bevan
C. Paul Bianchi
David A. Blake
Alan S. Bloom
Floyd E. Bloom
Peter G. Bradford
Carl K. Buckner
Theodore J. Cicero
Doris H. Clouet
Marlene L. Cohen
Charles R. Craig
Luigi X. Cubeddu
E. E. Daniel
William C. de Groat
Louis Diamond
Gerald F. DiBona
Robert J. Dinerstein
Walter R. Dixon
J. W. Downie
Linda Dykstra

Hugh L. Evans
Jerry M. Farley
Harold Feinberg
Gregory D. Fink
Stephen K. Fisher
Garret A. FitzGerald
Ray W. Fuller
Timothy S. Gagarella
Gerard L. Gebber
James W. Gibb
C. Norman Gillis
Shri N. Giri
Frank R. Goodman
Thomas P. Green
Garrett J. Gross
R. Adron Harris
Richard J. Head
J. Paul Hieble
Stephen G. Holtzman
Jerry B. Hook
E. H. Jeffery
Robert M. Joy
Alain F. Junod
George J. Kaloyanides
Alexander G. Karczmar
Terry Kenakin
Conan Kornetsky
Edwin A. Kroeger
David D. Ku
Suzanne G. Laychock
Tony J.-F. Lee

Roberto Levi
George E. Lindenmayer
Horace H. Loh
Benedict R. Lucchesi
K. U. Malik
Thomas A. McCalden
Robert B. McCall
Donald E. McMillan
W. H. Morse
Hasan Mukhtar
Kevin Mullane
L. Charles Murrin
Jose M. Musacchio
Allen H. Neims
Jon A. Norman
Robert F. O'Dea
Achilles J. Pappano
Leslie V. Parise
Gavril W. Pasternak
William A. Pettinger
Larissa A. Pohorecky
Garth Powis
Donald V. Priola
Russell A. Prough
David Raeburn
Arthur Raines
C. R. Ross
Arnold Schwartz
Lewis S. Seiden
Paul J. Silver
David J. Smith

Roger P. Smith
Roger D. Spealman
Janice L. Stickney
John L. Sutko
Boris Tabakoff
A. E. Takemori
David A. Taylor
Robert E. Ten Eick
Thomas R. Tephly
Richard E. Tessel
Martin J. M. C. Thoolen
Pieter B. M. W. M. Timmermans
Myron L. Toews
Theodore J. Torphy
U. Trendelenburg
Norman J. Uretsky
Paul M. Vanhoutte
Ralph Vinegar
Larry A. Walker
Martin A. Wasserman
R. Clinton Webb
I. M. Weiner
Richard M. Welch
Grant R. Wilkinson
Michael Williams
Martin M. Winbury
Raymond J. Winkquist
Barry B. Wolfe
Henry I. Yamamura
Ben G. Zimmerman

BOARD OF PUBLICATIONS TRUSTEES

William W. Fleming, *Chairman*: James A. Bain, Joseph R. Bianchine, Joel G. Hardman, Eva King Killam, Horace Loh, Jerry R. Mitchell, Marcus M. Reidenberg, Irving I. A. Tabachnick, Palmer W. Taylor, Vincent G. Zannoni

EXECUTIVE OFFICER OF THE SOCIETY

Kay A. Croker

THE JOURNAL OF PHARMACOLOGY AND EXPERIMENTAL THERAPEUTICS (ISSN 0022-3565) is an official publication of The American Society for Pharmacology and Experimental Therapeutics and is published monthly by Williams & Wilkins, 428 E. Preston Street, Baltimore, MD 21202-3993. Second class postage paid at Baltimore, MD and at additional mailing offices. POSTMASTER: Send address changes to THE JOURNAL OF PHARMACOLOGY AND EXPERIMENTAL THERAPEUTICS, 428 E. Preston St., Baltimore, MD 21202-3993. Indexed by *Current Contents* and *Index Medicus*. Subscription rates \$150.00 (\$205.00 foreign, \$302 Japan); institutions \$240.00 (\$295 foreign, \$392.00 Japan) single copy \$16.00 (\$20.00 foreign). (Japanese rates include air freight.) Prices are subject to change. Copyright © 1989 by The American Society for Pharmacology and Experimental Therapeutics.