Singularities

Volume 40 - Part 1

PROCEEDINGS OF
SYMPOSIA IN
PURE MATHEMATICS

AMERICAN MATHEMATICAL SOCIETY

http://dx.doi.org/10.1090/pspum/040.1

SINGULARITIES

PROCEEDINGS OF SYMPOSIA
IN PURE MATHEMATICS
Volume 40, Part 1

SINGULARITIES

AMERICAN MATHEMATICAL SOCIETY
PROVIDENCE, RHODE ISLAND

PROCEEDINGS OF SYMPOSIA IN PURE MATHEMATICS
OF THE AMERICAN MATHEMATICAL SOCIETY
VOLUME 40

PROCEEDINGS OF THE SUMMER INSTITUTE ON SINGULARITIES
HELD AT HUMBOLDT STATE UNIVERSITY
ARCATA, CALIFORNIA
JULY 20–AUGUST 7, 1981

EDITED BY
PETER ORLIK

Prepared by the American Mathematical Society
with partial support from National Science Foundation grant MCS 80-20208

1980 *Mathematics Subject Classification*. Primary 14-XX, 16-XX, 32-XX, 53-XX, 55-XX, 57-XX, 58-XX.

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

Singularities.

(Proceedings of symposia in pure mathematics; v. 40, pts. 1, 2)
Bibliography: p.
1. Singularities (Mathematics)—Addresses, essays, lectures. I. Orlik, Peter, 1938– . II. Series.
QA614.58.S55 1983 514'.74 83-2529

ISBN 0-8218-1443-5 (set) ISBN 0-8218-1466-4 (part 2)
ISBN 0-8218-1450-8 (part 1) ISSN 0082-0717

TABLE OF CONTENTS

PART 1

TABLE OF CONTENTS

PART 2

PREFACE

The American Mathematical Society held its twenty-ninth Summer Research Institute at Humboldt State University in Arcata, California, from July 20 to August 7, 1981.

The basic aim of the institute was to survey the various branches of Singularity Theory and to discuss recent progress and open problems. Some of the major topics were resolution and deformation of singularities in the algebraic and analytic categories; smoothing theory and mixed Hodge structures; equisingularity, the study of polar varieties and Whitney stratifications; Milnor fibration, monodromy and intersection pairing; analytic results, including the Gauss-Manin connection and relations with differential systems; metric properties and curvature; connections with knot theory and link theory; equivariant results and automorphic forms; unfoldings, adjacency, classification of singularities and modality; stability of singularities; Newton diagrams; Morse theory and intersection homology; and applications to physics and other sciences.

PRINCIPAL LECTURES

Canonical desingularization. SHREERAM ABHYANKAR, Purdue University

Milnor lattices and Dynkin diagrams. EGBERT BRIESKORN, University of Bonn, West Germany

Differentiable maps with small critical set. PHILIP CHURCH, Syracuse University

Topological triviality in versal unfoldings. JAMES DAMON, University of North Carolina

The low dimensional topology of singularities. ALAN DURFEE, Smith College

Rational curves with cusps. DAVID EISENBUD, Brandeis University

A-tangent spaces, classification and differential geometry. TERENCE GAFFNEY, Northeastern University

Steady-state bifurcation theory. MARTIN GOLUBITSKY, Arizona State University

Resolution games. HEISUKE HIRONAKA, Harvard University

The topology of real algebraic sets. HENRY KING, University of Maryland

Metric study of the neighborhood of a singularity. REMI LANGEVIN, University of Paris, France

Smoothing components of singularities. EDUARD LOOIJENGA, Catholic University, Nijmegen, Netherlands

Intersection homology. ROBERT MacPHERSON, Brown University

Distance function from a submanifold of Euclidean space. JOHN MATHER, Princeton University

Geometry of quasi-homogeneous surface singularities. WALTER NEUMANN, University of Maryland

On the stability of the Newton boundary. MUTSUO OKA, Tokyo Institute of Technology, Japan

Complements of hyperplanes. PETER ORLIK, University of Wisconsin, Madison

Vanishing homologies and the n-variable saddle method. FRÉDERIC PHAM, Nice University, France

Birational factorization of three-folds and singularities. HENRY PINKHAM, Columbia University

Periods of integrals over vanishing cycles. KYOJI SAITO, Kyoto University, Japan

Smoothings of isolated singularities and mixed Hodge structures. JOSEPH STEENBRINK, University of Leiden, Netherlands

Polar varieties and Whitney stratifications. BERNARD TEISSIER, Ecole Polytechnique, Paris, France

Topological description of Whitney stratifications. LÊ DŨNG TRÁNG, University of Paris, France

The structure of quasi-homogeneous singularities. PHILIP WAGREICH, University of Illinois at Chicago Circle

Classification of unimodal singularities of complete intersections. CHARLES T. WALL, University of Liverpool, England

SEMINAR SERIES

The names of the seminar speakers are listed in the order in which they appeared on the program.

(1) Organized by Philip Church and Martin Golubitsky:

When are germs finitely determined in general?, by Andrew du Plessis

Extension problems and related themes in differential analysis, by Gerald W. Schwarz

Poincaré-Hopf type theorems for maps to $\mathbf{R}^2$, by Daniel S. Chess

Calculating the Poincaré dual to $S^{1,1,1,1}_{(f)}$, by Terence J. Gaffney

Unfoldings of analytic foliation singularities, by Tatsuo Suwa

Composite differential functions, by Edward Bierstone

Caustics by reflexion, by Peter Giblin

The bending of a thin triangular beam, by Timothy Poston

Topological classification of smooth mappings, by Andrew du Plessis

Intrinsic derivatives, by Ian Porteous

Singular theory of submanifolds of Euclidean space, by Ian Porteous

Counting singularities, by James W. Bruce

An application of singularity theory to a nonlinear partial differential equation, by Philip T. Church

Equivalence of generic mappings, by Leslie C. Wilson

Some results on finite determinacy and stability not requiring explicit use of smoothness, by Yosef Yomdin

Newton filtrations, monomial algebras and nonisolated and equivariant singularities, by James Damon

Contact germs of the plane, by Chris Gibson

Topological type in families of germs, by Henry C. King

Topology of polarization fields in crystal acoustics, by Per Holm

Deformations of zero-dimensional complete intersections after M. Granger, T. Gaffney, by Anthony Iarrobino

Hilbert scheme as flat n-fold locus of a family of mapping germs, by André Galligo

Criteria for C^0-sufficiency of jets of maps, by David Trotman

On topological types of polynomial map germs, by Isao Nakai

A duality theorem of foliations, by Franz W. Kamber

Counting tritangent planes of space curves, by Clint McCrory

Bifurcation with symmetry, by Martin Golubitsky

Bifurcation involving the hexagonal lattice, by Ernesto Buzano

On Faa' de Bruno's formula and intrinsic derivatives, by Felice Ronga

Maps from $(n + 1)$-manifold to n-manifold, by James G. Timourian

Is singularity theory useful?, by A. John Coleman

Stratifications via co-rank one projections, by Robert Hardt

Lifting 3-manifolds out of the plane, by Harold Levine

The Euler numbers of singularity sets, by Barry Hill-Tout

Topology of tame polynomial hypersurfaces, by Allen Broughton

An algorithm of construction of the semi-universal deformation of an isolated singularity, by Herwig Hauser

Multiple points, chaining, and the Fulton Hansen connectedness theorem, by Terence Gaffney

(2) Organized by Alan Durfee and Lê Dũng Tráng

Introduction to the theory of D-modules (differential systems), by Zoghman Mebkhout

Report on b-functions (Bernstein-Sato polynomials), by Tamaki Yano

Relations between polar invariants and b-functions, by Benjamin Lichtin

Mixed Hodge structures, by Fouad Elzein

Global monodromy and structure of elliptic Lefschetz fibrations, by Richard Mandelbaum

Lefschetz theorems on affine algebraic varieties, by Helmut Hamm

Differential forms in π_1, by Toshitake Kohno

On the topology of smoothable singularities, by Gert-Martin Greuel
Harmonic PL-forms, by Gerald L. Gordon
Computation of some projective invariants, by Audun Holme
Regular stratification of subanalytic sets, by David Trotman
Vanishing cycles and Thom stratification, by Claude Sabbah
Asymptotic mixed Hodge structures, by Joseph Steenbrink
Mixed Hodge structure on the Milnor fiber, by John Scherk
Log complexes of currents and Hodge structure, by James King
Exponents and geometric genus, by Morihiko Saito
Transversality theorems for polar varieties, by Jean-Pierre Henry
Another view of critical point theory, by István Fáry
Polarized mixed Hodge structure and monodromy, by Eduardo Cattani
Questions on the proof of the hard Lefschetz theorem, by Klaus Lamotke
Morse theory on the intersection homology, by Mark Goresky
Structure of critical sets of complete intersection, by Yosef Yomdin
An integral formula for the Milnor number, by Gary Kennedy
The topology of the nondegenerate Newton boundary, by Mutsuo Oka
Saturations of plane curves, by Antonio Campillo
Vanishing folds in μ-constant families, by Donal O'Shea
On the equisingularity of quasi-ordinary surfaces, by Ignacio Luengo
On the topology of Deligne's weight filtration, by Clint McCrory
Coverings of quasi-homogeneous surface singularities, by Walter Neumann
Critical spaces and stratified mappings, by Andrew du Plessis
L_2 cohomology and intersection homology of locally symmetric varieties, by Steve Zucker
Kinematic theory of the linking number, by Remi Langevin
The tangent space and exponential map of an isolated singularity, by David Stone
Primitive elements in Lie algebras and Schubert singularities, by Donald King

(3) Organized by Peter Orlik and Philip Wagreich

Derivations and deformations of quasi-homogeneous singularities, by Jonathan Wahl
Milnor fibers and Alexander polynomials for plane curves, by Richard Randell
Quasi-ordinary singularities of surfaces in $\mathbf{C}^3$, by Joseph Lipman
Simultaneous resolution of some families of isolated surface singularities, by Henry Laufer
Regular singularities, by Stephen S. T. Yau
Analog of p-cyclic quotient singularities in characteristic p, by Peter Russell
Isolated line singularities, by Dirk Siersma
Newton clouds and isolated singularities, by Marc Giusti
Schubert's enumerative geometry of triangles, by Robert Speiser
Ample divisors on 3-folds, by Andrew Sommese
Alexander invariants of the complement of a plane singularity curve, by Anatoly Libgober

Finding the non-degenerate quadratic singularities, by Norman J. Goldstein
On the monodromy groups of singularities, by Norman J. Goldstein
Surfaces of general type with positive signature, by Richard Mandelbaum
Normally flat deformation of rational and minimal elliptic singularities, by Ulrich Karras
Differential invariance of multiplicity, by Yih-Nan Gau
Homology of projective varieties with good $\mathbf{C}^*$*-action*, by James Carrell
Topological classification of surfaces with $\mathbf{C}^*$*-action in* P^3, by Gottfried Barthel
On complex surfaces with small cohomology, by Ludger Kaup
Estimation of the Łojasiewicz exponent and Newton polygon, by Benjamin Lichtin
On the geometry of canonical singularities and Newton polygons, by Jonathan Fine
Weyl groups and Cremona transformations, by Igor Dolgachev
Liaison and deformation of singularities, by Ragnar-Olaf Buchweitz
Projected resolution of rational singularities, by Oswald Riemenschneider
Resolution of certain Gorenstein singularities, by Kurt Behnke
Singularities of period maps and weak Torelli theorems, by Roy Smith
Intersection homology of nilpotent orbits, by Robert MacPherson
Logarithmic differential forms and arrangements of hyperplanes, by Hiroaki Terao
The Gysin map of homogeneous spaces, by Ersan Akyildiz
On the $K(\pi, 1)$ *problem for isolated singularities of complete intersections*, by Horst Knörrer
$\mathbf{C}^*$ *equivariance of the semi-universal deformation of a* $\mathbf{C}^*$*-equivariant sheaf*, by Fernando Puerta
On singularities on degenerate Del Pezzo surfaces of degree 1, 2, by Tohsuke Urabe
Geometric genus for isolated singularities of quartic surfaces, by Isao Naruki
Rational double points and group representations, by Gerard Gonzalez-Sprinberg
Purely elliptic singularities of dimension > 2, by Kimio Watanabe
Special polars and curves with one place at infinity, by Robert Ephraim
Nets of curves in $\mathbf{P}^2$, by Michel Merle
Singularities of the tangent developable, by Ragni Piene
Nonsingular (*sic*) *complete intersections*, by John Wood
On global extensions of Dynkin diagrams, by Lawrence Brenton
On the Jacobian problem, by John Randall

Evening seminars were also arranged informally, and included talks by the following speakers:

Introduction to Enriques surfaces in characteristic area and characteristic p, by William Lang
Enriques surfaces of special type and curves of low genus, by François Cossec

Resolution games (continuation of hour lecture), by Heisuke Hironaka
Iterated torus links, by Walter Neumann
Projective degenerations of Enriques surfaces, by Jayant Shah
D-modules amplified, by Lê Dũng Tráng
Intersection homology; examples and background, by Mark Goresky
Desingularization, by Henry Laufer
Equisingularity, by Bernard Teissier
Resolutions, by Shreeram Abhyankar
Differential systems, by Lê Dũng Tráng
Arnold classification, by Alan Durfee
Coxeter groups, by A. John Coleman
Unfolding, stable mapping germs, by Charles T. Wall
Mixed Hodge structure, by Joseph Steenbrink

These volumes contain the proceedings of the Summer Institute. The revised texts of all but one of the principal lectures and almost all the seminar talks are included. There are some papers of purely expository nature and some containing mostly original research, while the majority fall somewhere between the two. We hope that the uninitiated will find a sufficient number of introductory articles, and that the experts will consider the proceedings a good summary of the state of the art and will find interesting new results and challenging problems in it. The participants served as referees and we all owe each other thanks for the thorough and painstaking work. The organizers invited a few Soviet mathematicians from the active and important school of V. I. Arnold. Unfortunately, none could come. We are therefore particularly pleased to include a translation of Arnold's article on open questions with the author's comments and with updated references.

The beautiful surroundings at Arcata contributed to the success of the Institute.

Peter Orlik
Madison, Wisconsin
June 15, 1982

LIST OF PARTICIPANTS

ABHYANKAR, Shreeram	Purdue University, West Lafayette, Indiana
AKYILDIZ, Ersan	Middle East Technical University, Ankara, Turkey
ASCENZI, Maria Grazia	Brandeis University, Waltham, Massachusetts
BARTHEL, Gottfried	University of Konstanz, West Germany
BEHNKE, Kurt	University of Hamburg, West Germany
BENNETT, Bruce	University of California, Irvine, California
BENSON, Max	Harvard University, Cambridge, Massachusetts
BIERSTONE, Edward	University of Toronto, Ontario, Canada
BRENTON, Lawrence	Wayne State University, Detroit, Michigan
BRIESKORN, Egbert	University of Bonn, West Germany
BROUGHTON, Sean A.	Queen's University, Kingston, Ontario, Canada
BRUCE, James William	University College of Cork, Ireland
BUCHWEITZ, Ragnar-Olaf	University of Hannover, West Germany
BUZANO, Ernesto	University of Torino, Italy
CAMPILLO, Antonio	Columbia University, New York, New York
CARRELL, James	University of British Columbia, Vancouver, B. C., Canada
CARTER, Roger W.	University of Warwick, Coventry, England
CASTELLANOS-PENUELA, Julio A.	University Complutense de Madrid, Spain
CATTANI, Eduardo	University of Massachusetts, Amherst, Massachusetts
CHESS, Daniel	Courant Institute of Mathematical Sciences, New York, New York
CHURCH, Philip T.	Syracuse University, Syracuse, New York
COLEMAN, A. John	Queen's University, Kingston, Ontario, Canada
COLLEY, Susan Jane	Massachusetts Institute of Technology, Cambridge, Massachusetts
CONNELL, Edwin	University of Miami, Coral Gables, Florida
COSSEC, François	University of North Carolina, Chapel Hill, North Carolina
COX, Cornelius	University of Utrecht, Netherlands
DAMON, James	University of North Carolina, Chapel Hill, North Carolina
DOLGACHEV, Igor	University of Michigan, Ann Arbor, Michigan
DUCHAMP, Thomas	University of Washington, Seattle, Washington
duPLESSIS, Andrew A.	Aarhus University, Aarhus, Denmark
DURFEE, Alan	Smith College, Northampton, Massachusetts
EBELING, Wolfgang	University of Bonn, West Germany
EISENBUD, David	Brandeis University, Waltham, Massachusetts
ELZEIN, Fouad	University of Paris VII, Paris, France
EPHRAIM, Robert	Brandeis University, Waltham, Massachusetts
FARY, István	University of California, Berkeley, California
FINE, Jonathan	Southern Illinois University, Carbondale, Illinois
FISCHER, Klaus	George Mason University, Fairfax, Virginia
GAFFNEY, Terence	Northeastern University, Boston, Massachusetts
GALLIGO, André	University of Nice, France
GAU, Yih-Nan	Purdue University, West Lafayette, Indiana
GIBLIN, Peter	University of Liverpool, England

GIBSON, Christopher G.	University of Liverpool, England
GIUSTI, Marc	CNRS, Paris, France
GOLDSTEIN, Norman	University of British Columbia, Vancouver, B. C., Canada
GOLUBITSKY, Martin	Arizona State University, Tempe, Arizona
GONZALEZ-SPRINBERG, Gerard	Ecole Polytechnique, Palaiseau, France
GORDON, Gerald	DePaul University, Chicago, Illinois
GORESKY, R. Mark	University of British Columbia, Vancouver, B. C., Canada
GRAYSON, Daniel	Columbia University, New York, New York
GREUEL, Gert-Martin	University of Bonn, West Germany
HAIN, Richard	University of Washington, Seattle, Washington
HAMM, Helmut	University of Münster, West Germany
HARDT, Robert	University of Minnesota, Minneapolis, Minnesota
HAUSER, Herwig	University of Innsbruck, Austria
HENRY, Jean-Pierre	Ecole Polytechnique, Paris, France
HILL-TOUT, Barry	University of Georgia, Athens, Georgia
HIRONAKA, Heisuke	Harvard University, Cambridge, Massachusetts
HOLM, Per	Oslo University, Oslo, Norway
HOLME, Audun	University of Bergen, Norway
IARROBINO, Anthony Jr.	Northeastern University, Boston, Massachusetts
JANSSEN, Wil	Catholic University, Nijmegen, Netherlands
KAMBER, Franz W.	University of Illinois, Urbana, Illinois
KARRAS, Ulrich	University of Dortmund, West Germany
KAUP, Ludger	University of Konstanz, West Germany
KEMPF, George	Johns Hopkins University, Baltimore, Maryland
KENNEDY, Gary	Purdue University, West Lafayette, Indiana
KING, Donald	Northeastern University, Boston, Massachusetts
KING, Henry	University of Maryland, College Park, Maryland
KING, James R.	University of Washington, Seattle, Washington
KLEIMAN, Steven	Massachusetts Institute of Technology, Cambridge, Massachusetts
KNIGHT, Karl	Brandeis University, Waltham, Massachusetts
KNÖRRER, Horst	Leiden University, Leiden, Netherlands
KOHNO, Toshitake	Nagoya University, Nagoya, Japan
KRAFT, Jürgen	Purdue University, West Lafayette, Indiana
LAMOTKE, Klaus	University of Cologne, West Germany
LANG, William E.	Massachusetts Institute of Technology, Cambridge, Massachusetts
LANGEVIN, Remi	University of Paris-Sud, Orsay, France
LAUFER, Henry	SUNY, Center at Stony Brook, Stony Brook, New York
LEVINE, Harold	Brandeis University, Waltham, Massachusetts
LIBGOBER, Anatoly	University of Illinois at Chicago Circle, Chicago, Illinois
LICHTIN, Ben	The Institute for Advanced Study, Princeton, New Jersey
LIEBERMAN, David	Institute for Defense Analyses, Princeton, New Jersey
LIPMAN, Joseph	Purdue University, West Lafayette, Indiana
LOOIJENGA, Eduard	Catholic University, Nijmegen, Netherlands
LORIST, Peter	Utrecht University, Utrecht, Netherlands
LUENGO, Ignacio	University of Madrid, Spain
MacPHERSON, Robert	Brown University, Providence, Rhode Island
MANDELBAUM, Richard	University of Rochester, Rochester, New York
MATHER, John	Princeton University, Princeton, New Jersey
McCRORY, Clint	University of Georgia, Athens, Georgia
MEBKHOUT, Zoghman	University of Orleans, France
MENTING, Eric	Catholic University, Nijmegen, Netherlands
MERLE, Michel	University of Paris VI, Paris, France
MILMAN, Pierre	University of Toronto, Toronto, Ontario, Canada
MONTALDI, James	Liverpool University, Liverpool, England

MORRISON, Kent	California Polytechnic State University, San Luis Obispo, California
MOUNT, Kenneth	Northwestern University, Evanston, Illinois
NAKAI, Isao	Kyoto University, Kyoto, Japan
NARUKI, Isao	Kyoto University, Kyoto, Japan
NEUMANN, Walter	University of Maryland, College Park, Maryland
OKA, Mutsuo	Tokyo Institute of Technology, Tokyo, Japan
ORLIK, Peter	University of Wisconsin, Madison, Wisconsin
ORTLAND, David	University of Michigan, Ann Arbor, Michigan
O'SHEA, Donal	Mount Holyoke College, South Hadley, Massachusetts
PELLIKAAN, Gerardus R.	University of Utrecht, Netherlands
PERSSON, Ulf	Institute Mittag-Leffler, Djursholm, Sweden
PESKIN, Barbara	University of Illinois, Urbana, Illinois
PHAM, Frédéric	Nice University, Nice, France
PIENE, Ragni	University of Oslo, Norway
PINKHAM, Henry	Columbia University, New York, New York
PITCHER, Everett	Lehigh University, Bethlehem, Pennsylvania
PORTEOUS, Ian R.	University of Liverpool, England
POSTON, Timothy	Medical University of South Carolina, Charleston, South Carolina
PUERTA, Fernando	University Politecnica, Barcelona, Spain
RANDALL, John	Rutgers University, New Brunswick, New Jersey
RANDELL, Richard	University of Oklahoma, Norman, Oklahoma
REES, Elmer	University of Edinburgh, Scotland
RIEMENSCHNEIDER, Oswald W.	University of Hamburg, West Germany
ROBERTS, Joel L.	University of Minnesota, Minneapolis, Minnesota
RONGA, Felice	University of Geneva, Switzerland
RUSSELL, Peter	McGill University, Montreal, Quebec, Canada
RYDEN, Roy	Humboldt State University, Arcata, California
RYFF, John	National Science Foundation, Washington, D.C.
SABBAH, Claude	Ecole Polytechnique, Palaiseau, France
SAITO, Kyoji	Kyoto University, Kyoto, Japan
SAITO, Morihiko	Kyoto University, Kyoto, Japan
SATAKE, Ichiro	University of California, Berkeley, California
SCHERK, John	University of Alberta, Edmonton, Alberta, Canada
SCHLESSINGER, Mike	University of North Carolina, Chapel Hill, North Carolina
SCHREYER, Frank	University of Hamburg, West Germany
SCHWARZ, Gerald	Brandeis University, Waltham, Massachusetts
SEADE, José A.	Univ. Nac. Autonoma de Mexico, Ciudad University, Mexico
SHAH, Jayant	Northeastern University, Boston, Massachusetts
SIERSMA, Dirk	University of Utrecht, Netherlands
SMITH, Kevin	Columbia University, New York, New York
SMITH, Roy	University of Georgia, Athens, Georgia
SOMMESE, Andrew	University of Notre Dame, Notre Dame, Indiana
SPEISER, Robert	Illinois State University, Normal, Illinois
STEENBRINK, Joseph	University of Leiden, Netherlands
STONE, David	CUNY, Brooklyn College, Brooklyn, New York
SUMNERS, DeWitt L.	Florida State University, Tallahassee, Florida
SUWA, Tatsuo	Hokkaido University, Sapporo, Japan
TEISSIER, Bernard	Ecole Polytechnique, Paris, France
TERAO, Hiroaki	International Christian University, Tokyo, Japan
THOMAS, P. Emery	University of California, Berkeley, California
TIMOORIAN, James	University of Alberta, Edmonton, Alberta, Canada
TRÁNG, Lê Dũng	Ecole Polytechnique, Palaiseau, France
TROTMAN, David	University of Paris-Sud, Orsay, France
URABE, Tohsuke	Tokyo Metropolitan University, Tokyo, Japan

VAN DER LEK, Harm	Catholic University, Nijmegen, Netherlands
VARLEY, Robert	University of Georgia, Athens, Georgia
VASQUEZ, Alphonse	CUNY, Graduate School & University Center, New York, New York
VITULLI, Marie	University of Oregon, Eugene, Oregon
WAGREICH, Philip	University of Illinois at Chicago Circle, Chicago, Illinois
WAHL, Jonathan	University of North Carolina, Chapel Hill, North Carolina
WALL, Charles T.	University of Liverpool, England
WASHBURN, Sherwood	Seton Hall University, South Orange, New Jersey
WATANABE, Kimio	University of Tsukuba, Ibaraki, Japan
WILSON, Leslie	University of Hawaii, Honolulu, Hawaii
WOOD, John	University of Illinois at Chicago Circle, Chicago, Illinois
YANO, Tamaki	Saitama University, Saitama, Japan
YAU, Stephen S.-T.	University of Illinois at Chicago Circle, Chicago, Illinois
YOMDIN, Yosef	Ben-Gurion University of the Negev, Beer-Sheva, Israel
ZUCKER, Steven	Indiana University, Bloomington, Indiana