## THE

## JOURNAL

## OF

# SYMBOLIC LOGIC 

EDITED BY

Jon Barwise
George Boolos
John P. Burgess
Stephen A. Cook
Herbert Enderton
Kit Fine
William A. Howard
Wilfrid Hodges
Akihiro Kanamori
Alexander Kechris
Angus Macintyre

Consulting Editors:
James Baumgartner Jiǩí Bečvár
Gregory L. Cherlin M. J. Cresswell

Matthew Foreman
Sy D. Friedman
Saul A. Kripke
Gregory Minc

Michael Makrai
Andre Scedrov
Richard A. Shore
A. S. Troelstra Johan van Benthem Bas vas Fraassen

Volume 53
1988

Published quarterly by the Association for Symbolic Logic, Inc. with SUPPORT FROM ICSU AND FROM INSTITUTIONAL AND CORPORATE MEMBERS

The four numbers of Volume 53 were issued at the following dates:
Number 1, pages 1-336, March 8, 1988
Number 2, pages 337-672, July 6, 1988
Number 3, pages 673-1008, October 17, 1988
Number 4, pages 1009-1344, December 13, 1988
Numbers 1-4 of this volume are copyrighted © 1988 by the Association for Symbolic Logic, Inc. Reproduction of copyrighted numbers of the Journal by photostat, photoprint, microfilm, or like process is forbidden, except by written permission, to be obtained from the Secretary of the Association, C. Ward Henson, Department of Mathematics, University of Illinois, 1409 W. Green St., Urbana, IL 61801.

The paper used in this Journal is acid-free and falls within the guidelines established to ensure permanence and durability.

This Journal has been registered with the Copyright Clearance Center, Inc. The appearance of a code at the bottom of the first page of an article indicates the copyright owner's consent for copying beyond that permitted by Sections 107 or 108 of the U. S. Copyright Law, provided that the per-copy fee stated in the code is paid directly to Copyright Clearance Center, Inc., 21 Congress Street, Salem, MA 01970. This consent does not extend to copying for general distribution, for advertising or promotion purposes, for creating new collective works, or for resale. Specific written permission for such copying must be obtained from the Association.

## CONTENTS OF VOLUME 53

## SURVEY PAPERS

Blok, W. J. and Pigozzi, Don. Alfred Tarski's work on general meta- mathematics ..... 36
Doner, John and Hodges, Wilfrid. Alfred Tarski and decidable theo- ries ..... 20
ETCHEMENDY, JOHN. Tarski on truth and logical consequence ..... 51
Feferman, SOlomon. Hilbert's program relativized: Proof-theoretical and foundational reductions ..... 364
Hodges, Wilfrid. See Doner, John
Levy, A zriel. Alfred Tarski's work in set theory ..... 2
Pigozzi, Don. See Blok, W. J.
Sieg, Wilfried. Hilbert's program sixty years later ..... 338
SIMPSON, STEPHEN G. Partial realizations of Hilbert's program ..... 349
SUPPES, PATRICK. Philosophical implications of Tarski's work ..... 80
van den Dries, Lou. Alfred Tarski's elimination theory for real closed fields ..... 7
RESEARCH PAPERS
Ambos-Spies, Klaus and Fejer, Peter. Degree theoretical splitting properties of recursively enumerable sets ..... 1110
Andréka, H., Craig, W. and Nemeti, I. A system of logic for partial functions under existence-dependent Kleene equality ..... 834
Bailin, Sidney C. A normalization theorem for set theory ..... 673
BARBACK, JOSEPH. On infinite series of infinite isols ..... 443
BECKER, HOWARD. A characterization of jump operators ..... 708
BELLISSIMA, FABIO. Finite and finitely separable intermediate propositional logics ..... 403
Berardi, Stefano. Equalization of finite flowers ..... 105
BIRÓ, B. and SHELAH, S. Isomorphic but not lower base-isomorphic cylin- dric set algebras ..... 846
Bouscaren, Elisabeth and Poizat, Bruno. Des belles paires aux beaux uples ..... 434
BUECHLER, STEVEN. The classification of small weakly minimal sets. II ..... 625
——. The classification of small weakly minimal sets. III: Modules ..... 975
BURGESS, JOHN P. Addendum to "The truth is never simple" ..... 390
COPESTAKE, KATE. 1-genericity in the enumeration degrees ..... 878
Craig, W. See Andréka, H.
DELON, FRANÇOISE. Extensions séparées et immédiates des corps valués ..... 421
___ and Rouani, Yamina. Indécidabilité de corps de séries formelles ..... 1227
DICKMANN, M. A. The model theory of chain-closed fields ..... 921
Dimitracopoulos, C. See Kaye, R.
Dosen, Kosta and Schroeder-Heister, Peter. Uniqueness, defin-ability and interpolation554
Fejer, Peter. See Ambos-Spies, KlausFlum, Jörg and Martinez, Juan Carlos. On topological spaces equiv-alent to ordinals785
Freiling, Chris and Payne, T. H. Some properties of large filters ..... 1027
FRENCH, JAMES D. The false assumption underlying Berry's paradox ..... 1220
Gropp, URSULA. Coinductive formulas and a many-sorted interpolation the- orem ..... 937
Grossberg, Rami. A downward Löwenheim-Skolem theorem for infinitary theories which have the unsuperstability property ..... 231
GUREVIC, R. On ultracoproducts of compact Hausdorff spaces ..... 294
HARAN, DAN. Quantifier elimination in separably closed fields of finite im- perfectness degree ..... 463
HODES, HAROLD. Cardinalty logics. Part II: Definability in languages based on 'exactly' ..... 765
HODKINSON, I. M. and MACPHERSON, H. D. Relational structures de- termined by their finite induced substructures ..... 222
HOWARD, MARK. A proofless proof of the Barwise compactness theorem ..... 597
IDZIAK, Katarzyna and IdZiak, PaWEl M. Decidability problem for finite Heyting algebras ..... 727
IDZIAK, PaWEl M. See IdZIAK, Katarzyna
IHODA, JAIME I. Strong measure zero sets and rapid filters ..... 393
——. $\Sigma_{2}^{1}$-sets of reals ..... 636
and Shelah, SAHARON. Souslin forcing ..... 1188
JOHNSON, C. A. Seminormal $\lambda$-generated ideals on $P_{\kappa} \lambda$ ..... 92
KAStanas, Ilias G. Initial segments of $\Delta_{2 n+1}^{1}$-degrees ..... 259
Kaye, R., Paris, J. and Dimitracopoulos, C. On parameter free induction schemes ..... 1082
KOMJÁth, PÉTER and Shelah, Saharon. Forcing constructions for un- countably chromatic graphs ..... 696
Kucera, T.G. Generalizations of Deissler's minimality rank ..... 269
——. Positive Deissler rank and the complexity of injective modules ..... 284
Kunen, Kenneth. Where MA first fails ..... 429
Kutyeowski, Miroseaw. Finite automata, real time processes and counting problems in bounded arithmetic ..... 243
Laskowski, Michael Chris. Uncountable theories that are categorical in a higher power. ..... 512
Legrand, Remi. A basis result in combinatory logic ..... 1224
LEMPP, STEFFEN. A high strongly noncappable degree ..... 174
LÓPEZ-ESCOBAR, E. G. K. Circumscription within monotonic inferences. ..... 888
LUBARSKY, ROBERT S. Correction to "Simple r.e. degree structures" ..... 103
—. Definability and initial segments of $c$-degrees ..... 1070
MaASS, WOLFGANG. On the use of inaccessible numbers and order indis- cernibles in lower bound arguments for random access machines. ..... 1098
MacCaull, W. A. On the validity of Hilbert's Nullstellensatz, Artin's the- orem, and related results in Grothendieck toposes ..... 1177
Macpherson, H. D. See Hodkinson, I. M.
MADDY, PENELOPE. Believing the axioms. I ..... 481
——. Believing the axioms. II ..... 736
Martin, Gary A. Definability in reducts of algebraically closed fields ..... 188
Martinez, Juan Carlos. See Flum, Jörg
Matet, Pierre. Some filters of partitions ..... 540
Matsubara, Yo. Splitting $P_{\kappa} \lambda$ into stationary subsets ..... 385
MAYER, LAURA L. Vaught's conjecture for o-minimal theories ..... 146
MCCARTY, Charles. Constructive validity is nonarithmetic ..... 1036
MCCARTY, Charles. Markov's principle, isols and Dedekind finite sets ..... 1042
MOSES, M. Decidable discrete linear orders ..... 531
Mytilinaios, Michael E. and Slaman, Theodore A. $\Sigma_{2}$-collection and the infinite injury priority method ..... 212
Németi, I. See Andréka, H.
OKada, Mitsuhiro. On a theory of weak implications ..... 200
Osherson, Daniel N., Stob, Michael and Weinstein, Scott. Mechanical learners pay a price for Bayesianism ..... 1245
Paris, J. B., Wilkie, A. J. and Woods, A. R. Provability of the pigeonhole principle and the existence of infinitely many primes ..... 1235
-. See KAYE, R.
Payne, T. H. See Freiling, Chris
Pillay, ANAND. Sheaves of continuous definable functions ..... 1165
Poizat, Bruno. Missionary mathematics ..... 132
——. MM. Borel, Tits, Zil'ber et le Général Nonsense ..... 124
RESSAYRE, J. P. Formal languages defined by the underlying structure of their words ..... 1009
Riedel, Herbert H. J. Existentially closed algebras and Boolean products ..... 571
Rouani, Yamina. See Delon, Françoise
Schroeder-Heister, Peter. See Dosen, Kosta
SCOWCROFT, Philip. A note on definable Skolem functions ..... 905
——. More on definable sets of $p$-adic numbers ..... 912
—— and VAN DEN DRIES, LOU. On the structure of semialgebraic sets over $p$-adic fields ..... 1138
Shelah, Saharon. See Biró, B.
Shelah, Saharon. See Biró, B.
——. See Ihoda, Jaime I.
———. See KOMJÁth, PÉter
SIMmONS, HAROLD. Large discrete parts of the $E$-tree ..... 980
Simpson, Stephen G. Ordinal numbers and the Hilbert basis theorem ..... 961
Slaman, Theodore A. See Mytilinaios, Michael E.
SMITH, JAN M. The independence of Peano's fourth axiom from Martin-Löf's type theory without universes ..... 840
SPECTOR, MITCHELL. Ultrapowers without the axiom of choice ..... 1208
Stanley, M. C. Backwards Easton forcing and $0^{\#}$ ..... 809
Stob, Michael. See Osherson, Daniel N.Stoltenberg-Hansen, V. and TUCKER, J. V. Complete local rings asdomains603
TAKEUTI, GAISI. Boolean simple groups and Boolean simple rings ..... 160
Tsuboi, AKito. Strongly 2-dimensional theories ..... 931
Tucker, J. V. See Stoltenberg-Hansen, V.
VAN DEN DRIES, LOU. On the elementary theory of restricted elementary functions ..... 796
———. See SCOWCROFT, PhiliP
Walker, D. J. On the transversal hypothesis and the weak Kurepa hypoth- esis ..... 854
Weinstein, Scott. See Osherson, Daniel N.
Wilkie, A. J. See Paris, J. B.
Woods, A. R. See Paris, J. B.
Yasumoto, Masahiro. Algebraic extensions in nonstandard models and Hilbert's irreducibility theorem ..... 470
ZAKRZEWSKI, PIOTR. On universal semiregular invariant measures ..... 1170
MEETINGS
Annual meeting of the Association for Symbolic Logic, New York City, December 1987 ..... 1287
Australasian Association for Logic, annual conference, Brisbane, 1987 ..... 1283
Logic and linguistics meeting, Stanford, 1987 ..... 1275
Meeting of the Association for Symbolic Logic, Auckland, 1986 ..... 330
Meeting of the Association for Symbolic Logic, New York City, May 1987 ..... 1270
Meeting of the Association for Symbolic Logic, San Antonio, 1987 ..... 1000
REVIEWS
Reviews ..... 301
Reviews ..... 643
Reviews ..... 985
Reviews ..... 1252
NOTICES
Notices ..... 335
Notices ..... 671
Notices ..... 1007
Notices ..... 1343
OFFICERS AND MEMBERS
List of officers and members of the Association for Symbolic Logic ..... 1300

Individual membership in the Association is open to anyone interested in its work. Annual dues for members are $\$ 36$, or $\$ 18$ for students. Dues include subscription to the current volume of the Journal. For their personal use, members may purchase back volumes at a discount. Persons wishing to subscribe to the JOURNAL for their individual use without becoming Association members should write to the Secretary-Treasurer.

Institutional membership in the Association is available to any academic institution or department. Annual dues are $\$ 225$. Membership privileges include choices of current subscriptions, of back volumes, and of student memberships; a detailed description is available from the Association. Information on corporate membership is also available from the Association.

Back volumes of the JOURNAL are available. Prices per volume in paper form are as follows: $\$ 35$ for Volumes 1-13, $\$ 70$ for Volumes $14-30, \$ 84$ for Volumes 31-45, $\$ 106$ for Volumes $46-47, \$ 140$ for Volumes $48-49$, and $\$ 125$ for Volumes $50-52$. Volume 26 is an index for Volumes $1-26 ;$ Number 4 of Volume 45 is an index for Volumes 27-45. The two indexes may be purchased together for $\$ 100$. Members of the Association may purchase back volumes for their personal use at a $25 \%$ discount. A Bibliography of Symbolic Logic by Alonzo Church (from Volumes. 1 and 3) may be purchased separately; the price is $\$ 15$ for members or $\$ 20$ for nonmembers.

Information on microfiche and microfilm editions of the JOURNAL can be obtained from University Microfilms, 300 North Zeeb Road, Ann Arbor, MI 48106.

Notices of change of address, dues, and subscriptions to the JoUrNAL should be sent to The Association for Symbolic Logic, P.O. Box 70557, Pasadena, CA 91107; all orders must be accompanied by payment.

Requests for information, applications for membership, business correspondence, and notices and announcements for publication in the JOURNAL should be sent to the SecretaryTreasurer of the Association, C. Ward Henson, Department of Mathematics, University of Illinois, 1409 W. Green Street, Urbana, IL 61801.

Books for review in the JOURNAL should be sent to Herbert Enderton, The Journal of Symbolic Logic, U.C.L.A., Los Angeles, CA 90024. The other editors of reviews are George Boolos, William Howard, Akihiro Kanamori, Michael Makkai, and Andre Scedrov.

Articles being submitted for publication in the JOURNAL should be sent in duplicate to one of the following editors: Jon Barwise, Genter for the Study of Language and Information, Ventura Hall, Stanford University, Stanford, CA 94305; or Stephen A. Cook, Department of Computer Science, University of Toronto, Toronto M5S 1A4, Canada; or Alexander Kechris, Department of Mathematics, California Institute of Technology, Pasadena, CA 91125; or Angus Macintyre, Mathematical Institute, 24-20 St. Giles, Oxford OX1 SLB, England; or Richard Shore, Department of Mathematics, Cornell University, Ithaca, NY 14853; or A. S. Troelstra, Mathematisch Instituut, Universiteit van Amsterdam, Roetersstraat 15, Amsterdam 1018 WB, The Netherlands; or Johan van Benthem, Mathematisch Instituut, Universiteit van Amsterdam, Roetersstraat 15, Amsterdam 1018 WB, The Netherlands; or Bas van Fraassen, Department of Philosophy, Princeton University, Princeton, NJ 08544. The editor in charge of survey and expository articles is John P. Burgess, Department of Philosophy, Princeton University, Princeton, NJ 08544.

Each manuscript should be typewritten with wide margins and with double spacing between the lines. Footnotes should be numbered consecutively and should also be typed with wide margins and double spacing, preferably on a separate sheet. Two copies of the manuscript should be sent to the editor, and the author should also keep a complete copy. Fifty reprints of each article are supplied at no charge, and additional reprints may be purchased if desired.

Authors of papers (excluding survey/expository papers and reviews) accepted for publication in the JOURNAL are notified of the approximate number of printed pages. At that time they are asked, if funds are available from supporting institutions or grants, to arrange for payment of page charges of $\$ 30$ per printed page. This involves no financial obligation for the author, and acceptance of the paper will not be affected by whether payment is made.

The JOURNAL invites submission of (1) original technical papers in the field of symbolic logic, (2) expository papers in this field, (3) papers whose main point is philosophical and which either bear upon logic or make use of its methods, and (4) studies in the history of logic in which modern technical developments are taken into account.

