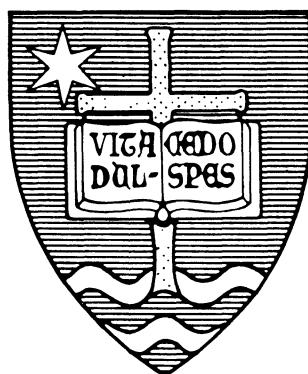


NOTRE DAME JOURNAL OF FORMAL LOGIC

Edited by

Bolesław Sobociński



VOLUME XVIII

1977

NOTRE DAME JOURNAL OF FORMAL LOGIC

Bolesław Sobociński, *Editor*

Business Manager
Michele Daugherty

Editorial Board

Ignacio Angelelli
F. Gonzalez Asenjo
Nuel D. Belnap, Jr.
Ivan Boh
William W. Boone
Karel L. de Bouvère

Robert Bull
John Thomas Canty
George Goe
Hugues Leblanc
Gerald Massey
Elliott Mendelson

Marian B. Pour-El
Jean E. Rubin
Luis Elpidio Sanchis
Wilson E. Singletary
Vito F. Sinisi
J. Jay Zeman

Notre Dame Journal of Formal Logic is published quarterly by the University of Notre Dame in January, April, July and October of each year. The Journal is composed by Beljan, Dexter, Michigan and printed by Cushing-Malloy, Inc., Ann Arbor, Michigan. Second-class postage paid at Notre Dame, Indiana 46556.

Authors should consult the "Guide to authors" for editorial information. Articles and editorial correspondence should be sent to *B. Sobociński, Editor, P.O. Box 28, Notre Dame, Indiana 46556, U.S.A.*

Subscriptions are \$20.00 per year for institutions and \$15.00 for individuals. Back volumes are \$10.00 each for Volumes 1-9, \$16.00 for Volumes 10-16. Orders for subscriptions and back volumes (accompanied by payment), and changes of address should be sent to the *Business Manager, P. O. Box 5, Notre Dame, Indiana 46556, U.S.A.*

Copyright ©1977 by the University of Notre Dame. All rights reserved.

NOTRE DAME JOURNAL OF FORMAL LOGIC

VOLUME XVIII, 1977

CONTENTS

Leśniewski's ontology extended with the axiom of choice. By James George Kowalski	1
A semantics model for imperatives. By Patric Cean Nolan	79
Logical truth and indeterminacy. By Steven E. Boër	85
Abnormal worlds and the non-Lewis modal systems. By G. N. Georgacarakos	95
Three-valued free tense logic. By Robert P. McArthur	101
A strong completeness theorem for 3-valued logic. Part II. By Hugues Leblanc	107
The Q-consistency of \mathcal{I}_{22} . By Jonathan P. Seldin	117
Are modal contexts referentially opaque? By J. M. Orenduff	128
On De Morgan's argument. By Daniel D. Merrill	133
Negation, material equivalence, and conditioned nonconjunction: completeness and duality. By Gerald J. Massey	140
A note on the completeness proof for natural deduction. By David W. Bennett	145
On two first order type theories for the theory of sets. By Fred Coppotelli	147
Variations of Zorn's lemma, principles of cofinality, and Hausdorff's maximal principle. Part II: Class forms. By Judith M. Harper and Jean E. Rubin	151
Classical logical relations. By A. J. Baker	164
Regressive order-types. By John L. Hickman	169
Next \mathcal{P} admissible sets are of cofinality ω . By Judy Green	175
A note on Thomason's representation of S5. By Satoshi Miura and Shigeo Ohama	177
First degree formulas in Curry's LD. By Robert K. Meyer	181
In memoriam Ivo Thomas (1912-1976). By Otto Bird	193
Bibliography of Ivo Thomas. By Deirdre La Porte	195
The modal predicate logics $\mathbf{PF}^*\mathbf{F}$. By Robert L. Wilson	208
Metalogical incompatibilities in the formal description of Buddhist logic (Nyāya). By Douglas Dunsmore Daye	221
An early fifteenth century discussion of infinite sets. By E. J. Ashworth	232
Łukasiewicz, Leibniz and the arithmetization of the syllogism. By David Marshall, Jr.	235
Generalizing König's infinity lemma. By Robert H. Cowen	243
Incomplete translations of complete logics. By Stewart Shapiro	248

On Yablonskii theorem concerning functional completeness of k -valued logic. By <i>Kanzo Hino</i>	251
Simplified formalizations of fragments of the propositional calculus. By <i>Alan Rose</i>	255
An answer to Armstrong's question about incompleteness in Copi. By <i>Paul J. Campbell</i>	262
Recursive and recursively enumerable manifolds. I. By <i>Vladeta Vučković</i>	265
A tableau system for propositional S5. By <i>Melvin Fitting</i>	292
Two notes on recursively enumerable vector spaces. By <i>Richard Guhl</i> . 295	
Infinite series of regressive isols under addition. By <i>Judith L. Gersting</i>	299
The one-one equivalence of some general combinatorial decision problems. By <i>Charles E. Hughes</i> and <i>W. E. Singletary</i>	305
Binary consistent choice of triples. By <i>Robert H. Cowen</i>	310
Second order and higher order universal decision elements in m -valued logic. By <i>John Loader</i>	313
Independent necessary conditions for functional completeness in m -valued logic. By <i>Yale N. Patt</i>	318
Two systems of presupposition logic. By <i>I. L. Humberstone</i> and <i>J. M. Bell</i>	321
A refoundation of modal logic. By <i>Graham Priest</i>	340
A note on metaphysics and the foundations of mathematics. By <i>Robert L. Wilson</i>	355
A reassessment of George Boole's theory of logic. By <i>James W. Van Evra</i>	363
An axiomatization of Herzberger's 2-dimensional presuppositional semantics. By <i>John N. Martin</i>	378
Recursive and recursively enumerable manifolds. II. By <i>Vladeta Vučković</i>	383
When do *continuous extensions exist? By <i>Robert Warren Button</i>	406
A note on the axiom of choice and the continuum hypothesis. By <i>Rolf Schock</i>	409
The entailment operator. By <i>Peter A. Facione</i>	415
Semantique des formules logiques en forme d'équivalence n -aire (demi-modèles). By <i>Metoděj K. Chytil</i>	421
The weak topology on logical calculi. By <i>Arnold R. Vobach</i>	436
The logic of closed categories. By <i>Manfred E. Szabo</i>	441
Hintikka's free logic is not free. By <i>Henri J. Sarlet</i>	458
The "conditionatim"-clause: one of the problems of existential import in the history of logic. By <i>Ivan Boh</i>	459
Some Post-complete extensions of S2 and S3. By <i>Robert V. Kohn</i>	467
A remark on Gentzen's calculus of sequents. By <i>Johannes Czermak</i>	471
The numeral axioms. By <i>Richard Butrick</i>	475

Additional extensions of S4. By G. N. Georgacarakos	477
Some applications of model theory to the metatheory of program schemata. By Richard A. DeMillo	489
Frequencies and beliefs. By Charles G. Werner	496
The continuum hypothesis is independent of second-order ZF . By Thomas S. Weston.	499
Semantics for S4.03. By G. N. Georgacarakos	504
On G. Spencer Brown's laws of form. By B. Banaschewski.	507
A deduction rule for $\text{VBTO}(\)_{i=1}^n$. By Richard Butrick	510
In memoriam Carew Arthur Meredith (1904-1976). By David Meredith.	513
Modal tree constructions. By Ralph L. Slaght	517
Critical points of normal functions. I. By John L. Hickman.	527
Pathologies in the ed-regressive sets of order 2. By Seth Catlin.	535
Degrees of unsolvability and strong forms of $\mathbf{A}_R + \mathbf{A}_R \not\leq \mathbf{A}_R$. By Thomas G. McLaughlin	545
Some thomistic properties of primordiality. By R. M. Martin.	567
Is the intuitionistic bar-induction a constructive principle? By Klaus Mainzer	583
A note on Suzuki's chain of hyperdegrees. By P. G. Odifreddi.	589
On Ackermann's theory of sets. By Dasharath Singh.	591
A note on the truth-table for 'If p then q '. By Lee C. Archie, B. G. Hurdle, Jr. and William Stewart Thomblison	596
On Ramsey's theorem and the axiom of choice. By Gabriele Lolli.	599
Modal trees for T and S5. By B. Davidson, F. C. Jackson and R. Pargettter.	602
Two comments on Lemmon's <i>Beginning Logic</i> . By Barry Coburn and David Miller.	607
"Not both p and not q , therefore if p then q " is a valid form of argument. By S. K. Wertz	611
On an enduring <i>non sequitur</i> of Quine's. By Gary H. Merrill.	613
An axiom system for three-valued Łukasiewicz propositional calculus. By Luisa Iturrioz	616
A semantical analysis of the calculi \mathbf{C}_n . By Newton C. A. da Costa and E. H. Alves.	621
Fitch-style rules for many modal logics. By David F. Siemens, Jr.	631
Necessitas consequentis in a singleton possible world. By Robert W. Murungi	637
A note on the roots of Peirce's division of logic into three branches. By Emily Michael	639

LIST OF AUTHORS

This list of authors gives a complete roster of all who have contributed articles to the *Notre Dame Journal of Formal Logic*. It is arranged alphabetically and contains the names of four hundred eighty-seven authors:

A. Abian, R. Ackermann, M. Adams, E. Alves, J. Anderson, M. Anderson, P. Andrews, I. Angelelli, C. Applebaum, R. Applebee, L. Archie, R. Armstrong, F. Asenjo, E. Ashworth, J. Bacon, A. Baker, J. Baker, B. Banaschewski, J. Baralt-Torrijos, J. Barback, J. Barker, R. Baxter, J. Beard, R. Beatty, R. Beazer, W. R. Belding, J. Bell, N. Belnap, Jr., D. Bennett, L. Beran, J. Berry, O. Bird, L. Birnbaum, J. H. Blackhurst, S. Bloom, A. Blum, I. Bocheński, S. Boër, I. Boh, D. Bollman, G. Boolos, K. de Bouvère, K. Bowen, M. Bradley, R. Brady, C. Bredlau, D. Brignole, J. Broido, B. Bruce, G. Brumm, R. Bull, A. Bullock, M. Bunder, A. Bundy, H. Burdick, R. Butrick, R. Button, H. Byerly, T. Bynum, P. Calabrese, R. Call, P. Campbell, J. Canty, J. Cargile, R. Carnes, A. Carpentier, H-N. Castafieda, S. Catlin, C. Caton, H. Chandler, E. W. Chapin, Jr., T. Chapman, C. Cheng, L. Chiaraviglio, J. Chidgey, M. Chytil, R. Clay, B. Coburn, N. Cocchiarella, R. Cogan, R. Cole, K. Collier, G. Collins, J. Cooley, F. Coppotelli, J. Corcoran, W. Cornish, N. da Costa, R. Cowen, M. Cresswell, W. S. Croddy, F. Crosson, E. Curley, J. Czermak, I. Dapunt, J. Davant, B. Davidson, C. Davis, D. Daye, J. Dekker, R. DeMillo, T. Denise, K. Döpp, J. Donnelly, D. Dorrough, R. Doss, A. Dou, S. Dowdy, J. Drabbe, B. Dreben, A. Dumitriu, J. Dunn, R. Eberle, E. Ellentuck, H. Enderton, G. Englebretsen, W. Essler, T. Evans, J. Evenden, P. Facione, G. Farre, R. Farrell, H. Fast, J. Feibleman, K. Fine, M. Fisk, M. Fitting, P. FitzPatrick, L. Foss, N. Fowler, III, F. Fox, E. Fosley, W. Frank, W. Frascella, G. Frei-Imfeld, J. Fulton, P. Gärdénfors, L. Gagnon, J. Garson, F. Gass, M. Gemignani, H. Gensler, G. Georgacarakos, N. Georgieva, G. Germano, J. Gersting, M. Gilbert, M. Ginsberg, R. Girle, M. Gladstone, G. Gleason, L. Goble, L. Goddard, G. Goe, A. Goetz, D. Gogol, H. Goldberg, R. Goldblatt, M. Goldstein, H. Gonshor, R. Goodstein, J. Gracia, R. Grandy, J. Grant, J. Green, J. Gregg, T. Grilliot, W. Grosky, R. Güting, R. Guhl, K. Gyekye, E. Hacker, J. Halpern, C. Hamblin, N. Hanson, J. Harper, J. F. Harris, J. H. Harris, W. Harris, W. Hart, B. Hawkins, S. Hayes, A. Hazen, T. Hearne, I. Heath, T. Hecht, H. Hendry, D. Henry, L. Herman, H. Hermes, A. Heyting, K. Hickin, J. Hickman, K. Hino, H. Hiż, M. Hocutt, J. Hooley, C. Hoermann, Jr., P. Horwich, C. Hughes, I. Humberstone, B. Hurdle, Jr., A. Ihrig, L. Iturrioz, P. Jablon, F. Jackson, W. Jackson, W. Jaffe, B. Jeffcott, Z. Jordan, G. Kalinowski, D. Kaplan, T. Katriňák, B. Katz, J. Kearns, H. Kennedy, C. Kielkopf, R. Kohn, J. Kotelly, J. Kowalski, M. Krom, A. Kron, G. Küng, L. Kulathungam, F. von Kutshera, L. Laita, J. Lake, K. Lambert, M. Laplaza, D. La Porte, L. Larouche, A. Lauer, H. Leblanc, J. Lee, R. Lee, A. Lehmann, S. Lehmann, C. Leininger, C. Lejewski, E. Lemmon, B. Lercher, D. Lichtblau, N. de Lillo, S. Liu, J. Loader, K. Loewen, G. Lolli, M. Loux, W. Lycan, C. Lyngholm, M. Machover, J. Mackie, E. Madison, K. Mainzer, D. Makinson, W. Malcolm, R. Manor, D. Marans, J. Markham, E. Marsden, D. Marshall, J. Martin, N. Martin, R. Martin, A. Martinich, G. Massey, R. McArthur, S. McCall, S. McCleary, C. McKay, J. McKean, V. McKim, T. McLaughlin, J. McLelland, E. Mendelson, K. Menger, C. Merchant, C. Meredith, D. Meredith, D. Merrill, G. Merrill, R. Meyer, L. Meyers,

E. Michael, E. Mihailescu, C. Milici, D. Miller, D. M. Miller, J. Miller, J. Minichiello, S. Miura, R. Montague, L. Monteiro, H. Montgomery, A. Moreno, C. Morgan, N. Moutafakis, M. Mullick, A. Mullin, R. Murungi, J. Muzio, J. Myhill, O. Narbutt, A. vander Nat, E. Nemesszeghy, W. Nemitz, H. Nielsen, P. Nolan, D. Nute, W. O'Briant, P. Odifreddi, S. Ōhama, K. Ohashi, J. Okee, J. Orenduff, J. Owings, B. Pahi, T. Pak, R. Pargetter, R. Z. Parks, M. Parnes, W. Parry, C. Parsons, M. Partis, Y. Patt, T. Patton, J. Paulos, T. Payne, B. Peklo, D. Pelletier, P. Perkins, R. Peters, J. Peterson, C. Pinter, R. Piziak, K. Pledger, J. Plotkin, H. Pogorzelski, N. Pole, J. Pollock, H. Pospesel, R. Poss, L. Pozsgay, G. Priest, A. Prior, M. Prullage, R. Purtill, H. Putnam, C. Quinn, A. Raggio, G. Rainich, A. Rao, E. Rasof, R. Redmon, Jr., J. Reichbach, M. Rennie, N. Rescher, M. Resnik, V. F. Rickey, T. Ristea, F. Rivetti Barbő, F. Roberts, B. van Rootselaar, A. Roqué, A. Rose, J. Rosenberg, S. Rosenberg, Y. Rosenberg, J. Rosenthal, R. Routley, H. Rubin, J. Rubin, Janet Ryback, John Ryback, A. Sade, P. Sagal, S. Saito, L. Sanchis, H. Sarlet, T. Satre, K. Sayre, T. Scharle, H. Schneider, R. Schock, H. Schott, E. Schuh, M. Schultz, G. Schumm, S. Sehgal, J. Seldin, R. Setlur, S. Shapiro, A. Shukla, Sibajiban, D. Siemens, Jr., W. Sierpiński, J. Sikora, L. Simons, D. Singh, W. Singletary, V. Sinisi, F. Sioson, M. Sirridge, H. Skala, T. Skolem, B. Skyrms, R. Slaght, T. Smiley, D. Smith, T. Smith, M. Smyth, D. P. Snyder, J. Sobel, B. Sobociński, W. D. Solomon, C. de Renna e Souza, P. Spade, W. Stegmüller, J. Stevenson, L. Stevenson, T. Stihl, H. Stopes-Roe, P. Strauss, T. Sudkamp, T. Sullivan, S. Summersbee, R. Suszko, A. Sweet, P. Swiggart, M. Szabo, D. Székely, J. Tamburino, S. Tamura, M. Tapia, R. Tax, I. Thomas, W. Thomas, R. Thomason, S. Thomason, W. Thomblison, R. Tompkins, J. Trentman, A. Trew, C. Turek, R. Tursman, F. Tytus, J. Ullian, D. Ulrich, J. Van Evra, W. Verloren van Themaat, R. Vesley, A. Vobach, J. Volgo, V. Vučković, J. Vuillemin, H. J. Wadleigh, C. Wagner, A. Walters, H. Wasserman, G. Weaver, S. M. Webb, P. Weingartner, D. Welker, P. Welsh, Jr., R. Wengert, C. Werner, S. Wertz, T. Wesselkamper, K. Weston, T. Weston, B. White, W. Wilcox, A. Wilde, H. Williams, C. Williamson, R. Wilson, J. Winnie, J. Wiredu, W. Wisdom, P. Woodruff, J. Woods, C. Works, J. Wu, M. Yntema, W. Yourgrau, H. Zassenhaus, J. Zeman, M. Zuckerman.

NOTRE DAME JOURNAL OF FORMAL LOGIC

Bolesław Sobociński, *Editor*

Michele Daugherty, *Business Manager*

Guide to authors submitting articles for publication

Articles are invited for publication in the Journal which bring new results to any of the following areas: algebraic logic, classical logical systems, constructive mathematics, methodology of deductive systems, model theory, non-classical formal systems, proof theory, recursion theory, and set theory. The Journal is devoted primarily to logic and the foundations of mathematics and papers which are historical or philosophical in nature will only be considered for publication provided they employ the methods of formal logic in their exposition.

Manuscripts should be typewritten with wide margins on bond paper, using double (or triple) spacing between lines throughout (including notes and references). Particular care should be given to allow sufficient space between lines containing subscripted and superscripted symbols. Each page of the manuscript (including notes and references) should be numbered. The first page should contain the article title and author's name. The last page should contain the institutional affiliation and the exact mailing address. A concise abstract should accompany each article. Authors have full responsibility for the proper preparation of manuscripts. When the manuscript is not properly prepared it may be returned to the author for retyping; services performed by the editorial offices in this regard are properly chargeable to authors. The original copy of the manuscript should be submitted (to only one journal at a time); authors should retain one copy of everything submitted.

Footnotes should be indicated by consecutive superscript numerals and listed with wide spacing between lines at the end of the article. Footnotes may appear in print at the bottom of the appropriate pages, but should nevertheless be submitted in this form. A footnote which acknowledges a debt of the author to a foundation grant or individuals should be indicated by an asterisk.

References should be cited by consecutive numerals in square brackets and listed with wide spacing between lines at the end of the listing of footnotes.

A *list of symbols* used should be submitted with the manuscript. This list may be headed "Note to the Printer"; it should not define the symbols mathematically, but should identify them typographically. Authors should underline various types of symbols in different colors throughout the manuscript, blue for bold, red for Greek, green for Gothic and other characters. It is suggested that authors refer to back issues of the Journal for examples of the style of composition.

Proof sheets are generally given authors for correcting errors that occur in composition. However, any special composition costs arising out of an author's revision of text of an article in proof will be charged to the author.

Fifty offprints without covers of each article will be supplied free of charge. Additional offprints or covers for offprints may be purchased.

Editorial correspondence and articles should be sent to:

B. Sobociński, Editor, P.O. Box 28, Notre Dame, Indiana 46556, U.S.A.

The Journal is published quarterly by the University of Notre Dame. Subscriptions are \$20.00 per year for institutions and \$15.00 for individuals. Back volumes are \$10.00 each for Volumes 1-9, \$16.00 for Volumes 10-16. Orders for subscriptions and back volumes (accompanied by payment), and changes of address should be sent to the Business Manager, P.O. Box 5, Notre Dame, Indiana 46556, U.S.A.

Australasian Journal of Philosophy

Editor: ROBERT BROWN

Published in May, August and December

Subscriptions are \$8 (Aust.) for institutions and \$5 (Aust.) for individuals. They should be sent to the Business Manager at the *Department of Philosophy, School of General Studies, A.N.U., Canberra, A.C.T., 2600.*

Manuscripts should be sent to the Editor at the *Department of Philosophy, Research School of Social Sciences, A.N.U., Canberra, A.C.T., 2600.*

RATIO

edited by STEPHAN KÖRNER

Volume XVIII	December 1976	No. 2
Kant on Existence		J. MICHAEL YOUNG
How to Dispense with Things in Themselves (II)		M. S. GRAM
Freedom of Indifference		NICHOLAS NATHAN
The Source of the River of Time		FERREL CHRISTENSEN
On the Alleged Importance of Moral Rights		WILLIAM NELSON
Mentezin: On the Problem of the Rehabilitation of Criminals		KEVIN MCCORMICK

Reviews

Annual Subscription: £8.00 (inland) £9.00 (overseas) \$24.00 (U.S.A. and Canada)

Published by BASIL BLACKWELL, Oxford

Orders to: Journals Department, Basil Blackwell & Mott Ltd.,
108 Cowley Road, Oxford OX4 1JF, England.

The British Journal for the Philosophy of Science

Contents, Volume 28 Number 1 March 1977

Articles

- JOHN MAYBERRY On the Consistency Problem for Set Theory: An Essay on the Cantorian Foundations of Classical Mathematics (I)
ALFONS GRIEDER Relativity, Causality and the 'Substratum'
FERREL CHRISTENSEN How to Establish Non-Conventional Isochrony
JON DORLING The Eliminability of Masses and Forces in Newtonian Particle Mechanics: Suppes Reconsidered

Discussion Note

- PETER URBACH Putnam and Wilks and Mind and Body

Review Articles

- MICHAEL REDHEAD Wave-Particle Duality (Review of M. Audi: *The Interpretation of Quantum Mechanics* and J. M. Jauch: *Are Quanta Real?*)
FRED D'AGOSTINO Knowledge of Language (Review of D. Cooper *Knowledge of Language*)

Reviews

- W. V. QUINE on I. Lakatos: *Proofs and Refutations: The Logic of Mathematical Discovery*;
SUSAN HAACK on D. J. O'Connor: *The Correspondence Theory of Truth* and C. J. F. Williams: *What is Truth?*; TOM SETTLE on M. Bunge: *Method, Model and Matter*;
JOHN BELL on R. C. Jeffrey and G. S. Boolos: *Computability and Logic*

Announcements

Published for the British Society for the Philosophy of Science by
Aberdeen University Press, Farmers Hall, Aberdeen AB9 2XT, Scotland

Editors: John Watkins and John Worrall

Price £2.50 (\$8.00)

Subscription Price £7.00 (\$22.00)

Synthese

An International Journal for Epistemology and Philosophy of Science

Editor-in-Chief: Jaakko Hintikka, Academy of Finland and Stanford University.

Associate Editors: Risto Hilpinen, Department of Philosophy, Harvard University,
Ilkka Niiniluoto, Institute of Philosophy, Helsinki.

Review Editor: Dagfinn Føllesdal, Institute of Philosophy, University of Oslo.

Editorial Assistant: Esa Saarinen, Institute of Philosophy, Helsinki.

Board of Consulting Editors: David M. Armstrong, Yehoshua Bar-Hillel, Arthur W. Burks, Robert S. Cohen, Donald Davidson, Hans Freudenthal, Ian Hacking, Jerrold J. Katz, G. Nuchelmans, Wesley C. Salmon, Wolfgang Stegmüller, Erik Stenius, Patrick Suppes, Klemens Szaniawski, Ladislav Tondl, H. Törnebohm, Marx W. Wartofsky.

Synthese publishes articles in all the fields covered by the subtitle. These include the theory of knowledge; the general methodological problems of science; the methodological and foundational problems of the different departmental sciences; those aspects of symbolic logic and of the foundations of mathematics which are relevant to the philosophy and methodology of science; and those facets of the history and sociology of science which are important for contemporary topical pursuits.

Subscription price per volume of four issues Dfl. 110,- / US \$44.00, plus Dfl. 15,- / US \$6.00 for postage and handling. Two volumes will be published yearly. Personal subscription price on request.



D. Reidel Publishing Company

Dordrecht - Holland / Boston - U.S.A.