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2008–2009 WINTER MEETING OF THE ASSOCIATION FOR SYMBOLIC LOGIC

Marriott Wardman Park Hotel, Washington, DC
January 7–8, 2009

The 2008–09 Winter Meeting of Association of Symbolic Logic was held on January 7–8, 2009 at the Marriott Wardman Park hotel, in conjunction with the annual Joint Mathematical Meetings. The members of the Program Committee were Ali Enayat (Chair), Simon Thomas, and Rebecca Weber. The program consisted of six invited 50-minute talks and 12 contributed talks. The ASL hosted a welcoming reception on January 7 at the Marriott. In addition, there were two joint AMS-ASL Special Sessions. **Logic and Dynamical Systems**, organized by Stephen G. Simpson, was held during January 5–6; and **Model Theoretic Methods in Finite Combinatorics**, organized by Martin Grohe and Johann M. Makowsky, was held during January 6–7.

The 50-minute invited addresses were:

Barbara F. Csima (University of Waterloo), *Computable model theory*.

Inessa Epstein (California Institute of Technology), *Orbit equivalence and ergodic actions of countable groups*.

Rahim Moosa (University of Waterloo), *Jet spaces and the Zilber dichotomy*.

Christian Rosendal (University of Illinois at Chicago), *Descriptive set theory and the classification of separable Banach spaces*.

Jouko Väänänen (ILLC, Amsterdam, and University of Helsinki), *Set theoretic methods in model theory*.

Albert Visser (Utrecht University), *Can we make the Second Incompleteness Theorem coordinate free*?

Abstracts of the invited talks and contributed talks given (in person or by title) by members of the Association for Symbolic Logic follow.

For the Program Committee
ALI ENAYAT

Abstracts of invited talks

► BARBARA F. CSIMA, *Computable structure theory*.
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In computable structure theory, one examines various countably infinite structures (such as linear orderings and graphs) for their computability theoretic properties. For example, the standard theorem that any two countable dense linear orders without endpoints are

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isomorphic can be carried out computably, in the sense that if the two countable dense linear orders are nicely presented, then there must be a computable isomorphism between them. However, there are many examples of computable structures that are isomorphic but not computably isomorphic.

This talk will be an introduction to computable structure theory, explaining some standard examples, and indicating areas of current research.

► INESSA EPSTEIN, *Orbit equivalence and ergodic actions of countable groups*.
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Consider a countable group G acting in a Borel way by measure preserving automorphisms on a standard probability space X. The orbits of this action give rise to an equivalence relation on X. We say two measure preserving actions of groups G and H on spaces X and Y, respectively, are orbit equivalent if there is a measure preserving bijection between conull subsets of X and Y identifying the orbits.

The motivation for studying orbit equivalence originally stemmed from operator algebras. In this talk, I will discuss a result concerning the number of orbit inequivalent free, measure preserving, ergodic actions that exist for a given countable group. I will also consider the Borel complexity of the classification problem of the orbit equivalence of these actions.

► RAHIM MOOSA, *Jet spaces and the Zilber dichotomy*.
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In 2002, abstracting from a theorem in complex-analytic geometry, Anand Pillay introduced a certain model-theoretic condition, called the canonical base property (CBP), which is conjectured to hold in finite-rank theories. This condition is interesting because it provides a direct proof of the Zilber dichotomy in certain geometric contexts. What seems to be required in establishing the CBP in any given situation is an appropriate notion of "jet space". In my talk I will explain this circle of ideas and discuss recent developments.

► CHRISTIAN ROSENDAL, *Descriptive set theory and the classification of separable Banach spaces*.
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The classification problem for separable Banach spaces is notoriously difficult, so much that for a long time no one really seriously has believed that actual progress could be made on it. This belief is underscored by the tremendous developments in the geometric theory of Banach spaces in the '90s with the construction, especially by Gowers and Maurey, of a multitude of badly behaved spaces that showed that the variety of Banach spaces was even bigger than expected.

On the other hand, Ramsey theoretical techniques introduced by Gowers indicate that, rather than hoping for an outright classification, one could attempt to classify spaces by finding recognisable subspaces present in all spaces (in logic terminology this is the "basis problem").

We shall present two separate pieces of work, one by Ferenczi, Louveau and Rosendal and the other by Ferenczi and Rosendal that prove the correctness of the first belief, respectively makes progress on the second type of classification.

► JOUKO VÄÄNÄNEN, *Set theoretic methods in model theory*.
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I raise the question, how can we make sense of the statement that we have found an extremely complicated structure? The orbit of a countable structure is always on some level of the Borel hierarchy. The transfinite levels of the Borel hierarchy, calibrated by countable ordinals, put countable structures on levels. The higher the level, the more complicated the structure. What about uncountable structures? Models of cardinality $\aleph_1$ can be thought of as points in the space $\mathcal{N}_1$ of functions $f : \omega_1 \to \omega_1$, endowed with the G_δ topology. The class of *Borel* sets of the space $\mathcal{N}_1$ is the smallest class of sets containing the open sets and closed under complements and unions of length ω_1. A set is *analytic* if it is a continuous image of a closed subset of $\mathcal{N}_1$. Orbits of structures of cardinality $\aleph_1$ are, a priori, *analytic*, but are they Borel? We give an overview of set-theoretic and model-theoretic methods for getting at least partial solutions to this problem.

► ALBERT VISSER, *Can we make the second incompleteness theorem coordinate free*?
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Is it possible to give a coordinate free formulation of the Second Incompleteness Theorem? Can we eliminate the arbitrariness of choices like the choice of the specific proof system, the representation of the axioms, the specific Gödel numbering employed? We pursue one possible approach to this question.

We show that (i) cutfree consistency for finitely axiomatized theories can be uniquely characterized modulo EA-provable equivalence, (ii) consistency for finitely axiomatized sequential theories can be uniquely characterized modulo EA-provable equivalence.

The case of infinitely axiomatized ce theories is more delicate. It seems to me that there are two ways to go. We can replace the single consistency statement by an infinity of restricted consistency statements. Alternatively, we can reaxiomatize the theory by a scheme. This can be done using a method disovered by Vaught. We will briefly discuss the scope of Vaught's result. The specific scheme produced by Vaught's result is crucially dependent of the representation of the axiom set. Thus, in this last approach, we can obtain independence of the choice of the proof system, but not of the representation of the axiom set.

Abstracts of contributed talks

► LOGAN AXON, *Random closed sets and probability*.
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Barmpalias, Broadhead, Cenzer, Dashti, and Weber defined a notion of randomness for closed subsets of Cantor space by coding each infinite binary tree without dead ends as a ternary real. The set of paths through such a tree is said to be random if the ternary code for the tree is (Martin–Löf) random. Every closed set of Cantor space is the set of paths through a unique binary tree without dead ends and so we have a well founded definition of random closed set.

Probability theorists, on the other hand, have defined a random closed set to be something quite different. A random closed set as defined in the literature of probability theory is a measurable map from a probability space to the space of closed sets of a topological space (where this space is equipped with the Fell topology and the corresponding Borel σ-algebra). In particular a random closed set of Cantor space is simply a measurable map from any probability space to the space of closed sets of Cantor space.

This talk addresses one way of reconciling these two notions of random closed set. First we use the probability theory framework to develop a measure-based theory of randomness for the space of closed sets of Cantor space. Then we show that random closed sets in the sense of Barmpalias, et al. are a specific example of randomness with respect to this new framework. To conclude we will look at some other examples of randomness for closed sets that arise from this framework.

► KATALIN BIMBÓ AND J. MICHAEL DUNN, *Canonicity in symmetric generalized Galois logics*.
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Weak forms of distributivity of $\circ$ (fusion) and $+$ (fission) are required for the algebraic cut rule. They also hold in the positive fragment of the relevance logic R (when $+$ is included). Other motivations for similar weak distributivity principles between the residuals of these two operations include algebraic and category theoretic considerations (see [2]), as well as linguistic phenomena (see [3]).

We define relational semantics for a series of logics (that were not dealt with in [1]). The algebra of each of these logics includes a distributive lattice ordered residuated groupoid with left identity together with its dual. The logics differ from each other with respect to which weak distribution law(s) they include. We prove that the logics are sound for certain classes of topological structures. Furthermore, each logic is canonical, therefore, complete with respect to the same class of structures. We also show that the weak distributivity principles' canonicity is independent of the presence or absence of the other operations.

[1] K. Bimbó and J. M. Dunn, ***Generalized Galois Logics. Relational Semantics of Nonclassical Logical Calculi***, CSLI Lecture Notes, vol. 188, CSLI Publications, 2008.

[2] N. V. Grishin, *On a generalization of the Ajdukiewicz-Lambek system*, ***Investigations into Nonclassical Logics and Formal Systems*** (A. I. Mikhaĭlov, editor), Nauka, Moscow, 1983, pp. 315–334.

[3] M. Moortgat, *Symmetries in natural language syntax and semantics: the Lambek-Grishin calculus*, ***WOLLIC 2007***, (D. Leivant and R. de Queiroz, editors), vol. 4576, Springer, Berlin, 2007, pp. 264–284.

► W. CALVERT, V. S. HARIZANOV, AND A. SHLAPENTOKH, *Coding Turing degrees in geometric objects*.
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Jockusch and Richter introduced the study of the *Turing degree of an isomorphism type*. While most structures have isomorphic copies in many Turing degrees, the Turing degree of the isomorphism type is an attempt to assign a Turing degree as an isomorphism invariant to a structure. In particular, if A is a structure, the Turing degree of the isomorphism type of A is the least Turing degree **d** such that there is $\mathsf{B} \simeq \mathsf{A}$ where $\mathsf{B} \equiv_T \mathbf{d}$. A degree of this type need not exist for a particular structure.

For certain classes of objects occurring in algebraic geometry, we show that any Turing degree can be realized as the degree of the isomorphism type of an element of this class, and that there are members of the class whose isomorhpism types have no Turing degree. In this way, these classes are like the classes of graphs and fields, and distinct from the classes of algebraically closed fields and linear orderings.

► RUMEN D. DIMITROV, *Automorphisms of certain filters of $\mathcal{L}^*(V_\infty)$.*
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We consider the infinite dimensional fully effective vector space V_∞ over a computable field F. In the study of the filters of the lattice $\mathcal{L}^*(V_\infty)$ of computably enumerable subspaces of V_∞ (modulo finite dimension) we came upon a field with elements that are partial computable functions with values in F. We call such fields cohesive powers of F. I will talk about cohesive powers of computable structures, the isomorphism of different co-maximal powers of the field Q, and the relationship of these isomorphisms to the question about the number of automorphisms of $\mathcal{L}^*(V_\infty)$.

[1] R. D. Dimitrov, *Quasimaximality and principal filters isomorphism between $\mathcal{E}^*$ and $\mathcal{L}^*(V_\infty)$*, ***Archive for Mathematical Logic***, vol. 43 (2004), pp. 415–424.

[2] ———, *A class of Σ^0_3 modular lattices embeddable as principal filters in $\mathcal{L}^*(V_\infty)$*, ***Archive for Mathematical Logic***, vol. 47 (2008), no. 2, pp. 111–132.

[3] M. Lerman, *Recursive functions modulo co-r-maximal sets*, ***Transactions of the American Mathematical Society***, vol. 148 (1970), no. 2, pp. 429–444.

► DAMIR D. DZHAFAROV AND JEFFRY L. HIRST, *The strength of the polarized Ramsey's theorem.*
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Consider the following version of Ramsey's Theorem, which is an immediate consequence of the usual version.

PT: Suppose $f : [\omega]^n \to k$ is a finite coloring of the subsets of ω of size n. Then there is a $c < k$ and sequence of infinite sets $H_1, \ldots, H_n$ such that if $\{h_1, \ldots, h_n\}$ is a set of distinct elements with $h_i \in H_i$ for each i, then $f(h_1, \ldots, h_n) = c$.

This talk examines the reverse mathematics and computability theory of variants of PT. Roughly, when $n \geq 3$, PT behaves very much like Ramsey's theorem, and when $n = 2$, the situation is more complex. Details appear in [1].

[1] Damir D. Dzhafarov and Jeffry L. Hirst, *The polarized Ramsey's theorem*, ***Archive for Mathematical Logic***, to appear.

► JOHANNA N. Y. FRANKLIN, *Van Lambalgen's Theorem and weaker randomness notions.*
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Van Lambalgen's Theorem for Martin–Löf randomness states that if $A_0 \oplus A_1$ is Martin–Löf random, then A_0 is Martin–Löf random relative to A_1 and vice versa. It had been shown previously that van Lambalgen's Theorem fails for Schnorr randomness and recursive randomness, but for reals of relatively low computational strength. Here, we show that every high degree contains a recursively random real for which van Lambalgen's Theorem fails and present other, related results.

► VICTORIA GITMAN, *Ramsey-like cardinals*.
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One of the less known characterizations of a Ramsey cardinal κ involves the existence of certain types of elementary embeddings for transitive sets of size κ satisfying a large fragment of ZFC. I introduce new large cardinal axioms by isolating and generalizing the key properties of Ramsey embeddings and show that they form a natural hierarchy between weakly compact cardinals and measurable cardinals. The stronger of these large cardinal notions are better suited than Ramsey cardinals for indestructiblity arguments. The weaker of the new large cardinals further our knowledge about the elementary embedding properties of smaller large cardinals, in particular those still consistent with $V = L$.

Some of this work is joint with Philip Welch.

► YUN LU, *Reducts of the generalized random bipartite graph*.
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Let $\mathcal{M}$ be a countably categorical structure for a finite relational language. A reduct of $\mathcal{M}$ corresponds, up to bi-interpretability, to a closed subgroup of $Sym(M)$ containing $Aut(M)$. In this talk, I will describe the classification of reducts given by Thomas [3] and Bennett [1], then present my own results classifying the irreducible reducts of the random bipartite graph with three or more cross types [2].

[1] J. Bennett, ***The reducts of infinite homogeneous graphs and tournaments***, Ph.D. thesis, Rutgers University, New Brunswick, 1995.

[2] Y. Lu, ***Reducts of countably categorical graphs***, Ph.D. thesis, Wesleyan University, Middletown, 2007.

[3] S. Thomas, *Reducts of random hypergraphs*, ***Annals of Pure and Applied Logic***, vol. 80 (1996), pp. 165–193.

► BILLY JOE LUCAS, *Some theories concerning deontic implications of proof for belief*.
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Let L include O (P), a strong (weak) deontic operator, and uE (uB), a strong (agent indexed) evidence (belief) operator. $\langle \mathrm{W, R^\circ, E, B} \rangle$ is a normal multi-modal deontic evidential doxastic frame. Twenty theories are proposed for consideration. (5B)–(12B) result from replacing uE (uB) by uB (uE) in the (uE/uB) degree two parts of (5E)–(12E).

	THEORIES	CANONICAL FRAMES
(1)	$O(\mathrm{uEp} \supset \mathrm{uBp})$	$\forall x \forall y \forall z\,[(xR^\circ y \cdot yBz) \supset yEz]$
(2)	$\sim \mathrm{P}(\mathrm{uEp} \cdot \mathrm{uB} \sim \mathrm{p})$	$\forall x \forall y\,[xR^\circ y \supset \exists z\,(yBz \cdot yEz)]$
(3)	$\sim (\mathrm{OuEp} \cdot \mathrm{O} \sim \mathrm{uBp})$	$\forall x \exists y\,[xR^\circ y \cdot \forall z\,(yBz \supset yEz)]$
(4)	$\sim \mathrm{O}(\mathrm{uEp} \cdot \mathrm{uB} \sim \mathrm{p})$	$\forall x \exists y\,[xR^\circ y \cdot \exists z\,(yBz \cdot yEz)]$
(5E)	$\sim \mathrm{P}(\mathrm{uEp} \cdot \sim \mathrm{EuBp})$	$\forall w \forall x \forall y \forall z\,[(wR^\circ x \cdot xEy \cdot yBz) \supset xEz]$

(6E)	$\sim P(\mathrm{uEp} \cdot \mathrm{uE} \sim \mathrm{uBp})$	$\forall w \forall x\,[wR^{\circ}x \supset \exists y(xEy \cdot \forall z(yBz \supset xEz))]$
(7E)	$O(\mathrm{uE}{\sim}p \supset \mathrm{uE}{\sim}\mathrm{uBp})$	$\forall w \forall x\,[(wR^{\circ}x \cdot xEy) \supset \exists z\,(yBz \cdot xEz)]$
(8E)	$\sim P(\mathrm{uEp} \cdot \mathrm{uEuB}{\sim}p)$	$\forall w \forall x\,[wR^{\circ}x \supset \exists y\,\exists z\,(xEy \cdot xEz \cdot yBz)]$
(9E)	$\sim(\mathrm{OuEp} \cdot \mathrm{O}{\sim}\mathrm{uEuBp})$	$\forall w\,\exists x\,[wR^{\circ}x \cdot \forall y\,\forall z\,((xEy \cdot yBz) \supset xEz)]$
(10E)	$\sim O(\mathrm{uEp} \cdot \mathrm{uE}{\sim}\mathrm{uBp})$	$\forall w\,\exists x\,\exists y\,[wR^{\circ}x \cdot xEy \cdot \forall z\,(yBz \supset xEz)]$
(11E)	$P(\mathrm{uE}{\sim}p \supset \mathrm{uE}{\sim}\mathrm{uBp})$	$\forall w\,\exists x\,[wR^{\circ}x \cdot \forall y(xEy \supset \exists z\,(yBz \cdot xEz))]$
(12E)	$\sim O(\mathrm{uEp} \cdot \mathrm{uEuB}{\sim}p)$	$\forall w\,\exists x\,\exists y\,[wR^{\circ}x \cdot xBy \cdot \forall z\,(yBz \supset xEz)]$

With R°, E, and B serial, the only provable implications among 1–4 (5E–8E, 9E–12E) are given by $1 \supset (2 \cdot 3)$ & $(2 \vee 3) \supset 4$ (and, respectively, $(5E \supset (6E \cdot 7E)$ & $(6E \vee 7E) \supset 8E)$, and $(9E \supset (10E \cdot 11E)$ & $(10E \vee 11E) \supset 12E)$; moreover, the only additional provable implications among 1–12E are given by $5E \supset 9E$, $6E \supset 10E$, $7E \supset 11E$, and $8E \supset 12E$. Exactly similar results hold among 1–4 and 5B–12B. Plausible alternative logics for obligation (belief, proof) generate additional connections among these twenty theories.

► JONAS REITZ, *Set-theoretic geology*.
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Forcing is typically viewed as a method for constructing outer models—from a given model V, we adjoin a suitable generic set G to obtain the extension $V[G]$. However, a change in perspective allows us to use forcing to study the inner structure of a model of set theory. A *ground* of a model V is a transitive class W satisfying ZFC, such that V can be obtained by forcing over W, i.e., $V = W[G]$ for some W-generic G. Given a model of set theory, we consider the the collection of all of its ground models. This collection forms the background structure for the area that we call set-theoretic geology. Digging deeper, the *mantle* of V is the intersection of all grounds of V. Despite its apparent second-order nature, the mantle is first-order definable in V. A more robust notion, the *generic mantle*, is the intersection of all grounds of all forcing extensions of V. While little is known in general about the first-order properties of the mantle, the generic mantle is always a model of ZF. On the other hand, every model of ZFC is both the mantle and the generic mantle of another model.

This is joint work with Joel David Hamkins (The City University of New York) and Gunter Fuchs (Westfälische Wilhelms–Universität Münster).

► EREZ SHOCHAT, *Non-isomorphic automorphism groups of short recursively saturated models of PA*.
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A short recursively saturated model of PA is a short elementary initial segment of a recursively saturated model. In this talk, we outline results concerning the automorphism groups of countable short recursively saturated models of PA. In particular, we modify Kaye's Theorem [1] to show that there is a Galois correspondence between the closed normal subgroups of the automorphism groups of a countable short recursively saturated model of PA and the invariant initial segment of the model. Using the above result, we show that there are short recursively saturated models of arithmetic whose automorphism groups are non-isomorphic as topological groups.

[1] RICHARD KAYE, *A Galois correspondence for countable recursively saturated models of Peano Arithmetic*, ***Automorphisms of first-order structures***, (Richard Kaye and Dugald Macpherson, editors), Oxford University Press, New York, 1994, pp. 293–312.

► SANDRO SKANSI, *The MP axiom of intensionality: connecting types and sets*.
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This paper should be regarded as a sequel to our paper presented at the 2008 ASL Winter Meeting: we will summarize the most important theorems of the nonstandard set theory MP, developed from Russell's assumptions in his *Introduction to Mathematical Philosophy* [1], and our main focus will be the clarification of the most notable feature of MP—the axiom of intensionality. We will show that stratification is not needed if we adopt a few simple propositions introducing several type-theoretical notions in this nonstandard set theory. This should be regarded as a necessary step in the demonstration of the advantages of MP over ZFC, which does not discriminate the concepts of 'set' and 'predicate' as it is needed in other areas of logic. There is also a very important philosophical point to be made: Although technically a second order theory, MP constitutes a more ontologically innocent approach than ZFC, providing the same results while presuming significantly less.

[1] BERTRAND RUSSELL, ***Introduction to mathematical philosophy***, Dover, New York, 1993.

Abstracts of papers submitted by title

► JOHN CORCORAN, *Self-denying and self-affirming statements*.
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This lecture clarifies discussion of paradoxes. A statement made in English to the effect that the speaker does not know English is *self-denying* (*SD*) in the sense that it *denies* one of its own *implicatures* (or, equivalently, it *implicates* the negation of a proposition it *affirms*). Examples of SD statements are: a statement to the effect that the speaker is not making a statement; is (using* not using) a word that in fact (is not* is) being used; or is (addressing* not addressing) an audience that in fact (is not* is) being addressed. An English statement to the effect that the speaker knows English is *self-affirming* (*SA*) in the sense that it *affirms* one of its own *implicatures* (or, equivalently, it *implicates* a proposition it *affirms*). Examples of SA statements are: a statement to the effect that the speaker is making a statement; is (using* not using) a word that in fact (is * is not) being used; or is (addressing* not addressing) an audience that in fact (is * is not) being addressed. A statement (*affirms* * *denies*) the propositions (implied * contradicted) by the proposition it states. A statement is (*correct** *incorrect*) if (every * some) proposition it affirms or implicates is (true* false). Every SD statement is incorrect. Nevertheless it is not the case that every SD statement affirms a proposition is that is contradictory or even false: the proposition stated in a statement to effect that the speaker disbelieves a certain one of the statement's own affirmations need not contradict itself. Such a statement could be made using a sentence such as 'Abe is alive but I *disbelieve* it'. Not every SA statement is correct. In fact, every SA lie is incorrect.

► JOHN CORCORAN AND GEORGE BOGER, *Aristotle's independence proofs*.
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This paper discusses Aristotle's methods of establishing that given conclusions are *independent of* (not logically implied by) given premises. Most passages quoted are from Smith's 1989 translation [4]. The focus is mainly on two methods in [1]: the *method of counterarguments* MCA discussed in [3], and the *method of contrasted instances* MCI discussed in [2].

In each application, MCA uses one counterinterpretation and deals with one conclusion in relation to one premise set. MCA is first used at 25a23 to treat the non-convertibility of the existential negative or O proposition. In contrast, each application of MCI uses two counterinterpretations and deals with four conclusions in relation to one premise set. MCI is first used at 26a5 to treat the fact that none of the four categorical propositions follow from a certain premise pair. One issue is whether the method of contrasted instances was regarded by Aristotle as a compact combination of four applications of the method of counterarguments or whether he regarded it as a separate and independent method. Corcoran favors the former; Boger the latter. We also discuss the historical reception of the two methods. Both methods were ignored for centuries, both have been criticized as logically inadequate, and both have been praised as clear foreshadowings of modern model-theoretic procedures.

[1] ARISTOTLE, ***Prior analytics***, Book A, Chapter 1–6.

[2] G. BOGER, *Aristotle's Underlying Logic*, ***Handbook of the History of Logic***, (D. Gabbay and J. Woods, editors), Elsevier, Amsterdam, 2004.

[3] J. CORCORAN, *Aristotle's prior analytics and Boole's laws of thought*, ***History and Philosophy of Logic***, vol. 24 (2003), pp. 261–288.

[4] R. SMITH, (Translator), ***Aristotle's prior analytics***, Hackett, Indianapolis, 1989.