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The 29rd Annual Conference of the Australasian Association for Logic was held at Macquarie University (Sydney), from July 10th through 12th, 1998. The conference was organized by Greg Restall, and the AAL President, John Slaney, gave the presidential address. The conference was held in the memory of Richard Sylvan, who died in 1996. He was one of the most influential figures in Australasian logic, and was the 1994/95 President of the AAL. A tribute was also given to Ian Hinckfuss, who died in 1997. He was the 1995/96 president of the AAL, and his death has robbed Australasia of another influential logician and philosopher. The 1999 conference will be held from July 2–5, 1999, at the University of Melbourne, and will be organized by the 1998/99 president, Ross Brady.

Abstracts of talks follow.

Conference Organizer
GREG RESTALL

Abstracts of contributed talks

► SEIKI AKAMA, *Negative facts and constructible falsity*.
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We formalize the notion of negative facts due to Russell (1956) in terms of Nelson's (1949) logic of constructible falsity. We generalize van Fraassen's (1969) theory of facts so that we can deal with a positive fact as a true proposition and a negative fact as a false proposition in a constructive manner. We extend the previous work in Akama and Sylvan (1994). We provide some adequacy results for the revised van Fraassen semantics with respect to several versions of Kripke semantics for strong negation (cf. Routley (1974), Akama (1988, 1990)). The advantage of van Fraassen semantics is to avoid the unnecessary commitment of semantic entities like possible worlds or set-ups in that we allow for various kinds of facts. The proposed semantics can thus be expanded for other non-classical logics.

► JC BEALL, *The justification of deduction - one last time*.
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David Hume told us that induction faces a dilemma: Its alleged justification will be

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either too strong (if deductive) or circular (if inductive); in either case, induction will lack justification. Susan Haack, in her famous *The justification of deduction* [1], told us that deduction faces a perfectly parallel dilemma: Its justification will be either too weak (if inductive) or circular (if deductive).

As many know, the point of Haack's paper isn't to show that deduction isn't in fact justified; rather, it is to show that deduction and induction are on the same justificatory footing. As she puts it:

"The moral of the paper might be put, pessimistically, as that deduction is no less in need of justification than induction; or, optimistically, as that induction is in no more need of justification than deduction. But however we put it, the presumption, that induction is shaky but deduction is firm, is impugned." [1], reprinted in [3] and in [2]).]

I will argue that Haack's paper affords no such moral. What Haack fails to notice is simply this: One can argue deductively that induction faces a justificatory problem; one cannot, however, argue inductively that deduction faces a parallel problem. But, then, Haack's argument succeeds only if it is a justified deductive argument, in which case her argument doesn't succeed. But, then, Haack's argument doesn't succeed.

After filling in the details of this objection, I consider possible replies. In each case, I show that my objection remains intact or Haack's argument fails on other grounds.

[1] S. HAACK, *The justification of deduction*, ***Mind***, vol. 85 (1976), pp. 112–119.

[2] S. HAACK, ***Deviant logic, fuzzy logic***, Chicago University Press, Chicago, 1996.

[3] R. I. G. HUGHES, editor, ***A philosophical companion to first-order logic***, Hackett, Indinapolis, Indiana, 1993.

► ROSS BRADY, *Semantic decision procedures for some relevant logics*.
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In *Relevant logics and their rivals* (pp. 399–406), Richard Sylvan purported to have established the decidability of a range of weak relevant logics. He first claimed to have proved decidability for the system B, using a filtration method upon the Routley-Meyer semantics, which yielded the finite model property for B. He extended the axioms

$$A \,\&\, (A \to B) \to B, \quad A \to {\sim}A \to {\sim}A, \quad \text{and} \quad A \to {\sim}B \to B \to {\sim}A.$$

Sylvan then examined the use of a second filtration, but realized its shortcomings in establishing postulate $p2$, if $a \leq b$ and $Rbcd$ then $Racd$, for the finite model. He briefly examined a third filtration, realized that it would not yield a decidability result without deductive closures on the worlds of the finite models, and hence suggested using operational semantics instead of the Routley-Meyer semantics.

However, Sylvan had erred in two places in his first filtration. His second filtration can still be used and his results can be revised and extended using the simplified semantics of Priest, Sylvan and Restall. The object of this paper is to show how this is to be done, as well as deciding by semantic methods some contractionless logics already shown decidable using Gentzen methods. We also examine some extensions of these logics.

► MARTIN BUNDER, *Intersection types and logics*.
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The first part of this paper consists of an introduction to typed lambda calculus. These (arrow-)types can be interpreted as the theorems of intuitionistic implicational logic and the lambda terms, that have these types, as their proofs. There are simple algorithms that, given an implicational formula (or type), generate a proof (a lambda term inhabitant of the type). Not all closed lambda terms (ones without free variables) have types, an extension of type

theory which includes intersection types resolves this problem. We will briefly discuss the unusual logic whose theorems are the arrow-intersection types.

The full arrow-intersection type theory is known to be undecidable, though we conjecture that an extension of the algorithm mentioned above will find inhabitants of types (i.e., proofs of theorems). Some subsystems of this extended system are decidable. The rest of the paper will discuss various nonequivalent subsystems.

► PETER DOLNÍK, *An approach to hyperintensional analysis*.
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Two general principles underlie Carnap's approach to hyperintensional analysis:

(A) identity criteria of hyperintensions are definable in terms of logical equivalence of 'simple designator matrices' of a language and
(B) the Principle of Tolerance.

Church's objection can be locked against the approach: by the Principle of Tolerance one can construct a language simple matrices of which are logically equivalent, yet do not express the same hyperintensions. The paper discusses two possible modifications of the Carnap's approach arising from the objection:

1. reject (A) and keep (B) as suggested by Church (1954) and
2. reject (B) and keep (A).

Reasons are given why the latter modification is considered more adequate. A distinction between languages all matrices of which are isomorphic with structure of hyperintensions and languages where this is not the case is made. Formal properties of both types of languages are investigated.

► NORMAN FOO, *Local closure and EnE sentences*.
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Most diagrams, even if they can be interpreted as embeddings in infinite objects, are nevertheless finite in extent if they are to be presented conventionally. In many applications where diagrams are used to explain, instruct, communicate, cogitate or conjecture, this finiteness implies local extent. By this we mean that even if they are used to reason about potentially unbounded domains or constructs, the fact that they can be used at all suggests that only local properties are being examined. We are interested in how the features of such diagrams can be described in logic, and how diagram manipulations that represent actions can be justified. In particular, we establish a correspondence between a substructure construction which formalizes local extent and a class of sentences preserved under extension from, and reduction to, this substructure. The sentence class is called EnE because it has the form of successively nested existential and negated existential subsentences, and appear to cover most of the applications so far encountered. The hope is that this understanding can be used to mark out the local regions of diagrams that can be safely isolated for manipulations. Two papers that describe the theory and applications pertinent to this abstract may be downloaded from the publications page of the URL: http://www.cse.unsw.edu.au/~ksg with the titles "Local Extent in Diagrams" and "Diagrammatic Reasoning about Linked Lists".

► RODERIC A. GIRLE, *Dialethic dialogue*.
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In this paper we discuss the use of the Hamblin/Mackenzie Formal Dialectic (*HMFD*) for the classical/non-classical debate about the status of contradictions and of non-trivial

inconsistent theories. We consider the suggestions in Mackenzie and Priest's "Paraconsistent Dialogues".

We sketch a Dialogue Logic of *HMFD* style with classical logic principles. *HMFD* contains three main features. First, there is a rule governed interaction between dialogue participants—the minimal case being two participants. Second, each participant has a commitment store which changes as the dialogue progresses. Third, the changes in the commitment store are govered by rules for additions and withdrawals of material. These rules contain certain restrictions which are classical in nature. These restrictions give *HMFD* an apparently strong bias against dialetheism.

We consider how the *HMFD* restrictions work in practice, and see if they need to be modified so as to better serve the debate about dialetheism without begging the question.

We consider some comments of John Woods about both the argument against disjunctive syllogism, and the well known set theory paradox in the Russell-Frege correspondence. The comments were made in response to a dialogue system presented by Girle in *Belief sets and commitment stores* (*OSSA* Conference, Brock University, 1997). The question for us is, "How can debate continue? Can such profound difference be amenable to rational argument?"

We then consider what is involved in modifying *NMFD* for such a debate. This will bring us to consider some points about contradiction, contradiction tolerant logics, and contradiction tolerant dialogue logic.

► NICHOLAS GRIFFIN, *Problems in item theory*.
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While there is no doubt that item theory has much to commend it, it remains entangled in very serious difficulties. The chief of these arise from the clash between the two central Meinongian principles of (absolutely unrestricted) freedom of assumption and (absolutely unrestricted) characterization. Roughly speaking, the former allows us to think of absolutely anything, and the latter ascribes to what we think of whatever properties we think of it as having. Clearly, this won't do. Most of the standard objections to item theory, from Russell onwards, have been special cases of this. In the course of the development of the theory, various piecemeal responses have been made to particular forms of the problem. These, I argue, leave much to be desired. The fact that the problems arise from the two central principles of the theory suggests that a more radical restructuring of the theory is required. In the final section, I sketch the beginnings of an alternative which looks promising and which, while remaining clearly in the item theoretic tradition, involves substantial changes to forms of item theory so far presented.

► A. P. HAZEN, *Object theory and structuralist philosophies of mathematics*.
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Sylvan argued for a non-reductive program in philosophical analysis that would employ a catholic notion of object, allowing (and here his metaphysical imagination is clearly informed by his experience with non-classical logics) incomplete and inconsistent objects. Structuralism, with its proposal that many mathematical objects be construed as mere "positions" in a structure, seems to be a view arising in "hard-headed" philosophy of science (in contrast to standard Meinongianisms with their motivating examples drawn from myth and illusion) with a clear need for incomplete objects. Variants are considered; it is tentatively concluded that a realist form of structuralism does not need Sylvan's radical logical innovations to accommodate positions in structures.

► DOMINIC HYDE, *Vague conditionals*.
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A few years ago Richard and I worked on an account of the conditional invoked in the sorites paradox. In what follows I shall outline my preferred account, describing a vague conditional. This connective, I shall argue, serves to underwrite a common-sense solution to the paradox. In arguing that an important dimension of the semantics of 'if ... then ...' is given by this vague conditional, one weaker than the material conditional, I chart a non-classical course which nonetheless avoids what I take to be the excesses of fuzzy logic so frequently imported into the debate on vagueness.

► WILLIAM LYCAN, *On a defense of the truth-condition theory of meaning*.

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This paper highlights and refines a certain argument for the Truth-Condition theory (found embryonically in David Lewis' "General Semantics"), and then defends the argument against objections based on recent deflationism about truth.

► EDWIN MARES, *Negation, impossibility and relevance*.

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Recently, Dunn has provided an interpretation of the Routley star operator using a compatibility relation. In this paper, I present the impossibility semantics for relevant logics and give an interpretation of Dunn's relation in that framework. I give a metaphysics of negation based on an information-theoretic reading of Routley and Meyer's semantics for negation-free relevant logics. I show that the impossibility and compatibility semantics coincide for stronger relevant logics and discuss the point at which this match breaks down.

► ROBERT K. MEYER AND EDWIN MARES, *Relevant provability logic*.

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Our aim is to gladden Mike Dunn's heart. Even in graduate school, Dunn discerned *two* levels on which to (mis)understand Gödel's theorems.

(1) *Stratospheric*: Let G say of itself that it's unprovable. If G is provable, something is *very wrong*.
(2) *Subterranean*: Yes, we've checked; and step 721 does follow formally from steps 1 to 720.

Dunn insisted on a *Terrestial* level (1.5), intermediate between the handwaving of (1) and the soul-destroying tedium of (2). And yes, recent logicians have found, studied, and even Gentzenized *logics* like Sambin-Valentini's **GL**, which provide (1.5).

But **GL** has *no regard* for relevance, laying waste the Belnap relevance principle by validating monstrosities like $LMp \geq LMq$. So we introduce here a *relevant* system **RGL**, extending **R** as **GL** extends classical **CL**.

Query: Is **RGL** well-motivated? Answer: We doubt it. For the most striking thesis of **GL** (and hence **RGL**) is Loeb's axiom

LAx. $$L(LA \geq A) \geq LA$$

or (equivalently, given other **GL** principles) Loeb's rule

LRu. From $LA \geq A$ infer A.

But LAx and LRu are motivated via "reflection principles" of "sufficiently strong" first-order theories, and depend ultimately on (sneaky) diagonal tricks. We investigate these tricks in the **R** context.

► CHRIS MORTENSEN, *Topological separation principles and logical theories*.
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This paper obtains results linking topological separation principles, specifically T1, T2 and normality, with the existence of various kinds of logical theories of topological logic. The models are then extended to cater for variations in the properties of identity, producing the "ring of fire" model and the "scorched earth" model.

► DANIEL NOLAN, *An uneasy marriage*.
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Interpreted broadly, "Meinongianism" is the doctrine according to which there is some acceptable and true use of natural language quantifier expressions in which they quantify over things which do not exist. Most of the best arguments for Meinongianism come from considerations in the philosophy of language. Most of the best objections come from metaphysical considerations. This suggests that a middle way might be tried: One might try to keep an actualistic and existential metaphysics, but provide for the truth of claims employing neutral quantifiers. This paper is to explore on what terms such a marriage might be arranged. I examine some previous proposals, and finding them unsatisfactory, tentatively suggest a new way in which the alliance might be forged.

► UWE PETERSEN, *Induction without contraction*.
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On the one hand, the absence of contraction is a safeguard against the logical (*property theoretic*) paradoxes; but on the other hand, it also disables inductive and recursive definitions, in its most basic form the definition of the series of natural numbers, for instance. The reason for this is simply that the effectiveness of a recursion clause depends on its being available after application, something that is usually assured by contraction. This paper presents a way of overcoming this problem by unashamedly employing unrestricted abstraction in one of its most vicious forms. A consistency proof is provided, along with a definition of a weak implication, which, in turn, allows the definition of an appropriate notion of natural number, suitable for an explicit definition of addition and multiplication.

► GRAHAM PRIEST, *Paraconsistent set theory and metatheory*.
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(1) Paraconsistent set-theory, based on the naive abstraction schema, is a theory of interest in its own right, but—as far as one can presently tell—because the underlying logic must be weaker than classical logic, it does not deliver many of the theorems of ZF set theory. Must a paraconsistent set-theorist give up much of ZF as mistaken?

(2) Orthodox metatheory is standardly thought of as carried out using classical logic; do its results have any significance at all for a paraconsistent logician, who cannot endorse all the moves made?

The paper answers these questions, which are, in fact, connected, since standard metatheory is usually thought of as carried out, not just with classical logic, but within a set theory such as ZF.

For (1), I argue that a paraconsistent set-theorist may take the universe of sets to contain the cumulative hierarchy, a consistent structure. ZF therefore makes perfectly good sense as describing that substructure.

It follows, for (2), that even for a paraconsistent logician, classical soundness and completeness proofs establish that a logic is sound and complete with respect to all structures within the cumulative hierarchy. Can this be extended to soundness and completeness with respect to *all* structures? I argue 'yes'. Completeness is, in fact, easy. Soundness is harder. I argue this, using an idea due to Kreisel for solving a similar problem within the metatheory of classical logic itself.

► GREG RESTALL, *Constant domain quantified modal logics without Boolean negation*.
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There is a natural way to add rules for first-order quantifiers to proof theories for propositional relevant logics, and there is a natural way to add evaluation conditions for quantifiers to the semantics for propositional relevant logics. Kit Fine has shown us that these two natural ways of modelling first order relevant logics do not match up. Furthermore, Fine has given a semantics for the natural proof-theory for quantified relevant logics. Unfortunately, the semantics is quite baroque. It seems sensible to look for alternatives.

In this paper I will begin to explore constant domain quantified relevant logics by examining a simpler case – I will look at constant domain *modal* logics without Boolean negation. That is, I will examine the proof theory and semantics for logics extending distributive lattice logic with extra *one place* operators. These are a simplification of relevant logics, which extend distributive lattice logic with the *two place* intensional connectives of implication and fusion. I end this paper by gesturing towards what needs to be done to extend the results of this paper to the more general setting of relevant logics.

► LESLEY ROBERTS, *An alternative semantics for* **B**.
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In this paper I offer a probabilistic semantics for **B**. The semantics makes no use of the Routely Star or the cross world ternary relation of Routley and Priest's simplified semantics.

► JOHN SLANEY, *Making sense of Routley and Meyer*.
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This paper provides a motivation for the Routley-Meyer semantics for relevant logics in terms of a family of agents and their 'beliefs' about each other's beliefs.

► KOJI TANAKA, *Three schools of paraconsistency*.
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The talk concerns three schools of paraconsistency: Australian, Belgian and Brazilian. Arguably the most radical school, the Australian school of paraconsistency, led by Priest and Routley/Sylvan, claims that there are some true contradictions and that *the* logic is paraconsistent. The Belgian school, led by Batens, and Brazilian school, led by da Costa, argue against the Australian school. They question the existence of true contradictions. More importantly, they not only reject the idea that *the* logic is paraconsistent but they also

deny that there is one true logic. I argue that their objections are based on mis-interpretation of the claim of the Australian school. I conclude then that the Australian school needs not be closed down on the basis of Belgian and Brazilian schools' objections.

► JOAO TEIXEIRA, RICHARD SYLVAN, AND B. J. COPELAND, *Paraconsistent computability*.
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Once upon a time, back in the golden age of recursive function theory, computability was an absolute. But serious cracks have begun to appear in this absolutism. We suggest that such an absolutism is false: Computability is relative, not only to physics but, more generally, to frameworks that include underlying logics. One of the most striking results emerging from the rejection of classical logic as the only paradigm to conceive of computability is asserting the possible existence of an algorithm for the problem of non-terminating computations.

► PAUL THISTOLL, *Paraconsistent computation*.
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In two as yet unpublished papers, Richard Sylvan and Jack Copeland discuss the implications on classical computation theory of the burgeoning field of paraconsistent logic and dialethic philosophy. In this paper, the author wishes to briefly outline the ideas of Sylvan and Copeland and then go on to discuss two central issues in the author's own research:

(1) Do traditional proofs of the halting problem fail when a weaker logic than the classical logic is used as the underlying logic of the proofs, specifically a paraconsistent logic such as Priest's LP? Does this entail that no proof of the halting problem exists using such a logic or merely that we need to construct a new one? How could we tell the difference? What would be the implications of the halting problem result being reversed on computation theory as it is now conceived?

(2) What would a truly paraconsistent computing machine look like? Could such a thing exist? It is not at issue that you can write computer programs in classical logic to run on a turing machine to force contradictions to be handled by classical means, nor is it at issue that you can program a classical turing machine to do paraconsistent logic, but is that the same as saying you have a paraconsistent computing machine in any substantive sense? Would paraconsistent computing machines if they exist be like quantum computers (i.e., the improvements are merely in speed and not in the class of algorithms that can be solved) or would they belong to an entirely new category of computing objects?

► CHENG-CHIH TSAI, *A semantics with levels for modal logic*.
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In Kripke's possible-worlds semantics, statements (modal and non-modal) are interpreted as 'subsets of a set of possible worlds W'. In this paper, we shall however, show that the essence of modality lies in the richness of the structure of 'subsets of iterated power sets of W' rather.

Let U be a universal set of possible worlds. A level-n universe is defined to be an element of the n-th iterated power set of U. This renders each universe a tree-like structure, on which our modal structure will be based. A (simple) statement is a pair of universes whose levels differ by one, and the statement is said to be true if the higher level universe (a "state" as we

shall call it) contains the lower level one. The modality is then revealed by defining 'Box' to be the power set operator applied to states. A semantics for modal logic which distinguishes talks of different levels is subsequently established. Theorems of this modal logic which bear forms similar to (yet different from) the characterization axioms of the standard modal systems K, T and $S5$ are obtained, and the stone paradox can be shown to be simply a confusion coming from mixing talks of different levels together.

► HONGXUE WANG AND JOHN SLANEY, *UniLog: A unified logic framework*.
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In this paper, we report UniLog, a unified logic framework which has been developed to uniformly formalise different aspects of knowledge, and to support different reasoning mechanisms on UniLog formalisations.

Rather than by combining existing logic systems and knowledge representation schemes, UniLog was developed from our ontological investigations into generalities of intelligent systems. However, UniLog can be explained as extensions to the First Order Logic:

First, unlike some other logic systems, UniLog allows us to give detailed descriptions for a world in form of constrained object hierarchies, and allows us to set several parameters on an ancient world. Second, UniLog allows to construct a domain as a multiple set, and allows to attach a domain dx to an object variable x in three ways: $x : dx$, $x- : dx$ and $x+ : dx$. Third, we use sixteen quantifiers to capture much more quantity aspects of knowledge. Fourth, UniLog allows us to attach truth labels to formulas, which consists of world, modal and temporal sublabel at the most. Fifth, in UniLog, inference is generally treated as specific agent actions on UniLog formalisations. Sixth, inference rules for abduction, induction, analogy, generalisation, specialisation, classification, nonmonotonic reasoning, reasoning about uncertainties, actions, changes and time are defined.

► BYEONG-UK YI, *The logic of plurals*.
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I present a system of logic that can accommodate the logical validity of arguments like the following:

Ezra and Thomas are critics who admire only each other. Therefore, there are some critics who admire only one another.

Russell and Whitehead are philosophers who coauthored a book. Therefore, there are some philosophers who coauthored a book.

And I compare and distinguish it from other, better-known systems of logic, such as the second-order logic or two-sorted first-order logics.

► EDWARD N. ZALTA, *A classically-based theory of impossible worlds*.
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The appeal to possible worlds in logic and philosophy has led philosophers and logicians to introduce other kinds of "worlds" in order to study various philosophical and logical phenomena. The literature contains discussions of "non-normal worlds", "non-classical worlds", "non-standard worlds", and "impossible worlds". These atypical worlds have been used in the following ways:

(1) To interpret unusual modal logics,
(2) to distinguish logically equivalent propositions,
(3) to solve the problems associated with intensional contexts, and

(4) to interpret systems of relevant and paraconsistent logic.

However, those who have attempted to develop a genuine metaphysical theory of such atypical worlds tend to move too quickly from philosophical sketches of such entities to formal semantical models that assume them as basic.

In this paper, I derive a metaphysical theory of impossible worlds from an axiomatic theory of abstract objects. The underlying logic of theory is classical. Impossible worlds are not taken to be primitive entities but are instead characterized intrinsically using a definition that identifies them with, and reduces them to, abstract objects. The definition is shown to be a good one—the proper theorems derivable from the definition assert that impossible worlds have the important characteristics that philosophers suppose them to have. None of these consequences, however, imply that any contradiction is true (though contraditions can be "true at" impossible worlds).

This classically-based conception of impossible worlds provides a subject matter for paraconsistent logic and demonstrates that there need be no conflict between the laws of paraconsistent logic and the laws of classical logic, for they govern different kinds of worlds. It is argued that the resulting theory constitutes a theory of genuine (as opposed to ersatz) impossible worlds. However, impossible worlds are not needed to distinguish necessarily equivalent propositions or for the treatment of the propositional attitudes, since the underlying theory of propositions already has that capacity.