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§1 Editorial

It is now the moment for me to deliver on a promise I made to readers of *The Reasoner* back in July 2007, when I said I would later talk about the ideas discussed on the blog I jointly run, the The n-Category Café. Well, naturally enough, we talk about n-categories, and a good place to begin is with the case $n = 1$. So let me start with a few words about categories.

People often wonder what all the fuss is about when they read the definition of a category as a collection of objects, with arrows, or *morphisms*, running between pairs of objects, including an identity arrow looping from each object to itself, and a partial composition so that a pair of arrows can be composed if the head of one matches the tail of the other. The focus is on functions rather than just on objects, as easily seen in categories of structured sets, such as groups or rings, and structure preserving homomorphisms. But there's an enormous versatility to the language, so that we also have a category with objects one-dimensional closed manifolds, that is collections of circles, and with two-dimensional surfaces as arrows, so that a pair of trousers (US: pants) is seen as a map from one circle, the waist, to a pair of circles, the leg holes.

Things start to get more interesting when surprising commonalities are observed in categories of apparently different kinds. For example, that category of manifolds I just described above is very similar to the category of sets with relations as morphisms. Bending a trouser leg about, so we now have a cobordism from two circles (waist and one leg hole) to one circle (other leg hole) is very similar to taking a relation between sets A and $B \times C$ and finding the corresponding relation between $A \times B$ and C.

Morphisms can represent any kind of process taking us from one state to another. Category Theory: object, morphism; Physics: system, process; Topology: manifold, cobordism; Logic: proposition, proof; Computation: data type, program. This idea is developed in a paper, *Physics, Topology, Logic and Computation: A Rosetta Stone*, written by my co-blogger John Baez and

Mike Stay, which attempts to "clarify the analogies between physics, topology, logic and computation". John has many other excellent pieces of exposition, including Quantum Quandaries.

But the story doesn't stop here. In all of the fields in the above list we need a way to represent processes between processes. For example, in the field of concurrent computing, the execution path taken by multiple parallel processors determines a one-dimensional entity in computation space, and we need to find ways to compare computation paths to prevent deadlock. In topology we need 2-categories to consider manifolds with corners, while just possibly the next step in the foundational reformulation of physics will require 2-categories or higher, (see A history of n-categorical physics). Once you start climbing the n-category ladder there seems like no good reason to stop.

The world of higher-dimensional category theory is an exciting place to be at the moment, and it's good to see the UK well represented, with groups in Cambridge, Sheffield and Glasgow. I have asked someone from the latter group to join us for an interview.

David Corfield
Philosophy, Kent

§2

Features

Interview with Tom Leinster

Tom Leinster is an EPSRC Advanced Research Fellow working in the University of Glasgow Mathematics Department.

David Corfield: How did you become interested in ordinary category theory, and later higher-dimensional category theory?

Tom Leinster: I heard of category theory as an undergraduate. Before long I found Saunders Mac Lane's book "Mathematics: Form and Function" in the library, and ended up renewing it so many times that I decided it would be less trouble to photocopy the whole thing. It's an unusual and inspiring book, full of satisfying conceptual explanations of widely varying pieces of mathematics, and interspersed with short passages of Mac Lane's philosophy of mathematics.

I knew that I wanted to do more mathematics, but at the same time I didn't relish the idea of painting myself into a highly specialized corner in which I was going to spend the rest of my intellectual life. I wanted to do something that was involved with many parts of mathematics at once.

Martin Hyland offered to supervise me for a PhD on any part of "abstract mathematics", which suited me very well. Soon enough he had me reading about higher-dimensional category theory. I took to it immediately. Not only were there dizzying connections with some very diverse parts of the mathematical sciences, but also it was a subject desperately in need of good definitions. At that time I was much more passionate about definitions than theorems or proofs. There were very few theorems in my thesis or my subsequent work on higher-dimensional category theory.

Many mathematicians would regard this as odd, but I don't: isolating an elusive concept and pinning it down with a definition can be very difficult and very important. For instance, I think the formulation of the definition of compactness in topology was a much greater achievement than the proof of the Heine-Borel Theorem (one of the basic theorems on compactness).

DC: How large are the changes that it is bringing about? Might we use the word 'revolution'?

TL: Category theory has certainly brought about huge changes. My perception is probably skewed, but whereas a few decades ago it was apparently quite normal to profess awed ignorance of elevated concepts such as "category" or "functor", now that would seem rather mannered. For large parts of pure mathematics, you simply won't be able to get on if you don't, at least, learn what those two words mean.

The word "revolution" implies to me a sudden change, so I wouldn't use it: rather, I think category theory has gradually woven itself into the fabric of our mathematics, to the point where it's now an integral part. There are still some people who resist anything categorical, but the battle is essentially won.

On the other hand, I think higher-dimensional category theory has yet to prove itself. There are fantastic big ideas of how higher-dimensional categories will function and what it implies for other parts of mathematics. Moreover, at some narrative or heuristic level there seems to be good reason to believe that these ideas will work out.

So lots of people have had high hopes. However, the problem is that those hopes haven't been achieved yet. Perhaps this shouldn't be a cause for surprise or disenchantment, because those big ideas were really big— you shouldn't expect them to be realized soon. But the continued failure to establish a good clean theory of n-categories has been a constant source of frustration, even embarrassment, and without that it's hard to see how we're going to get very far.

The impact of higher-dimensional category theory has perhaps been greatest in homotopy theory and the junction of homotopy theory with algebraic geometry. Early on, people realized that in homotopy theory, it is almost always one particular type of higher-dimensional categorical structure that arises: the so-called $(n, 1)$-categories, which are a very special case of n-categories. Since n-categories are so hard, they figured that it would be worth their while to concentrate on just $(n, 1)$-categories, and develop the theory of them. (This has been done most notably by André Joyal, who calls them quasi-categories.) Even the theory of $(n, 1)$-categories is highly nontrivial and, at the moment, full of mess and mystery. But the effort put into it does seem to be yielding good results. I don't know enough about this field to say more.

DC: We are seeing the impact of the programme on mainstream algebraic geometry, a field of requiring a terrifying range of prerequisites to contribute. In your own research, alongside technical work on the framework of n-categories, would it be fair to say that your interests have been somewhat oblique? I mean the work on cardinality, self-similarity and now more recently entropy (Part I, Part II).

TL: If "oblique" means that I don't know where I'm going, then yes, it's fair. On the other hand, I do see a common thread in my work. Since I stopped concentrating on n-categories several years ago, I've mostly been interested in what I've called at different times "self-similarity" and "recursive descriptions". This is, if you like, a categorification of the theory of linear simultaneous equations. A line segment looks like two copies of itself glued end to end; similarly, a square looks like four copies of itself glued together, and a sphere can be represented as several squares bent round and glued together. This theory touches many parts of mathematics; almost all of what I've done recently has sprung from it. But I'm not the most disciplined person about publishing promptly, so I guess the connections aren't always apparent to others.

If I were writing a grant application I'd also say that the two big theories that I've studied—higher-dimensional categories and self-similarity—require similar mathematical skills. Both are unavoidably categorical. In both, a big challenge is to take something highly complex (such as an infinite sequence of ever more complex coherence laws, or an apparently infinitely complicated fractal) and find a simple, transparent way of describing it. "Simple" makes it possible to understand and manipulate the thing, and "transparent" means that if you want to look inside and see the complexities, you can.

DC: Was it a surprise to you in your work on the entropy of a probability metric space that ecologists had in effect already hit on the idea of the cardinality of a metric space? Or should we be less surprised given the pervasiveness of category theory, as shown by Lawvere in, say, his Metric Spaces paper?

TL: Yes! Perhaps I shouldn't have been surprised, but I was. I'm used to categorical concepts showing up all over algebra, topology, etc., but for it to happen in ecology was something really new for me. And, in fact, I don't know of any other connections between category theory and ecology.

The story of how I found this connection is perhaps the most interesting thing. Ordinarily I wouldn't be reading a journal with a name like "Environmental and Ecological Statistics"—I know next to nothing about the environment, ecology or statistics. But the colleague in Glasgow who I talk mathematics with most often is a mathematical ecologist, Christina Cobbold. Although by some measure she is the one of the most "applied" members of our department and I am one of the most "pure", she has a very good instinct for connections between different fields, and that sets my category theorist's heart racing. I'd told her about my categorical approach to measuring metric spaces, and she suggested that there might just be a connection with the ecologists' approaches to measuring biodiversity—and, indeed, there was.

There seem to be many parts of applied mathematics that category theory hasn't touched. By "applied mathematics" many people understand "differential equations applied to physics". I think it should be understood much more generally; for example, the application of category theory to computer science is certainly applied mathematics. But, for instance, has category theory ever been found useful in fluid mechanics?

DC: You were involved in an event in Westminster to interest politicians in mathematics, and you write wonderful posts for the n-Category Café. Do you think it important for mathematics to find new modes of communication, from raising public awareness to sharing research in progress with colleagues?

TL: Thank you! I think many mathematicians are very happy to communicate in the classic way: by publishing papers, giving and attending talks, and sending letters (now emails). And as long as society continues to fund us, I think that mathematics "needs" no more than those classic modes of communication in order to flourish.

But while we might not "need" more, there's more on offer, and yes—I like taking advantage of some of the new ways of communicating. There are some fantastic, high-quality research blogs, for instance. I'm impatient with people who are sniffy about blogs. Of course the writing isn't as careful or crafted as a published paper; that's like expecting the words that come out of someone's mouth to resemble the words you'd read in a novel. And my own research has been advanced in really crucial ways by two internet-based facilities: the categories email list and the n-Category Café.

I'm not sure what I think about raising public awareness. I have a limited appetite for doing it myself, and perhaps most members of the public would be happier if mathematicians left them alone. After all, for many people maths means a bad memory from school. But of course there are also people with a non-professional interest in mathematics, and when I did a Café Scientifique in Glasgow I was bowled over by the hunger for mathematical knowledge.

The Paradox of Omnipotence: Not for an omnipotent God

The paradox of omnipotence—also known as the paradox of the stone—is: God, either can or cannot create a stone that he cannot lift. In either case he is not omnipotent.

The paradox has led some to argue that God while "all mighty" is not omnipotent. See Peter Geach (1979: *Providence and Evil*, chapter 1 especially pp. 6-18) and Yugin Nagasawa (2008: 'A New Defence of Anselmian Theism', *The Philosophical Quarterly*, 58, pp. 577-596).

But surely God cannot create a stone that he cannot lift, for then God would have to be able to create a stone which in principle cannot be lifted. For what is too heavy for an omnipotent being to lift is not possible to lift. And omnipotence does not trump logical impossibility.

If an omnipotent being should be able to do what is logically impossible, and God cannot, there would be no paradox; since every necessary truth would then attest to his impotence. And if God can make one logically false statement true he can make them all true. Again, there would then be no paradox.

The classical solution of George Mavrodes (1963 'Some Puzzles Concerning Omnipotence', *The Philosophical Review*, 72, pp. 221-3) sees the paradox as a request of God to perform two incompatible tasks. On our view the paradox fails at the very first instance for requiring God to create a logical impossibility. That is, to create a stone too heavy for him to lift and yet be logically possible to lift. Perhaps this is what Geach meant when he said that the paradox in requiring that God create a stone that he cannot lift may have "a buried inconsistency in it" (op. cit., p. 18). (Many thanks for discussion to David Widerker.)

Alex Blum
Philosophy, Bar-Ilan University

Liars, Divine Liars and Semantics

I've a little question about the proper use of names. Patrick Grim (2000: 'The being that knew too much'. *International Journal for Philosophy of Religion*, 47, pp. 141-154), for example, tries to show that no one is omniscient—knows all and only truths—via the following sentence, which he (2000: 144) called '(4)'.

God doesn't believe that (4) is true.

Let's say (as many do) that a sentence is true insofar as it describes reality. Were propositions (or statements) rather than sentences our truth-bearers, we could instead consider (4*) = 'God doesn't believe that (4*) ever expresses a true proposition.' And while, in general, a sentence has a variable and fuzzy truth-value, with sentences like (4) such complexities can be safely ignored.

Grim (2000: 145) argued that if 'God' names an omniscient being then 'God' is an empty name, as follows. If (4) is true then (4) is a truth that God doesn't believe, and if (4) is false then there is a falsehood that God does believe. Furthermore, if (4) is not so much false as senseless then, since (4) is still not true, and since God is omniscient (if he exists), God doesn't believe that (4) is true. But that is just (4), so (4) is true, whereas *ex hypothesi* (4) is not true. Nonetheless, before concluding that (4) is true, because God doesn't exist, we should notice a lacuna in Grim's argument.

Let *B* = 'This sentence is not (now) true.' The traditional resolution of the (strengthened) Liar paradox was that to be a Liar-style sentence (or set of sentences or propositions) such as *B* or (4) is to be senseless, a bit like such 'nonsense' (or falsity) as 'I met a man who wasn't there.' *B* does not seem to be senseless, of course; it seems to be saying that B is not true, which is sensible (and true). However, insofar as *B* is asserting that, it is thereby asserting the opposite of that. We are naturally rather charitable in our first stabs at what words mean, and the *prima facie* appearance of sense is the result of ordinary language use, which revolves around simple subject/predicate sentences; but *B* is an extraordinary sentence, which presents itself as nothing if not misrepresenting itself.

B is certainly not true because if *B* is true then it is what it says it is, and it says that it is not true (and otherwise *B* is not true, too). But when we take *B* to be saying that B is not true we see only part of what *B* is saying, the part that would normally be the whole meaning of a simple subject/predicate sentence. *B* seems to be saying that *B* is not true because it is sufficiently similar to an ordinary sentence that simply says that *B* is not true, e.g. '*B* is not true.' But upon closer inspection it becomes, I think, clear that *B* is nonsense disguised as a contradiction, and disguised again as just one of the inconsistent conjuncts.

Dale Jacquette (2007: 'On the Relation of Informal to Symbolic Logic', in his (ed.) *Philosophy of Logic*, North-Holland, 131-154) thinks that Liar sentences are disguised contradictions (2007: 143). And they do seem to be saying, not only that they are not true but also, if less obviously, that they are (therefore) true. By the falsity of that latter conjunct, what they say would therefore be false, overall. But note that the first conjunct, which Liars seem most obviously to be saying, gives rise to both of those conjuncts. A mathematical analogy for why B might therefore be senseless is the deduction from $x = x + -x$ (or indeed, from $x = -x$) of $x = 0$.

Nonetheless such a resolution is, as it stands, insufficient to save God's omniscience from (4). Indeed, it cannot even deal with the following sentence, called 'C': C is not true. I want to say 'C is not true' truthfully on the grounds that 'C is not true' is nonsense, which seems hopeless. Various other options are available—e.g. Tarskian hierarchies of truth-predicates, and dialetheism—but in view of their counter-intuitive consequences I would first question the naming of that sentence as 'C'. After all, names are most naturally given to pre-existing things.

Non-well-founded names do have their uses, of course. E.g. the non-well-founded set $U = \{U\}$ rightly belongs to applicable mathematics. But such formal entities exist insofar as their underlying axioms are coherent, whereas our primary concern as philosophers is with *correspondence* truth; e.g., with how well modelled by U something is.

This sentence (which may be referred to as 'D') is composed of English words, grammatically—indeed, truthfully—arranged.

It seems to me that D is true. And although Laureano Luna (2008: 'A note on tokenism and self-reference,' *The Reasoner*, 2(11), 4-5) may well be right about why such names cannot occur (outside formal contexts), the Liar's traditional resolution requires only that the introduction of such names is not necessarily legitimate—that it might be shown in certain cases to be illegitimate. A mathematical analogy might be the introduction of objects whose properties have not been shown to be contradictory—as standard mathematics became the exact science of set-theoretical ordinals, various paradoxes become proofs of such theorems as that there is no set of all such ordinals.

So I am wondering why non-well-founded names are so widely used, seemingly at whim (e.g., to make a neater argument), without explicit justification. The derivation, from Liar-style sentences, of a stream of counter-intuitive semantic theories—as well as Grim's more plausible conclusion—surely indicates a *prima facie* requirement for some justification. Incidentally, although Grim's argument contained that lacuna, God's omniscience is impossible anyway. E.g. no one could be fully justified in being completely certain of negative existential facts of empirical matters, e.g. the non-existence of others of one's (apparently unique) kind. And (perfect) knowledge requires (perfect) justification, as well as truth.

Martin Cooke

Van Fraassen on Presupposition and Self-Reference

Presuppositions

Bas C. van Fraassen used the Logic of Presuppositions to solve the Liar paradox. van Fraassen (1968: Presupposition, Implication, and Self-Reference, *The Journal of Philosophy*, pp. 136–152.)

Let

$$X = \text{“This sentence is false!”}$$
$$Y = \text{“This sentence is not true!”}$$

Van Frassen has concluded that the Plain Liar paradox is solved when $\sim T(X)$ & $\sim F(X)$. He has further claimed that $\sim T(Y)$ necessitates Y, and as a result the Strengthened Liar paradox is unsolvable except by denying the bivalence of $T()$ sentences. **But why does $\sim T(Y)$ necessitate Y?** We will re-examine this claim.

Van Frassen's definitions are below. The *negation* of sentence A is true if (respectively, false) iff A is false (respectively, true.)

1. *A presupposes B* if and only if
   (a) if A is true then B is true
   (b) if $\sim A$ is true then B is true
2. *A necessitates B* iff whenever A is true then B is true
   From 1 and 2 we obtain:
3. A presupposes B if and only if
   (a) A necessitates B
   (b) $\sim A$ necessitates B

Truth:

1. If P is true then $T(P)$ is true, otherwise $T(P)$ is false
2. If the second level sentence A is false, then $\sim A$ is true, and if A is true then $\sim A$ is false.
3. If either A is true or B is true, then $(A \vee B)$ is true, otherwise $(A \vee B)$ is false.

The Plain Liar Paradox

Van Fraassen has observed that X and $T(\sim X)$ necessitate each other. The situation is illustrated in Table 1.

The table reveals that

1. if $\sim X$ is true then $T(\sim X)$ is true [d3]
2. iif X is true then $T(\sim X)$ is true [e1]

Therefore X presupposes $T(\sim X)$

But $T(\sim X)$ cannot be true. Hence X does not have a truth value.

	a	b	c	d	e	f
	X	$\sim X$	$T(X)$	$T(\sim X)$	$T(\sim X)$	$\sim T(\sim X)$
1	**T**	F	T	F	**T**	F
2	N	N	F	F	**F**	**T**
3	F	**T**	F	**T**	F	T

Table 1: The columns c, d represent Tarski's principle, columns e, f represents what the Liar says.

		$\sim T(Y)$ necessitates Y	$T(Y)$ necessitates $\sim Y$
1	Assumption	Y means same as $\sim T(Y)$	Y means same as $\sim T(Y)$
2	Premise	$T(\sim(T(Y))$ [f1]	$T(T(Y))$ [e3]
3	Tarski's principle from 2	$\sim T(Y)$	$T(Y)$
4	Principle 1 from 1,3	$T(Y)$	$T(\sim Y)$

Table 2:

The Strengthened Liar Paradox

Van Fraassen suggests that $\sim T(Y)$ necessitates Y. We can indeed show this, as well as that $T(Y)$ necessitates $\sim Y$, by a relatively simple argument using the principle that if two different sentences mean the same thing and one is true then the other one is also true:

	Principle 1
Assumption	A means the same as B
Premise	$T(B)$
Conclusion	$T(A)$

Let us assume that Y and $\sim T(Y)$ have the same meaning. See Table 2.

We have indeed proven that $\sim T(Y)$ necessitates Y, but we have also proven a contradiction in the process. If Y and $\sim T(Y)$ mean the same thing then one cannot be trivalent and the other bivalent.

By the definition of necessitation if $\sim T(Y)$ necessitates Y and Y is N then $\sim T(Y)$ must *not* be T [f2]. Analogously if $T(Y)$ necessitates $\sim Y$ and Y is N then $T(Y)$ must *not* be T [e2].

		$T(\sim X)$ necessitates X	$\sim T(\sim X)$ necessitates $\sim X$
1	Assumption	X means same as $T(\sim X)$	X means same as $T(\sim X)$
2	Premise	$T(T(\sim X))$ [e1]	$T(\sim T(\sim X))$ [f3]
3	Tarski's principle from 2	$T(\sim X)$	$\sim T(\sim X)$
4	Principle 1 from 1,3	$T(X)$	$T(\sim X)$

Table 3:

	a	b	c	d	e	f
	Y	$\sim Y$	$T(Y)$	$\sim T(Y)$	$T(Y)$	$\sim T(Y)$
1	T	F	T	F	F	T
2	N	N	F	T	**F**	**F**
3	F	T	F	T	T	F

Now e2 and f2 contradict each other. Van Fraassen argues that "The Strengthened Liar paradox is averted if we hold that $T(Y)$ and $T(\sim Y)$ are themselves neither true nor false. From this it follows immediately that the sentence $\sim T(Y)$ & $\sim T(\sim Y)$ also is neither true nor false." van Fraassen (1968: p.149.) But this is implausible. If it is the case that Y is neither true nor false then by Tarski's principle $\sim T(Y)$ & $\sim T(\sim Y)$ is true.

The Plain Liar Again

The same argument can can be used against the Plain Liar. See Table 3.

Neither $T(\sim X)$ nor $\sim T(\sim X)$ can be the case. Furthermore in the table below e2 and f2 conflict.

	a	b	c	d	e	f
	X	$\sim X$	$T(X)$	$T(\sim X)$	$T(\sim X)$	$\sim T(\sim X)$
1	T	F	T	F	T	F
2	N	N	F	F	**F**	**F**
3	F	T	F	T	F	T

Haim Gaifman pointed out that:

> The contradiction returns also if the sentence says of itself that it is false: If it lacks a truth value, then it is not false; but it says of itself that it is false, hence it is false after all. Gaifman (Pointers to Propositions, Columbia University, p.16.)

There is no essential difference between the Plain Liar and the Strengthened Liar.

Conclusion

What is wrong with the argument is of course the assumption that Y means $\sim T(Y)$. We have in front of us is a proof by contradiction that Y is *not* the same as $\sim T(Y)$. And if $\sim T(Y)$ is the only thing Y could possibly mean then Y is meaningless, and $\sim T(Y)$ says that Y is not true.

X.Y. Newberry

§3 News

The Formal Epistemology Project (FEP)

The Formal Epistemology Project (FEP) is an interdisciplinary research project dedicated to investigating the foundations and applications of formal epistemology.

The Project is directed by Igor Douven, and combines methodological and research expertise from philosophy, logic, probability theory, psychology, cognitive science, and artificial intelligence. Please visit our website: http://www.formalphilosophy.org! The Project was founded in October 2007, and fully launched in October 2008. It is composed of an active team of postdoctoral researchers and visiting researchers. FEP is based at the Centre for Logic and Analytical Philosophy at the Institute of Philosophy at the University of Leuven.

The research activities of FEP members include Formal Social Epistemology, Dynamic Information Processing, Epistemic and Doxastic Logics, Substructural Logics, Conditionals, Formal Theories of Truth, Bayesian Epistemology, and Empirical Psychological studies of Formal Reasoning.

The academic year contains a full range of research-based activities, including research presentations and visiting lectures. FEP hosts a regular Formal Philosophy Seminar series on Friday afternoons, as well as the Bi-Annual Konstanz-Leuven Series in Formal Epistemology. FEP also hosts a regular series of workshops and guest lectures. FEP members play an active role in graduate teaching at the university, and the project also hosts its own graduate students. For more information on FEP members and activities, see the People and Events pages on our website.

The Project recently ran a Workshop on Computer Simulations in Social Epistemology. Held on October 30–31, participants included Jason McKenzie Alexander (LSE), Igor Douven (Leuven), Stephan Hartmann (TiLPS), Paul Humphreys (Virginia), Carlo Martini (TiLPS), Alexander Riegler (Leuven), Gerhard Schurz (Duesseldorf), and Kevin Zollman (Carnegie Mellon). The program and pictures from the Workshop are available at the Project website.

FEP welcomes wide participation in all of its workshops and seminars and related events. To keep up to date on all things FEP, subscribe to our low-traffic announcement list: send an email containing 'subscribe fep' [without quotes] in the body of the email to listserv@listserv.cc.kuleuven.be.

We look forward to seeing you at the project!

Igor Douven
Philosophy, Leuven

Sebastian Sequoiah-Grayson
Philosophy, Leuven

British Logic Colloquium, 4–6 September

The annual meeting of the British Logic Colloquium was held at the University of Nottingham on the 4–6 September 2008. As usual, the invited speakers were logicians working in and across a variety of different fields, in this instance computer science, mathematics, linguistics and philosophy. Invited talks were given by Michael Benedikt (Oxford University), Ulrich Kohlenbach (Technische Universitä Darmstadt), Dexter Kozen (Cornell University), Hannes Leitgeb (University of Bristol), Peter Milne (University of Stirling), Michael Moortgat (Utrecht Institute of Linguistics OTS), Alan Weir (University of Glasgow) and Mikhail Zakharyaschev (Birkbeck College). There were also a number of contirbuted talks.

Michael Zakharyaschev began the first day's proceedings with a talk entitled 'Two etudes on modal logic in computer science' in which he argued that modal logic has successful applications in reasoning about such diverse areas as space (connected regions etc.) and concept hierarchies in ontologies. Dexter Kozen talked about Kleene algebras with tests and Kleene coalgebras with tests—the former corresponding to regular expressions and the latter to automata—and on using them for verifying computer programs. James Brotherston gave a talk on a classical extension of O'Hearn and Pym's logic of bunched implications for which an algebraic semantics and cut eliminating proof system had been developed. Dmitry Tishkovsky gave an overview of joint work with Renate Schmidt on a general tableau method for deciding Description Logics, Modal Logic and First Order Logic. The day ended with a presentation by Roy Dyckhoff of joint work with Mehrnoosh Sadrzadeh which had resulted in the definition of a cut-free sequent calculus for distributive lattices with adjoint pairs of modal operators.

The second day began with a talk by Rob Goldblatt on Lindenbaum's Lemma and its transfer to certain varieties of infinitary logic. Michael Moortgat charted the progress which had taken place in the development of Lambek's 50-year-old syntactic calculus. In particular he discussed recent attempts toward resolving tractability issues without incurring concomitant losses in expressivity, efforts which had culminated in the definition of symmetric categorial grammar. Michael Benedikt's talk 'Logic on Streams' focused on the complexity of model checking for query languages on trees.

Ulrich Kohlenbach described recent results in 'proof mining': extracting effective bounds as well as new uniformity results from standard ineffective mathematical proofs. Hannes Leitgeb gave a talk on the relation between truth and probability. Among other things Leitgeb discussed a novel justification of the axioms of probability theory, as well as producing a probabilistic semantics for conditional logic. Laura Crosilla ended the second day by presenting joint work with Andrea Cantini on a new system of constructive set theory which could be viewed as a link between Aczel's constructive set theory and Feferman's explicit mathematics.

The final day commenced with a presentation by Basil Smith of results taken from his work on the elementary theory of relations. Alan Weir considered the question of what made logic compelling and ways of potentially meeting the challenges posed by the Irrationalist Dilemma. Finally Peter Milne concluded this year's series of talks with a discussion of Dutch book arguments for Fuzzy Logic.

Natasha Alechina
Computer Science, Nottingham

Fahad Khan
Computer Science, Nottingham

Kazimierz Naturalism Workshop, 6–10 September

This year's workshop in Kazimierz Dolny (Poland) explored various themes in philosophical naturalism. The keynote speakers were Peter Gärdenfors, Ingo Brigandt, Susan Haack, Susan Stuart and David Papineau.

Gärdenfors presented his detailed account of representing actions in conceptual spaces. In a similar methodological manner, Mark Alfino talked about naturalising wisdom and modelling it, and Randy Mayes about making the concept of cruelty applicable to non-human animals.

Discussion on naturalist metaphysics was started by Marcin Miłkowski who tried to explicate the notion of ontological naturalism vs. physicalism. Jonathan Knowles followed by asking in what respect naturalism is a threat to metaphysics in general. Christian Cocos argued that natural kinds are undetermined by multiple equivalent but ontologically different scientific theories, and that there couldn't be a single formal ontological framework that could capture them all. Nicholas Wiltsher showed that Hilary Kornblith's account of knowledge as a natural kind is problematic.

The second day of the workshop was started by Haack who offered an account of belief within a broadly pragmatist naturalism. This was followed by Rui Silva's discussion of Haack's explication of the relation between social and natural sciences, and Piotr Leśniak's remarks on Haack's account of perception. Lisa Warenski offered a nonreductive, naturalistic account of normativity in epistemology that went against Knowles' denial of any role for epistemic normativity. The question of normativity was again brought up by Kevin DeLapp the next day who showed that in metaethics, the notion of naturalism—and its philosophical commitments—are highly unstable. Still another possible facet of naturalism, this time a semantic one, was proposed by Tadeusz Ciecierski and Katarzyna Kuś. A naturalistic account of meaning as born from information in the world was suggested by John Collier.

The third day was started by Stuart's energetic presentation on Kantian naturalism. Stuart argued that, contrary to what is usually assumed, Kant's insights may very well provide an inspiration for embedded/embodied mind research. The dynamics of knowledge was the topic of talks by Ryszard Wjcki and Gergely Kertsz, from the point of view of evolutionary epistemology and knowledge system accounts.

Another theme was started by Brigandt who talked about the use of intuitions in naturalism. Brigandt argued that biology shows that conceptual analyses are always connected to epistemic goals and that they regulate the use of concepts rather than vindicate intuitions. Nevertheless, Karol Polcyn contended that the intuition of dualism is a problem for naturalists to explain. Paweł Grabarczyk showed, in turn, how thought experiments might shape ontological intuitions. The last presentation of the workshop was given by Papineau who argued that philosophical analysis doesn't offer a priori claims but a posteriori synthetic theses.

The workshop ended with a discussion panel with keynote speakers and Wójcicki (the previous editor-in-chief of *Studia Logica*). The attendees seemed to share the organizers' conviction that, though this year's workshop theme was much broader than in previous years which focused on naturalised epistemology, the talks seemed to organize around several attractors in the phase space of problems in naturalism.

For more details, see `http://www.obf.edu.pl/Naturalism`. We plan to upload most presentations and mp3 files of the talks there. Next year's workshop will again be more focused—the theme for '09 will be Naturalism and the Mind.

Marcin Miłkowski
Institute of Philosophy and Sociology, Polish Academy of Sciences, Warsaw

The Place of Epistemic Agents, 2–3 October

The conference The Place of Epistemic Agents took place at the University Carlos III of Madrid, 2-3 October 2008. It gathered a number of international participants to discuss both the role of the autonomous epistemic agent and the role that the dependence on others has in our epistemic endeavours.

The conference opened with a paper by Ernest Sosa (Rutgers), which introduced different levels of competence to account for the performance of an agent in a given epistemic task, corresponding to four varieties of credit. Other contributors inquired into the sources of epistemic normativity (Anthony-Robert

Booth, Utrecht), or addressed specific normativity issues, questioning how agents can be regarded as responsible for what they believe (Gian-Andri Toendury, Fribourg) and suggesting that an adequate account of epistemic rationality should draw on the notion of intellectually responsible behaviour (Joshue Orozco, Rutgers).

Many papers concerned the possibility of epistemic agency. Pascal Engel (Geneva) examined different accounts and concluded that this notion refers to a process of belief formation and inquiry rather than to a state of knowledge or belief. Questions were raised as to whether epistemic agency involves some kind of voluntary control (Conor McHugh, Edinburgh), or whether it maintains an interesting link to freedom, both doxastic (Philipp Nickel, UCIrvine) and practical (Boudejwijn de Bruin, Groningen). Particularly interesting were discussions about the possibility of having alienated or unendorsed beliefs (David Hunter, Ryerson), and the role of "epistemic evasion" (Berislav Marusic, Brandeis). Zamora Bonilla focused on how to model epistemic agency building on Brandom's notion of "deontic scoring" (UNED-Madrid).

Klemens Kappel (Copenhagen) offered a critical analysis of Craig's account of the "knowledge" predicate to flag approved sources of information, contending that it is used in different circumstances and for various purposes. Jennifer Lackey (Northwestern) illustrated a set of such uses. In cases of isolated second-hand knowledge, we evaluate the epistemic credentials of the agent and the epistemic propriety of the utterance given the epistemic norms that govern the specific situation. Baron Reed (Northwestern) described the set of expectations that enter into our evaluations of an agent's cognitive performance, in particular, the ability to deliver a single cognitive response relevant to the epistemic situation.

A last set of topics focused on the role of epistemic agents in testimonial contexts and the issuing problem of trust. Estany and Casacuberta (UAB) defended that distributed social cognition models would better address these topics. In order to secure the quality of our beliefs, the search for reliable (Mayoral de Lucas, Zaragoza) and relevant sources (Rodrguez Hannikainen, Principia) was emphasized. Lilian O'Brien (Cork) looked at cases where epistemic dependence on others does not carry with it the agent's loss of epistemic control. Aaron Bogart (Sheffield) argued that a principle of self-trust follows from our basic epistemic rationality. David Eng (Victoria) argued against the view that an agent's testimonial belief is justified on the basis of an analogy between testimony and memory, while Ben Almassi (Washington) defended that we are sometimes warranted in refraining from trusting others in order to counteract epistemic arrogance.

Alberto Rubio
Universidad Autónoma de Madrid

Mario Santos
Universidad Autónoma de Madrid

Calls for Papers

Sir Karl Popper Essay Prize: British Society for the Philosophy of Science, deadline 31 December.

Practical Reasoning and Normativity: Special Issue, *Philosophical Explorations*, deadline 1 February 2009.

Reasoning for change: Special issue of the journal *Informal Logic*, deadline 10 February.

Representing, Learning, and Processing Preferences: Theoretical and Practical Challenges: Special issue of *Artificial Intelligence*, deadline 15 February.

Just Reason: Special issue of the journal *Studies in Social Justice*, deadline 1 April.

Experimental Philosophy: Forthcoming issue of *The Monist*, deadline April 2011.

§4
Introducing ...

In this section we introduce a selection of key terms, texts and authors connected with reasoning. Entries will be collected in a volume *Key Terms in Logic*, to be published by Continuum. If you would like to contribute, please click here for more information. If you have feedback concerning any of the items printed here, please email thereasoner@kent.ac.uk with your comments.

Logic programming

A declarative style of programming based on first-order logic, generally used for artificial intelligence and computational linguistics. The best known logic programming language is Prolog. A logic program consists of a database of clauses, which can be facts or rules. An example of a fact is 'Socrates is human', which can be written in Prolog as $human(socrates)$. An example of a rule is 'All humans are mortal', which in Prolog becomes $mortal(X) : -human(X)$. After supplying the logic programming system with a database, the user asks the system to prove a goal, e.g. $mortal(socrates)$, in Prolog. The system then attempts to prove the goal by resolution and recursively breaking it down into subgoals and trying to prove them until it reaches facts in the database. A fact is a goal without subgoals, so it is always true. Prolog combines this recursive way of proving the goal with backtracking: if it can prove the first subgoal and then cannot prove the other subgoals based on the solution of the first subgoal, the system 'backtracks' and tries the next possible solution to the first subgoal. Backtracking terminates when there are no more solutions of the first subgoal. A clause can contain variables such as 'X' in our example. In the resolution step, this variable can take the value of the logical constant it is matched to, such as 'socrates'. Logic programming has also been extended with higher-order programming features derived from higher-order logic, such as variables appearing in quantifications.

Koen Vervloesem

W. V. Quine, *Mathematical Logic*, New York, Norton, 1940

First published in 1940, this book was based upon Quine's graduate teaching during the 1930s at Harvard University. He presents a new system of mathematical logic that he claimed was accessible to those with no previous exposure to formal logic. But it was supposed to serve not just as an introduction to the subject, but also as a serious contribution to logic—or as Quine puts it in the preface: as a 'textbook and treatise . . . within the same covers'. The serious contribution the book was intended to make was in the vein of logicism, i.e. to show that mathematics is reducible to logic. The system Quine outlines in the book was supposed to avoid the known set-theoretical paradoxes in a simpler and more satisfying way than any proposed by previous authors, and in particular Russell and Whitehead in Principia Mathematica. With one caveat, this claim is considered to be substantiated. The caveat is that the system presented in the first edition of *Mathematical Logic* was discovered by Barkley Rosser to be inconsistent (specifically, a paradox called the Burali-Forti paradox could be derived from it), but this mistake was rectified in the second edition.

Chapter 1 is an elegant account of the propositional calculus. Chapter 2 introduces quantification theory. In chapters 3 and 4 Quine applies the general theory to the study of classes, and it is these two chapters that contain the core of Quine's new system. In chapter 5 Quine shows us how to reduce relations to classes. In Chapter 6 we are given the derivation of mathematics from logic, where the numbers (natural, rational, and real) and arithmetical operations are again defined in terms of classes. Finally, in chapter 7 we are given a sharply delineated proof of an incompleteness theorem that closely parallels Gödel's famous result.

Benjamin L. Curtis
Philosophy, Nottingham

§5 Letters

Dear Reasoners,

The last issue of *The Reasoner* regrettably contains an inadequate discussion of

"Line 1: The sentence written on Line 1 is nonsense."

A sentence can be (a) true, (b) false, or (c) neither. In case (c) it is nonsense.

(a) Assuming that the sentence on Line 1 is true, it follows that the sentence on Line 1 is false.

(b) Assuming that the sentence on Line 1 is false, it follows that Line 1 is false. Hence the sentence on Line 1 is false.

(c) Assuming that the sentence on line 1 has no truth value, it follows that it is true. Hence it is false.

Hence, the sentence on Line 1 is false. All this is in Karl R. Popper, *The Open Society and Its Enemies*, chapter 24, note 8.

Sincerely,

Joseph Agassi
Tel Aviv University

Dear Reasoners,

In a recent issue of *The Reasoner* (2008: "The Indiscernibility of Identicals" *The Reasoner* 2(11), p.12) Andrew Mills raises an objection to the principle of the indiscernibility of identicals, on the ground that while Superman has the property of 'being thought by Lois to be able to fly', Clark does not. And yet Clark and Superman are one.

Surely we cannot grant that Superman and Clark are one and yet fail to share a property, say F. For 'Fx & not Fx' is a contradiction. Hence if Lois believes that Superman can but that Clark cannot fly, she has inconsistent beliefs. However, Lois is not irrational as a result, for she does not believe, nor does she have good reason to believe that Superman and Clark are one.

Alex Blum
Philosophy, Bar-Ilan University

§6
Events

December

Metaphysics of Science: Grenoble, Universit Pierre Mends France, MSH-Alpes, 1–2 December.

Institutionalizing Epistemic Standards for Science: LSE, London, 1–2 December.

Inference, Consequence, and Meaning: Sofia, 3–4 December.

ICLP: 24th International Conference on Logic Programming, Udine, Italy, 9–13 December.

Causality: objectives and assessment: Whistler Resort & Spa and Westin Hilton, BC, Canada, 12 December.

CIMCA: International Conference on Computational Intelligence for Modelling, Control and Automation, Vienna, Austria, 10–12 December.

Trends in Logic VI: Logic and the foundations of physics: space, time and quanta, Brussels, Belgium, 11–12 December.

Concepts and Intuitions: Department of Philosophy at the University of Turku, Finland, 13–15 December.

ICDM: 8th IEEE International Conference on Data Mining, Pisa, 15–19 December.

PRICAI: Tenth Pacific Rim International Conference on Artificial Intelligence, Hanoi, Vietnam, 15–19 December.

January 2009

LFCS: Symposium on logical foundations of computer science, Deerfield Beach, Florida, 3–6 January.

SODA: ACM-SIAM Symposium on Discrete Algorithms, New York Marriott Downtown, 4–6 January.

Biomolecular Networks: from analysis to synthesis: Pacific Symposium on Biocomputing, Fairmont Orchid, The Big Island of Hawaii, 5–9 January.

3rd Indian Conference on Logic and its Application: The Institute of Mathematical Sciences, Chennai, India, 7–11 January.

LOGOS: Barcelona Workshop on Singular Thought, 15–17 January.

Graduate Conference: Second Cambridge Graduate Conference on the Philosophy of Logic and Mathematics, 17–18 January.

VAF: 3th Conference of Dutch Flemisch Association for Analytical Philosophy, Tilburg University, the Netherlands, 22–23 January.

Bayesian Biostatistics: Houston, Texas, 26–28 January.

Very Informal Gathering of Logicians: UCLA Logic Center, 30 January–1 February.

February

ACM International Conference on Intelligent User Interfaces: Sanibel Island, Florida, 8–11 February.

AIA: IASTED International Conference on Artificial Intelligence and Applications, Innsbruck, Austria, 16–18 February.

Colloquium: PhD's in Logic, Ghent, 19–20 February.

CICLing + Lexicom: 10th International Conference on Intelligent Text Processing and Computational Linguistics; pre-conf event: Lexicom-Americas workshop, 24–28 February.

InterOntology: 2nd Interdisciplinary Ontology Conference Tokyo, Japan, 27 February–1 March.

March

Models and Simulations 3: Charlottesville, Virginia, 3–5 March.

&HPS2: Integrated History and Philosophy of Science, University of Notre Dame, 12–15 March.

ADS: Agent-Directed Simulation Symposium, Part of the Spring Simulation Multiconference, San Diego, California, 22–27 March.

Evidence, Science and Public Policy: Sydney Centre for the Foundations of Science, 26–28 March.

EACL: Computational Linguistic Aspects of Grammatical Inference, Athens, 30 March.

CSIE: World Congress on Computer Science and Information Engineering, Los Angeles/Anaheim, 31 March–2 April.

April

Foundations of Math: New York University, 3–5 April.

EuroGP: 12th European Conference on Genetic Programming, Tübingen, Germany, 15–17 April.

AISTATS: Twelfth International Conference on Artificial Intelligence and Statistics, Clearwater, Florida, 16–19 April.

ESANN: 17th European Symposium on Artificial Neural Networks Advances in Computational Intelligence and Learning, Bruges (Belgium), 22–24 April.

Philosophical Methodology: AHRC Project on 'Intuitions and Philosophical Methodology' at the Arché Philosophical Research Centre, University of St. Andrews, 25–27 April.

May

Logic of John Duns Scotus: 44th International Congress on Medieval Studies at Western Michigan University, 7–10 May.

AAMAS: The Eighth International Joint Conference on Autonomous Agents and Multi-Agent Systems, Budapest, Hungary, 11–15 May.

Philosophy and Cognitive Science: The XIXth edition of the Inter-University Workshop, Zaragoza, 18–19 May.

UR: Uncertain Reasoning, Special Track of FLAIRS, Island, Florida, USA, 19–21 May.

AI: The twenty-second Canadian Conference on Artificial Intelligence, Kelowna, British Columbia, 25–27 May.

Science and Values: The Politicisation of Science: Center for Interdisciplinary Research (ZiF), Bielefeld, Germany, 25–30 May.

CSHPS: The Canadian Society for History and Philosophy of Science, annual conference as part of the Congress of the Humanities and Social Sciences (CFHSS), Carleton University, Ottawa, 26–28 May.

June

Argument Cultures: Ontario Society for the Study of Argumentation, Windsor, Canada, 3–6 June.

CNL: orkshop on Controlled Natural Languages, Marettimo Island, Sicily, 8–10 June.

NA-CAP: Networks and Their Philosophical Implications, Indiana University in Bloomington, 14–16 June.

NAFIPS: 28th North American Fuzzy Information Processing Society Annual Conference, University of Cincinnati, Cincinnati, Ohio, 14–17 June.

ICML: The 26th International Conference On Machine Learning, Montreal, Canada, 14–18 June.

Formal Epistemology Workshop: Carnegie Mellon University, 18–21 June.

WoLLIC: 16th Workshop on Logic, Language, Information and Computation, Tokyo, Japan, 21–24 June.

July

Two Streams in the Philosophy of Mathematics: Rival Conceptions of Mathematical Proof, University of Hertfordshire, Hatfield, UK, 1–3 July.

ECSQARU: 10th European Conference on Symbolic and Quantitative Approaches to Reasoning with Uncertainty, Verona (Italy), 1–3 July.

E-CAP: Computing and Philosophy, Universitat Autònoma de Barcelona, 2–4 July.

Metaphysics of Science: University of Melbourne, 2–5 July.

SPT: Converging Technologies, Changing Societies, 16th International Conference of the Society for Philosophy and Technology, University of Twente, Enschede, The Netherlands, 8–10 July.

ISHPSSB: International Society for the History, Philosophy, and Social Studies of Biology, Emmanuel College, St. Lucia, Brisbane, Australia, 12–16 July.

Logic and Heresy in the Middle Ages: Leeds Medieval Congress, 13–16 July.

ISIPTA '09: 6th International Symposium on Imprecise Probability: Theories and Applications, Durham University, 14-18 July.

August

Meaning, Understanding and Knowledge: 5th International Symposium of Cognition, Logic and Communication, Riga, Latvia, 7–9 August.

Practice-based Philosophy of Logic and Mathematics: ILLC, Amsterdam, 31 August–2 September.

September

Mechanisms and Causality in the Sciences
University of Kent, Canterbury, UK, 9–11 September

Phloxshop II: Humboldt-Universität, Berlin, 9–11 September.

MoS: Grand Finale Conference of the Metaphysics of Science AHRC Project, Nottingham, 14–16 September.

ISMIS: The Eighteenth International Symposium on Methodologies for Intelligent Systems, University of Economics, Prague, Czech Republic, 14–17 September.

October

Developmental and Comparative Psychology, and Cognitive Science: Bentley University, Greater Boston, 1–3 October.

Breaking Down Barriers: Blackwell Compass Interdisciplinary Virtual Conference, 19–30 October.

EPSA: 2nd Conference of the European Philosophy of Science Association, 21–24 October.

§7
Jobs

Independent New Investigator: Onna-son or Urumashi, Okinawa, Japan, applications open 17 November, until position is filled.

Assistant Professor: Institute of Cognitive Science at Carleton University, 1 December.

Assistant Professor: Philosophy of social sciences, Université du Québec à Montréal, Montréal, Canada, 1 December.

Postdoc position: in Philosophy of Science, Department of Philosophy at Bielefeld University, 5 December.

Visiting Fellowships: Sydney Centre for the Foundations of Science, 8 December.

Visiting Fellowships: The Tilburg Center for Logic and Philosophy of Science (TiLPS), 15 December.

Lecturer: Philosophy / Critical Thinking / Informal Logic, Department of Philosophy, University of Auckland, New Zealand, 5 January.

Junior or Senior Level Faculty: Machine learning or statistics, the Gatsby Computational Neuroscience Unit at UCL, 5 January.

Lecturer: Critical Thinking/Informal logic, Faculty of Arts, University of Auckland, 5 January.

Visiting Fellowships schemes: British Academy, 12 January.

Newton Fellowships: The Fellowships enable researchers to work for two years with a UK research institution, thus establishing long-term international collaborations, 12 January.

Two Faculty Positions: Statistics for Life Sciences and Statistics for Stochastic Processes, Institute of Statistics, Université catholique de Louvain, Belgium, 12 January.

5 Tenure-Track Faculty in Complex Systems: Faculty Position in Intelligent Systems at the University of Vermont, 16 January.

Assistant Professor: Mathematics & Statistics, College of Engineering and Mathematical Sciences, University of Vermont, 16 January.

Post-Doctoral Fellowship: Irish Research Council for the Humanities and Social Sciences, 23 January.

§8
Courses and Studentships

Courses

Master Programme: Philosophy of Science, Technology and Society, Enschede, the Netherlands.

MSc in Mathematical Logic and the Theory of Computation: Mathematics, University of Manchester.

MA in Reasoning
An interdisciplinary programme at the University of Kent, Canterbury, UK. Core modules on logical, causal, probabilistic, scientific, mathematical and machine reasoning and further modules from Philosophy, Psychology, Computing, Statistics, Social Policy and Law.

MSc in Cognitive & Decision Sciences: Psychology, University College London.

Summer Schools in Logic and Learning: Australian National University, Canberra, Australia, 26 January–6 February 2009.

Summer Institute on Argumentation: University of Windsor, Canada, contact H.V. Hansen or C.W. Tindale, 25 May–6 June 2009.

Studentships

PhD position: History and Philosophy of Logic, Semantics and Axiomatics, Faculty of Philosophy, VU University Amsterdam, 8 December.

PhD positions: The Formal Epistemology Project (FEP) at the Centre for Logic and Analytical Philosophy at the University of Leuven, Belgium, 31 December.

4 year PhD Programme: Gatsby Computational Neuroscience Unit, UCL, 11 January 2009.

Two PhD Studentships: The AHRC Project on ‘Intuitions and Philosophical Methodology’ in the Arché Philosophical Research Centre at The University of St Andrews, 15 January.