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Edited by Vincent F. Hendricks and Stig Andur Pedersen

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Department of Philosophy and Science Studies
Roskilde University, PA6
P. O. Box 260
DK4000 Roskilde, Denmark
Phone: (+45) 4674 2343 Fax: (+45) 4674 3012
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Edited by
Vincent F. Hendricks (vincent@ruc.dk)
Stig Andur Pedersen (sap@ruc.dk)

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1 EDITORIAL

Welcome to the second volume of ΦNEWS, the newsletter published by ΦLOG—The Danish Network for Philosophical Logic and Its Applications, sponsored by The Danish National Research Council for the Humanities. ΦNEWS is published twice a year through 2002-2003. The newsletter is freely distributed to the ΦLOG-members and an on-line copy may be obtained from the ΦLOG homepage

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This second volume features an essay on epistemic logic and information concerning future conferences under the ΦLOG auspices: the third ΦLOG conference on The Logic of Time and Modality scheduled for the spring of 2003; the fourth conference, FOL75, arranged in association with Humboldt University to take place in Berlin in the fall of 2003; and the fifth conference celebrating 50 Years of Studia Logica—Trends in Logic, arranged jointly by ΦLOG, IFIS—The Institute of Philosophy and Sociology, The Polish Academy of Sciences, and *Studia Logica—An International Journal for Symbolic Logic* to take place in the late fall of 2003.

Besides the conference announcements the newsletter also offers information on new/forthcoming publications and new initiatives/activities within the scope of ΦLOG.

Finally, this volume holds a conference booklet for the upcoming conference on Self-Reference and the preceding introductory seminar to take place later this month. Thus, keep this newsletter as your conference booklet if you are attending this event.

The next volume of ΦNEWS is scheduled for spring 2003. ΦNEWS accepts and publishes contributions in terms of shorter

essays or reports, book reviews, announcements of workshops, seminars, conferences, forthcoming publications, new initiatives and other material relevant to philosophical logic and its applications.

Send your written contribution (preferably in TEX, LATEX, LATEX 2ε) to either one of the ΦNEWS editors. Contact information is available on page 85.

October, 2002
Vincent F. Hendricks
Stig Andur Pedersen
Editors

2 ACTIVE AGENTS

▸ Vincent F. Hendricks

Department of Philosophy
and Science Studies
Roskilde University
vincent@ruc.dk

Epistemic logic can be tracked back to the Middle Ages. The subject was really boosted to the attention of logicians and philosophers by Von Wright's first systematic surveys in the 1950's. Roughly 10 years later Hintikka published his seminal work on the logic of knowledge and belief. Epistemic and doxastic logics have since then grown into powerful enterprises enjoying many important applications.[1] The purpose of this paper is twofold:

1. to place some central themes of epistemic logic in a general epistemological context, and

2. to outline a new framework for epistemic logic developed jointly with S. Andur Pedersen unifying some key 'mainstream' epistemological concerns with the 'formal' epistemological apparatus.

[1] To track the history and development of epistemic logic from the first formulations to its contemporary forms; to consider some of the many applications in philosophy, computer science, game theory, economics, linguistics etc.; and to discuss the developments of epistemic logic in multi-modal systems were the conference aims of the first ΦLOG conference, *Dimensions in Epistemic Logic*, held at Roskilde University, Denmark, May 2-4, 2002. The conference featured lectures by some of the most important contributors to epistemic logic over the years including Joseph Halpern (USA), Jaakko Hintikka (USA), Wiebe van der Hoek (NL), Wolfgang Lenzen (DE), Hans Rott (DE), Krister Segerberg (SE), John Sowa (USA), Moshe Vardi (USA) and Ryszard Wojcicki (PL).

In 1970, when epistemic logic was still partly in its infancy, Scott prophetically noted:

> Here is what I consider one of the biggest mistakes of all in modal logic: concentration on a system with just one modal operator. The only way to have any philosophically significant results in deontic logic or epistemic logic is to combine these operators with: Tense operators (otherwise how can you formulate principles of change?); the logical operators (otherwise how can you compare the relative with the absolute?); the operators like historical or physical necessity (otherwise how can you relate the agent to his environment?); and so on and so on. [45], p. 143.

The criticism is obviously quite severe both theoretically and for applications. In recent years however modal logicians have begun to take Scott's perennial criticism to heart. In branching tense logic researchers are mixing alethic and tense logical operators [4], [49]. In the epistemic logic of Fagin, Halpern, Moses and Vardi, epistemic operators are combined with tense logical operators while modelling the knowledge dynamics of an entire system of agents [6]. Sowa's theory of nested graph models based on Dunn's semantics for laws and facts combined with a theory of contexts is a way of simplifying the reasoning tasks in multi-modal reasoning [46], and can be adapted to Kripke models, situation semantics, temporal models and variants of these.

Epistemic variants of modal logics usually begin with the slippery and much debated notion of 'possible worlds':

> In order to speak of what a certain person a knows and does not know, we have to assume a class ('space') of possibilities. These possibilities will be called scenarios. Philosophers typically call them possible worlds. This usage is a symptom of intellectual megalomania. [25], p. 19.

A difference between a philosophical logician and a philosopher is that while the logician often remains rather agnostic about the ontological significance of the possible worlds and may just refer to them as scenarios, situations, states, contexts or conceptual constructions, the philosopher is usually quite concerned with the metaphysical baggage that comes along with the notion.

Possible worlds are often viewed as largely unanalyzed or even unanalyzable entities complete in their spatio-temporal history whatever they are. Another way to fulfill Scott's wishes is to decompose or 'deconstruct' possible worlds, provide them with some structure that allows one to model and study their temporal extensions, their spatial extensions and the agent to which these extensions are epistemically pertinent. This is in a way what Sowa is doing when levelling contexts and another way of decomposing worlds and providing them with explicit structure is accomplished by *modal operator theory.*

Modal operator theory (a term coined in [15], [18], [19]) is the cocktail obtained by mixing epistemic, tense and alethic logic with some concepts drawn from formal learning theory[2] and has so far been used to study the validity of limiting convergent knowledge.

The initial setup is adopted from Kelly's computational epistemology in [29]. First, an evidence stream is what supplies a scientific inquiry method or agent with evidence.[3] An evidence stream, ε, is an ω-*sequence* of natural numbers, i.e. $\varepsilon \in \omega^{\omega}$. According to the definition it is assumed that the method of inquiry is studying some system with discrete states that may be encoded by natural numbers, so that in the limit the method receives an infinite stream ε of numbers. Hence, an evidence stream $\varepsilon = (a_0, a_1, a_2..., a_n, ...)$ consists of *code* numbers of evidence, i.e. at each state i of inquiry ε_i is the code number of all the evidence acquired at this state. Let the lower case Greek letters $\tau, \theta, \zeta, \mu, \varsigma, \upsilon, ...$ denote evidence streams. It is now possible to provide possible worlds with some explicit analyzable structure leaving the metaphysics behind:

> A possible world is a pair consisting of an evidence stream ε and a state coordinate n, i.e., (ε, n), where

[2] Recently redubbed *computational epistemology* by K. Kelly.
[3] The terms 'method' and 'agent' are used interchangeably.

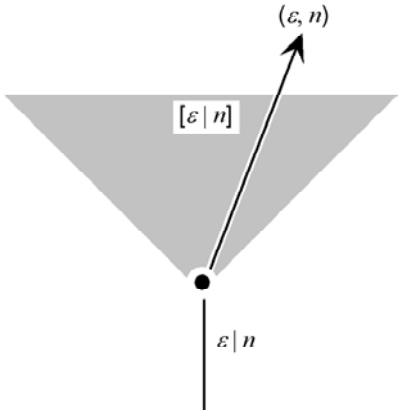

Figure 1 Handle, fan and possible world

$\varepsilon \in \omega^\omega$ and $n \in \omega$.

The set of all possible worlds $\mathcal{W} = \{(\varepsilon, n) \mid \varepsilon \in \omega^\omega, n \in \omega\}$. The following notational conventions are introduced with respect to worlds:

- Let all pairs $(\varepsilon, n), (\tau, n'), (\theta, m), (\varsigma, m''), ...$, denote possible worlds.
- Let $\varepsilon \mid n$ denote the finite initial segment of an evidence stream also called the *handle*.
- Let $\omega^{<\omega}$ denote the set of all finite initial segments of evidence streams.
- Let $(\varepsilon \mid n)$ denote the set of all infinite evidence streams that extend $\varepsilon \mid n$, also called the *fan*.

The handle $\varepsilon \mid n$ represents the evidence seen up to state n, i.e. $\varepsilon \mid n = a_0, a_1, ...a_{n-1}$. The rest $\varepsilon \backslash \varepsilon \mid n = a_n, a_{n+1}, a_{n+2}, ...$, is the evidence that one would observe if the world develops according to (ε, n). The set of possible worlds in the fan is defined by $[\varepsilon \mid n] = (\varepsilon \mid n) \times \omega$. In other words $[\varepsilon \mid n] = \{(\tau, k) \mid k \in \omega \text{ and } \tau \mid n = \varepsilon \mid n\}$. (Figure 1)

The world fan $[\varepsilon \mid n]$ represents the *minimal background knowledge* of possible empirical possibilities or values that the world may take according to the method.

This simple characterization of evidence streams, state coordinates and possible worlds imposes a branching time structure. For any finite time the method has observed some handle of the world, but from that point onwards, the world may 'branch' in any way it pleases for all the method knows. So points or moments in time can be defined as finite initial segments of evidence. This indicates a branching time structure and a branching tense logic rather than a linear model of time. The current structure is closely related to standard Ockhamistic semantics. An Ockhamistic tense structure is typically given by:

1. O is a non-empty set of moments in time,

2. $\prec$ is an irreflexive and transitive earlier-later relation which is backwards linear:

$$\forall n, n', n'' \in O : (n \prec n' \wedge n'' \prec n') \rightarrow \\ (n \prec n'' \vee n'' \prec n \vee n = n'').$$

The notion of *chronicles* plays an important role in Ockhamistic semantics; they may be understood as possible courses of events or evidence and are defined as maximal linear subsets of structure $(O, \prec)$. In general, define the Ockhamistic model to be a triple $(O, \prec, V)$ where V is a valuation function which assigns truth-values $V(n, a)$ to all pairs where the first argument is an element of O and the second argument a is a propositional variable. Then a curious thing arises:

> Now truth is relative to a moment as well as a chronicle to which the moment belongs. The moment with respect to which truth is relative, is the moment where the formula is interpreted. [4], p. 4.

Hence the valuation function V takes three arguments including a specific moment in time n, the chronicle c to which the particular moment belongs and a propositional variable a. It is possible to define an Ochamistic tense structure in modal operator theory as a pair $(\mathbb{T}, \prec)$ such that*:*

1. $\mathbb{T} = \{\varepsilon \mid n \mid \varepsilon \in \omega^\omega, n \in \omega\}$

2. $t_1 \prec t_2$ iff $\varepsilon \mid n = \tau \mid m$ and $n < m$

where a *moment* in time t is the branching moment of times. In other words, a moment in time is a finite initial segment $t \in (\mathbb{T}, \prec)$. Hence a moment in time is defined as the course of events up until 'now'. Time is based on events and thus the branching time structure is given by events. We are working on the entire tree of finite sequences of natural numbers where finite initial segments (of events) define moments in time.

The evidence stream ε is the actual evidence stream. The state coordinate n, for some specified n, is to be thought of as the 'age' of the world (ε, n), i.e., n is the time in the branch (or the universal clock). The earlier-later relation is defined with respect to finite initial segments.

The structure $(\mathbb{T},\prec)$ satisfies the requirements above; the relation is irreflexive, transitive and backwards linearly ordered. There exist, of course, many other Ockhamistic tense structures. One example would be a structure that extends into the indefinite past. The current structure, however, has a starting point.

A chronicle c can now be defined as a maximal linear subset of $(\mathbb{T},\prec)$ with the form

$$c_\varepsilon = \{\varepsilon \mid k \mid k \in \omega\}$$

for some $\varepsilon \in \omega^\omega$. The set of all chronicles is

$$\mathcal{C} = \{c_\varepsilon \mid \varepsilon \in \omega^\omega\}.$$

The agents will eventually need some hypotheses to have knowledge of. Hypotheses will be identified with sets of possible worlds. Define the set of all simple empirical hypotheses

$$\mathcal{H} = P(\omega^\omega) \times P(\omega).$$

So $h \in \mathcal{H}$ iff $h = (a_1, a_2)$ where $a_1 \subseteq \omega^\omega$ and $a_2 \subseteq \omega$. An empirical hypothesis h is said to be *true* in world (ε, n) iff

$$(\varepsilon, n) \in h \text{ and } \forall l \in \omega : (\varepsilon, n + l) \in h.$$

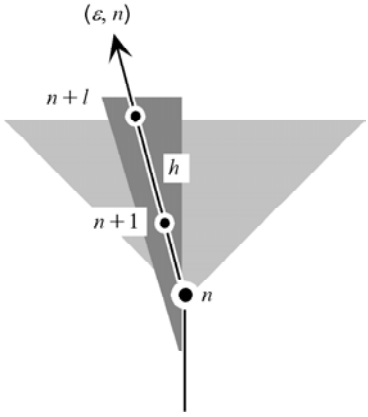

Figure 2 Truth of an empirical hypothesis in a possible world

Truth requires identification and inclusion of the actual world (ε, n) in the hypothesis for all possible future states of inquiry. (Figure 2)

Given the branching time structure, a host of different types of hypotheses are definable with respect to their truth-value fluctuations over time but for now it is assumed that the hypotheses of interest are *absolute time-invariant* empirical hypotheses.[4] In order to define absolute time invariance, define first consistency between evidence and a hypothesis: An empirical hypothesis h is consistent with respect to the evidence iff

$$\exists(\tau, k) : (\tau, k) \in [\varepsilon \mid n] \cap h \text{ and } k \geq n.$$

From here one may define absolute time invariance such that an empirical hypothesis is absolute time invariant with respect to a possible world (ε, n) insofar

$$\text{if } \exists(\mu, k) \in [\varepsilon \mid n] \cap h \text{ then } \exists\tau \in (\varepsilon \mid n)\forall l \in \omega : (\tau, k' + l) \in h,$$

where $k' = \max\{n, k\}$.

Modal operator theory now allows for the introduction of tense and alethic operators in the following intuitive way where the temporal operators F, G, P and H take their usual meaning.

[4] In [6] such hypotheses are called *stable* in truth-value.

1. $(\varepsilon, n) \vDash Fh$ *iff* $\exists k > n : (\varepsilon, k) \vDash h$.
2. $(\varepsilon, n) \vDash Gh$ *iff* $\forall k > n : (\varepsilon, k) \vDash h$.
3. $(\varepsilon, n) \vDash Ph$ *iff* $\exists k < n : (\varepsilon, k) \vDash h$.
4. $(\varepsilon, n) \vDash Hh$ *iff* $\forall k < n : (\varepsilon, k) \vDash h$.
5. $(\varepsilon, n) \vDash \Box h$ *iff* $\forall (\tau, m) \in \mathcal{W} : (\tau, m) \vDash h$.
6. $(\varepsilon, n) \vDash \boxdot h$ *iff* $\forall k \in \omega : (\varepsilon, k) \vDash h$.
7. $(\varepsilon, n) \vDash \boxminus h$ *iff* $\forall (\tau, m) \in [\varepsilon \mid n] : (\tau, m) \vDash h$.

The operator '$\Box$' is called universal necessity since it quantifies indifferently over the set of all possible worlds simpliciter. Operator '$\boxdot$' is called temporal necessity because it quantifies indifferently over all times. Finally '$\boxminus$' is called empirical necessity because it ranges over all the empirically possible alternatives relative to the world fan.

Now that both tense and alethic operators have been defined it remains to introduce the epistemic operators in this new framework.

From Indices to Functions

Having defined the space of possibilities, the early epistemic logic – what is referred to as the 'first generation epistemic logic' by Hintikka in [25] – proceeded axiomatically. 'An agent δ knows that p' (where p is some proposition) is formalized as a modal operator $K_\delta p$ in a formal language which is interpreted using the standard apparatus of modal (alethic) logic. One of the hopes was that cataloguing the possible complete systems of such logics would allow for a picking of the most appropriate or intuitive ones often ranging from **S4** over the intermediate systems **S4.2**-**S4.4** to **S5**.[5] By way of example, in [22] Hintikka

[5] Refer to Gotchet and Gribomont's forthcoming paper for an excellent survey of epistemic logic and its key issues [9].

settled for **S4** while Lenzen in [31] argued for **S4.2**. The significant difference between alethic logic and epistemic logic at the time was the addition of the agent δ to the syntax. The interesting epistemological question is what roles are assigned the agents in the first generation epistemic logic since they are the ones who apparently have knowledge which is, say, **S4.3** valid. That agents hold the knowledge is also the natural understanding of the notation $K_\delta p$:

> Epistemic logic begins as a study of the logical behavior of the expression of the form 'b knows that.' One of the main aims of this study is to be able to analyze other constructions in terms of 'knows' by means of 'b knows that.' The basic notation will be expressed in the notation used here by 'K_b.' This symbolization is slightly misleading in that a formula of the form K_bS the term b for the agent (knower) is intended to be outside the scope of K, not inside as our notation might suggest. [24]

The problem is that the only roles of the agents in the 'first generation epistemic logic' are to serve as indices on the accessibility relation between possible worlds. Now, epistemic-logical principles or axioms building up modal systems are relative to an agent whom may or may not validate these principles or axioms like the KK-thesis. Indices on accessibility relations will not suffice for epistemological and cognitive pertinence simply because there is nothing particularly epistemic about being indices. The agents are *inactive* in the first generation epistemic logic (Figure 3).

This pans out in the more principal discussion of whether there is, or should be, a relation between the formal results of epistemic logic and more general epistemological concerns like justification, methodology, reliability and rationality? Some epistemic logicians were of the opinion that there should be no such relation:

> The search for the correct analysis of knowledge, while certainly of extreme importance and interest to epistemology, seems not significantly to affect the object of epistemic logic, the question of validity of certain epistemic-logical principles. [31]

Figure 3 An inactive agent

In contrast, Hintikka has all along pursued the idea that epistemic logic should aim at hooking up with broader epistemological issues. Early on in [22] Hintikka argued that the axioms or principles of epistemic logic are conditions describing a certain kind of general (strong) *rationality*. Whatever statements can be proved false by application of the epistemic axioms or principles are not inconsistent in the sense that their truth is logically impossible but rather 'indefensible.' Indefensibility is defined by the agent's sloppiness or incapacity in the past, present or future to follow the implications of what he knows. Defensibility is in turn defined as not falling victim of what Chisholm called 'epistemic neglience'. The idea of defensibility provides a hint as to the cognitive status of the epistemic axioms. An epistemic statement for which its negation is simply indefensible is referred to as 'self-sustaining.' Self-sustenance corresponds to the meta-logical concept of validity. In other words, a self-sustaining statement corresponds to a logically valid statement. Thus, a statement which is rationally indefensible to deny. But then the epistemic principles are descriptions of rationality.

If epistemic logics are not to be pertinent to the knower who are they to be pertinent to? An agent may have knowledge which is **S4.3** valid but what one would really like to know – what really bakes the epistemological noodle – is *why* and *how* the agent has to *behave* in order to gain the epistemic strength that it has in terms of validity. We want active agents in order to make epistemic logic pertinent to epistemology, computer science, artificial intelligence and cognitive psychology, and the

Figure 4 An active agent

original formalization of a knowing agent suggests this. Inquiring agents are agents who read data, change their minds, interact or have common knowledge, act according to strategies and play games, have memory and act upon it, follow various methodological rules, expand, contract or revise their knowledge bases, etc. all in the pursuit of knowledge—inquiring agents are *active agents* (Figure 4).

This is admittedly an extended interpretation of one of the characterizing features, and great virtues of, what Hintikka calls the 'second generation epistemic logic' in [25]: The realization that the agents of epistemic logic should play an active role in the knowledge acquisition, validation and maintenance processes. In [25] and elsewhere, Hintikka observes this obligation by emphasizing the strategies for his new game–theoretical semantics, or epistemic logic as the logic of questions and answers and the search for the best questions to ask.

Game-theory is about strategies for winning games—and it is an agent who may or may not have a winning strategy among the other agents. Fagin, Halpern, Moses and Vardi, Auman, Stalnaker and other logicians studying game theory have demonstrated how epistemic logic uncovers important features of *agent rationality* [7]. Additionally in [6] Fagin et al. stipulate (sometimes) for the multi-agent systems that the agents may possess certain *epistemic properties*—in particular *perfect recall*. The idea of perfect recall is that the interacting agents' knowledge in the dynamic system may grow while the agents still keep track of old information. An agent's current local

state encodes all that has happened so far in the system run. That is also an aspect of the active agents paradigm in the new trends of epistemic logic. Hoek develops a 'dynamic epistemic logic' which studies how information changes, model *actions* with epistemic aspects and provides a new language to reason about these actions. Actions are viewed as multi-agent Kripke models where a precondition function replaces the usual denotation function for propositional variables [26]. Belief revision theorists like Rott model 'informational economy' or 'conservatism' and consider cognitive economics and the problem of rational choice for *agents* [42].

Modal operator theory joins the second generation epistemic logic obligation. The theory has at its base rather than as a derivative the idea that whatever epistemic axioms and epistemic systems are possible to validate for some epistemic operator is *acutely sensitive to the methodological behavior of the agent involved*. This will be clear when it is realized that agents can be viewed as functions rather than indices as in modal operator theory.

Say that a scientific inquiry method, in particular a *discovery method*, conjectures hypotheses in response to the evidence received. More specifically, a discovery method δ is a function from finite initial segments of evidence to hypotheses, i.e.

$$\delta : \omega^{<\omega} \longrightarrow \mathcal{H}.$$

The only immediate criterion of rationality imposed on a discovery method is that it is not allowed to conjecture absurdities. Thus, for any discovery method δ and for any world (τ, n'): $\delta(\tau \mid n') \neq \emptyset$. What remains to be defined is a criterion of successful convergence for a discovery method.

The convergence criterion imposed on discovery methods in [15], [18], [19], [20] is a limiting one. Limiting convergence is not a novel concept. Peirce held the view that it is impossible to say anything about the direction of science in the short run but science may all the same asymptotically approach the truth in the long run [41]. James also argues for limiting convergence because knowledge of general laws is impossible if one is required to say when science has succeeded [28]. Since James and Peirce, limiting convergence has become a more and more respected convergence criterion both in philosophy [3], computer science [10] and in methodology where for an example computational epistemology uses limiting convergence for obtaining certain characterization theorems [29] while Bayesians apply a limiting convergence criterion to facilitate 'almost sure' convergence theorems [14]. Limiting convergence simply means that the method is allowed to vacillate some number of times, which cannot be specified in advance, before it reaches its modulus of convergence. The user of the method, or the agent himself, may not know when this state of stabilization has occurred since no determinate sign of convergence may ever be produced.

Successful limiting discovery in a possible world is now definable together with the discovery method's modulus of convergence. δ discovers h in (ε, n) iff

$$\exists k \forall n' \geq k \forall (\tau, n') \in [\varepsilon \mid n] : \delta(\tau \mid n') \subseteq h$$

for which the convergence modulus

$$cm(\delta, h, (\varepsilon, n)) = \mu k \forall n' \geq k \forall (\tau, n') \in [\varepsilon \mid n] : \delta(\tau \mid n') \subseteq h.$$

The method may be subject to various methodological recommendations, programs commands or behavioral patterns. For a well-known example, say that a discovery method δ is *consistent* iff

$$\forall (\tau, n') : [[\tau \mid n'] \cap \delta(\tau \mid n') \neq \emptyset] .$$

Consistency may be strengthened to another recommendation for which the discovery method δ has *perfect memory* iff

$$\textit{if } (\mu, k) \in \delta(\varepsilon \mid n) \textit{ then}$$

$$(\mu \mid n = \varepsilon \mid n) \textit{ and } \forall l \leq k : (\mu, l) \in \delta(\varepsilon \mid n).$$

Furthermore a discovery method δ is said to be *consistently expectant* iff

$$\textit{if } (\mu, k) \in \delta(\varepsilon \mid n) \textit{ then } [k \geq n \textit{ and } (\mu \mid n = \varepsilon \mid n)].$$

Perfect memory and consistent expectation are inconsistent: Suppose $(\mu, k) \in \delta(\varepsilon \mid n)$. If the discovery method has perfect memory, then $\forall l \leq k : (\mu, l) \in \delta(\varepsilon \mid n)$. Now if the method simultaneously is consistently expectant, then $(\mu, k) \in \delta(\varepsilon \mid n)$ implies $k \geq n$, but by perfect memory $(\mu, n-1) \in \delta(\varepsilon \mid n)$. Contradiction! Thus, a discovery method cannot obey perfect memory and consistent expectation at the same time so methodological recommendations may conflict as Nozick emphasizes in [40] and Kelly proves on numerous occasions [29].

It is possible to define a variety of limiting concepts of knowledge in modal operator theory. It suffices for the current purposes to restrict attention to the following concept of knowledge which may be informally portrayed in the following way (for a thorough epistemological motivation of the concept please refer to [15]):

δ may scientifically know *h in the limit iff there exists a possible world which validates δ's knowledge of h. In other words:*

1. *h is true,*
2. *δ conjectures h after some finite evidence sequence has been read and continues to conjecture h in all future.*

Thus, there is a time n, such that for each later time $n' : \delta$ conjectures h at n' in all possible worlds admitted by the background knowledge in which h is true. Now if we modify this definition by telling the method only to conjecture something

entailed by the evidence and the background knowledge then we formally end up with:[6]

$(\varepsilon, n) \vDash K_\delta h$ *iff*

1. $(\varepsilon, n) \in h$ and $\forall l \in \omega : (\varepsilon, n + l) \in h$,
2. $\forall n' \geq n, \forall(\tau, n') \in [\varepsilon \mid n] :$
   (a) $\delta(\tau \mid n') \subseteq h$,
   (b) $(\tau, n') \in \delta(\tau \mid n')$.

This definition of knowledge is very strong, especially given (2b). It implies entailment of the truth by the evidence and the background knowledge. The method is both logical reliable and *infallible*, and hence condition 1 is obsolete in which case one may simply say that $(\varepsilon, n) \vDash K_\delta h$ iff

$$\forall n' \geq n, \forall(\tau, n') \in [\varepsilon \mid n] : \delta(\tau \mid n') \subseteq h, (\tau, n') \in \delta(\tau \mid n').$$

One should observe that since the agent is a function from finite initial segments of evidence to hypotheses there is no knowledge without the method conjecturing a hypothesis. Thus, the agent is *actively within the scope of the operator* so $K_\delta h$ in modal operator theory is genuinely faithful to the intended meaning of the standard formalization of the knowledge operator. Note that the Gettier-cases are automatically handled since there is no way the evidence for (h or h') can be undercut if the evidence entails (h or h').

All these set-theoretical intuitions are completely formalizable in a modal propositional logic $\mathcal{L}$ with some modifications to the standard setup. In short, the syntax includes an infinite supply of propositional variables, brackets, the Boolean operators, the unary modal operators $F, G, H, P, \Box, \boxdot, \boxminus, K_\delta$. The construction of well-formed formulas follow the usual recursive recipe. A model $\mathbb{M}$ is a triple $\langle \mathcal{W}, \varphi, \delta \rangle$ where $\mathcal{W}$ is a non-empty set of possible worlds, φ is a denotation function from propositional variables into $P(\mathcal{W})$ and δ a discovery function:

[6] This methodological recommendation is called *infallibility* in [15].

$\delta : \omega^{<\omega} \longrightarrow P(\mathcal{W})$. A few more modifications to the standard setup are required but the reader is referred to [15] for the details.[7]

Once the syntax and semantics are fixed one may then ask the following pair of questions:

1. *Now which epistemic axioms can be validated by an epistemic operator based on the definition of limiting convergent knowledge for discovery methods?*

2. *Does the validity of the various epistemic axioms relative to the method depend upon enforcing methodological recommendations?*

The first question is close to the first generation issue of epistemic logic, the second question a variety of the second generation issue. It is possible to prove the following theorem:

If knowledge is defined as limiting convergence, then knowledge validates **S4** *iff the discovery method has consistent expectations.* [15], p. 203

Neither axioms (T) or (K)[8] require methodological recommendations for their validity; they are valid given the definition of knowledge as it stands. But axiom (4), or the KK-thesis,[9] does require you to entertain a methodological recommendation even if the discovery method is infallible![10] Some more detail pertaining to KK-thesis and the stated theorem will be provided in the last section.[11] It can additionally be shown for instance that perfect memory is an impediment to validating axiom (4). Thus, methodological recommendations may be classified as to

[7] Some formal sloppiness in this presentation will occur for ease of readability. By way of example, in the modal formalization, A denotes the proposition defining a hypothesis h. However not to introduce too much new notation we continue to write h except where explicitly stated otherwise.

[8] Axiom (T): $K_\delta h \rightarrow h$. Axiom (K): $K_\delta(h \rightarrow h') \rightarrow K_\delta h \rightarrow K_\delta h'$.

[9] Axiom (4): $K_\delta h \rightarrow K_\delta K_\delta h$.

[10] Consistency and perfect memory don't halp either in validating **S4**.

[11] By the way, any method defined for limiting convergence is unable to validate **S5**. Intuitively the reason is that the axiom of wisdom, axiom (5): $\neg K_\delta h \rightarrow K_\delta \neg K_\delta h$, requires the method to turn non-convergence into convergence but when knowledge is defined by convergence this is impossible.

whether they are *boosting* in the sense that a methodological recommendation is *conducive* to validating epistemic axioms and systems, *debilitative* in the sense that the methodological recommendation is an *impediment* to validating epistemic axioms and systems, or *neutral* if it is neither boosting or debilitative.[12]

The general lesson to be learned from the theorem is that whatever epistemic axioms or systems the method is capable of validating is very sensitive to the very behavior of the method and the methodological recommendations one may be required to impose on it in order to obtain the desired epistemic strength—active agents again.

Modal operator theory provides a rich framework for other investigations of which a few highlights will be mentioned. Some axioms including tense modalities turn out to be valid like

$$K_\delta h \rightarrow \begin{cases} 1. & FK_\delta h \\ 2. & GK_\delta h \end{cases}$$

which by the way is independently discussed by Fagin, Halpern, Moses and Vardi in [6]. Axioms including tense and alethic modalities may also be investigated for validity—see further [15], chap. 13.

So far attention has been restricted to discovery methods. One may equally well define an assessment α as a function from finite initial segments of evidence and hypotheses to $\{0, 1\}$ where 0 denotes false and 1 denotes truth:

$$\alpha : \omega^{<\omega} \times \mathcal{H} \longrightarrow \{0, 1\}$$

which is a standard method of justification assessing hypotheses in the light of incoming evidence. Successful limiting convergence can be defined for assessment such that α decides h in the limit in (ε, n) iff

1. if h is true, then

$$\exists k \geq n, \forall n' \geq k, \forall (\tau, n') \in [\varepsilon \mid n] : \alpha(h, \tau \mid n') = 1,$$

[12] These notions are similar to Kelly's distinction between permissive and restrictive architectures.

2. if h is false, then

$$\exists k \geq n, \forall n' \geq k, \forall (\tau, n') \in [\varepsilon \mid n] : \alpha(h, \tau \mid n') = 0$$

with the following limiting convergence modulus:

$$cm(\alpha, h, (\varepsilon, n)) = \\ \mu k \geq n, \forall n' \geq k, \forall (\tau, n') \in [\varepsilon \mid n] : \alpha(h, \varepsilon \mid n) = \alpha(h, \tau \mid n').$$

In sum, the assessment α verifies h in the limit when h is true and refutes h in the limit when h is false.

It turns out that discovery methods can *induce* assessment methods in the following way:

If a discovery method δ discovers h in (ε, n) in the limit, then there exists a limiting assessment method α which verifies h in (ε, n) in the limit.

This is not hard to see. Assume that δ discovers h in (ε, n) in the limit and let $cm(\delta, h, (\varepsilon, n))$ be its convergence modulus. Define α in the following way:

$$\alpha(h, \varepsilon \mid n) = 1 \textit{ iff } \delta(\varepsilon \mid n) \subseteq h.$$

It is clear that if $n' \geq cm(\delta, h, (\varepsilon, n))$ then for all $(\tau, n') \in [\varepsilon \mid n] : \delta(\tau \mid n') \subseteq h$. Consequently $\alpha(h, \tau \mid n') = 1$ and therefore

$$cm(\alpha, h, (\varepsilon, n)) = cm(\delta, h, (\varepsilon, n)).$$

Assessment methods can also induce discovery methods along similar lines. This is interesting because a limiting notion of knowledge defined using an assessment method rather than a discovery method also validates **S4**. This information may in turn be used when *knowledge transmissibility* is studied in what has been labelled *multiple method systems* [15]. Knowledge transmissibility was first studied by Hintikka in [22]. Hintikka investigated whether

$$K_a K_b p \rightarrow K_a p \tag{2.1}$$

held for his definition of knowledge where p is some arbitrary proposition and a, b are agents. In a certain sense knowledge

transmissibility is rather trivial here because it is essentially the iterated version of axiom (T) with different agents. As long as the agents index the same possible worlds knowledge transmissibility holds in the sense of (2.1). But in the current scheme of things knowledge transmissibility is far from trivial because there are agents or methods of different natures based on either discovery or assessment. Thus we have to consider in all generality whether

$$K_\Theta K_\Xi A \rightarrow K_\Theta h \tag{2.2}$$

is valid for arbitrary inquiry methods $\Theta, \Xi \in \{\alpha, \beta, \gamma, \delta\}$ where γ, δ are discovery methods while and α, β are assessment methods. This means a classification of the transmissibility instances paraphrased as:

Uniform Transmissibility: Is it possible that a discovery method δ having knowledge of the fact that another discovery method γ has knowledge of some hypothesis h, may obtain knowledge of this hypothesis h and similarly for assessment?

Non-Uniform Transmissibility. Is it possible that a discovery method δ having knowledge of the fact that another assessment method α has knowledge of some hypothesis h, may obtain knowledge of this hypothesis h and similarly starting with an assessment method?

It turns out, given inducement, that the answers to both questions are affirmative, a result which partially breaks the back of the classical, and much celebrated, dichotomy between assessment and discovery in the philosophy of science.

Finally, only absolute time invariant or stable hypotheses have been considered so far. A hypothesis h is a *stable* hypothesis iff

1. $h \subseteq \mathcal{W}$,
2. if $(\varepsilon, n) \in h$ then $\forall m \in \omega : (\varepsilon, m) \in h$.

Such a hypothesis may be expressed model-theoretically in the following way: Proposition A defines a stable hypothesis in $\mathbb{M}$ iff

$$\mathbb{M} \vDash A \rightarrow \boxdot A$$

since a hypothesis is temporally necessary iff $\forall k \in \omega : (\varepsilon, k) \vDash h$ which is equivalent to the definition of a stable hypothesis.

In [20] we consider the knowledge acquisition possibilities of hypotheses which are far from stable due to philosophical problems like meaning variance and relativism. The framework allows for the definitions of various hypotheses based on their truth-value fluctuations over time. By way of example, h is an *eventually stable* hypothesis iff

1. $h \subseteq \mathcal{W}$,
2. if $(\varepsilon, n) \in h$ then $\exists k \forall m \geq k \in \omega : (\varepsilon, m) \in h$.

An eventually stable hypothesis is depicted in figure 5. Given the tense-logical operators proposition A defines an eventually stable hypothesis in $\mathbb{M}$ iff

$$\mathbb{M} \vDash A \rightarrow \neg \boxdot \neg GA.$$

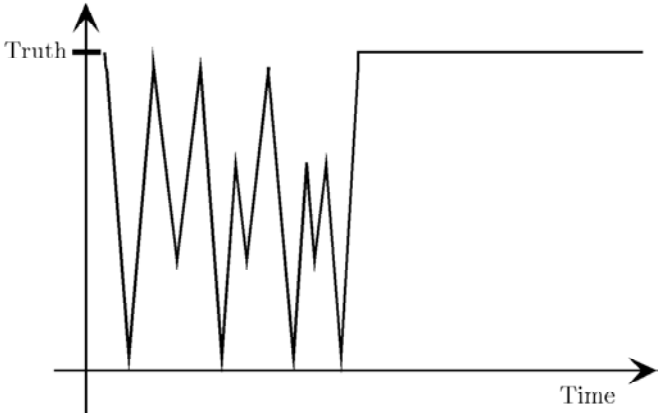

Figure 5 The eventually stabilizing truth-value

Further, say that h is an *oscillating* hypothesis iff

$$\begin{array}{l}\text{if } (\varepsilon, k) \in h \text{ then } \forall n \exists n_1 \exists n_2 : \\ n_1 \geq n \wedge n_2 \geq n \wedge (\varepsilon, n_1) \notin h \wedge (\varepsilon, n_2) \in h.\end{array}$$

Then proposition A defines an oscillating hypothesis in $\mathbb{M}$ iff

$$\mathbb{M} \vDash A \rightarrow \boxdot(FA \wedge F\neg A).$$

Yet other hypotheses may be defined. This is still work in progress but so far it has been established that some methodological recommendations which otherwise are boosting for the methods in the stable paradigm are debilitative in the relativistic paradigm!

Epistemic Logic and Epistemology

Contemporary epistemological studies are roughly either carried out in

1. a *mainstream* and traditionally rather informal way using largely common-sense considerations and concentrating on sometimes folksy and sometimes exorbitantly speculative examples / counter-examples, or

2. a *formal* way by applying a variety of tools and methods from logic, computability theory or probability theory to the theory of knowledge.

The two traditions have unfortunately proceeded largely in isolation from one another. It may sometimes be hard to see how the formal results hook-up with more traditional epistemological themes. But the two approaches have much in common both epistemologically and methodologically and can significantly benefit from one another.

Forcing

Epistemology is a reply to skepticism. Skeptics have since the days of old cited *prima facie* possibilities of error as the most substantial arguments against knowledge claims. A contemporary response to skepticism is to invoke *forcing*—a term coined in [15]. Forcing is a kind of 'logical sufficiency.' Perhaps it is more of an heuristic principle than really a thesis:

Whenever knowledge claims are challenged by alleged possibilities of error, the strategy is to show that the possibilities of error fail to be genuine in the relevant sense.

By way of examples, the influential *epistemic reliabilism*, Nozick's elegant formulation of the *counterfactual reliabilism* and Lewis' new *modal epistemology* are informal epistemological proposals observing the forcing relation.

Epistemic reliabilism [11], [12], [13] acknowledges the agent's limited cognitive abilities and accordingly deflates the agent's epistemic responsibilities. The idea is to substitute the excessive requirements often proposed by skepticism for knowledge acquisition with more moderate conditions. Hence a justified belief may itself very well be false, but its mode of acquisition must in general yield truth. Besides the requirement that the target belief must be true in order to gain knowledge, its mode of acquisition must rule out all relevant possibilities of error. Thus, the forcing is given by the mode of acquisition: The mode of acquisition may not be able to exclude the possibility that a Cartesian demon is feeding systematically misleading sensations, or that they are vat-generated impressions. Then again these are not realistic possibilities of error.[13] To combat the skeptic it suffices to note that infallible or certainty-producing methods are not required for knowledge.

Nozick's counterfactual reliabilistic knowledge definition [39] (a similar one was advocated earlier by Dretske in [5]) is also a forcing proposal. The inherent decision procedure and the counterfactual semantics require the agent to succeed in all possible worlds sufficiently close to the actual world in order to acquire knowledge. The agent may not know that he is not a brain in a vat—but then again, that possibility of error is so remote. Asking a physicist whether it is viable possibility of error that his voltmeter is calibrated incorrectly while measuring the voltage drop over some LRC circuit is reasonable, asking him then whether it is a realistic possibility of error that he is a brain in a vat is just silly and far out.

[13] ... even though the method may not be able to determine this which is the entire point of the brains and the demons. Kelly has shown that global underdetermination exactly like demons and brains equals the impossibility of reliable inquiry [29].

Lewis' modal epistemology assumes knowledge of a great many things [34]. Considering brains in vats and Cartesian demons is to 'epistemologize' which may make the knowledge we thought we had evaporate into thin air. Hence, all we need are rules to slice off possible worlds and then describe how we avoid error and gain truth in the ones left (as humans actually do).

It turns out that a host of formal epistemological proposals share the forcing heuristic as well. Knowledge claims may be restricted by the constraints imposed on the accessibility relation between possible worlds, which may be viewed as the forcing foundation for epistemic logic. Also, probability theory, in particular Bayesian epistemology, requires the agent to succeed in circumstances with high probability and dispose of sets of possibilities carrying low probability [27], [14]. Thus, if the truth lies in worlds ascribed 0 or infinitesimal priors the truth will never be found. That is forcing. Computational epistemology requires success in all worlds in accordance with the background knowledge of empirical possibilities which likewise is to pay homage to the forcing thesis. Finally, modal operator theory requires success in only possible worlds consistent with what has been observed until now which satisfies the forcing relation.

From the forcing perspective what separates the different epistemological proposals, whether mainstream or formal, are the criteria imposed for circumscribing the set of relevant worlds over which to succeed for knowledge to come about. Additionally, if one also observes the difference between what may be called a *first person perspective on inquiry* following Lewis [34] in which

- it is considered what an agent can solve, can do or defend considering the available means for an end given the epistemic environment he is sunk into

and a *third person perspective on inquiry* in which

- it is considered what an agent could solve, could do or defend considering the best means for an end independently of the epistemic environment he is sunk into

the mainstream and formal approaches have even more to say to each other as will become apparent below. A detailed treatment

of forcing epistemology is to be found in [16].

Justification and Methodology

Since Plato's *Meno* and *Theatetus* epistemology has sought to identify the necessary and sufficient conditions for the possession of knowledge. The result has been the much celebrated tripartite definition of knowledge as justified true belief.

The justification condition of this definition has probably received the greatest attention of the three components from Plato to contemporary epistemology because it is apparently difficult to define it properly:

> Though there is basic agreement that *something* must be added to true belief to obtain knowledge, what precisely this 'something' is, remains far from being evident. Because of the vagueness of such notions as 'having sufficient reasons for believing', 'being justified in believing', it is difficult to make a decision concerning the adequacy of (5), *i.e.* that knowledge implies justification. [31], p. 28.

In the standard definition, any claim to knowledge requires that the satisfaction of the belief condition is 'adequately' connected to the satisfaction of the truth condition. The two conditions alone are thought to be jointly insufficient to secure knowledge since some true beliefs may be the fortunate result of lucky conjectures, various accidental inferences, evidence collected under obscured perceptual circumstances etc. Now, such beliefs should on the standard analysis obviously not count as knowledge since the belief and truth conditions are inadequately connected to each other due to the questionable *means* by which the *de facto* true beliefs have been derived. According to the justification condition, if some argument or other justificational structure can be provided which describe why the first two conditions are properly connected, then the agent may be said to have secure indication that a known proposition is true.

On top of Lenzen's point of vagueness pertaining to the justificational issue, Gettier's *succés de scandale* counterexamples to the thesis that knowledge is justified true belief did nothing

much but to make matters even worse. To avoid the Gettier-cases some mainstream epistemologists have appealed to *reliability*. For an example, Goldman argues that the belief in some hypothesis is justified if and only if the method by which the belief is formed is reliable in the sense of producing more true convictions than false ones in the actual world.[14] Nozick insists on a 'heavier' strategy by appealing to a strongly reliable recursive procedure with a halting condition imposed in all nearby worlds, while Lewis in his modal epistemology speaks of the rule of reliability and refers in a footnote to a type of nomic sufficiency account à la Armstrong. Observe that independently of what reliability is supposed to mean, *it is a criterion imposed on the inquiry method or agent* generating the belief:

The justification condition of epistemology ends up in methodology as the study of how science arrives at its posited truths, i.e. how beliefs are justified by the canons, norms or recommendations and internal workings of the method applied or agent in question.

Whatever is vague about justification has obviously to be resolved and can be resolved methodologically as Sankey recently noted:

> These are questions about the truth-conduciveness of the method. While they relate directly to the epistemic status of the method, they bear *indirectly on the nature of rational justification*. For if use of method conduces to truth, then, given the relation between method and justification, the warrant provided by the method is warrant with respect to truth. [43], p. 1.

Also a mainstream epistemologist like Bonjour stresses a similar point:

> An adequate epistemological theory must establish a connection between its account of justification and its account of truth: *i.e.* it must be shown that justification, as viewed by that theory, is truth-conducive, that

[14] Sometimes Goldman does advocate a many world view but is to this day indecisive on the issue. The (possibly limiting) ratio of true beliefs over false beliefs remains at the core of his reliabilistic theory unfortunately reinviting the Gettier paradoxes which reliability was introduced to block.

> one who seeks justified beliefs is at least likely to find true ones. [2], p. 75.

Methodological recommendations, truth-conduciveness, reliability, convergence, strategies for winning games, changing your beliefs economically and reliably[15] and the like are at the very *core* of many formal epistemological proposals. Computational epistemology scrutinizes the feasibility of recommendations for getting to the truth reliably for both ideal and computationally bounded agents; game-theory models rationality among agents possibly through the use of epistemic logic; belief revision concentrates on informational economy and the agent's rational change of beliefs etc. In general what the mainstream epistemologists are looking for seems to be what the formal epistemologists have to offer.

This article is concluded with an example of the demand and supply situation hopefully revealing the fruitful epistemological and methodological interactions between mainstream and formal theories of knowledge.

KK'ing Diachronically

Also before, but especially after Hintikka's publication of *Knowledge and Belief* in 1962, and to this day, epistemologists have been concerned with two philosophical themes as they relate to *Knowledge and Belief*: (1) the problem of logical omniscience, and (2) the plausibility of the KK thesis both of which are consequences of the logical epistemology advocated in the book.

The logical omniscience problem will not be dealt with here but an elegant treatment of the problem together with a new logic of knowledge and belief for agents with limited reasoning powers and a way of modelling first vs. third person perspectives on inquiry is to be found in Segerberg's recent work [44].

[15] See [30] for a logical reliabilistic analysis of belief revision. Also Martin and Osherson discuss belief revision in the light of computational epistemology [36].

Wojcicki's new approach may also be extended to cover similar issues [48].

The KK plausibility is still unsettled. A mainstream epistemologist like Nozick abandons it because the agent may not be tracking the fact that he is tracking. Not having self-awareness also supports James' distinction between absolutist's philosophy and pragmatism. One may not infallibly know when one has converged to the fact that one has converged to the correct answer. Formal learning theorists like Martin and Osherson are of the same opinion:

> This does not entail that Ψ knows he knows the answer, since (as observed above) Ψ may lack any reason to believe that his hypotheses have begun to converge. [36], p. 13.

In the previous section a concept of knowledge was introduced based on the idea of limiting convergence, and yet limiting convergence is often cited as one of the primary reasons for not validating the KK-thesis! But if one wants to validate the KK-thesis and simultaneously entertain a limiting concept of knowledge how is it possible to have the cake and eat it too?

Given that both tense and alethic modalities can be treated in modal operator theory together with epistemic modalities it makes sense to distinguish between two interpretations of epistemic axioms:

Synchronic axiom: *An epistemic (or doxastic or combined) axiom is* **synchronic** *if the consequent obtains by the very same time the antecedent obtains.*

Diachronic axiom: *An epistemic (or doxastic or combined) axiom is* **diachronic** *if the consequent either obtains later or would have obtained later than the antecedent even if things had been otherwise.*

Malcolm's autoepistemology defends the KK-thesis synchronically from a first person perspective [35]. There are other models of first person knowledge operators validating KK synchronically in particular R.C. Moore [38], Fitting [8] and Arló-Costa [1]. Actually these models yield a stronger logic than **S4**—they

validate **S5**. On the other hand, Nozick denies KK at least synchronically from the 1st person point of view. Then there is Levi's epistemological program which essentially is a garden-variety of a first person view in which the main issue in the semantics for Levi is Ramsey's distinction between *the logic of truth* and *the logic of consistency* rather than first and third person distinctions [33]. These two sets of distinctions are obviously related but not exactly identical. In the paper Levi argues against the validity of the KK-principle as an axiom of an epistemic logic of truth which, somewhat simplified, is tantamount to denying that KK is an axiom for a third person knowledge operator. What Levi really argues is that the KK-principle is valid as a principle regulating the consistency of a rational epistemic agent while the logic of truth for epistemic agents need not be regulated by such a principle. Lewis seems to follow suit and their underlying suggestion must in the end be that if there is a universal third person logic of knowledge, such a logic is probably rather weak [34].

With these two interpretations of the epistemic axioms in hand return to the question of how to have the cake and eat it too and the current line of defense for KK.[16] To have knowledge of a hypothesis is to have reached a modulus of convergence after which the method continues to project the conjecture over all later times and possible worlds. Now, knowledge of a hypothesis h is a subset of the hypothesis h. To have knowledge of knowledge of a hypothesis h must be to reach a modulus of convergence only *after* convergence to knowledge of h has arisen. This is because knowledge of knowledge of a hypothesis is a subset of knowledge of a hypothesis, so knowledge of knowledge can only happen once knowledge of the hypothesis has obtained. Hence

$$K_{\Xi}K_{\Xi}h \subseteq K_{\Xi}h \subseteq h. \tag{2.3}$$

One has to *force strategically* to validate KK.

Suppose the method has perfect memory and hence remembers the past evidence. Then KK becomes impossible to validate. Perfect memory demands that the method starts to force for KK at a time l in worlds prior to the modulus of convergence

[16] This is obviously tentamount to the proof of validating axiom (4) of the previous section.

has been reached for mere knowledge of h which only happens at a later stage $n > l$. Forcing for KK prior to knowledge of h is impossible because there may exist a world λ required for KK veering off the actual world ε before the knowledge of h has arisen. Since the method has perfect memory it will attempt to 'crawl' below n to get this world λ in the KK-conjecture. If the method crawls below n and captures λ, then λ will be in $K_{\Xi}K_{\Xi}h$ but not necessarily in $K_{\Xi}h$ and thus violating (2.3) above.

Suppose on the other hand, that the method entertains *consistent expectation*. Consistent expectation implies that any additional convergence and forcing in terms of knowing that one knows h takes place at a point in time $n' > n > l$ where the method *has* converged to h and hence forces already. Adding knowledge to knowledge requires forcing and then later some more forcing. For more detail refer to [15] and [18]

This is fairly easy to see if one stands outside looking in, i.e. if one adopts a third person perspective on inquiry as modal operator theory does. It is less obvious how one could stand in the epistemic environment and know that if one has consistent expectations, then one is eventually going to know that one knows when one does. The validity of KK is up to the method rather than to the world, and hinges on the diachronic interpretation of the KK thesis, but given consistent expectation, *not* unwarranted confidence in the status of one's own earlier beliefs—*the method already knows* if you look at it from the third person point of view, but not necessarily from the first.

The point of introducing the two interpretations of epistemic axioms; the point of distinguishing between first and third persons perspectives on inquiry and the point of forcing are to square away confusion and misunderstandings between mainstream and formal epistemologies. To open up for profitable interactions and exchanges between the two approaches. For example, in criticizing some position, whether formal or informal, without noticing that the criticism is based on a third person perspective and the position advocated is first person may turn out to be criticizing an apple for not being an orange. Similarly if an epistemic axiom is advocated diachronically, then it is not advocated synchronically or indifferently. A mainstream epistemological paradigm may be a forcing strategy, and a formal one

may be too—the question is then how they do force respectively putting them on par for comparison.

Admittedly, epistemology becomes significantly more complex with these additional parameters added in and we are going to need all the help we can get from formal and mainstream epistemology alike. That's just the way it goes with active agents.

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Funny Fragments

Isaac Asimov

1920—1992 *American science fiction writer*

University President: 'Why is it that you physicists always require so much expensive equipment? Now the Department of Mathematics requires nothing but money for paper, pencils, and erasers ... and the Department of Philosophy is better still. It doesn't even ask for erasers.'

Jerry Fodor

1935— *American philosopher*

It is a curiosity of the philosophical temperament, this passion for radical solutions. Do you feel a little twinge in your epistemology? Absolute skepticism is the thing to try. Has the logic of confirmation got you down? Probably physics is fiction. Worried about individuating objects? Don't let anything in but sets. Nobody has yet suggested that the way out of the Liar paradox is to give up talking, but I expect it's only a matter of time. Apparently the rule is this: if aspirin doesn't work, try cutting of your head.

Bertrand Russell

1872—1970 *English mathematician, logician and philosopher*

In very abstract studies such as philosophical logic, ... the subject-matter that you are supposed to be thinking of is so exceedingly difficult and elusive that any person who has ever tried to think about it knows you do not think about it except perhaps once in six months for half a minute. The rest of the time you think about the symbols, because they are tangible, for the thing you are supposed to be thinking about is fearfully difficult and one does not often manage to think about it. The really good philosopher is the one who does once in six months think about it for a minute. Bad philosophers never do.

3 THE LOGIC OF TIME AND MODALITY

Arthur Norman Prior (1914-69) was the founding father of the modern logic of time and modality. In the 1950s and 1960s he laid out the foundation of temporal logic and showed that this discipline was intimately connected with modal logic.

Since then, temporal and modal logic has grown into a mature discipline with many important applications in philosophy, computer science, and also linguistics.

One characteristic of Prior's work is the point of view that logic should be related as closely as possible to intuitions embodied in everyday discourse. He also argued that temporal logic is fundamental for understanding and describing the world in which we live. One important contribution by Prior was the foundation of what is now known as hybrid logics. One simple form of a hybrid logic is a temporal logic in which a special sort of formulas called instant-propositions can be used to refer to specific instants in a model. Thereby further expressive power is obtained. Hybrid logics are closely related to the so-

called description logics used for knowledge representation in computer science. Prior's work on hybrid logic was motivated by a philosophical debate regarding two different conceptions of time: The A-series and B-series conceptions of time. The A-series conception is based on the notions of past, present, and future, as opposed to a 'tapestry' view on time, as embodied by the B-series conception of time according to which time is just a set of instants ordered with an earlier-later relation. Prior considered the A-conception to be the fundamental one and in his view, the B-concepts can be defined in terms of the A-concepts using instant-propositions. Branching time logic is another important contribution by Prior. Using this temporal logic, he analyzed the fundamental philosophical question of determinism versus freedom of choice. In this analysis Prior demonstrated that it is possible to interpret the general idea of branching time in several fundamentally different ways.

There is still a lot to learn from the study of Prior's writings, indeed, later this year Oxford University Press will publish a revised and enlarged edition of Prior's last book, *Papers on Time and Tense*. Since Prior's foundational work on the logic of time and modality, this discipline has attracted ever more attention not only within logic, but also within computer science, formal linguistics and philosophy in general. It is the aim of the conference at Aalborg University to discuss the modern challenges, problems, and applications of the Priorean approach to the logic of time and modality.

The conference is directed at researchers as well as graduate and PhD students in the fields of philosophical, computational, and mathematical logic.

The conference is scheduled for April 25-26, 2003 at Aalborg University, Denmark

The conference chair consists of **Peter Øhrstrøm** (Aalborg University), **Torben Braüner** (Roskilde University), and **Per Hasle** (The University of Southern Denmark – Kolding)

The list of invited speakers and abstracts are to be announced. Refer also the conference home page at

`http://www.philog.ruc.dk`

75 years ago Hilbert and Ackerman published their *Grundzüge der Theoretischen Logik* announcing the start of modern mathematical logic. ΦLOG in association with Humboldt University celebrate 75 years of first order logic by hosting the conference entitled

FOL75

In 1928 Hilbert and Ackerman published their famous work *Grundzüge der Theoretischen Logik*. In the impressively short book they were able to cover the propositional calculus, the calculus of classes, the higher order calculus of relations and most importantly present an axiomatic system of the first order logic, which altogether may be viewed as the very starting point of modern mathematical logic. Today, 75 years later, FOL is a powerful tool and an indispensable companion in a variety of fields ranging from philosophy over mathematics to computer science, linguistics and psychology.

This calls for a celebration. ΦLOG in association with Humboldt University, Berlin honor the 75 years since the publication of the seminal book by hosting this conference dedicated to first

order logic, its history, its wide range of applications and its extensions and alternatives.

The conference is scheduled to take place at Humboldt University in Berlin, September 18-21, 2003. For more information refer to the FOL75 site on web

`http://www.fol75.philog.ruc.dk`


GRUNDZÜGE
DER THEORETISCHEN
LOGIK

VON

D. HILBERT

UND

W. ACKERMANN

Nachlaß
Geschenk
W. KLEBER

BERLIN
VERLAG VON JULIUS SPRINGER

FOL75 offers both plenary lectures and sessions for contributed papers. The list of invited speakers for the plenary lectures include:

- **Hajnal Andreka** (Hungary)
- **George Englebretsen** (Canada)
- **William Ewald** (USA)
- **Jeroen Groenendijk** (The Netherlands)
- **Petr Hájek** (Czech Republic)
- **Jaakko Hintikka** (USA)

- **Wilfrid Hodges** (Great Britain)
- **István Németi** (Hungary)

  Alan Robinson (USA)
- **Dana Scott** (USA)
- **Valentin Shehtman** (Russia)

The Core Group of Organization for FOL75 consists of

- **Vincent F. Hendricks**, Director of ΦLOG, Roskilde University, DK
- **Fabian Neuhaus**, Department of Philosophy, Humboldt University, DE
- **Stig Andur Pedersen**, Director of ΦLOG, Roskilde University, DK
- **Uwe Scheffler**, Department of Philosophy, Humboldt University, DE
- **Heinrich Wansing**, Institute of Philosophy, Dresden University of Technology, DE (program chair)

The Program Committee for FOL75 consists of the Core Group and

- **Johan van Benthem**, ILLC, University of Amsterdam, NL
- **Michael Dunn**, Department of Computer Science, University of Indiana, USA
- **Heinz-Dieter Ebbinghaus**, Department of Mathematics, Albert-Ludwigs-Universität Freiburg, DE
- **Dov M. Gabbay**, Department of Computer Science, King's College, GB
- **Gabriel Sandu**, Department of Philosophy, University of Helsinki, FI

CALL FOR PAPERS

Contributions to FOL75 are invited in the form of papers according to the following areas related to FOL: FOL and the History of Logic; Extensions of and Alternatives to FOL; Cognition and Knowledge Representation; The Unity of Logic and FOL as the *lingua franca* of the Formal Sciences; FOL and Ontology, FOL and Natural Language Semantics.

Anonymous submissions in terms of extended abstracts of up to 10 pages (sent preferably in postscript format by e-mail to Prof. Uwe Scheffler, **fol75@philosophie.hu-berlin.de**, with the subject line 'Submission FOL75' accompanied by a covering letter with name and address of author(s)) must be *received* by March 31, 2003. The abstracts must be written in English and give enough detail to allow the program committee to assess the merits of the work. The abstracts should start with a brief statement of the issues, a summary of the main results, and a statement of their significance and relevance to the conference. References and comparisons with related work is also expected. Results must be unpublished and not submitted for publication elsewhere, including the proceedings of other symposia, workshops or conferences. One author of each accepted paper will be expected to attend the conference in order to present it. Authors will be notified of acceptance by May 31, 2003, and final versions (in LaTeX 2_ε format) will be due by November 30, 2003. Authors of accepted papers will be asked to send a short abstract of two pages for the conference booklet. The full invited and accepted contributed papers will appear in a proceedings published by Logos Verlag in Berlin.

5 50 YEARS OF *STUDIA LOGICA*

Year 2003 is the 50th Anniversary of *Studia Logica—An International Journal for Symbolic Logic*. ΦLOG in association with *Studia Logica* pay tribute to this Anniversary by hosting the second of two conferences entitled

50 Years of Studia Logica—Trends in Logic

The journal *Studia Logica* has for the past 50 years been one of the leading journals in symbolic logic. The journal covers contemporary formal logic and its applications and relations to other disciplines. These include artificial intelligence, informatics, cognitive science, philosophy of science, and the philosophy of language. However this list is not exhaustive, moreover, the range of applications, comparisons and sources of inspiration is open and evolves over time. The journal is also serving as an important East-West link.

The aim of the two conferences, the first to be held in Poland, the second in Denmark, is to bring together scholars in the fields of philosophy, logic, mathematics, computer science and other

disciplines who have contributed significantly to what *Studia Logica* is today. The conferences will include lectures by distinguished scholars covering topics within the aim and scope of the journal. For more information refer to

`http://www.50yrs.philog.ruc.dk`

The first conference is scheduled for October 4-6, 2003 in Warsaw and is organized by IFIS—Institute of Philosophy and Sociology, Polish Academy of Sciences Faculty of Mathematics and Computer Science, Adam Mickiewicz University, Poznan, Poland Faculty of Mathematics and Computer Science, University of Warmia and Mazury, Olsztyn, Poland, Banach Center. The program includes the following invited speakers:

- **Michael Dunn** (USA)
- **Jens Erik Fenstad** (Norway)
- **Dagfinn Føllesdal** (Norway)
- **Vincent F. Hendricks** (Denmark)
- **Grzegorz Malinowski** (Poland)
- **Ewa Orlowska** (Poland)
- **Krister Segerberg** (Sweden)
- **Joachim Lambek** (Canada)

For more information on the first conference, refer to

`http://www.50yrs.philog.ruc.dk/conference1.html`

The Honorary Committee for the first conference consists of Henryk Domanski, Zbgniew Palka, Jerzy Pelc, Jan Rychlewski and Henryk Samsonowicz. The Program Committee for the first conference consists of

- **Ryszard Wojcicki**, Institute of Philosophy and Sociology, The Polish Academy of Sciences, Warsaw, Poland stud@ifispan.waw.pl

- **Wojciech Buszkowski**, Department of Computation Theory, Faculty of Mathematics and Computer Science, Adam Mickiewicz University, Poznan, Poland
buszko@amu.edu.pl

- **Vincent F. Hendricks**, Department of Philosophy and Science Studies, Roskilde University, Denmark
vincent@ruc.dk

- **Jacek Malinowski**, Institute of Philosophy and Sociology, The Polish Academy of Sciences, Warsaw, Poland
jacekm@cc.uni.torun.pl

- **Ewa Orlowska**, Institute of Telecommunications, Poland
orlowska@itl.waw.pl

- **Stig Andur Pedersen**, Department of Philosophy and Science Studies, Roskilde University, Denmark
sap@ruc.dk

- **Jan Zygmunt**, Logic and Methodology of Sciences, Wroclaw University, Poland
logika@uni.wroc.pl

The second conference is scheduled for November 20-22, 2003 in Copenhagen and is organized by ΦLOG and *Studia Logica* and sponsored by ΦLOG. The invited speakers include

- **Johan van Benthem** (Holland)
- **Wojciech Buszkowski** (Poland)
- **Leo Esakia** (Georgia)
- **Melvin Fitting** (USA)
- **Joseph M. Font** (Spain)
- **Robert Goldblatt** (New Zealand)
- **Daniele Mundici** (Italy)
- **Hiroakira Ono** (Japan)
- **Heinrich Wansing** (Germany)

For more information on the second conference, refer to

`http://www.50yrs.philog.ruc.dk/conference2.html`

The Organizational Chair for the second conference consists of

- **Vincent F. Hendricks**, Department of Philosophy and Science Studies, Roskilde University, Denmark vincent@ruc.dk
- **Jacek Malinowski**, Institute of Philosophy and Sociology, The Polish Academy of Sciences, Warsaw, Poland jacekm@cc.uni.torun.pl
- **Stig Andur Pedersen**, Department of Philosophy and Science Studies, Roskilde University, Denmark sap@ruc.dk
- **Ryszard Wojcicki**, Institute of Philosophy and Sociology, The Polish Academy of Sciences, Warsaw, Poland stud@ifispan.waw.pl

Registration is free. Please write the ΦLOG-secretary Pelle Guldborg Hansen to register for the second conference:

Department of Philosophy and Science Studies
Roskilde University, PA6
P. O. Box 260
DK4000 Roskilde, Denmark
Phone (+45) 4674 2540 / (+45) 2334 2175
Fax (+45) 4674 3012 Email pgh@ruc.dk

Be sure to include your name, institution, country and zip-code and your email address.

If email is used include '50YRS—DK' in the subject entry. All questions pertaining to registration and accommodations should be directed to Pelle Guldborg Hansen. No individual notification upon registration will be forwarded to individual participants but the home page will keep a list of registered participants.

6 ANNOUNCEMENTS

Conferences

Self-Reference. ΦLOG hosts its second conference on the concept of self-reference in philosophy, mathematics and computer science, October 31-November 2, 2002 at The Carlsberg Academy in Copenhagen, Denmark. The conference booklet for this event is to be found on page 67.

The Logic of Time and Modality. ΦLOG hosts its third conference, April 25-26, 2003 at Aalborg University, Denmark. For more information see page 41 and refer to

`http://www.philog.ruc.dk`

FOL75. ΦLOG in association with Humboldt University host the fourth conference celebrating 75 years of first order logic, September 18-21, 2003 at the Humboldt University in Berlin, Germany. For more information see page 43 and refer to

`http://www.fol75.philog.ruc.dk`

50 Years of Studia Logica—Trends in Logic. ΦLOG in association with *Studia Logica* celebrates the 50th Anniversary of *Studia Logica—An International Journal for Symbolic Logic.* Conference I: Warsaw, Poland; October 4-6, 2003. Conference II: Copenhagen, Denmark; November 20-22, 2003. For more information see page 47 and refer to

`http://www.50yrs.philog.ruc.dk`

An Introduction to Mathematical Logic and Type Theory: To Truth through Proof. Peter B. Andrews. Kluwer Academic Publishers. Publication Date: August 2002. Price: $81.00.

The Philosopher's Toolkit: A Compendium of Philosophical Concepts and Methods. Julian Baggini and Peter S. Fosl. Blackwell Publishers. Publication Date: October 2002. Price: $54.95.

Contemporary Analytic Philosophy. James Baillie. Prentice Hall Professional Technical Reference. Publication Date: April 2002: Price $50.67.

This self-contained anthology collects some of the most influential primary source contributions to contemporary analytic philosophy, together with introductions and commentaries for each selection. It traces the development of a few central themes in analytic philosophy, in sufficient detail from philosophy of mind and language, metaphysics, epistemology, and philosophical logic. Frege, Russell, Moore, Wittgenstein. Logical Empiricism. Ordinary Language Philosophy. Quine. Truth, Meaning,...

Uncertain Logics, Variables, and Systems. Zdzisaw Bubnicki. Springer-Verlag New York, Incorporated. Publication Date: August 2002. Price: $48.80.

Uncertainty is one of the main features of complex and intelligent decision-making systems. There exists a great variety of definitions and descriptions of uncertain systems. The ideas of uncertain variables based on uncertain logics have been introduced and developed for a wide class of uncertain systems. In this monograph basic concepts, definitions and results concerning uncertain variables are presented. Applications to analysis and decision problems in uncertain systems, described by traditional mathematical models and by knowledge representations, are demonstrated. In this monograph basic concepts, definitions and results concerning uncertain variables are presented. Applications to analysis and decision problems in uncertain systems,

described by traditional mathematical models and by knowledge representations, are demonstrated.

Computing Meaning and EP: Volume 2. Edited by Harry C. Bunt, Reinhard Muskens and Elias Thijsse. Kluwer Academic Publishers. Publication Date: January 2002. Price: $119.00.

Computational Semantics is concerned with computing the meanings of linguistic objects such as sentences, text fragments, and dialogue contributions. As such it is the interdisciplinary child of semantics, the study of meaning and its linguistic encoding, and computational linguistics, the discipline that is concerned with computations on linguistic objects. From one parent computational semantics inherits concepts and techniques that have been developed under the banner of formal (or model-theoretic) semantics. This blend of logic and linguistics applies the methods of logic to the description of meaning. From the other parent the young discipline inherits methods and techniques for parsing sentences, for effective and efficient representation of syntactic structure and logical form, and for reasoning with semantic information. Computational Semantics integrates and further develops these methods, concepts and techniques. This book is a collection of papers written by outstanding researchers in the newly emerging field of computational semantics. It is aimed at those linguists, computer scientists, and logicians who want to know more about the algorithmic realization of meaning in natural language and about what is happening in this field of research. There is a general introduction by the editors.

Dewey's Logical Theory—New Studies and Interpretations. Edited by F. Thomas Burke, D. Micah Hester and Robert B. Talisse. Vanderbilt University Press. Publication Date: March 2002. Price: $27.95. (paperback).

Despite the resurgence of interest in the philosophy of John Dewey, his work on logical theory has received relatively little attention. Ironically, Dewey's logic was his first and last love. The essays in this collection pay tribute to that love by addressing Dewey's philosophy of logic, from his work at the beginning of the twentieth century to the culmination of his logical thought in the 1938 volume, *Logic: The Theory of Inquiry.* All the essays are original to this volume and are written

by leading Dewey scholars. Ranging from discussions of propositional theory to logics social and ethical implications, these essays clarify often misunderstood or misrepresented aspects of Dewey's work, while emphasizing the seminal role of logic to Dewey's philosophical endeavors. This collection breaks new ground in its relevance to contemporary philosophy of logic and epistemology and pays special attention to applications in ethics and moral philosophy.

Information and Randomness: An Algorithmic Perspective. C. Calude. Springer-Verlag New York, Incorporated. Publication Date: September 2002. Price: $54.95.

'Algorithmic information theory (AIT) is the result of putting Shannon's information theory and Turing's computability theory into a cocktail shaker and shaking vigorously,' says G.J. Chaitin, one of the fathers of this theory of complexity and randomness, which is also known as Kolmogorov complexity. It is relevant for logic (new light is shed on Gödel's incompleteness results), physics (chaotic motion), biology (how likely is life to appear and evolve?), and metaphysics (how ordered is the universe?). This book, benefiting from the author's research and teaching experience in Algorithmic Information Theory (AIT), should help to make the detailed mathematical techniques of AIT accessible to a much wider audience.

The Logical Structure of the World and Pseudoproblems in Philosophy. Rudolf Carnap, translated by Rolf A. George. Open Court Publishing Company. Publication Date: October 2002. Price: $22.00.

Available for the first time in 20 years, here are two important works from the 1920s by the best-known representative of the Vienna Circle. In *The Logical Structure of the World*, Carnap adopts the position of 'methodological solipsism' and shows that it is possible to describe the world from the immediate data of experience. In his *Pseudoproblems in Philosophy*, he asserts that many philosophical problems are meaningless.

Paradoxes from A to Z. Michael Clark. Routledge. Publication Date: May 2002. Price: $11.17. (paperback)

This essential guide to paradoxes takes the reader on a lively tour of puzzles that have taxed thinkers from Zeno to Galileo

and Lewis Carroll to Bertrand Russell. Michael Clark uncovers an array of conundrums, such as Achilles and the Tortoise, Theseus' Ship, Hempel's Raven, and the Prisoners' Dilemma, taking in subjects as diverse as knowledge, ethics, science, art and politics. Clark discusses each paradox in non-technical terms, considering its significance and looking at likely solutions. He also includes a full glossary.

Algebras, Diagrams and Decisions in Language, Logic and Computation. Edited by Ann Copestake. CSLI Publications. Publication Date: August 2002. Price: $25.00 (paperback)

Types, Tableaus, and Gödel's God. Melvin Fitting. Kluwer Academic Publishers. Studia Logica Library Series: Trends in Logic. Publication Date: July 2002. Price: $67.00.

Gödel's modal ontological argument is the centrepiece of an extensive examination of intensional logic. First, classical type theory is presented semantically, tableau rules for it are introduced, and the Prawitz/Takahashi completeness proof is given. Then modal machinery is added, semantically and through tableau rules, to produce a modified version of Montague/Gallin intensional logic. Extensionality, rigidity, equality, identity, and definite descriptions are investigated. Finally, various ontological proofs for the existence of God are discussed informally, and the Gödel argument is fully formalized. Objections to the Gödel argument are examined, including one due to Howard Sobel showing Gödel's assumptions are so strong that the modal logic collapses. It is shown that this argument depends critically on whether properties are understood intensionally or extensionally.

Handbook of Philosophical Logic, Vol. 6-9. Edited by Dov M. Gabbay F. Guenthner. Kluwer Academic Publishers. Publication Date: September 2002. Price: Varying depending on volume.

The third volume of the second edition contains major contributions on Basic and Advanced Modal Logic, Quantification in Modal Logic and Correspondence Theory. Audience: Students and researchers whose work or interests involve philosophical logic and its applications.

Studies in Logic and Practical Reasoning, Volume 1: Handbook of the Logic of Argument and Inference: The Turn Towards the Practical. Edited by Dov M. Gabbay, H. J. Ohlbach, R. J. Johnson and J. Woods. Elsevier Science. Publication Date: April 2002.

Internal Logic. Foundations of Mathematics from Kronecker to Hilbert. Yvon Gauthier. Kluwer Academic Publishers. Synthese Library Series. Publication Date: June 2002. Price: $78.00.

Internal logic is the logic of content. The content is here arithmetic and the emphasis is on a constructive logic of arithmetic (arithmetical logic). Kronecker's general arithmetic of forms (polynomials) together with Fermat's infinite descent is put to use in an internal consistency proof. The view is developed in the context of a radical arithmetization of mathematics and logic and covers the many-faceted heritage of Kronecker's work, which includes not only Hilbert, but also Frege, Cantor, Dedekind, Husserl and Brouwer.

Sheaves, Games, and Model Completions: A Categorical Approach to Nonclassical Propositional Logics. Silvio Ghilardi and Marek Zawadowski. Kluwer Academic Publishers. Publication Date: August 2002. Price: $85.00.

This book investigates propositional intuitionistic and modal logics from an entirely new point of view, covering quite recent and sometimes yet unpublished results. It mainly deals with the structure of the category of finitely presented Heyting and modal algebras, relating it both with proof theoretic and model theoretic facts: existence of model completions, amalgamability, Beth definability, interpretability of second order quantifiers and uniform interpolation, definability of dual connectives like difference, projectivity, etc. are among the numerous topics which are covered. Dualities and sheaf representations are the main techniques in the book, together with Ehrenfeucht-Fraissé games and bounded bisimulations. The categorical instruments employed are rich, but a specific extended Appendix explains to the reader all concepts used in the text, starting from the very basic definitions to what is needed from topos theory.

The Philosophical Status of Diagrams. Mark Greaves. CSLI

Publications. Publication Date: May 2002. Price: $23.00. (paperback)

Papers on Time and Tense New Edition—Arthur N. Prior. Edited by Per Hasle, Peter Øhrstrøm, Torben Braüner, and B. Jack Copeland. Oxford University Press. Publication Date: October 2002. Price: £16.99 (paperback)

Arthur Norman Prior (1914-1969) was the founding father of temporal logic. This discipline has attracted ever more attention not only within logic, but also within computer science, formal linguistics and philosophy in general. This book is the 2nd revised and enlarged edition of Prior's last book, *Papers on Time and Tense*, which was published in 1968. As the title suggests the volume is a collection of papers by Prior, the subject being in a broad sense the logic of time. Prior's fundamental ideas about temporal logic are presented here along with his investigations into the formal properties of time and tense. Thus the volume offers the opportunity of understanding these ideas and to follow their development in the course of Prior's authorship. However, *Papers on Time and Tense* does not only offer insight into the thought of Prior. It is also one of the best expositions ever of the philosophical issues related to the logic of time and is a first class example of philosophical logic. Already one year after the publication of *Papers on Time and Tense*, Prior considered a second revised edition, extended with a number of recent papers. He wrote a suggestion for the contents of this new edition and also a preface for it. Unfortunately, because of his sudden death in October 1969 Prior was never able to go on with this proposal. His new table of contents as well as the new preface were deposited in the Bodleian Library after his death, along with other unpublished material by Prior. The editors of this 2nd revised edition have closely followed Prior's suggestions for the second revised edition. One major change has been made, though. Prior's use of the now defunct Polish notation for logic has been systematically replaced by standard logical notation, making the work more accessible to present-dayreaders. Moreover, 'Editors' notes' have been added in the cases where it has been possible to give useful information about Prior's text. These editorial notes are of course clearly distinguished from Prior's own footnotes. The volume also contains

a new and much enlarged bibliography of Prior's works, and an interview with Prior's widow, Dr. Mary Prior, on the life and work of Arthur Norman Prior. Readership: Researchers and graduate students in philosophy and logic, also linguistics and computer science.

For more information see the on-line catalogue of Oxford University Press `http://www.oup.co.uk/isbn/0-19-925607-1`.

Moderne elementær logik. Vincent F. Hendricks and Stig Andur Pedersen. Forlaget Høst og Søn. Publication Date: April 2002. Price: 300.00 Dkr. (paperback)

We are all capable of drawing logically valid inferences on many occasions.. Rarely do we concern ourselves with how we are able to do so. That's the business of logic and one of the main reasons why logic plays such a paramount role in many different sciences today. Beginning with simple arguments and inferences *Modern Elementary Logic* takes the reader on a systematic tour of contemporary logic—from the propositional calculus, through the first order predicate calculus to non-standard logics like alethic, temporal and epistemic logic. The book also includes advanced chapters on formal structures, model theory and meta-theoretical discussions of the propositional, first and high order calculi including soundness and completeness, compactness, Tarski's theorem, Gödel's incompleteness theorems, Lövenheim-Skolem's theorem, Lindström's theorem, categorisity and logical paradoxes most notably Russell's, Cantor's, Richard's and Tarski's paradoxes. *Modern Elementary Logic* is a university textbook which may be used at the undergraduate level in philosophy, mathematics, computer science and linguistics but may also be used at the graduate level. Then again, the book is also intended for everyone interested in the fundamental laws of thought. An English version is forthcoming.

For more information see `http://www.ruc.dk/~vincent` and `http://www.ruc.dk/~vincent/melustoc.pdf` for an English table of content.

Knowledge—Foundations and Applications. Edited by Vincent F. Hendricks, Klaus Frovin Jørgensen and Stig Andur Pedersen. *Synthese Library Series* (special volume). Kluwer Academic Publishers, forthcoming 2003. Price: $32.00. (paperback)

Contributions from R. Fagin, J. Halpern, J. Hintikka, W. v. d. Hoek, W. Lenzen, Y. Moses, H. Rott, K. Segerberg, J. Sowa, M. Vardi and R. Wojcicki.

A Companion to Philosophical Logic (Blackwell Companions to Philosophy). Edited by Dale Jacquette. Blackwell Publishers. Publication Date: February 2002. Price: $124.95.

This collection of newly commissioned essays by international contributors offers a representative overview of the most important developments in contemporary philosophical logic. Written by experts from a variety of different logical and philosophical perspectives, the volume presents controversies in philosophical implications and applications of formal symbolic logic.

Fuzzy Logic. Edited by V. Korotkich and V. Dimitrov. Physica-Verlag. Publication Date: February 2002. Price: $90.00.

The book focuses on both the engineering applications of fuzzy logic and soft computing and its social applications and philosophical insights at the dawn of the third millennium. The included papers clearly demonstrate that fuzzy logic revolutionizes general approaches to solving applied problems and reveals deep connections between those approaches and the underlying unique theoretical framework. The book consists of three parts: Understanding Society, Mathematics, and Modelling and Control Systems. The first part reveals different aspects of fuzziology, a new study of fuzziness inherent in human knowledge. The second part explores the mathematical foundations of soft computing, while the third part elicits its innovative engineering applications.

Probability Is the Very Guide of Life: The Philosophical Uses of Chance. Edited by Henry E. Kyburg and Mariam Thalos. Open Court Publishing Company. Publication Date: April 2002. Price: $36.95.

The theory of probability grew up in gaming rooms, graduated to insurance companies, and was eventually applied by philosophers to all kinds of ordinary choices. This collection represents the best recent work on the subject and includes essays by Clark Glymour, James H. Fetzer, and Wesley C. Salmon.

Introduction to Languages and the Theory of Computation. John C. Martin. McGraw-Hill Higher Education. Publication Date: August 2002. Price: $110.50.

This book is an introduction for undergraduates to the theory of computation. It emphasizes formal languages, automata and abstract models of computation, and computability. It also includes an introduction to computational complexity and NP-completeness.

Hilary Putnam: Realism, Reason and the Uses of Uncertainty. Christopher Norris. Manchester University Press. Publication Date: November 2002. Price $29.95. (paperback).

In this detailed study, Christopher Norris defends the kinds of arguments advanced by Hilary Putnam. Norris makes a point of placing Putnam's early realist work in a wider philosophical context, and relating it to various current debates in epistemology and philosophy of science. Much like Putnam, Norris is willing to take full account of opposed viewpoints while maintaining a vigorously argued commitment to the values of debate and enquiry.

Substructural Logics: A Primer. Francesco Paoli. Kluwer Academic Publishers. Publication Date: 2002.

Substructural logics are by now one of the most prominent branches of the research field usually labelled as 'nonclassical logics'—and perhaps of logic tout court. Over the last few decades a vast amount of research papers and even some books have been devoted to this subject. The aim of the present book is to give a comprehensive account of the 'state of the art' of substructural logics, focusing both on their proof theory (especially on sequent calculi and their generalizations) and on their semantics (both algebraic and relational).

The Semantics and Proof Theory of the Logic of Bunched Implications. David J. Pym. Kluwer Academic Publishers. Publication Date: October 2002.

This monograph provides a thorough account of the model theory, proof theory and computational interpretations of BI, the logic of bunched implications, which freely combines intuitionistic logic and multiplicative intuitionistic linear logic.

Starting, on the one hand, from elementary observations about modelling resources and, on the other, from a desire to develop a system of logic within which additive (or extensional) and multiplicative (or intensional) implications co-exist with equal logical status, we give natural deduction calculi, sequent calculus, categorical semantics, Kripke models, topological models, logical relations and computational interpretations for both propositional and predicate BI, within which both additive and multiplicative quantifiers also co-exist.

Investigating Irreality: A Study of Unreal Possibilities. Nicholas Rescher. Open Court Publishing Company. Publication Date: February 2002. Price: $32.95.

This book looks at the various ways philosophers have considered the realm of unreal possibilities and nonexistent objects. Nicholas Rescher ties together the diverse approaches and makes an argument against the philosophical trend of dealing with nonexistent possible worlds as though they were authentic objects.

Advances in Computational Intelligence: Theory and Practice. Edited by Hans-Paul Schwefel, Ingo Wegener and Klaus Weinert. Springer-Verlag New York, Incorporated. Publication Date: October 2002.

The 30 coherently written chapters by leading researchers presented in this anthology are devoted to basic results achieved in computational intelligence since 1997. The book provides complete coverage of the core issues in the field, especially in fuzzy logic and control as well as for evolutionary optimization algorithms including genetic programming, in a comprehensive and systematic way. Theoretical and methodological investigations are complemented by prototypic applications for design and management tasks in electrical engineering, mechanical engineering, and chemical engineering. This book will become a valuable source of reference for researchers active in computational intelligence. Advanced students and professionals interested in learning about and applying advanced techniques of computational intelligence will appreciate the book as a useful guide enhanced by numerous examples and applications in a variety of fields.

Vagueness and Contradiction. Roy Sorensen. Clarendon Press. Publication Date: April 2002. Price: $35.00.

The Applicability of Mathematics as a Philosophical Problem. Mark Steiner. Harvard University Press. Publication Date: October 2002. Price: $19.95.

This book analyzes the different ways mathematics is applicable in the physical sciences, and presents a startling thesis—the success of mathematical physics appears to assign the human mind a special place in the cosmos.

Post-Analytic Tractatus: A Critical Reader. Edited by Barry Stocker. Ashgate Publishing Company. Publication Date: August 2002. Price: $69.95.

The Dynamics of Judicial Proof. Edited by Peter Tillers and Marilyn MacCrimmon. Springer-Verlag New York, Incorporated. Publication Date: July 2002.

Logic and Set Theory. George J. Tourlakis. Cambridge University Press. Publication Date: 2003. Price: $61.75.

Paradox and Paraconsistency: *Conflict Resolution in the Abstract Sciences*. John Woods. Cambridge University Press. Publication Date: September 2002. Price: $26.00. (paperback)

In a world plagued by conflict, one might expect that the exact sciences of logic and mathematics would provide a safe harbor. In fact, these disciplines are rife with internal divisions between different, often incompatible systems. This original work explores apparently intractable disagreements in logic and the foundations of mathematics and sets out conflict resolution strategies that evade these stalemates. The book is a significant contribution to such areas of philosophy as logic, philosophy of language and argumentation theory. It is also of interest to mathematicians and computer scientists.

New—*Logic, Epistemology and the Unity of Science*. Announcing the launch of a new bookseries from Kluwer Academic Publishers.

Editors: Shahid Rahman (University of Lille III) and John Symons (University of Texas at El Paso).

Editorial board: Jacques Dubucs (Sorbonne I), Anne Fagot-Largeault (Collège de France), Dov M. Gabbay (King's College), Jaakko Hintikka (Boston), Karel Lambert (California), Graham Priest (St. Andrews/Melbourne), Gabriel Sandu (Helsinki), Wolfgang Spohn (Konstanz), Jean Paul van Bendegem (Brussels), J. v. Benthem (Amsterdam), B. v. Fraassen (Princeton), Heinrich Wansing (Dresden), Timothy Williamson (Oxford).

The aim of this series is to reconsider the question of the unity of science in light of recent developments in logic. At present, no single logical, semantical or methodological framework dominates the philosophy of science. However, the editors of this series believe that formal techniques like, for example, independence friendly logic, dialogical logics, multi-modal logics, game-theoretic semantics and linear logics, have the potential to cast new light on basic issues in the discussion of the unity of science.

This series provides a venue where philosophers and logicians can apply specific technical insights to fundamental philosophical problems. While the series is open to a wide variety of perspectives, including the study and analysis of argumentation and the critical discussion of the relationship between logic and the philosophy of science, the aim is to provide an integrated picture of the scientific enterprise in all its diversity.

We invite you to contact us with comments and suggestions: Shahid Rahman (rahman@univ-lille3.fr); John Symons (jsymons@utep.edu).

Please send manuscripts and book proposals to: Floor Oosting (floor.oosting@wkap.nl), Publishing editor, Kluwer Academic Publishers, PO Box 17, 3300 AA Dordrecht, The Netherlands.

PHIS—The Danish Research School in Philosophy, the History of Ideas and History of Science

PHIS—*The Danish Research School in Philosophy, the History of Ideas and the History of Science*

`http://www.phis.ruc.dk`

Denmark has a number of small but very active institutions specializing in philosophy, the history of ideas and the history of science. The institutions range from university departments, research centers to museums. None of the institutions however have a sufficient flow of PhD-students to warrant a research school. Additionally it has often been a problem for Danish PhD-students to find research courses relevant to their projects since the institutions have been, given their size, unable of providing continuous and/or reoccurring courses. The Danish Research School in Philosophy, the History of Ideas and the History of Science is a national conglomerate of all the Danish institutions offering a research program in the relevant fields. The school is sponsored by the Danish Research Training Council.

PHIS will coordinate the activities scattered throughout the country and simultaneously develop a more permanent PhD-curriculum intended to secure the quality of the research education in general. Currently, and without further funding, the school has approximately 40 PhD-students.

The school is organized according to the following four 'pillars':

- Theoretical philosophy

- Practical philosophy
- The history of ideas, and
- The history of science

These pillars are by no means disjoint and the school encourages interdisciplinary courses, workshops, seminars and other academic activities demonstrating the fruitful interaction between history, philosophy and the special sciences.

The courses offered by the school are either of an introductory or of a specialized and advanced nature. The academic language will be mostly Danish and English. The courses are open to Danish as well as international PhD-students.

`http://www.phis.ruc.dk/activitites.html`

An annual 'Graduate Conference' is scheduled for PhD-students (and supervisors) to present and exchange ideas, establish contacts, networking, etc. the first one to be held December 2-4, 2002 at The University of Southern Denmark – Odense.

`http://www.phis.ruc.dk/phisact/gconference.html`

A number of conferences, domestic and international, are hosted either by affiliated networks, institutions or other initiatives.

`http://www.phis.ruc.dk/conferences.html`

AiML

AiML—*Advances in Modal Logic* has changed publisher. Volume 3 will appear in September 2002 with World Scientific Publishers, Singapore/London. *Advances in Modal Logic* is a biannual workshop and book series in modal logic founded in 1995 by Maarten de Rijke (Amsterdam), Heinrich Wansing (Dresden), and Michael Zakharyaschev (Moscow). The aim of the

workshop series is to report on important new developments in pure and applied modal logic, and to do so at varying locations throughout the world. The book series is based on the workshops. For more information refer to

http://www.aiml.net

SELF REFERENCE

CONFERENCE BOOKLET

October 31—November 2, 2002
The Carlsberg Academy, Copenhagen
Denmark

ΦLOG

CONTENT

SELF-REFERENCE

ΦLOG

7 SELF-REFERENCE

This is the conference booklet for *Self-Reference*, October 31-November 2, The Carlsberg Academy, Copenhagen, Denmark. The conference is directed at researchers as well as graduate and PhD students in the fields of mathematical, philosophical and computer science logic. For students and other interested parties there will be held an introductory seminar on self-reference the day before the conference. Below you will find useful information pertaining to the conference and seminar.

Conference Aim

Self-reference is used to denote any situation in which someone or something refers to itself. Self-reference is an important issue in philosophy, mathematics and computer science amongst others.

In the philosophy of language the naive theory of truth has been challenged by the Liar Paradox. The Liar Paradox is the contradiction that emerges from trying to determine whether the sentence

'This sentence is false'

is true or false. The sentence is obviously self-referential in that it claims itself to be false.

In mathematics the naive concept of set has been challenged by Russell's paradox. Russell's paradox is the contradiction that

emerges from trying to determine whether the sentence

> 'Is the set of all sets that are not
> members of themselves an element of itself?'

is true or false. This sentence, as well, involves self-reference, though maybe not in a way as obvious as the Liar sentence.

In computer science one of the important problems is the question of how to implement introspection (self-reflection) in artificial intelligence agents. Through introspection an agent is able to refer to itself. On the naive account of agent introspection this again leads to a paradox of self-reference, e.g. in the form of the Knower's Paradox:

> 'I know that what I say now is not true.'

In the light of these paradoxes the naive theories have to be abandoned and several new, consistent theories are introduced instead. In these theories the paradoxes are avoided either by blocking self-reference altogether or by finding consistent ways to treat self-reference. The blocking strategy will most often result in theories that are limited in important ways. Thus, to construct powerful, consistent theories one has to get to a deeper theoretical understanding of self-reference and of how to live consistently with it. It turns out that all three paradoxes above are structurally similar. This implies that coming to an understanding of the basic structure involved in self-reference and theoretically investigate how to tame it has promising perspectives for all three fields of research.

Self-reference is not in any way restricted to occur only in the theories considered above. Actually, any theory that could be considered to be part of its own subject matter has some degree of self-referentiality. This applies to many theories of language, economy, sociology, psychology, etc. With respect to these theories an understanding of self-reference is essential to avoid performing unsound self-referential reasoning as in the paradoxes above. The aim of the conference is to bring together researchers in the fields of philosophy, mathematics, and computer science to present theories of and related to self-reference – especially with respect to theories that explain and resolve the above paradoxes and thereby advance new theories for the involved fields.

Andrea Cantini

Department of Philosophy, University of Florence, Italy

▶ Fixed Point Constructions: Some Applications to Undecidability and Consistency Problems for Self-Referential Systems

Self-reference is a major cause of entanglement in logical and foundational investigations involving predicate and function application. In all these cases, fixed point theorems are essential tools. In this talk we survey some applications thereof, mainly concerned with:

1. Naive set theory GS within contraction-free logic (à la Grišin).

2. Applicative systems based on combinatory logic CL.

As to (1), we prove an undecidability result for GS by simulating CL-computations into GS itself.

As to (2), we investigate the problem: To what extent is the fixed point theorem for self-applicable operations compatible with forms of the choice axiom for operations?

The coda should (hopefully) provide a (novel) foundational application of the fact that sometimes closed expressions, built up by self-reference, have a *generic meaning* (consider, for instance, the possible values of truth-teller-like sentences in non-minimal models of Kripke's theory of truth, or the possible denotations of the term $\Omega = (\lambda x.xx)(\lambda x.xx)$ in lambda-calculus models).

Anil Gupta

Department of Philosophy, University of Pittsburgh, USA

▶ Truth, Definitions, and Rational Choice

Nuel Belnap and I have argued in our book, *The Revision Theory of Truth*, that circular definitions and concepts are logically

legitimate and that truth is a circular concept. I will begin my presentation with a brief explanation and defense of these claims. I will go on to sketch a simple semantics for definitions. This semantics provides a way of making sense of a range of circular definitions (but not all circular definitions). Finally, I will apply this semantics to a problem about rational choice. I will show that the semantics yields some dividends here.

Melvin Fitting

Department of Mathematics and Computer Science, Lehman College, New York, USA

▶ Bilattices are nice things

One approach to the paradoxes of self-referential languages is to allow some sentences to lack a truth value (or to have more than one). Then assigning truth values where possible becomes a fixpoint construction and, following Kripke, this is usually carried out over a partially ordered family of truth-value assignments. Some years ago, Matt Ginsberg introduced the notion of bilattice, with applications to artificial intelligence in mind. It turned out that bilattices generalize partial orderings in a certain natural sense, while making the algebra simpler and more perspicuous. In addition, work such as that of Yablo fits naturally into the bilattice setting. What I will do is to present the general background of bilattices, discuss why they are natural, and show what fixpoint approaches to truth in languages that allow self-reference look like when bilattices are used. This is not new work, but rather is a summary of research I have done over many years.

Vann McGee

Department of Philosophy, MIT, USA

▶ In Praise of the Free Lunch

Frege wondered why truth was significant, inasmuch as asserting a sentence to be true doesn't accomplish anything more than asserting the sentence itself. The standard disquotational answer, due to Quine, is that truth is a device we use to affirm many

statements at once. Most efforts to cash this out emphasize the communicative role of truth, as in Everything the Pope says is true. Instead, I would like to emphasize its cognitive role, as an aid in acquiring new knowledge. Conservativeness results of Kotlarski, Krajewski, and Lachlan and of Halbach show that we can accept a Tarski-style theory of satisfaction at no cognitive cost. Once we have the notion of satisfaction, we can use it, for example, in formulating induction axioms, and doing so significantly enhances our mathematical knowledge.

Donald Perlis

Department of Computer Science, University of Maryland, USA

▶ Theory and Application of Self-Reference: Logic and Beyond

This talk presents a brief (and probably rather personal and one-sided) view of self-reference as seen in logic and AI, then slides over to natural language and philosophy, and eventually returns to AI and theories of the conscious mind based on one kind of self-reference (arguably the most fundamental kind).

Graham Priest

Department of Philosophy, University of Melbourne and Department of Philosophy, University of St. Andrews, Australia / Scotland

▶ Paradoxes of Denotation

The paradoxes of denotation, such as Berry's and Richard's, form a distinctive subclass of the paradoxes of self-reference. In particular, they possess features and properties that make them somewhat different from the other semantic paradoxes, such as the Liar. This fact is, I think, insufficiently appreciated. In this talk I will discuss these features and how they bear on the issue of whether commonly mooted solutions to the semantic paradoxes can be applied to them.

Raymond Smullyan

Department of Mathematics and Department of Philosophy, University of Indiana, USA

▶ Self-Reference in All Its Glory

This talk will consist of some amusing self-referential anecdotes, some logic matters and some special technical devices for achieving self-reference in formalized languages.

Stephen Yablo

Department of Philosophy, MIT, USA

▶ What's Circularity Got To Do With It?

Russell blamed the paradoxes on violations of the Vicious Circle Principle. Suppose the circularity diagnosis is correct. Then it ought to block the semantic paradoxes if we insist like Tarski on a hierarchy of metalanguages, and it ought to block the class paradoxes if we insist like Russell on a hierarchy of logical types. I ask whether these predictions are borne out. I maintain that Russell's diagnosis of the semantic paradoxes is wrong because the Liar has non-circular variants; and, much more tentatively, that his diagnosis of the class paradoxes is wrong because Russell's paradox *either* has non-circular variants or is not itself a paradox of circularity.

Conference Chair

▶ Vincent F. Hendricks, vincent@ruc.dk
(Roskilde University)

▶ Stig Andur Pedersen, sap@ruc.dk
(Roskilde University)

▶ Thomas Bolander, tb@it.dtu.dk
(The Technical University of Denmark)

All presentations will take place at

The Carlsberg Academy

Gamle Carlsberg Vej 15, DK2500 Valby, in Copenhagen. On the back of this booklet, please find a map of the conference site.

To reach the Carlsberg Academy at 09:00 on Thursday, October 31 and Friday, November 1 from Roskilde University, follow the schedule below:

Departure	**Arrival**
08:10, Trekroner St.	08:30, Valby St. ♯
08:34, Valby St.	08:38, Bjerregårdsvej ♣
08:38, Bjerregårdsvej	08:43, Carlsberg Academy ♠

♯ = Train RE 4422, Direction Østerport St.
♣ = Bus 18, Direction Nordhavn St.
♠ = Walk

To reach the Carlsberg Academy at 09:00 on Saturday, November 2 from Roskilde University, follow the schedule below:

Departure	**Arrival**
08:19, Trekroner St.	08:38, Valby St. ♯
08:47, Valby St.	08:50, Bjerregårdsvej ♣
08:50, Bjerregårdsvej	08:55, Carlsberg Academy ♠

♯ = Train RE 5504, Direction Østerport St.
♣ = Bus 18, Direction Nordhavn St.
♠ = Walk

To reach the Carlsberg Academy at 09:00 on Thursday, October 31 and Friday, November 1 from Copenhagen Central Station, follow the schedule below:

Departure	**Arrival**
08:38, Central Station.	08:42, Enghavevej. ♣
08:42, Enghavevej	08:54, Carlsberg Academy ♠

♣ = Bus, 650S Direction Avedøre St.
♠ = Walk

To reach the Carlsberg Academy at 09:00 on Saturday, November 2 from Copenhagen Central Station, follow the schedule below:

Departure	**Arrival**
08:43, Central Station.	08:50, De Små Haver ♣
08:50, De Små Haver	09:00, Carlsberg Academy ♠

♣ = Bus, 550S Direction Glostrup St.
♠ = Walk

For more information on transportation, refer to the DSB website (Danish Transportation Authority) and the journey planner at

`http://www.dsb.dk/journey_planner/`

Time Tables

	Thursday, Oct. 31
09:00 - 09:20	Registration
09:20 - 09:30	Opening
09:30 - 10:30	D. Perlis
10:30 - 11:00	Discussion
11:00 - 11:30	Coffee Break
11:30 - 12:30	V. McGee
12:30 - 13:00	Discussion
13:00 - 14:00	Lunch
14:00 - 15:00	M. Fitting
15:00 - 15:30	Discussion
15:30 - 16:00	Coffee
16:00 - 18:00	Sight-seeing Tour

Conference Chair: Vincent F. Hendricks

	Friday, Nov. 1
09:00 - 09:30	Coffee
09:30 - 10:30	A. Cantini
10:30 - 11:00	Discussion
11:00 - 11:30	Coffee Break
11:30 - 12:30	A. Gupta
12:30 - 13:00	Discussion
13:00 - 14:00	Lunch
14:00 - 15:00	S. Yablo
15:00 - 15:30	Discussion
15:30 - 16:00	Coffee
19:00 -	Dinner

Conference Chair: Stig Andur Pedersen

	Saturday, Nov. 2
09:00 - 09:30	Coffee
09:30 - 10:30	G. Priest
10:30 - 11:00	Discussion
11:00 - 11:30	Coffee Break
11:30 - 12:30	R. Smullyan
12:30 - 13:00	Discussion
13:00 - 14:00	Lunch
14:00 - 14:30	Closing

Conference Chair: Thomas Bolander

Lunch and Dinner Arrangements

On Thursday, Friday and Saturday participants may choose to order lunch through the conference organization; payments for these arrangements are due during final conference registration

on Thursday, October 31. Each lunch costs 60,00 Dkr and includes besides Danish 'smørrebrød' (open sandwiches) one beverage.

A conference dinner is scheduled for Friday, November 1 at 19:00, Restaurant Gråbrødre Torv in the center of Copenhagen. The dinner costs 350,00 Dkr and includes a three course meal and wine. The student price is reduced to 175,00 Dkr. Only a limited number of seats is available.

Participants interested in lunch orders and/or conference dinner participation should notify ΦLOG-secretary Pelle Guldborg Hansen (see address below) no later than **Friday, October 25**. Only *cash* payments are accepted and no later than upon final conference registration during Thursday, October 31.

Sight-seeing Tour

A sight-seeing tour of Copenhagen is planned for Thursday, October 31. The tour will cost 50,00 Dkr which includes transportation, guides and passes. Signing up for the tour is, as for the lunch and dinner arrangements, no later then **Friday, October 25**, and payment is due no later than upon final registration.

Registration

Registration is free. Please write the ΦLOG-secretary Pelle Guldborg Hansen:

Department of Philosophy and Science Studies
Roskilde University, PA6

P. O. Box 260
DK4000 Roskilde, Denmark
Phone (+45) 4674 2540 / (+45) 2334 2175
Fax (+45) 4674 3012 Email pgh@ruc.dk

Be sure to include your name, institution, country and zip-code and your email address.

If email is used include 'SELF-REFERENCE' in the subject entry. All questions pertaining to registration and accommodations should be directed to Pelle Guldborg Hansen. No individual notification upon registration will be forwarded to individual participants. An updated list of participants may be found by consulting the ΦLOG homepage at

`http://www.philog.ruc.dk/regself.html`

Introductory Seminar

The Department of Philosophy and Science Studies at Roskilde University is arranging a one day introductory seminar prior to the conference. The seminar will take place on

Wednesday, October 30, 09:00-18:00
Department of Philosophy and Science Studies
Roskilde University, P6, Teorirum 6

The seminar is intended to 'prep' graduate students, research scholars and others attending the conference with foundational knowledge of the issues relevant to the conference theme. The crash course will include lectures addressing the role of self-reference in computer science, logic, mathematics and philosophy. It will be sought to give a soft introduction to the subjects and theories to be discussed by the invited speakers at the conference, and to relate these items to each other and to the history of self-reference.

The list of speakers include:

- **Thomas Bolander**, Informatics and Mathematical Modelling, Technical University of Denmark (tb@it.dtu.dk)

- **Roy T. Cook**, Arché: Centre for the Philosophy of Logic, Language, Mathematics and Mind, University of St. Andrews, Scotland (rtc1@st-andrews.ac.uk)

- **Neil Jones**, Computer Science Department, The University of Copenhagen, Denmark (neil@diku.dk)

- **Klaus Frovin Jørgensen**, Department of Philosophy and Science Studies, Roskilde University, Denmark (frovin@ruc.dk)

See the seminar schedule on page 82. Lunch is included. To sign up for the seminar, contact ΦLOG-secretary Pelle Guldborg Hansen (pgh@ruc.dk).

A seminar dinner is arranged for all the attendees of the introductory seminar on **Tuesday, October 29** (the day before the seminar). The dinner will take place at 19:00 in the lunch room of the Department of Philosophy and Science Studies. To sign up for the seminar dinner, contact the ΦLOG secretary as well.

Those not too familiar with self-reference may find help in the literature listed below.

- Albert Visser, 'Semantics and the Liar Paradox,' *Handbook of Philosophical Logic*, 617-706, D. Reidel Publishing Company, 1989.

- *Reflexivity—A Source-Book in Self-Reference*, Bartlett, S. J. (ed.), North-Holland, Amsterdam, 1992.

- Quine, W. V., 'Paradox,' *Scientific American*, 1962, vol. 2: 84-96. Reprinted in *Reflexivity—A Source-Book in Self-Reference*, Bartlett, S. J. (ed.), North-Holland, Amsterdam, 1992.

- Smullyan, Raymond M., 'Languages in which Self-Reference is Possible,' *The Journal of Symbolic Logic*, 1975: 55-67. Reprinted in *Reflexivity—A Source-Book in Self-Reference*, Bartlett, Steven J. (ed.), North-Holland, Amsterdam, 1992.

- *Recent Essays on the Liar Paradox*, Robert L. Martin (ed.), Oxford University Press, 1984.
- Kripke S., 'Outline of a Theory of Truth,' *The Journal of Philosophy*, 1975: 690-716. Reprinted in R*ecent Essays on the Liar Paradox*, Robert L. Martin (ed.), Oxford University Press, 1984.
- Sheard, Michael, 'A Guide to Truth Predicates in the Modern Era,' *The Journal of Symbolic Logic*, 1994: 1032–1054.
- Belnap, Nuel, 'Truth by Ascent,' *Dialectica*, 1999: 291-306.
- Bolander, Thomas, 'Self-Reference and Logic,' ΦNEWS, vol. 1, 2002: 9-48.
  `http://www.philog.ruc.dk/phinews1.pdf`
- Barry Hartley Slater's entry on *Logical Paradoxes*, *The Internet Encyclopedia of Philosophy*:

  `http://www.utm.edu/research/iep/p/par-log.htm`

An elaborate list of references on self-reference, self-reflection and the like, ordered according to field may be found at Thomas Bolander's subpage:

`http://www.imm.dtu.dk/~tb/literature.html`

Wednesday, October 30

09:00-10:00	A Primer to Contemporary Self-Reference I (Thomas Bolander)
10:00-10:30	Coffee Break
10:30-11:30	A Primer to Contemporary Self-Reference II (Thomas Bolander)
11:30-12:00	Coffee Break
12:00-13:00	A Primer to Contemporary Self-Reference III (Thomas Bolander)
13:00-14:00	Lunch
14:00-15:00	Self-Reference in Philosophy (Roy T. Cook)
15:00-15:30	Coffee Break
15:30-16:30	Self-Reference in Mathematics (Klaus Frovin Jørgensen)
16:30-17:00	Coffee Break
17:00-18:00	Self-Reference in Computer Science (Neil D. Jones)

Accommodations

The Department of Philosophy and Science Studies is prepared to house, free of charge, as many as 30 students during the conference and introductory seminar. However it is of immanent importance that students who wish to take advantage of this opportunity register as early as possible, and inform of their intensions to take up the offer, in order for ΦLOG to arrange for these accommodations. Please contact Pelle Guldborg Hansen (pgh@ruc.dk) for more information.

ΦLOG —The Danish Network for Philosophical Logic and Its Applications

is sponsored by The Danish National Research Council for the Humanities for a period of two years starting in January 2002 and ending in December 2003.

ΦLOG is an interdisciplinary network for philosophical logic aiming at coordinating research activities and promoting the field of philosophical logic both in Denmark and abroad.

ΦLOG is located at the

Department of Philosophy and Science Studies
Roskilde University, PA6
P. O. Box 260
DK4000 Roskilde, Denmark
Phone: (+45) 4674 2343 Fax: (+45) 4674 3012

The directors are

- Vincent F. Hendricks (vincent@ruc.dk)
  `http://www.ruc.dk/~vincent`
- Stig Andur Pedersen (sap@ruc.dk)
  `http://akira.ruc.dk/~sap`
- Pelle Guldborg Hansen, secretary (pgh@ruc.dk)

The network also has an organizational committee consisting of

- Torben Braüner, The Computer Science Department, Roskilde University (torben@ruc.dk)
- Henning Christiansen, The Computer Science Department, Roskilde University (henning@ruc.dk)

- Jan Riis Flor, Department of Philosophy, Rhetorics and Education, University of Copenhagen (flor@hum.ku.dk)
- Cynthia M. Grund, Department of Philosophy, The University of Southern Denmark – Odense (cmgrund@filos.sdu.dk)
- Lars Bo Gundersen, Department of Philosophy, Aarhus University (fillg@hum.au.dk)
- Per Hasle, Department of Business Communication and Information Science, The University of Southern Denmark – Kolding (hasle@sitkom.sdu.dk)
- K. Hvidtfeldt Nielsen, Department of German Philology, Aarhus University (gerkhn@mail.hum.au.dk)
- Peter Øhrstrøm, Department of Business Communication and Information Science, The University of Southern Denmark – Kolding (ohrstrom@sitkom.sdu.dk)

Membership of ΦLOG is free. Send a letter, fax or email to the network directors Vincent F. Hendricks or Stig Andur Pedersen to apply for membership. Remember to state your name, position and affiliation and a short description of your interest in philosophical logic.

Members of ΦLOG will receive ΦNEWS, published biannually, free of charge. The newsletter is edited by Vincent F. Hendricks and Stig Andur Pedersen. Contributions to ΦNEWS should be sent to the editors.

The ΦLOG site on the web is located at

`http://www.philog.ruc.dk`

with the two sub-sites

`http://www.50yrs.philog.ruc.dk`
`http://www.fol75.philog.ruc.dk`

Questions, comments and suggestions should be directed to the webmaster Vincent F. Hendricks.

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