Bulletin of the **S**ection of **L**ogic
Volume 35:2/3 (2006), pp. 133–150

Jean-Yves Béziau

13 QUESTIONS ABOUT UNIVERSAL LOGIC

13 questions to Jean-Yves Béziau, by Linda Eastwood

The expression "universal logic" prompts a number of misunderstandings pressing up against to the confusion prevailing nowadays around the very notion of logic. In order to clear up such equivocations, I prepared a series of questions to Jean-Yves Béziau, who has been working for many years on his project of universal logic, recently in the University of Neuchâtel, Switzerland.

1. Although your proposal to develop a universal logic is very appealing, isn't it a utopian one? Isn't it an absurd, or even dangerous thing to believe that it would be possible to develop a unique logic accounting for everything?

Let us immediately reject some misunderstanding; universal logic, as I understand it, is not one universal logic. In fact, from the viewpoint of universal logic the existence of one universal logic is not even possible, and this is a result that can easily be shown. One might thus say somehow ironically the following: according to universal logic there is no universal logic.

Some people in some countries have always tried to elaborate a universal system that would account for any sort of reasoning, or reasoning as a whole. Aristotelian logic was depicted itself as a universal one. More recently, first-order classical logic appeared to some as a universal system accounting for mathematical reasoning as well as current one, that is, the one used to buy your bread at the bakery.

But first-order classical logic was also criticized at length, whether concerning its claim to describe mathematical reasoning or physical, computational, current, philosophical ones, and the like. Many new logics were further developed, namely: intuitionistic logic, combinatory logic, linear logic, quantum logic, erotetic logic, modal logic, paraconsistent logic, polar logic, relevant logic and so many others, all the more that each of these is

often to be divided into a disparate multiplicity, as in the case of modal logics.

Among advocates of these logics, some forcefully believe that their own logic is the best one, that it explains everything, solves everything, so that their logic is universal, as was formerly the case with Stanisław Leśniewski or, more recently, with Jean-Yves Girard and its linear logic, Jaakko Hintikka and its IF logic, and, even more explicitly, Ross Brady with its relevant logic he squarely dubbed a "universal logic".

Such a view is not shared by people working in quantum logic, for example; indeed, these only want to account for one particular reasoning related to one particular area, without ever claiming that such is the reasoning we are using or should use whenever we go at the bakery. Now is such a view consistent? Are we entitled to say the following: to each area, to each situation, its own logic, or even to each group of persons, to each individual, its own logic. So there would be a logic of chemistry, logic of clouds, logic of sex, logic of women, logic of dogs, the logic of Bouvard and the logic of Pécuchet.

Actually, such a relativization of logic is equally absurd as the opposite stance according to which only one logic could explain everything. Obviously, there is also one intermediary situation according to which there are neither only one nor thousand and one logics, but three or four: so is the middle, not to say mediocre position of people who cut the cake into three parts saying that there is the reasoning for formal sciences, on the one hand, the reasoning for empirical sciences, on the other hand, and finally the natural reasoning for daily life. Behind such a stance we see again the old contradistinction between inductive logic and deductive logic.

The view of universal logic is that one plausibly can unify the large kaleidoscopic variety of logics, while preserving their diversity. In the case of universal logic, as opposed to those who support the view of one universal logic, unity is entailed by diversity. Universal logic is not a logic but a general theory of different logics. This general theory is no more a logic itself than is meteorology a cloud.

2. How is it possible to develop a general theory of logics, to unify logics so various as quantum logic, erotetic logic or fuzzy logic?

In order to solve such a question, we have to ask, how two different systems can be considered both as logics, and this naturally leads to ask

what a logic is. That is the central point. The key of the problem.

Even a Girard, a Brady or a Hintikka would admit that, while anything cannot be considered as a logic, there are different logics, their is not the only one even if it appears to them as the only true one, as depicting the reasoning most adequately. In fact their systems are like many other ones, whether concerning their properties or the technicalities displayed in order to elaborate them.

Hence, it seems natural to consider what is commonly shared by all logical systems. Such is the approach of universal logic. Now what does mean all logical systems: all systems called logical? Recognized as logical? Or every possible and conceivable systems? What is the criterion according to which we can say that such a thing is a logic and such another one has nothing to do with a logic, is only a paralogic or something totally illogical?

Universal logic cannot be a descriptive theory: it cannot claim to describe what is logical in a variety of systems considered as logics by the people or the elite. No theory in human science is a purely descriptive one: it seems impossible to account for an inconsistent variety of various viewpoints, some of which appear to be completely arbitrary ones, unless some very special logic is used for this purpose like Bychovsky's paraconsistent turbopolar logic.

On the other hand, to develop a theory that would be a purely normative one, imposing some viewpoint that has just a slight bearing to what is ordinarily called logic or logics, wouldn't appear to be satisfactory at all unless it is some genial view that would give us a new insight, making us realize that we were entirely mistaken. But if so, the theory would not be a properly normative one, it will impose the force of a description we didn't already know. It cannot be said that the Einsteinian theory is more normative than the Newtonian one. In any case we have to vacillate between normative and descriptive. We have to be cautious concerning variety while having some unitary view that doesn't reduce to such a variety.

The basic view of universal logic is double, inspired both by Tarski and Birkhoff. From the late twenties, Tarski suggested its theory of the consequence operator that is a very general theory of the notion of logical consequence, making abstraction of the logical operators. He thus made a jump into abstraction. Laws of logic don't appear any more as for example laws concerning negation such as principles of contradiction or excluded middle, but as laws ruling the notion of consequence: self-deducibility, monotony, transitivity. However these very laws can be and have actually

been criticized, so that the view is to reject any law, any axiom, and even those located at a more abstract level. This may appear as totally absurd, *prima facie*.

Then Birkhoff comes into play. He himself developed a general theory of algebra from a primary notion of algebraic structure not obeying any axiom, whereas its predecessors sought to unify algebra around such very general laws as associativity or commutativity. But as he aptly said himself, such a unification was no more possible to a certain stage, and especially it was not possible to unify two large trends, algebras studied by the Noether school, on the one hand, and, on the other hand, the Boolean trend including the notion of lattice as developed in particular by Birkhoff himself. Thus Birkhoff developed universal algebra without taking axioms into account.

Such a surprising approach can be called a conceptual one, as opposed to an axiomatic one. Category theory is itself more conceptual than axiomatic. The point is not to produce a large axiomatic system like ZF set-theory from which everything could be deduced; rather, it is to elaborate some concepts that could serve to describe the whole of mathematical phenomena in a unitary fashion.

The approach of universal logic is also a conceptual one, where the point is to capture the whole logical phenomena, not to be looking for some axiomatic Graal or genuine laws of thought or reality, from which everything could be deduced.

3. What is meant exactly by a logic according to universal logic ? You often refer to Bourbaki, although the latter is often considered as a suspicious guy by logicians.

According to universal logic, a logic is a certain kind of structure. The project of universal logic is in the spirit of modern mathematics. As it is well known, from the 1930's onward, Nicolas Bourbaki made the proposal to reconstruct the entire mathematics through the notion of structure.

For Bourbaki, any mathematical object does only make sense from the perspective of a structure or, better, of a set of structures. The number 4 does not exist in itself and per se, but as connected with other numbers that form the entire structure of natural numbers. Now its existence is not confined to the structure of natural numbers, it also extends to the structure of integers, rational, real numbers, and so on. So such connections between these various structures also characterize what the number 4 is.

Bourbaki's insight consists in reconstructing every mathematical structure from some "fundamental structures" or "mother structures" through a crossing process, which gives rise to "cross-structures". He distinguishes between three sorts of basic structures, namely: algebraic structures, topological structures and structures of order, and reconstructs the structure of real numbers as a crossing between these three fundamental mother structures.

The idea of universal logic is that logical structures are fundamental ones but departing from the Bourbakian trinity. Note that this is not in opposition with the insight of the very famous General, given that he admitted the plausible appearance of other core structures. What does matter with such a perspective is that we argue against any reduction of logic to algebra, since logical structures are differing from algebraic ones and cannot be reduced to them. Universal logic is not universal algebra.

Some logicians are at a loss to understand this because two basic trends are often contrasted in the history of modern logic, namely: Boolean and Fregean trends, and one tends to assimilate any mathematization of logic with the Boolean trend, the notion of Boolean algebra, or algebraic logic. For some people, any structure is an algebraic structure. Historically, algebraic structures certainly played a crucial role in promoting the notion of structure, since someone like Glivenko used this word structure as a synonym for lattice. But nowadays, such a confusion appears ridiculous after Bourbaki and category theory.

There is no good reason to say that any logic is an algebra, or algebraic. For instance, to take such a connective as negation to be a function seems to be quite arbitrary, given that negation can be equally seen as a relation. Another pernicious assimilation is that of logical structures with ordering structures: this leads one to think that the notion of logical consequence has to be naturally transitive, but this is quite questionable.

In order to avoid any ambiguity, it should be said that the stance of universal logic is a Neobourbakian and not a Bourbakian one, not only because Bourbaki did not see logics as fundamental structures but he once adopted some axiomatic-formalistic stance that is not ours and which is quite independent of his informal conceptual stance, the stance we are following was mainly expressed in his famous paper, "L'architecture des mathématiques".

4. Universal logic takes the notion of structure as a starting point; but what is a structure, should not the notion of structure be analyzed also from a logical viewpoint ? If so, aren't we in the sin of circularity ?

Here we are faced with some of the most favourite problems of logicians, those who are fond with gossiping about Buridan's donkey that bites his own tails, the barber who shaves his own wife or the fool who claims not to be a fool, and so on. I have to say that I'm hardly interested with such problems, and here I agree with Wittgenstein when the latter suspected the Paradox of the Liar to have absolutely no logical philosophical relevance. I don't intend to go any further into some Lacanian analysis, but it seems to me that such problems are somehow infantile. Many paradoxes are nothing but toys and those who play with them often have a mental age of six or seven.

As it was rightly stressed by the very witty Baron of Chambourcy: "Si les mathématiques ne sont qu'un jeu, je préfere jouer a la poupée" ("If mathematics is just a game, then I prefer to play with dolls"). The notion of structure is much more than a mere toy, but that doesn't prevent it from being a funny thing. First and foremost, let us stress that the notion of structure doesn't reduce to the notion of mathematical structure and therefore, any logicist who would reduce mathematics to logic couldn't spell out the concept of structure. The notion of structure largely goes beyond the mathematical area, and Bourbaki said himself that he was influenced by such linguists as Benveniste. During the sixties, "structuralism" was meant as a large movement that mainly occurred in human sciences. But structuralism as we understand it is something still larger that includes linguistics, mathematics, psychology, and so on.

In his book entitled *Pensée formelle et sciences de l'homme*, Granger makes some rather interesting comments about the source of structuralism in the wide sense. Now what concerns us are not so much historical and sociological considerations about the development of structuralism, but rather the issue of the ultimate view of structuralism as underlying mathematical structuralism and universal logic.

The view is that there is no object in itself, that any object is defined by the relations it bears with any other objects within a structure; that is typically the analysis Saussure offers for language: nasty only makes sense with respect to angry, nice, and so on. Moreover, any object x in

a structure can be identified with an object y in another structure if one considers that both behave in a similar way within some similar structures. This makes translations possible. If Quine had read Saussure, he would have relativised his thesis about indeterminacy of language.

Contrarily to what one could expect, there is presently no general mathematical theory of structures. Some elements can be found in Bourbaki, universal algebra, category theory, or model theory, but nothing conclusive.

Universal logic can contribute itself to the development of a general theory of structures in stating and solving such crucial issues as for example identity between logical structures. When and how two mathematical structures are identical is a problem of crucial import in the theory of structures. The notion of isomorphism is too weak to be satisfactory. The point is to be in position to identify structures of different sorts. In the history of mathematics, a canonical example is identification between an idempotent ring and a complemented distributive lattice by Marshall Stone, both being two equivalent formulations of what is called a Boolean algebra. The concept that helps to account for the identification as revealed by Stone appears nowadays as a concept from model theory, namely: the notion of expansion by definition.

Now it happens that when we try to apply such a concept to the identity between logical structures, we are then faced with various problems that betray its very deficiency. Thus we are led to put such a series of questions as the following: do a structure and one of its expansion really have one and the same domain ?

To sum up, universal logic conclusively helps to make think us about the nature of a structure, and this is much more significant than to solve paradoxes about donkeys or monkeys.

5. How and when does universal logic begin? Who is really the pioneer of universal logic?

The real starting point is in the 1920's, when Hertz on the one hand and Tarski on the other hand make a jump into abstraction and are interested with general theories that give rise to the study and development of various systems. Tarski's stance is a characteristic one: whereas Łukasiewicz develops many-valued logic for the philosophical purpose to solve questions about determinism, the former takes this as a tool in order to elaborate a general theory of logic. Lindenbaum goes towards such

a trend, too, while proving several crucial theorems. In Poland, Łoś and Suszko pursue this line after the World War II, namely with their joint paper "Remarks on sentential logics" in which they introduce the notion of structural logic. While Łoś gave up to logic and turned to economy, Suszko pursued his works and developed with Bloom et Brown what he called "abstract logic". After his death, these works were pursued by Czelakowski in Poland and by Font and Jansana in Barcelona.

One word should be said within this Polish trend about the French logician Jean Porte, whose book entitled Recherches sur la théorie générale des systemes formels was published in 1965 and contained some results from the Polish school. Porte's book is very interesting, because he clearly and overtly argues for the independence of logic from the issue of mathematical foundations, so that he rejects logic as metamathematics. On the other hand, Porte distinguished logic from algebra, and that is not always the case with Polish people who regrettably tend to assimilate logic with universal algebra. Porte was a PhD student of René de Possel, one of those who founded Bourbaki. Porte's book didn't have much influence unfortunately, and this may be for several reasons: he was a forerunner, the book is written in French and hasn't been translated, Porte went to Africa and stayed there many years in isolation from the community of logicians.

It is in the 1980's that the trend of universal logic actually became prominent. Issues about mathematical foundations were already eclipsed in logic at that time. Logic was revived by some "practical" questions from AI, linguistics and computer science. Many non-classical logics were considered: non-monotonic logics, substructural logics, together with all the conceivable variants of modal logics. General techniques of systematisation started to be developed. Either old techniques were studied again and reworked such as logical matrices, consequence operator (as used by Makinson for investigating AGM theory of belief revisions as well as non-monotonic logics), sequent calculus (substructural logics); or new techniques were developed such as LDS (Dov Gabbay's Labelled Deductive Systems).

Apart from some very active and dynamic groups, like Gabbay's in London and van Benthem's in Amsterdam, some works from isolated people like Epstein, Cleave, or Koslov should also be mentioned.

6. How did you come to universal logic?

I explained this at length in a paper entitled "From paraconsistent logic to universal logic". So I'll merely sum up. During the eighties, I was studying logic in Paris and observed the rise of all these new logics. On the one hand, I attended a logical course with Jean-Yves Girard who presented us in a unified and comparative way classical, intuitionistic and linear logics through the sequent calculus ; on the other hand, I attended a course with Daniel Andler who presented us a complete list of the new logics (default logics, and so on). I myself discovered by chance paraconsistent logic from the Brazilian logician Newton da Costa, a very unknown logic at that time, and I was particularly interested with it because I wanted to know whether one could still consider as a logic one in which the principle of contradiction does not hold. Then I was quickly convinced that one could, and was increasingly concerned with general techniques as used to generate this sort of logic, especially with the theory of valuation as developed by da Costa and on which I worked with him during a first stay in Brazil, in 1991. Then all followed in a quick and natural way: I found Porte's book that contained some similar ideas to mine, and this ensured me in my own researches. Then I went to Poland, in order to get acquainted with Polish works da Costa had told me about and Porte mentioned in his book. During my stay in 1993 at the University of Wrocław, Poland, I decided to employ the expression "universal logic" that would appear later in the title of my PhD, written in 1994 and defended in 1995 in the department of mathematics at the University of Paris 7 under the supervision of Daniel Andler.

Then the story goes on all over the world. I travelled a lot, and the view of universal logic made its way too. The 1st World Congress of Universal Logic took place in Montreux in Spring 2005, gathering about 200 logicians from 40 different countries. The book Logica Universalis was launched on that occasion by Birkhäuser.

Finally, I want to precise my own contribution: it is difficult to say who has created the expression "universal logic" or used it for the first time, what I did is to use it to mean "a general theory of logics". Furthermore, there are several ways of framing a general theory of logics and, as we just saw it, a large trend developed around this since twenty years. I do not see universal logic as a general theory among others but as a concept, an expression designed to depict such a whole trend.

7. Is universal logic a new way to view logic?

Surely. The view that dominated in the beginning of the 20th century and still dominates in some way is a hybrid view in which some rather different influences are mixed, namely: formalism, linguistics, and logical atomism. This can be seen as a rather monstrous, inconsistent whole. To give just one example: the traditional distinction between syntax and semantics. What does it really mean? Does it have a foundation? And, if so, which one? Syntax only means the construction of a formal language for some, and for others it also includes what is called proof theory; for others, like Chang and Keisler, it concerns all what is recursive, in particular they call syntax the semantics of truth tables for sentential logic.

A more reasonable thing would be to make a distinction between model theory and proof theory, but even such a distinction is questionable because there are a lot of intermediary theories, e.g. Beth tableaux. The path from proof theory to model theory could be said to be a continuous one ; when one comes out from the land of proofs and enters into the land of models, it is difficult to know, this is an issue we'll leave for bald persons who like to sit on heaps of rice.

What is crucial in universal logic is that logics are considered irrespective of the way they are generated, so that one thus makes a jump into abstraction. And this is not surprising at all, it's the most natural thing you could have. Classical propositional logic can be generated in a hundred different ways, through Hilbert systems, Gentzen systems, tableaux, two-, three- or infinite-valued semantics. What is this object that can be defined in so much different ways? Everybody believes in it, and nobody would venture to claim that classical propositional logic reduces to one particular way of constructing it.

Universal logic consequently brings an answer to this question, saying that classical propositional logic is a logical structure in just the same way as intuitionistic or linear logic. Hence this helps to throw some light on the connection between various ways to generate a given logic, as well as on the relation between different logics.

8. What are philosophical consequences of universal logic?

They are tremendous, since universal logic gives a way to bring every logical philosophical problem into some new light. Given that the traditional view of logic is highly obscure, so is the philosophy connected to it.

Let us take a canonical case, namely the famous distinction by Susan Haack between logics as deviations from the classical one and logics as conservative extensions from this same logic. Here is prima facie something like a nice and easy thing to understand: for instance, the modal logic S5 is a conservative extension of classical logic since additional operators are added that don't alter the previous content, whereas intuitionistic logic is a deviant logic with respect to classical logic because properties of negation and implication are altered. However, such a nice distinction vanishes once one sees that classical logic is definable within intuitionistic logic. Then intuitionistic logic appears in some sense as a conservative extension of classical logic.

The trouble with Haack's distinction is that it doesn't rest upon any serious and systematic theory, but only on some ideas thrown in the air and explained and justified with basic elementary examples. On this respect, philosophers of logic are not so much different from other superficial philosophers like Deleuze or Lacan. That logic is unclear itself is certainly an excuse for them, but the task for a philosopher is to clear up confusion, not to adorn it with nice concepts. Their behaviour is unproductive and doesn't bring any real understanding.

Philosophy and logic should not indeed be viewed separately. In order to catch the difference between deviant logics and conservative extensions, some news concepts and an entire theory are required, and universal logic turns out to be a framework for this purpose. In order to construct such a theory, one needs to be a philosopher, that is, to try to understand how things are. Every good logician is a philosopher. Others are just applying and reproducing some devices at their disposal. This equally holds for logic and for science in general. On the other hand, any philosopher of science who is not a scientist cannot be taken seriously; to borrow a favourite view of Newton da Costa, it's like a priest philosophizing about women. How to take seriously a philosopher of logic who had never proved any theorem ? He is a historian of logic, at the very best and, at worst, a charlatan who talks about something he doesn't understand.

9. What is the connection between universal logic and history of logic?

Roughly speaking, there are two ways of doing history of logic or history of science in general. The first can be called the philosophical one: priority is given to texts and source materials, all the time is spent

describing who said what, who inspired who. The second, that can be called the problematic one, consists in trying to understand what someone understood from the perspective of a given problem.

The philological, bookworm's approach, is fruitless and merely adds some additional volumes that will serve as further food for worms. On the other hand, the problematic approach is fruitful and brings theories back to life, it constitutes some witty dialogue over the centuries. Such was the move followed in logic by people like Jan Łukasiewicz and Abraham Robinson. Łukasiewicz developed many-valued logics in order to solve the problem of future contingents and determinism; whereas Robinson developed non-standard analysis in order to explain infinitesimals. Here are two great theories that brought some considerable advance to human mind, whereas philologists have discussed during several centuries and are still endlessly discussing about whether or not Aristotle did admit the principle of bivalence, or whether it was Newton or Leibniz who developed infinitesimal calculus.

History of science, the problematic one, is crucial for any science, since each science is a historical process that expands throughout the ages but not always in a linear way. One direction formerly discarded may well be taken again later, as was the case with infinitesimals. Thus we have to keep track to the past since it may always prompt inspiration.

Some people like van Heijenoort promoted the view that modern logic entirely went as ready-made out of Frege-the-Genius' head and represented some fundamental break with all previous habits. Wittgenstein boasted that he had never read Aristotle. It is true that to create something new requires not to have the mind full with a host of outmoded theories, and no Aristotelian professional philologist could have ever written the Tractacus Logico-Philosophicus.

However, turning back to Łukasiewicz, we see that he developed equally innovative views as compared with Frege and Wittgenstein while reading Aristotle in Greek, but he read it critically and problematically. Łukasiewicz's book On Aristotle's Principle of Contradiction, published in 1910, served as a starting point for the Polish logical school Tarski originated from, a school that dominated logic throughout the twentieth century and, as was said earlier, Tarski can be properly seen as the major forerunner of universal logic. Another emblematic character in the prehistory of universal logic, namely Paul Hertz, considered that the cut rule from his abstract system of logic was nothing but another formulation for the Barbara syllogism.

The problematic history of logic is part and parcel of universal logic. From the standpoint of universal logic for example the square of oppositions may be entirely reconsidered. Such a square displays a theory of oppositions by distinguishing several types of opposition. Some much subtler theory can be developed in the light of modern logic, first by turning the square into a hexagon, following Robert Blanch, and then into a polyhedron. These transformations are not mere geometrical ravings, given that a general theory is thereby elaborated that connects various types of negations and modalities. Such a problematic approach to the square of oppositions is completely opposed to the philological one, in which one just quibbles about small variations in the square of oppositions.

10. What is the connection between universal logic and natural or informal logic? Is universal logic a theory of reasoning, or argumentation?

Evidently classical logic is not a good account of our way of reasoning in everyday life, so, many other logics were constructed, the so-called non-classical ones that would give a better account for natural reasoning. However, such logics as relevant or paraconsistent ones, are nothing else than variants of classical logic, constructed from some similar ontological ground and relying upon a formalist view of logic, among other things. Some wanted to go further and out of the formal framework, namely those working in informal logic or the theory of argumentation. The trouble is that one runs the risk of being tied up again in natural language, while it has nothing sacred as such.

Such a rejection of the formal, which brings very often back to the cosy little nest of natural language, turns on some confusion in assimilating the formalist doctrine with mathematics, a confusion generated by formalists themselves. Now it is clear that mathematics don't need to be connected with the formalist doctrine, and a mathematical theory can be well developed irrespective to this confused formalist jumble in which such a sentence as *Santa Claus lives in Lapland* is nothing but a sequence of signs called "formula".

The idea of universal logic is to deal with any types of reasoning, whether men's, women's or even dog's ones, not by returning to the natural language but by developing a mathematical theory free from the formalist jumble.

What we must pay attention to, when developing a theory of reasoning, is the connection between the problem at hand and this theory. It turns out very often that the link between both is too smooth. It is typically the case with relevant logic. The basic point in such a logic is to say that some meaning connection should occur between premises and conclusion of an argument ; now instead of rejecting the paradigm of structural logics in which the substitution theorem holds, relevantist partisans go on working within the traditional atomist formalistic framework and require for premises and conclusion to have at least one atomic sentence in common. That is a very narrowed and unsatisfactory way to account for the meaning connection between premises and conclusion.

From the perspective of universal logic, there are much more elegant and significant ways to proceed.

11. What are the applications of universal logic?

Universal logic considers the world of all possible logics and ways to construct them, so that it gives a way out of many requirements and problems.

Let us imagine a given Mr Ixman; he comes to see you, says he needs a logic accounting for some given situation, say medicine, and gives you an exposition of its typical problems. Universal logic gives rise to a quick diagnosis. You see what is specific to the situation and what is universal, common to some other sorts of reasoning, so that you are able to build a logic that fits the bill. Mr Ixman points out to you the issue of contradictory diagnosis, for instance, that one and the same symptom could be analysed in a different ways by a physician, or even by different kinds of medicine, and you see that therefore some paraconsistent logic should be used. He also insists that we are only given incomplete sets of information in medicine and any further information may lead to challenge the first diagnosis. Hence a paraconsistent, paracomplete and non-monotonic logic will be needed. And so on, so that after having listed all what Mr Ixman has to say you'll be in position to supply him with the proper tool for an analysis of reasoning in medicine. For this purpose, you'll have use general techniques that help to construct various logics and to combine them.

Hence universal logic allows understanding some particular reasoning in supplying one with a tool box that serves to construct a logic accounting for that sort of reasoning; moreover, it allows locating such a new born in connecting it with the set of conceivable reasonings. Such a technique as

combination of logics is very important. The art of combining logics is somehow like that of setting mayonnaise: you have different ingredients such as temporal, deontic or erotetic operators, for instance, and you want to bring them together into one consistent whole that will account for some particular reasoning.

Universal logic plays a crucial role with respect to AI, expert systems and automated reasoning, since it helps to develop systems adapted to the most various data: that is called "logic engineering". It is clear that some given technique, some specific logic cannot solve every problem ; there is no miraculous universal logic, a logic, gift of god that would apply to any situation. However we can have a science, universal logic, that allows proceeding in connection with reality because it happens to be itself in a continuous interaction with reality. Universal logic is not a fixed theory, it's a progressive science in which the study of particular cases is always significant for the development of abstract reasoning that, in turn, will be fruitfully applied.

Universal logic is not cut off from reality, as is the case of Aristotelian syllogistic or first-order logic. It is a useful theory.

12. Could you give an overview of the main problems and prospects in universal logic?

First there is a series of questions about the nature of logical structures. Several types of structures can be considered and, depending upon the choice to be made, different results are obtained. For instance, classical propositional logic is decidable as a structure with a unary predicate that corresponds to the set of tautologies, but this is not so if it is considered as a structure with a consequence operator or relation, with no restriction on cardinality.

Another question may be then put, that is, the equivalence between various logical structures. Can both structures be said to correspond to one and the same logic while differing with respect to one fundamental property, that is decidability? Another crucial question related to equivalence between logical structures is the question of connections between different logics: when can a logic be considered as weaker or stronger than another one, as an extension of another one, as merging or being translatable into another one?

Then comes the question about the combination of two logics: how can we form from two logics a third one that is their combination? Such

question is directly related to the former one, since combination is defined very often as the smallest conservative extension of combined logics. Now such a definition is unsatisfactory, because two logics may have no common conservative extension while being combinable.

These three questions, that is, identity of logical structures, connections between logical structures, and combination between logical structures, are part of what may be called the heart of universal logic.

Further questions are somehow related to these, and other problems will remain confuse as long as no satisfactory theory or clear insight will be obtained for these questions. But to study such other less central problems also gives rise to some evolvement, especially because any abstract theory is not a pure abstraction but an abstraction of something else; to consider what exemplifies abstraction is to make some advance in elaborating the latter.

Therefore, it is also useful to work on the systematisation of some classes of logics like modal, non-monotonic, paraconsistent logics, and so on. This is indeed a dialectical movement between the general and the particular, given that the basic concepts of universal logic are not only designed from such specific classes but applied back in return.

Methods for generating various logics should be taken into account, namely: logical matrices, tableaux, Kripke structures, proof systems, and so on. Some attention will be paid also to the scope of validity and application of important theorems like interpolation, definability, cut-elimination, and so on. There is also the historical and philosophical dimension we already mentioned.

To sum up, we can distinguish five groups of research which are mutually interrelated:

1) Basic concepts (identity, extension, combination)
2) Systematic study of classes of logics
3) Tools and building methods for logics
4) Scope of validity of important theorems
5) Historical and philosophical aspects.

13. What is the future of universal logic?

Universal logic is about to expand naturally and will plausibly become soon the mainstream in logic in a short time, supplanting "formal logic", "symbolic logic", or "mathematical logic". It helps logic and logicians to be again meaningful. It helps logicians with very distinct concerns to keep in

touch together. At a certain time, logic splashed in every direction; at some point it lost its way or specialized into unintelligible branches, except for small circles of specialists or even only one guy. Thanks to universal logic, logicians find themselves back in a common ground in which communication is possible, because of the very nature of universal logic, namely: the study of the most general and abstract properties of the various possible logics.

In concrete terms, a 2nd World School and Congress on Universal Logic should take place in China in 2007 following the first event, 1st World School and Congress on Universal Logic, that took place in Montreux in spring 2005; the story should continue with biannual meetings. Concerning publications, after the book Logica Universalis, published by Birkäuser, some other books should be published within the scope of a series Studies in Universal Logic with the same editor. The launching of a new periodic journal Logica Universalis is also projected with Birkhäuser in 2007.

Acknowledgements This work was supported by a grant of the Swiss National Science Foundation. Thanks to Fabien Schang for helping transcribing the text.

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