# **FRITZ HAMM AND MICHIEL VAN LAMBALGEN:** *THE PROPER TREATMENT OF EVENTS.* **A REVIEW.**

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One of the differences between formal languages and natural languages is the fact that in natural languages predicates do not seem to have a fixed arity. Adjuncts and modifiers can be added seemingly in any number. This is impossible in predicate logic. In Brutus kills Caesar violently with his knife both violently and with his knife are syntactically not required. But since they can be added, we must decide how many arguments the predicate kill actually takes. If we assume it is a 4-place predicate we must always supply four arguments, while if it were a 2-place predicate we would not know where the two extra arguments should go. Events provide a solution to this problem. Rather than saying that the sentence means kill(brutus, caesar, knife, violently) we shall now say that it asserts the existence of an event of killing whose actor is Brutus, whose patient is Caesar, whose manner was violent, and whose instrument was a knife. Thus arguments and adjuncts are analysed on a par, and they are all translated as adjuncts in the formal language (see [1]).

The introduction of events raised at least as many questions as it answered. Their ontological status was and still is unclear. For example, if John is running between 2 and 4, how many events of running do we have? One, or infinitely many? For example, do we also have John's running between 2:30 and 3:00 and John's running between 2:15 and 3:35? This question is answered differently by different people, if at all. The literature is full of proposals that analyse the meaning of simple sentences using an infinite series of events rather than a single one. However, recall the dictum 'No entity without identity'. If we are not able to say what constitutes an event there is no theory of events whatsoever and the formalisation using events remains a mindless game: it cannot be grounded in reality.

The linguistic literature passes this state of affairs mostly with silence. However, this threatens to undermine the usefulness of events. Truth conditions are given in models that have events in them but we have no indication as to how to evaluate sentences in real life. For we are not given any guideline as to how to find events in the real world.

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True, one may have similar problems with the basic notions such as objects themselves; but there is a consensus that the notion of an object inasfar as its extensional side is concerned is subject to the laws of physics, among other. This means that we can determine with some certitude where an object is located at a given time.

This is not a necessary state of affairs: what we need to ask for is how we can identify events in reality and what governs their behaviour. This is what the present book is about. Its aim is nothing more and nothing less than what its title suggests: the proper treatment of events. To do that it draws on insights from physics, computer science and robotics. The reason for this exceptional synthesis is that all of these disciplines actually have looked at the problem of *change*. What they converge on is this: in order to study events one must give up the idea that motion is nothing but a succession of snapshots. It is not the place here to subject this problem area to scrutiny; suffice it to say that the idea of continuity is meaningless if that were so. Rather, one should embrace the idea that in inertial motion there is no real change. Inertial motion is the natural flow of events (*sic*!) unless something intervenes. The law of inertia is a physical law. It has given physicists headaches, too, see [2], but it remains a fact of life, e.g., that this billiard ball will bounce if nothing unforeseen intervenes. The second ingredient is foreshadowed in the word 'unforeseen'. Of course, the billiard ball might not bounce—for various reasons. The fact that it is unforeseen depends (if you believe in determinacy) simply on our ignorance of the exact state of the world; but that does not eliminate our problem of saying what the word 'unforeseen' is doing here. Moreover, that we do not know everything is simply a fact and has to be taken into account when modelling reasoning and semantics. And so we are thrown into the arms of logic programming: we say goodby to omniscience and make do with our limited knowledge.

If we would do only physics, however, we would not get very far. For language talks about a lot more than that. However, it does seem that constant change is somehow hardwired as 'no change'. If cars are driving past this is no reason to be alert. But if a car is changing gear or starts to turn it gets our attention. The idea that constant change actually means 'no change' has been taken seriously in robotics. Reasoning in presence of constant change is what is required. This has given rise to the introduction of *fluents*. Fluents may be constructed as time dependent properties or quantities, but they are seen here as simple entities. There is a fluent of the door being open, a fluent of Max crossing the road, a fluent of Columbo building a house, and so on. Fluents are of course interdependent. There are some basic predicates, for example clipped or terminates, that describe the way events and fluents interact with each other. What we get is a many-sorted firstorder logic that comprises the following: objects, real numbers, variable quantities such as states and activities, spatial locations, event types that mark the beginning and end of time dependent properties. All this is needed to describe a simple affair such as Max crossing the road and the imperfective paradox.

It may sound mysterious why we have events in conjunction with fluents. However, the authors remind us right at the start of the book of a known problem of physics: that of defining time. What is time and how is it we can witness the progress of time? The answer is that time is actually constructed from states-of-affairs. If this door is open and closed on different occasions, this means that time must have passed in between those two states. Time has no independent reality (nor does space). Time is intimately connected with causality. It is the causal structure of the world that lets us construct time from mere states-ofaffairs. It turns out that this is exactly the way in which humans deal with the world. We construct time from what happens around us. In the present context this means: events are defined through changes in the truth of fluents. If Max is reaching the top of Ben Nevis then that is an event; as such it terminates Max's climbing Ben Nevis. Notice that climbing Ben Nevis is an activity, and requires among other gradual change in height.

Now we have all the ingredients together: event calculus, logic programming, and some physics. This is what the first part of the book is about. It defines the event calculus, which is a logical theory. Then it turns to logic programming and reasoning with time and events. In the second part the authors put this theory to use. They propose an analysis of aktionsart on the basis of the event calculus. Then they give an in-depth account of tense in natural language, focussing on some specific cases, such as the passé simple and the imparfait of French. Next they deal with aspect, wth coercion, and finally with event nominalisation.

This book presents a highly innovative approach to the semantics of natural language. The authors manage with admirable ease to draw together insights from different fields and show how their theory can actually explain facts rather than simply assuming them. This is not a trivial achievement: to derive even the most simple sounding conclusion requires a lot of effort. This book is a truly intellectual book, written with love for the subject. I consider it a must for everyone who is interested in events or natural language semantics in general.

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## References

- [1] Terence Parsons. Events in the Semantics of English. A Study in Subatomic Semantics. Number 19 in Current Studies in Linguistics. MIT Press, 1994.
- [2] Carl Friedrich von Weizsäcker. Zeit und Wissen. Carl Hanser Verlag, München, 1992.

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