Logic and **L**ogical **P**hilosophy
Volume 2 (1994), 7–22

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A FESTIVAL OF FACTS

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Received May 15, 1995

1. Four films

Consider yourself invited to a filmfestival — a festival of shorts. Regrettably it is a festival with a limitation: you will not be able actually to see the films. However, this limitation is offset by an unusual feature: the films to be shown are not only short but ultrashort — with one exception, each film consists of only a few frames. Instead of showing the films we shall be able to give a complete description of them.

All the films to be discussed share what may perhaps be called the scenery or the backdrop which consists of twelve contiguous, rectangular, linearly ordered sections. Here is a still representing it (Fig. 0):

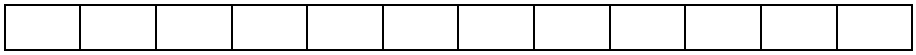

Fig. 0

Our first real film, *Uno*, consists of a single frame (Fig. 1):

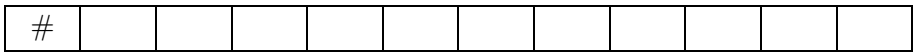

Fig. 1

One may wonder how a critic would describe the content of this film. He might refer to the hatch symbol "#" as "the hatch" or perhaps even as "Hatch". The critic would not be far off if he said that nothing much happened in the film. In fact, nothing did happen. All there was, was Hatch in the left-most rectangle. If the film went on for some time (which presumably would be indistinguishable from running a film consisting of a number of frames identical to the given one) it would be fair to say that Hatch never moved, that Hatch did not do anything. The hatch stayed where it was. The hatch was sitting in the left-most rectangle throughout the film.

Now let us watch *Due*, a film with some action (Fig. 2):

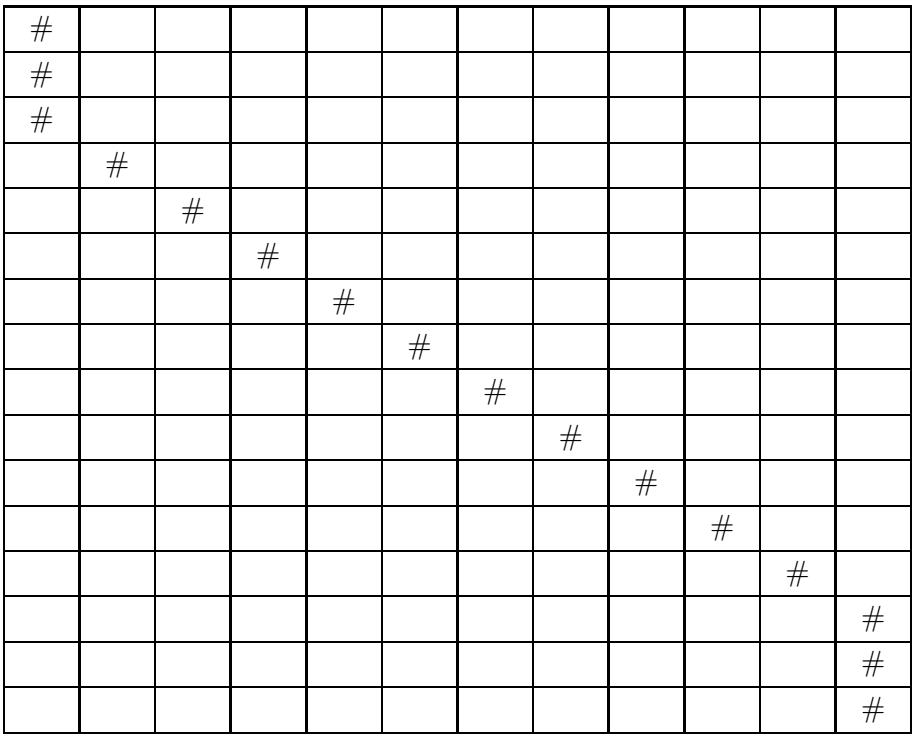

Fig. 2

The idea behind the representation of the film should be obvious: the frames of the film are ordered from top to bottom. A showing of the film would consist in first showing the top frame, then the second one, then the third one, and so on. Thus when the film begins, Hatch is over in the left--hand corner. After a while he begins to move and continues to move all the way to the right. There he stops and stays. Or impersonally: at first the hatch is in the left-hand corner. After a while it begins to move and continues to move all the way to the right. There it stops and stays.

Before the intermission there is yet another film, *Tre* (Fig. 3). This film starts out the same way as the previous one. But while Hatch is moving (or the hatch is moving or is being moved) across the screen something happens: he (or it) vanishes.

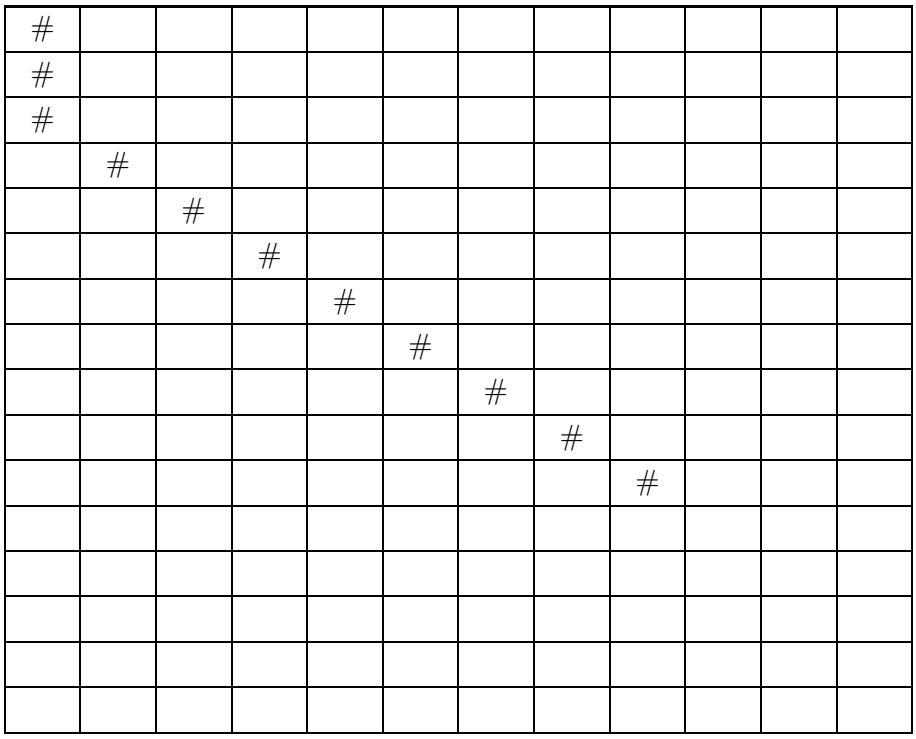

Fig. 3

The three films described belong to a family of indefinitely many films featuring Hatch (the hatch) against the given backdrop of twelve sections or rectangles. It is possible to give a complete description of this highly specialized genre; we will do so now.

By convention, each rectangle of the scenery can contain at most one individual at a time. Therefore, each rectangle either contains an individual or else is empty. So far we have only encountered Hatch; that is, #. In general there is a set I of individuals that may contain individuals in addition to #. However, here we wish to concentrate on really simple films, so we shall assume that $I = \{\#\}$. Furthermore, we shall assume that # is a unique individual and desist from *Doppelgänger* effects that would allow # to be in several places at once. A natural number is identified with the set of its predecessors. A *total state* is defined as a function $12 \to \{\#, \phi\}$, where ϕ indicates the absence of individuals (so ϕ is not an individual). We introduce the notation n° (where $0 \leqslant n < 12$) for the total state s in which, for all

$i < 12$, $s(i) = \#$ if $i = n$ and $s(i) = \phi$ if $i \neq n$. Similarly, we write ϕ° for the total state s in which $s(i) = \phi$, for all $i < 12$. Thus ϕ° is the total state in Fig. 0, while for example the total state in Fig. 1 is 0°. Let U denote the set of possible total states; it is clear that there are only thirteen possible total states. A *(Hatch) film* is a function whose domain is an initial of ω and whose range is U.

There may be logical reasons why there are no infinite shorts, but there is nothing logical to preclude infinite films. The following defines *Quattro*, an infinite film which is the only feature after the intermission:[1]

$$f(n) = \begin{cases} n^\circ & \text{if } 0 \leqslant n < 12 \\ (22 - n)^\circ & \text{if } 12 \leqslant n < 22 \\ f(n - 22) & \text{if } n \geqslant 22 \end{cases}$$

What happens in *Quattro* is that Hatch (the hatch) keeps moving between the sides: starting at the left hand side he first moves to the right hand side, then back to the left hand side, then once again to the right hand side, then once again back to the left hand side, and so on *ad infinitum*.

Although differing from them in a variety of aspects, the films in our festival are like ordinary films in posing problems for the critic who wants to describe what happens in them. Evaluation of a film is one thing; more basic is the question how to describe it. Showing the film frame by frame is not enough; to talk about the film the critic must be able to summarize and communicate to the reader what happened in the film. How is it done? How can one relate the bare goings-on in a film in a manner that attempts objectivity?

The brief descriptions of the films given above should be regarded as stop-gap interpretations meant to enable the reader to follow the exposition of the paper; if the reader had had the films on video, no such description had been necessary or even desirable. So let us discuss anew what happens in *Uno* through *Quattro*. First there is the problem how to relate to #. To discuss it we need a name. "The hatch" suggests something inanimate, "Hatch" something animate. Here is an interesting problem of perception. If we saw a great number of similar films, we would find it convenient to view # as having a will of its own, without committing us to what might

[1] *Quattro* may seem out of place in a festival that has been advertised as a festival of shorts. Notice, however, that Quattro is a recursive film and that a movie-goer will be able to get an adequate idea of what happens in the film by watching the beginning (that is, a sufficiently long initial portion of the film). (Just how long is sufficiently long? See footnote 6 below.)

be the truth of the matter. In the same way one speaks of the sun setting or the rain beating against the window without attributing real agency to the sun or to the rain. This is a kind of personification that seems harmless. So, with this reservation, let us speak of Hatch from now on and not of the hatch.

The content of *Uno* may be given by reporting a certain *state-of-affairs*: Hatch was in the left-most rectangle. There is little to add.

The content of *Due* may be given by reporting an *event*, that of Hatch's crossing from left to right. By the same token, in *Tre* we may say that there are two events to report: the event of Hatch's moving from the far left to a point right of the centre followed by the event of Hatch's disappearance (although perhaps it is debatable whether we should view what happens as one event or two events). There are also some less salient features, for example, Hatch's initial remaining still for a short time at the far left as well as the fact that his absence extends until the end of the film. Similar remarks hold for our description of *Due*.

Quattro does not seem to portray either a state-of-affairs or an event. Rather, what we witness while viewing the film is a *process*: Hatch keeps going from the far left to the far right over and over again. If we understand that, as in the case of the sun and the rain above, we do not attribute real agency, we might say that Hatch keeps bouncing from left to right and from right to left.

The reader is referred to Parsons [4] for a recent discussion of states-of affairs, events and processes. Georg Henrik von Wright has suggested "fact" as a generic term for these entities, a suggestion adopted by the author in a previous paper [5], but Parsons adopts Emmon Bach's "eventualities", a term less encumbered by connotations. Under whatever name, von Wright type facts or Bach type eventualities are useful for discussing what happens (in a film or in general).

To say that eventualities are useful is not to say that it is always clear how to use them or how they relate to each other. For example, we said above that the content of *Uno* may be described by reporting that a certain state-of-affairs obtains. But if the film was shown for any length of time one might say, perhaps equally correctly, that a certain process was going on: Hatch was sitting in the left-most rectangle.[2] One might even use the concept

[2] There are real films like that. The author once attended a film festival where a film was shown that consisted of one twenty-minute shot. The scene was a room with a bed on which rested a person of unknown sex, evidently asleep and with his or her back to the camera. Throughout the film the camera never moved. Nor did anything in the room.

of event, at least in a limiting sense of event. ("What happened, tell me, did Hatch make a move?", "No, that's what's so great about this movie; Hatch didn't move.")[3] To take another example, we discussed a number of events in connexion with *Tre*. One observation that we did not make is that Hatch vanished while crossing. But it would have been very natural to make it. This construction is very common in ordinary language: something happens while something else is happening — an event occurs while a process is going on. So here we have one process (Hatch's crossing, the same process that took place in *Due*) and one event (Hatch's sudden vanishing).

2. A formal modelling

Many philosophers have been reluctant to acknowledge the existence of events. Even those that do have rarely tried to give an account of them. This is in contrast with probability theorists who are happy to talk about events and have a good idea of what they are: subsets of some space of possible outcomes. As a philosopher one can only admire the clarity, the precision and the fruitfulness of their conception.

Is it possible to emulate the probabilists? Elsewhere the author has made an effort in such a direction. Let us quickly review the main ideas. Assume that a *universe* U of total states is given. A *path* in U is a (finite or infinite, discrete or continuous) sequence of elements of U; this includes the *empty* path for which we use the notation λ. If p is a path, then we write $p(*)$ for its first element and $p(\dagger)$ for its last element, provided of course that those elements exist. If p and q are paths such that $p(\dagger) = q(*)$ then pq denotes the path that agrees with p up to $p(\dagger)$ and with q from $q(*)$. The set of all nonempty paths in U is denoted by U^*; thus $\lambda \notin U^*$. If p and q are paths such that $q = pr$, for some $r \in U^*$, then e is an *episode determined by p and q* if

(i) $\quad p \notin e \;\&\; q \notin e,$

(ii) $\quad \exists_{u \in U} \forall_{r \in e} \, (p(*) = q(*) = r(*) = u)\,,$

(iii) $\quad \forall_{r \in e} \exists_{s,t \in U^*} \, (r = ps \;\&\; q = rt)\,.$

On the whole, the reception among the avant-garde audience was positive ("interesting idea").

[3] "I stopped. They weren't looking at me, the way they are trained not to look in Washington. [...] They still not-looked, and I went on." (Rex Stout, *The doorbell rang*)

We can now define the three classes of eventualities. A *state-of-affairs* is a subset of the universe. An *event* is a set of paths. A *process* is a set of episodes.[4] (The converse relations need not hold: not every subset of the universe need be recognized as a state-of-affairs, not every set of paths as an event, not every set of episodes as a process. In a particular application one would expect the three classes of eventualities to be determined, for example, as those entities of the right category that can be described in a particular language.)

The theory will not be worked out here in such detail that a complete formal account is warranted, so let us describe it in semi-formal terms. Suppose that we have a formal language with terms for states-of-affairs, events, and processes as well as predicates applying to those terms. A *model* is a universe together with a valuation of the terms in the universe. Note that a state-of-affairs term is assigned a state-of-affairs by the valuation, an event term an event, and a process term a process. For each term $\boldsymbol{T}$, let us write $\|\boldsymbol{T}\|$, called the *intension* of $\boldsymbol{T}$ in the model, for the entity assigned to $\boldsymbol{T}$ by the valuation.

We say that a formula $\boldsymbol{S}$ OBTAINS, where $\boldsymbol{S}$ is a state-of-affairs term, is true in a context if the context provides a total state u such that $u \in \|\boldsymbol{S}\|$, where $\|\boldsymbol{S}\|$ is the intension of $\boldsymbol{S}$ in the model (and thus is a set of total states). A formula $\boldsymbol{S}$ OBTAINED is true in a context if the context provides a past history containing a context in which $\boldsymbol{S}$ obtains is true. A formula $\boldsymbol{S}$ WILL OBTAIN can be given a similar analysis. Still other formulæ, like $\boldsymbol{S}$ MAY OBTAIN or $\boldsymbol{S}$ MAY OBTAIN IN THE FUTURE can be handled if the context is rich enough to provide the required information. But always at the centre is the question whether $u \in \|\boldsymbol{S}\|$, where u is a certain total state provided by a certain context.

We say that a formula $\boldsymbol{E}$ OCCURS, where $\boldsymbol{E}$ is an event term, is true in a context if the context provides a path p such that $p \in \|\boldsymbol{E}\|$, where $\|\boldsymbol{E}\|$ is the intension of $\boldsymbol{E}$ in the model (and thus is a set of paths). If the context provides a past history of which p is part, we would say that $\boldsymbol{E}$ OCCURRED or $\boldsymbol{E}$ HAS OCCURRED is true (the distinction in natural language between these expressions would require much further analysis). If the context provided a

[4] This definition of process, which differs superficially from that in [5], attempts to preserve what is valuable in Dana Scott's analysis of the progressive tense without laying it open to the standard objections (see [4], p. 168). Our episodes generalize his open intervals. Perhaps it would be desirable to include *convexity* as a defining condition of episodes: $\forall r, s, t \in U^* ((r = ps \;\&\; q = rt) \Rightarrow r \in e)$.

future history of which p is part, we would say that $\boldsymbol{E}$ will occur or $\boldsymbol{E}$ will have occurred is true. And so on.

We say that a formula $\boldsymbol{P}$ is going on, where $\boldsymbol{P}$ is a process term, is true in a context if the context provides an episode e and a path p such that $p \in e$ and $e \in \|\boldsymbol{P}\|$, where $\|\boldsymbol{P}\|$ is the intension of $\boldsymbol{P}$ in the model (and thus is a set of episodes). Truth-conditions for formulæ $\boldsymbol{P}$ was going on, etc., can also be defined.

Let us examine some remarks that can be made, truly or falsely, in connexion with Hatch films.

(1) "Hatch is in the left-most rectangle."

This is a statement of type $\boldsymbol{S}$ obtains, where $\boldsymbol{S}$ is state-of-affairs term. It is easy to agree on the intension of the latter: $\|\boldsymbol{S}\| = \{0^\circ\}$. Hence (1) is true with respect to a total state u if and only if $u \in \{0^\circ\}$.

(2) "Hatch crossed from left to right."

This is a statement of type $\boldsymbol{E}$ occurred. There are several ways in which $\|\boldsymbol{E}\|$ may be defined here, for a crossing need not be a straight crossing. But a natural requirement is that any definition will contain the straight crossing, that is, the path $\langle 0^\circ, 1^\circ, \ldots, 11^\circ \rangle$. Hence (2) is true if the past history h contains this path. That is to say, it is sufficient that there are paths p and q, not necessarily nonempty, such that $p(\dagger) = 0^\circ$ and $q(*) = 11^\circ$ and $h = p\langle 0^\circ, 1^\circ, \ldots, 11^\circ \rangle q$. It follows that (2) is true of *Due*.

(3) "Hatch was moving to the right when he vanished."

Involved here are two eventualities: a process and an event. Thus the statement is of the form $\boldsymbol{E}$ occurred while $\boldsymbol{P}$ was going on. The analysis of while is problematic, but let us make an *ad hoc* effort. The event that is involved is that of Hatch's vanishing. Something can vanish gradually, but there is also a concept of instantaneous vanishing, and we assume that it is the latter that we are dealing with here. Instantaneous events are singular; how to represent them, even within our simple-minded set-up, may be controversial. Nevertheless, here is one suggestion:

$$\{\, \langle i^\circ, f^\circ \rangle \;:\; 0 \leqslant i < 12 \,\}.$$

The process involved is that of Hatch's moving to the right. We suggest that it consists of all nonempty episodes e for which there are numbers i and k such that $i \geqslant 0, 1 < k < 12 - i$ and

$$e = \{\, \langle i^\circ, (i+1)^\circ, \ldots, (i+j)^\circ \rangle \;:\; 0 < j < k \,\}.$$

Note that *Tre* contains $\langle 0^\circ, 1^\circ, \ldots, 8^\circ, \phi^\circ \rangle$ as a subsequence and that $\langle 8^\circ, \phi^\circ \rangle$ realizes Hatch's disappearance as defined above. Thus in order to show that (3) is true with regard to *Tre* it would be enough to show, for example, that the context provides an episode containing $\langle 5^\circ, 6^\circ, 7^\circ, 8^\circ \rangle$, say

$$\{ \langle 5^\circ, 6^\circ \rangle, \langle 5^\circ, 6^\circ, 7^\circ \rangle, \langle 5^\circ, 6^\circ, 7^\circ, 8^\circ \rangle \}.$$

The difficulty is to show that such an episode is indeed provided by the context. We return to this topic below.

3. Some comments

A conceptual theory of the kind outlined may be useful in helping to create some kind of order in the analysis of eventualities. As an illustration we comment briefly on five topics.

3.1. The type/token distinction. Traditionally, a fundamental distinction in ethics has been that between act types and act tokens.[5] In our theory this is reflected by the fact that an event is a set of paths while what some authors have called a "concrete event" is a path.

In our festival example we would wish to regard 'moving two steps to the right' as an event. It can be given a number of exact meanings; suppose we decide on the set

$$\{ \langle s_0, \ldots, s_n \rangle \ : \ \exists_{m<10} \, (s_0 = m^\circ \ \& \ s_n = (m+2)^\circ) \}.$$

The sentence

(4) "Hatch moved two steps to the right"

would have to be evaluated, not with respect to a total state (point in time), but with respect to a sequence of total states (a past history). Suppose that h is a complete past history. Then (1) is true if and only if there are paths p and q such that $h = pq$ and q is an element of the event 'moving two steps to the right'. Here q may perhaps be identified with a concrete event that falls under the description "Hatch's moving two steps to the right". One might say that q *realizes* the event of Hatch's moving two steps to the right.

Similar remarks, *mutatis mutandis*, attach to processes.

[5] For the purposes of this paper we make the simplifying assumption that an action is a kind of event.

3.2. The one action/many action problem. A few years ago there was a vigorous debate about the number of actions that could be performed by flipping a switch. Donald Davidson pointed out that under certain circumstances flipping the switch would turn on the light and alert a nearby, undetected burglar [1]. How many actions are involved in such a case — one or many? Our theory adjudicates the debate by making a distinction between extension and intension, the former being the realization of the latter in a particular context. Both sides were right! The one-actioners were right about the extension of an action; it is always a unique path. But the many--siders were right that, on a particular occasion, any number of actions, if identified with their intensions, might be realized by one and the same path.

As an example, let us take the event 'going to the right hand side', which we propose to identify with the set

$$\{\, \langle s_0, \ldots, s_n \rangle \;:\; \forall_{i \leqslant n} \, (n > 0 \;\&\; s_i = 11^\circ \Leftrightarrow i = n) \,\}.$$

The path $\langle 9^\circ, 10^\circ, 11^\circ \rangle$ realizes both Hatch's moving two steps to the right and Hatch's going to the right hand side. Davidson's example is more complicated but can be given a similar modelling.

Similar remarks, *mutatis mutandis*, attach to processes.

3.3. Event generation and process generation. If (in a certain modelling) an event E is a subset of F, then a path realizing E also realizes F. Hence F is always realized by E. Yet another way of putting this is that E is a way of realizing F. This construction, called level-generation or just generation, which usually occurs in connexion with actions, was brought into prominence by Alvin Goldman [3]. He recognized several kinds of generation of which we only discuss what he called "simple" generation. We contend that simple generation can be understood with the help of the subset relation.

For example, the event 'Hatch's moving one step either left or right' is a subset of the event 'Hatch's changing position'. Accordingly, Hatch can always change position by moving one step either left or right. Moving one step left or right is always a way of changing position.

This example should be compared with the relationship between the events 'Hatch's moving one step to the left' and 'Hatch's changing his position'. If the actual total state of Hatch's world is 11°, then the former is a way of realizing the latter, so the latter can be realized by the former. But this is not so if the actual total state is 0°.

Thus we can distinguish cases when F is always realized by E, and cases when F, although not always realized by E, nevertheless in a certain situation is.

No doubt a full analysis will require more than has been said so far, particularly if we are dealing with actions. In order to undertake an action I must know how to perform it. This is the case with certain specific tasks; let us say that in such cases we have a routine available. Sometimes I can string routines together to perform a complex action, something that may or may not require planning or manœuvering . In general, doing E will be regarded a way of doing F only if it easier for the agent to figure out how to do E than how to do F.

Similar remarks, *mutatis mutandis*, attach to processes.

3.4. Analyzing the progressive tense. Our discussion above of the sentence "Hatch vanished while moving to the right", although pointing in a direction that seems promising to the present author, avoids many of problems facing any attempt to develop an analysis of the progressive tense of English. There is not room for an extensive discussion here, but we will touch on one of those problems. Consider the following related sentence, presumably also true of *Tre*:

(5) Hatch vanished while crossing from left to right.

Continuing in the fashion we have begun, it would be natural to identify the process 'crossing from left to right' with the set of episodes determined by the paths $\langle 0^\circ, 1^\circ, \ldots, i^\circ\rangle$ and $\langle 0^\circ, 1^\circ, \ldots, (i+k)^\circ\rangle$ where $i \geqslant 0$ and $1 < k < 12-i$. (The reason that this process deserves the name of crossing — one of the names! — is that every episode can be embedded in a maximal episode determined by $\langle 0^\circ\rangle$ and $\langle 0^\circ, 1^\circ, \ldots, 11^\circ\rangle$.) If this is the process provided by the situation, then an analysis along the lines in the preceding section can be given.

The problem is only this: by what right do we claim that process is "provided by the situation"? Without spelling out the formal details, note that there are infinitely many other processes we could have considered and which would not have verified the truth of (5). To indicate one example, take the process where Hatch goes right to the tenth rectangle from the left, then left to the third rectangle from the left, then right to the tenth rectangle

from the left, then left to the third rectangle from the left, and so on. Call this process 'oscillating'. Viewers of *Tre* would probably not regard

(6) Hatch vanished while oscillating

as true. Yet what is there to rule out that interpretation?

Before answering, let us note that many eventualities, in particular many processes, have no clear end point (what Parsons calls "culmination"). Some do; for example, the process 'crossing from left to right' — whatever happens after the right-most rectangle has been reached, if anything, is not part of the crossing. By contrast, the process 'moving' never culminates — it is always possible to go on. But even if a process is capable of culminating, it is quite possible to witness an episode of the process without witnessing the culmination, or even to witness its culmination without recognizing that it is the culmination. For example, we have suggested that in *Tre* Hatch vanished while moving. But perhaps he didn't — perhaps he vanished after having reached his final destination, the ninth rectangle, where he would have remained for ever after if he had not vanished. The film is consistent with both the claim that Hatch vanished while moving and the claim that he vanished while not moving.

Therefore, whenever one is dealing with an on-going process there is the problem: what process? The part of the process one has just witnessed can perhaps be continued in any number of ways that are all logically possible. Which of them would have been realized, had we been able to prolong our observation? It may be instructive to note that we have the same problem when we are confronted (as people sometimes are, for example on IQ tests) with a series of numbers and asked how to continue the series. Such a problem can be reformulated as the following question: what is the "simplest" recursive function that agrees with the given values? But there are always infinitely many recursive functions definable on a finite basis. Thus everything depends on what is regarded as "simple", which, to some extent at least, is a normative question.[6]

Thus the truth or falsity of statements like (5) and (6) cannot be answered without an account of how a process is "provided by the situation". In the case of a movie-goer, this is done by the movie-goer him- or herself.

[6] It was stated in footnote 2 that a movie-goer will be able to get an adequate idea of *Quattro* by watching a sufficiently long initial portion of that film. We see now that that statement will have to be taken with a grain of salt. However long the initial portion, the remaining, unwatched portion of the film will never be known for sure.

We often form judgements that go beyond given data, simply, as we say, to "make sense" of what is going on. Another way of saying this is that, perhaps by necessity, we impose a structure on observed data that is not to be found among the data.

What about "real" cases? What about "He was dying when his wife saved him"? Here a process of dying is going on when something happens to interrupt it. Suppose $p = p_0p_1p_2$ is a path representing what happened: p_0 the development before the man entered into the dying process, p_1 the further development before the wife interceded, p_2 the remainder. On our type of account, the dying process is a set of episodes containing a maximal episode e such that, while p_1 is an element of e, there is also an element q of e such that $q = p_0p_1r$, for some r, and at $q(\dagger)$ the man is dead. The difficulty here is that this account is counterfactual — after p_1, p_2 was realized, not r. How can we say that $\boldsymbol{P}$ is provided by the situation when we know that the man did not die?

Parsons, in a careful discussion of this question, does not believe that the tradition exemplified by Dowty and his "inertia worlds" can answer it. The present author is more optimistic. We all agree that it makes sense to say that a man, who was dying, did not die. That he was dying means that he would have died if something had not come in between. Evidently there are two observations involved here: (i) left to himself the man will die if Nature is allowed to take its course; (ii) his wife intercedes and prevents the death. The problem is to find a model that supports both observations.

Skipping a lot of technical groundwork we offer the following suggestion. In many cases it is natural to construe models as deterministic. A model modelling natural phenomena may be thought of as an automaton (often of great complexity). Such a world may be represented as developing according to a master program $\lambda p\Phi(p)$; given a past history p, the future of the world is $\Phi(p)$ (for simplicity one may think of past and future histories as paths). Agents can sometimes be modelled as part of Nature; this is to adopt a "third-person perspective". But if we wish to consider their wills we have to adopt a "first-person perspective". This can be done by assuming that agents influence the way the world develops. In our terms, the agents may influence the program according to which the world is developing. If there are agents $1, \ldots, n$, we may assume that they have conative inputs (wills) $\iota_1, \ldots, \iota_n$ and that these conative inputs, however we may represent them in detail, determine the program $\lambda p\lambda\iota_1, \ldots, \iota_n\Phi(p, \iota_1, \ldots, \iota_n)$ — thus Φ is a function of the wills of the agents modelled.

The case of the dying man can be modelled in several ways. In one such model the wife is the only agent. Let $\lambda p \lambda \iota \Phi(p, \iota)$ be the master program according to which the model develops. Suppose the conative input of the wife doing nothing, the null input, is ϕ, while her conative input doing what she did is ι_0. Then $\Phi(p_0 p_1, \phi)$ is a future beginning with r, while $\Phi(p_0 p_1, \iota_0)$ is a future beginning with p_2. The mathematical notation may make this difficult to digest, yet our suggestion seems very close to how we actually think. Essentially it is the solution of Dowty with Φ replacing the latter's notion of similarity [2].

3.5. Event verbs and process verbs. Some authors discuss whether (a certain class of) verbs can be divided into event verbs and process verbs. The present theory provides no support for such a division.

Verbs (of that class) are like programs. The semantic picture of a program, in a modelling of our kind, is a tree, the nodes of which are total states. When a program is run, a certain complete branch of the tree is realized (if it is an infinite run there is never a time when the entire branch has been realized; nevertheless there is a complete branch that corresponds to the run). A run of the program, or any part of it, is an event. But the running of the program, or any part of it, is a process.

4. Conclusion

We have rehearsed a theory outlined in [5] and discussed a particular modelling exemplifying that theory. The simplicity of the modelling severely limits what can be modelled. On the other hand, the very simplicity of such formal modellings make them tractable. Physicists depend for their success on their highly regimented experiments; in the same way philosophical logicians can benefit from studying very simple formal models. Although the models defined in this paper are so simple that most interesting phenomena are beyond it, nevertheless some basic phenomena can be modelled. That is perhaps a beginning.

References

[1] Davidson, Donald, *Essays on actions and events*, Oxford: Clarendon Press, 1980.

[2] Dowty, David R., *Word meaning and Montague grammar*, Dordrecht, Holland, 1979.

[3] Goldman, Alvin, *A theory of human action*, Englewood Cliffs, N. J.: Prentice-Hall, 1970.

[4] Parsons, Terence, *Events in the semantics of English: a study in subatomic semantics*, Cambridge, MA: The MIT Press, 1990.

[5] Segerberg, Krister, "Representing facts", [in:] *Knowledge, belief and strategic interaction*, edited by Cristina Bicchieri and Maria Luisa Dalla Chiara, Cambridge: Cambridge University Press, 1992, pp. 239–256.

[6] von Wright, Georg Henrik, *Norm and action: a logical inquiry*, London: Routledge & Kegan Paul, 1963.

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