INFORMATION PROCESSING 80, S.H. Lavington (ed.)
North-Holland Publishing Company


*Invited Paper*

# THE LIMITS OF TOGETHERNESS

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This paper makes a distinction between conversation and communication (signal transfer which may, or may not, be conversational). The word "conversation" is given an interpretation, which refines its commonsense meaning. Conversation maintains the autonomy or identity of systems and, also, generates independencies between systems (human, societal, or others), which is a prerequisite of dialogue.

The natural habitat of human beings is, increasingly, an "information environment" where communication and computation have altered suppositions about signal distance, or "togetherness". Limits are discussed with emphasis upon the hazards engendered by too much togetherness in person-person or man-machine interaction. Because it is possible to comment, cogently, upon the nature of conversation, these limits can be recognised and remedies to the malfunctioning which is likely to occur if they are exceeded, are proposed.

## The Limits of togetherness

The popularised word "togetherness" aptly captures a general notion of human proximity, of meeting and speaking, or dancing together at a festival. Social groups, be they families urban communities or the older universities, have institutions which promote togetherness; the dining table, a market, or a cafe as the case may be. On more or less ritualised occasions, and in the traditional places, humans converse; either verbally, or by image and gesture. I submit that the conversation which occurs, debate and sometimes agreement, is the stuff of civilised life and togetherness is essential to it. On the other hand there are also limits upon "togetherness"; too much of it, for example, gives rise to specific symptoms of individual and social malàise. These symptoms typically appear when the communication, allowed by proximity, is not conversation.

## 1. Introduction

Communication and conversation are distinct, and they do not always go hand in hand. Suppose that communication is liberally construed as the transmission and transformation of signals. If so, conversation requires at least some communication. But, enigmatically perhaps, very bad communication may admit very good conversation and the existence of a perfect channel is no guarantee that any conversation will take place.

Because communication theory is well known, differences between communication and conversation can be pointed out by comparison and contrast, at this juncture.

The technical aspect of the paper is devoted to saying what Conversation is. As a preliminary definition, Conversation is "Concept sharing".

### 1.1 Logical Discrimination.

The value of a communication is accuracy and veridicality imaged by the "True" and "False" values of propositional or descriptive logic (or its probabilistic extrapolation) where "True" or "False" are usually modelled as states 1, 0. In contrast, the value of a conversation is agreement, reached by commanding and obeying or questioning and answering (neither questions nor commands have factual truth values). Agreement may be imaged by the coherence truth values of a procedural logic and these values are conveniently modelled by physical coherence between non-linear processes.

In communication, information transfer is founded upon selection, albeit statistical, amongst states of transmitters and receivers that are extra-theoretically specified as independent (apart from the communication channels) but synchronised, for example, by a recognisible punctuating symbol. Notions such as "noise" and "capacity" rest upon these foundations. In contrast, the information transfer of a conversation is of the Petri-Holt [1] type, ie, the extent to which otherwise independent participants are rendered locally dependent, or otherwise asynchronous participants become locally synchronised when agreements are reached, as a result of concept sharing. Unlike transmitters and receivers, the participants, who converse and share concepts, are not unambiguously predefined and are not extra-theoretical importations. The act of conversing surely depends upon their autonomy or distinction but, also, this act generates a distinction.

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### 1.2 Some Background

My own conviction about the importance of conversation and its critical relation with togetherness took shape slowly. During the later 1950s and early 60s, we constructed what were glibly called "adaptive teaching machines". These devices operated in skills as varied as typewriting, tracking and problem solving [ 2, 3, 4, 5, 6, 7, 8, 9 ].

In this context the word "machine" means a piece of hardware constrained, algebraically, to act as a computer; nowadays, for example, the systems are more reliably implemented using standard microprocessors. The word "teaching" suggests that someone engages in conversation, usually non-verbal, but with the "teaching machine".

Only in the 1960s and early 1970s was it clear that this suggestion is utter nonsense. The algebraic constraints which give "machinehood" to the hardware are designed to prohibit conversation with machines. For instance, you cannot, by definition, "disagree" with a machine; you can only say it is a "broken" machine. Of course, people may and do communicate with machines (which, if they belong to this category are better called "training machines"). Also, given a different design, such as the learning monitor CASTE [ 10, 11, 12] conversation may take place through (not with) machines, which exteriorise the concepts that are shared as tangible records. As a result, it was possible to obtain empirical support for a theory of such transactions and, going a little further, to construct hardware artifacts which do have conversational capability because they are not, formally speaking, machines. (Conversation with machines is disallowed for algebraic reasons, not to do with material embodiment. Brains are biological hardware, after all).

These man/machine studies were set in the context of learning, hypothesis construction, and various kinds of design. At the moment, the chief focus is upon complex team decision making, which includes planning and strategy generation. The work provides a large, but laboratory contrived, situation in which the togetherness of people (or even the perpectives and roles they adopt) is determined by a communication/computation medium in which some, but only some, of the transactions are conversational. It may seem that this miniature world is a long way from a real world of geographical distance and transportation delays, the traditional indices of togetherness.

There is, of course, a great difference in scale, but I claim (a) that the real world is changing, due to various trends and technologies, so that its form is strictly comparable to these laboratory situations; (b) that the maladies and misfunctions due to a failure for one reason or another to converse, are typified by mechanisms observable, in the miniature, and (c) that remedies which promote conversation in the miniature situation are likely to prove effective in the real world of the future.

### 1.3 An Information Environment

In the past, conversation has often been hampered by lack of communication. In the future, the familiar barriers, such as geographical distance, are unlikely to be obtrusive; conversation will be more endangered by excessive togetherness; the possibility of communication can be safely assumed to exist. The matter is especially significant in the context of well known developments in communication, data storage, and (classical) computation, which are rapidly creating an "information environment".

There are, first of all, technological developments. For example, in communication, fibre optic technology, provides virtually unlimited bandwidth channels in urban districts, microwave and satellite communication over larger distances; in storage, video discs, high capacity ( > 80 megabyte) magnetic discs, and the complementary main store techniques of low energy semiconductors and magnetic domain (bubble) devices; in computation, widely disseminated microprocessors to connect storage media to channels and provide local processing capability; optical and array processors. Others, amongst them Hines [13], have argued, cogently and convicingly, for these technologies and the social, national and industrial pressures that are, willy nilly, going to carry technical breakthroughs into tangible structures.

Next, there are developments, for the most part anticipating the currently burgeoning technological base, concerned with information handling and processing. For example there are systems like Nelson's Hypertext [14] Winograd and Kaye's [15] KRL. There is Negroponte's "data space", and the video disc store of Aspen, Colorado, so accessed that a user can drive through the streets, industries, history or everyday activity of that town [16]. My own entailment meshes, perhaps, are candidates [17]. There is a host of reactive animated graphics facilities, exemplified by De Fantis' work.

These developments, combined with the technical advances and the pressures to implement them, lend substance to the claim that communication/computation proximity is no longer just a matter of geography. Rather, the natural environment of mankind becomes increasingly an information environment, chiefly determined by these communication/computation systems. This claim is not confined to dense conurbations (as it might have been a few years ago), nor is it a claim about the unforseeable future. It is a simple extrapolation from currently available facts and figures.

Forseeably, the industrial, social and national pressures which promote information technology will also give rise to legislation against privacy or isolation, all quite justifiable and "for our own good". Before long, the statute books will ordain that any partition, wall or enclosure is penetrated by a channel of so many megahertz capacity, and will include rules like "a fibre-optic-cable shall connect each legal house".

Little is known about the ecology of an information environment where distance is signal-distance conjoined to localised storage and computer power*. But it is fair to suppose that the pathologies manifest today at the limits of togetherness on the occasions when there is communication which looks like conversation but is not at all conversational, will be amplified in an information environment. They appear as major hazards in the future.

1.4 Illustrations

The following maxims exemplify the pathologies in question. (a) "Communication need not be conversation". For example, committees are often said to decide as a result of debate (conversation) between their members. By means of debates the committee members agree, or they agree to be at loggerheads. On salient topics, however a coherent view is reached. This ideal is seldom approximated, at any rate amongst the committees that proliferate in academia. Of course, a committee plays a social role; it gives reason for the members to gather and it provides a valuable forum for rhetoric. But, whatever else, big committees do not themselves decide. On the contrary, the communication of "business in hand" absorbs, rather than promotes, debate (Atkin [18]). In practice, decisions are made by persons, or small groups who do converse. The larger consensus amounts to distribution of blame; a "committee decision", for which no one is responsible.

(b) "Both subhuman and suprahuman organisations communicate with humans, but do not converse with them". It is a truism that any organism, such as a human being, depends upon communication with, and amongst, organs of the body and resources, for example, of food. As humans we call these necessary components and resources "subhuman". We may credit them with life but do not, as a rule, converse with them. The bounds are not entirely clearcut. For instance, after practice (perhaps, aided by biofeedback) you may, in a very real sense, learn to conditionally regulate your heart beat and rationally influence a functional system which usually operates automatically. Contrariwise there is ample evidence (Beer [21], Robb [22] Robinson [23] [24] amongst many others) that viable medium-to-large corporations, schools of thought (maybe committees) are "suprahuman" organisms which have, in a very real sense, an autonomy of their own. We communicate with them, by posting memoranda, receiving edicts, fiats, etc., but do not converse (share concepts) with them. Again, the boundaries are not clearcut; we do converse with our families, our extended families, members of a club, personal friends. But can one, for example, converse with the entire colloquy of professional peers ? That largely depends upon whether we have learned to translate natural-language concepts into the esoteric-language concepts, natural for organs of the body or divisions of an industrial enterprise.

(c) "Too much togetherness inhibits conversation". This maxim is illustrated by life admidst open-plan architecture, in vogue some years ago; apartments and houses where (as a phrase of that epoch), "parents grew up with their children". Under these circumstances conversation is impaired. If people live in such indecent proximity they cannot easily sustain the autonomy of participants, who might converse together, having distinct perpectives and points of view.

(d) "When there is too much togetherness communication acts as a mechanism of isolation rather than a vehicle for dialogue". For example, in my culture, dinner is an occasion for discussion. It is frightening to see a family who gaze at a television set over their evening meal, although the behaviour is typical of open-plan living. Clearly, a simultaneous conversation is out of court. Again clearly, the televisual communication serves to isolate the diners and give them the autonomy they need in order to be people (but also, the communication of TV prevents the use of that autonomy for conversing with each other).

(e) "Too little apparent-togetherness promotes uniform-surrogate-togetherness". Suburbs exemplify this dictum. If you live 20 miles from your office, then you commute in a uniform pattern, see and hear the mass-media, are part of the market for microprocessor games, and, likely as not, your youngsters play games identical to their geographically dispersed neighbours. Amongst the mechanisms promoting uniformity, temporal synchronisation whether of rush hours, or viewing peaks, produces a covert togetherness devoid of conversation .

1.5 Commentary

These examples of potential pathology have been chosen because they are poignant, generally relevant to such issues as computer conferencing (it could be a boon, or it could destroy the social raison d'ètre of committees), and universally available microprocessors. They are also snapshots of amplifying, self-replicating, and self-stabilising processes that grow and stereotype by entirely systemic mechanisms. In some conditions the mechanisms are intellectual, in others, the mechanisms are concrete. For instance, the "togetherness-movement" gave rise to open plan structures which were, in turn, adopted by property developers as cost

* *Eclectically minded anthropologists and ecologists point out that if man is to survive he must learn to live with nature. Bateson [19] and Illich [20], for example, support this view in very different ways. But both of them are aware that naive images of "returning to nature" have no more than local relevance (the localities in question can be quite large, of course), and that renders communication/computation essential.*

effective. In turn, again, the existence of open-plan accommodation induced a social phenomenon of "open-plan living".

Because the mechanisms are systemic, it is reasonable to suppose that they will operate in an information environment, where the constraints imposed by temporal or geographical boundaries are of decreasing consequence. Computation substantially eliminates the temporal dimension and signal neighbourhood bends the spatial dimension. System designers will be responsible for the kind of communication and computation that goes on, and for whether or not conversation may take place. They will be the engineers of togetherness, and must respect its limits.

## 2. Main Theme

The main contention of this essay is that most currently available theories of communication and computation are not adequate tools for engineering togetherness. Although these theories are beautifully developed and have mathematical elegance, they are unable, without extra-theoretic props, to distinguish between communication and conversation. Insofar as pathologies arise when communication looks like conversation but is not conversational, these theories do not provide a framework in which the pathological limits of togetherness can be detected.

Certainly there are exceptions which do not warrant this stricture (the work of Braten [25] , Byshovsky [26] , Flores and Winograd [27] , Gaines [28, 29] , Gergely [30, 31] , Goguen, Varela [35] , Maturana [36] , McCulloch [37] and Von Foerster [38, 39, 40, 41, 42] ). In order to give technical substance to the discussion, one of these theories, due to my own group, will be outlined. It is called "Conversation Theory" (abbreviated hence forward, to CT). [11, 12, 43, 44, 45, 46, 47, 48, 49. 50].

CT is a reflective (or participant) theory and comments upon the "concept sharing" of "participants" (A, B, ...), upon their agreement and failure to agree. CT is also a relativistic theory. The data structures relative to which it is specified (entailment meshes), have a logic of distinction and coherence. They are the "environment" or "domain" of conversations and offer an index of proximity which is interpretable as togetherness.

Although terms like "concept" or "stable concept" have a perfectly straightforward connotation, they are also used, with some refinement of meaning, as technical terms.

### 2.1 Concepts

Philosophers say that a concept is the meaning of a word, (or any perceptible symbol, it need not be written or spoken). Psychologists ascribe concepts to people and speak of A's concept of a house, (or riding a bicycle or A's great-uncle) as distinct from B's concept of a house (or riding a bicycle, or B's great uncle). A's and B's concepts of a commonly named event or entity may be quite alien, even if they are concepts of an abstract kind, like "circle" or "rectangle", which have standard textbook definitions.

So, if A and B are asked about "circle", they probably come up with different explanations, for example, A draws a circle with a compass on paper, B slices a cylinder. Equivalently, they would write different computer programs in order to generate circles. Even if A and B know the standard definition, "locus of all points, equidistant from a given point, on the plane" (for instance, because they are students in the same geometry course), the definition is usually reserved for examinations.

A and B can share concepts that are stable and given names $T_A$, $T_B$, in a language (say) L. Conversely, the common concept, the "meaning of the word", exists because of a concensus amongst a whole community of L users, A, B, ...N. Concepts are shared by means of requests, commands, persuasions, etc., from A, obeyed by B, or vice versa; through questions posed by A and answered by B, or vice versa. This activity, whether it is verbal or in a language for exchanging, executing and debugging programs (or a language of graphics, gesture, etc) is a conversation. If it results in a sharing of some or all of A's, B's concept, then there is an agreement $T_{AB}$ between A and B, or, in general, an agreement $T_{AB...N}$, the meaning of which for A, B, ... N is a shared concept where "T" (omitting subscripts) is the word, in the language, L, of this community, that designates it.

There is a danger of confusion between a static symbol, like T, and the philosopher's "meaning of T". In the company of psychologists, it is easy to believe that a concept is a stored templet, or pattern, in A's or B's brain, for that is often suggested. So far as this paper is concerned, the suggestion is outright denied; concepts, in either case, are kinetic. Specifically, concepts are near-coherent bundles of procedures (that is, programs composed in a language, L, and compiled for execution in a brain or some collection of brains). Personal concepts are executed to produce personal behaviours (like riding a bicycle), which implicate A's or B's environment, or else they are executed only in A's or B's brain to produce descriptions, such as A's or B's imagination of riding a bicycle. Concepts determine skilled behaviour and, in the sense that A or B have skills, concepts are skills, and, for instance when thinking about geometry, are purely intellectual skills.

### 2.2 Stable Concepts

"Memorable" or "resilient" concepts (in contrast, to the evanescent trace of a phone number whilst it is dialled), are stable because they are productive and reproduced (learned and relearned). Without unique commitment to mental operations, the criterion of stability equivalent to "productive and reproduced", is "organisational closure"††, or "autonomy"; of which the classical stabilities are special cases. The criterion is in line with Von Neumann's (51), Burke's (52) or Lofgren's (53, 54) work on self reproducing automata, and Fig 1 is an outline of it. Concepts are productive and reproduced (relearned, reconstructed) if, when operated upon by operations

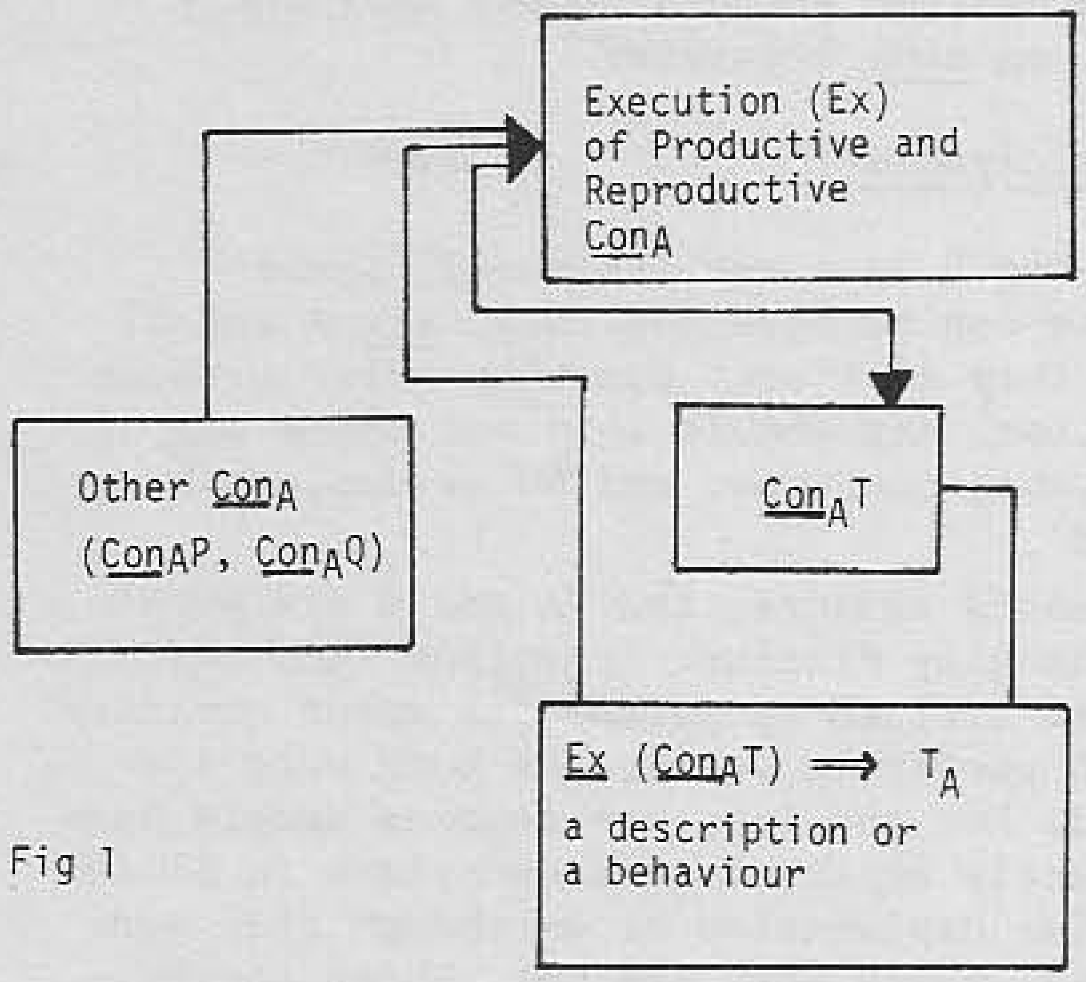



Fig 1

A stable (productive and reproduced) concept (ConAT) in participant A . The execution Ex (ConBT) produces a description (or image) and possibly a behaviour such as driving or drawing circles. Productive and reproductive operations are also of the type "concept" but act upon ConAT, $T_A$ or other concepts (say ConAP, where $P_A$ is a plane surface and ConAQ, where $Q_A$ is a compass) to reconstruct ConAT

*†† More or less independently, I devised P Individuation around 1970. Varela and Goguen's "Closure" is mathematically more elegant, Maturana's autopoiesis is a special case of it, manifest in biological systems. Bartlett (55) and Wertheimer (56) amongst others, are responsible for production and reproduction.*
*Fig 1 and Fig 2 can be formally expanded into concurrently operating free production systems such that the integrity of the production scheme is internally determined, and not, as usual, determined by an external controller, or program. The word "concurrent" means "usually parallel, and not, as a rule, conflict free". One scheme for agreement over a stable concept is given in "The Organisational Closure of Potentially Conscious Systems" (48).*

(themselves concepts), then (1) the original procedures are reproduced, and (2) fresh means (procedures) for achieving the same end are generated and rendered , eventually, coherent with other members of the collection (the "near-coherent-cluster" of procedures, some or all of which may be executed simultaneously). That is, "some process is executed" and "collections of processes tend to (but do not necessarily reach) coherence".

Notice that the structure of an organisationally closed system is rebuilt by the behaviours it sustains, and vice versa. Consequently, the customary differentiation of structure/behaviour is arbitrary.

## 2.3. Conversation

A conversation is sketched in Fig 2. Here, the stable concepts of A and B are "organisationally closed" but also "informationally open". Conversation, the act of concept sharing, is a process of conjoint concept execution, by participants A and B, as a result of which the agreed part of the concept is distributed or shared and cannot be functionally assigned "to A" or "to B".

In Fig 2 participant A is shown as constructing and reproducing a concept for $T_A$ (a circle) from concepts for $P_A$ (a plane) and $Q_A$ (a compass); B constructs and reproduces a concept for $T_B$ from concepts for $R_B$ (cylinder) and $S_B$ (slice).

These (collective) derivations are conveniently represented by the shorthand notation in Fig 3.

As a result of agreement both A and B have concepts that are distributive derivations - represented by the same shorthand notation, in Fig 4, where T*, P*, Q*, R*, S*, are the names of shared concepts.

Under what circumstances may A and B converse (learn, do each others' intellectual labour, as in Fig 2)?

One prerequisite of conversation is proximity or togetherness. But if, as submitted, togetherness is increasingly a matter of communication

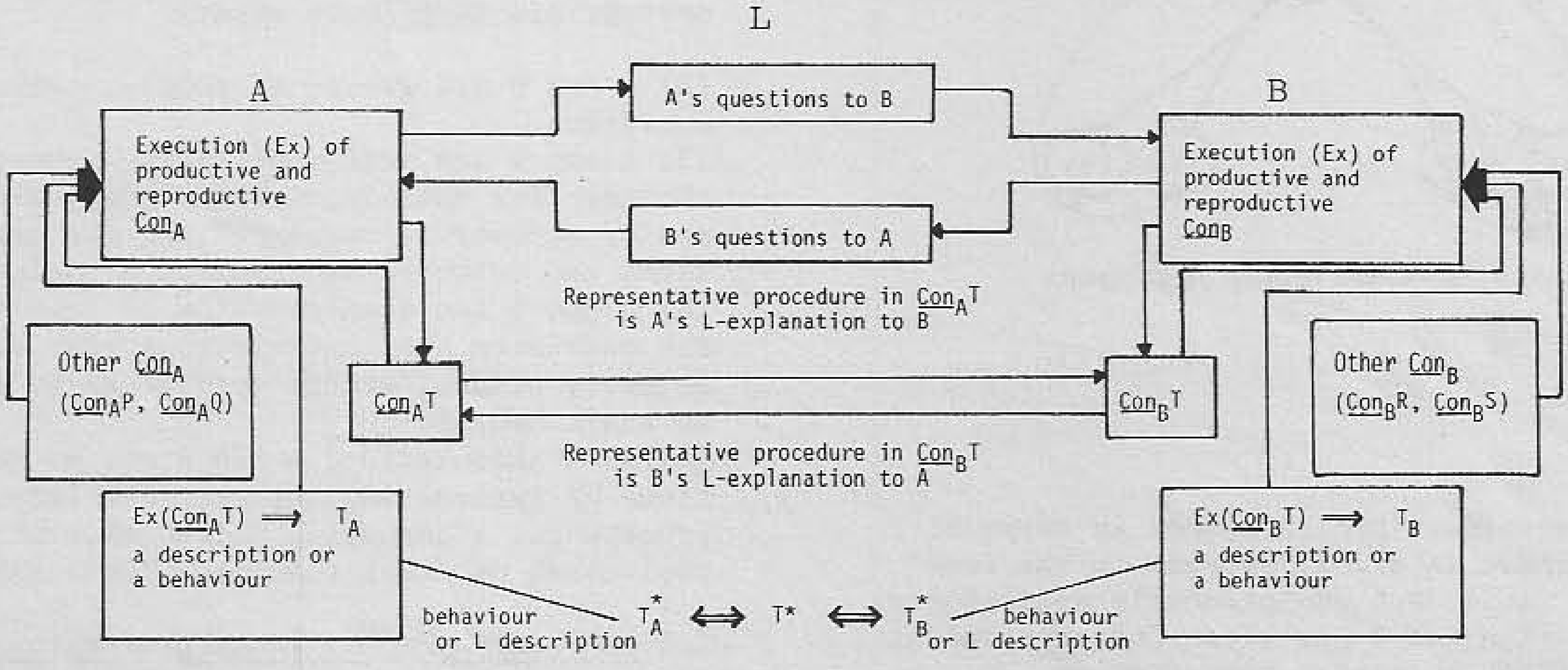



Fig 2: An A, B, conversation in Language L, as a result of which, if agreement is reached, some of A's procedures can be executed and reproduced as part of ConBT and some of B's procedures can be executed and reproduced as part of ConAT. Symbol "⟺" is isomorphism. $T_A^*$ is part, or all, of $T_A$, and $T_B^*$ is part, or all, of $T_B$


Fig 3: Initial condition of the conversation in Fig 2 where arcs are derivations and nodes stand for stable concepts

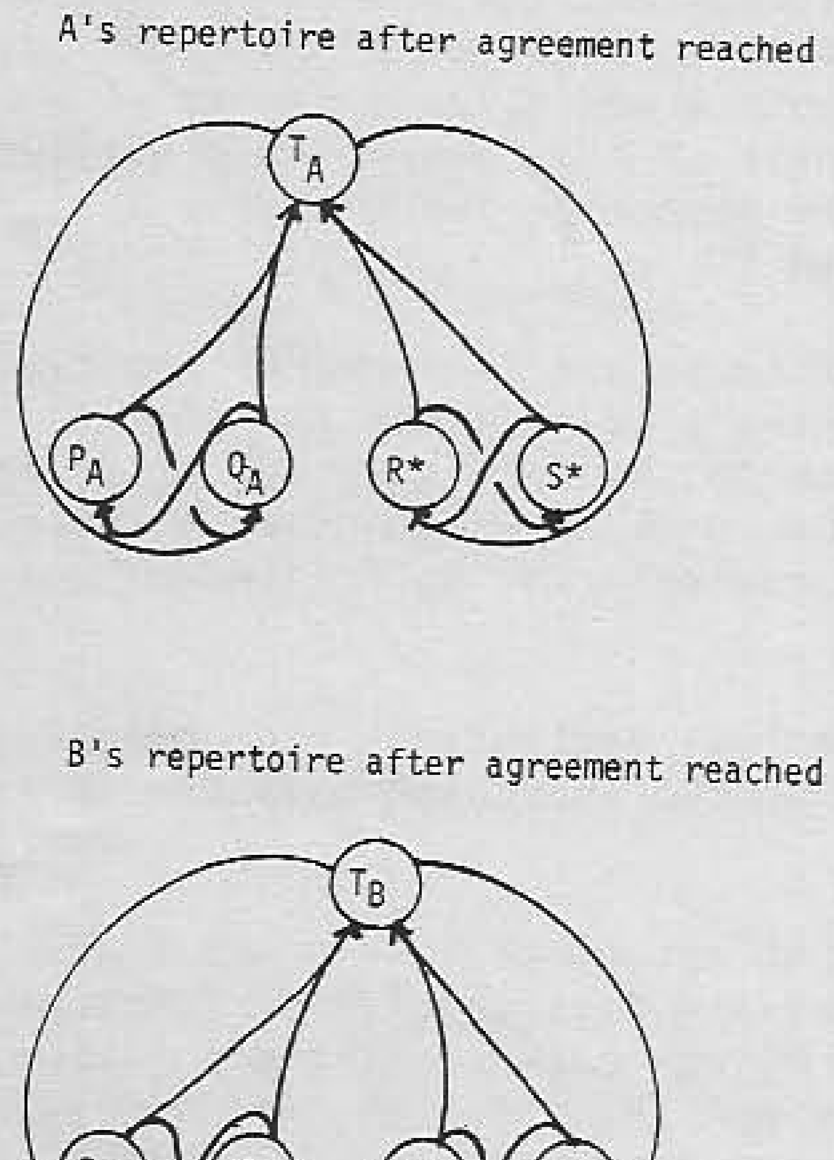



Fig 4: Result of agreement between participants

and computation, then an answer in terms of neighbourhood (A and B, persons in the same room) is valid, but exceptionally specialised. Further, if A and B are close for any reason, this does not guarantee conversation. They might, instead, retain the integrity of Leibnizian Monads. It is often possible to find reasons why A and B will benefit from conversing, as in cooperative action. These reasons are compelling and occasionally sufficient; quite literally A and B must converse if they are to survive. But, just as physical proximity is a specialist answer to the initial question (A and B may converse because they are together), so these constitute very specialised answers to why they must converse on some occasions.

## 2.4 Participants

Now, if Fig 2 is taken seriously, these questions can be reversed. What are A and B? How are they distinct? Can they exist without distinction? Why should they not share all of their stable concepts, and be as one, on every occasion?

The standard answers, that "A and B are people, geographically distinct organisms" and that "A and B are limited by perceptual motor capacity" are both perfectly valid, but both very specialised. For the last few decades people have consistently employed such exemplars in place of genuine explanation or as though they were canon law, which they are not. Quite obviously, you can also identify the participants in a conversation (and they can distinguish themselves) as systems of belief, as gourmets or wine connoisseurs, or gluttons, by their personalities, the political factions and social groups they belong to; in short, as clusters of stable concepts. As the environment, the natural habitat for man, becomes increasingly determined by communication/computation, so these answers gain utility. The relatively specialised standard answer is only "commonplace and evident" in limited areas, such as neurosurgery (it is important to pick the right person, in order to ablate bits of a brain).

The possibilities neither exclude nor derate the traditional demarcation of A and B, but they do open up some real and interesting possibilities such as the following.

(1) A and B are coherent points of view, or perspectives coexisting and interacting in one brain (for example, Minsky's [57] "proposer" and "critic", apposite in hypothesis formulation; my own "teacher" and "learner" appropriate to private study).

(2) A and B are groups of people, teams or societies.
(3) A and B are self replicating schools of thought; for example, Lakatos'[58] "programmes of scientific research", or the organisations and cultures evolving in a society.
(4) A and B are conglomerates of people and the machinery that exteriorises many of their, normally hidden, mental operations by computing on their behalf.
(5) As a speculation, A and B may be collections of interacting but a-priori-independent processors; a computing medium made of biological or other-than-biological fabric.

## 2.5 An Observer's Distinction of Participants

An observer may distinguish the participants

A, B, in any way ((1) to (5) for example), provided that the isolated units maintain an internal to A or an internal to B conversation (perhaps interpreted as A's thoughts and B's thoughts), as well as an optional "external" conversation between A and some other unit (like B). As an alternative statement A, B, ... must each be able to adopt more than one perpective (point of view, intention), at once.

In the role of scientists, we are anxious to observe certain "hard valued" events, like "A and B agree about T", and to credit them with factual truth (as a luxury, there may also be Fuzzy events based upon the existence of a "hard valued" substrate). This is surely possible. Equipment like CASTE includes mechanical detectors of evidence for agreement.

But is it essential to recognize an important difference between the hard data of mechanics (say) and the hard data of CT.

In mechanics, a sentence like "x is at y", designates a proposition. In CT, the hard data are sentences "A agrees with B over T" (which reflect A and B coherence or agreement) and designate analogies; very strict ones. For, in order to make the statement at all, the observer must distinguish in any desired way, between A and B. There are indefinitely many ways of doing so. Relative to this distinction, but only relative to this distinction, it makes sense to assert a similarity of process (in the limit, an isomorphism of process); that some relation proper to A is similar (maybe, isomorphic), to some relation proper to B. This is not a proposition but an analogy relation, or, if preferred, a proposition about an act of conversation, taken as the basic unit under scrutiny.

The point is fundamental. The epistemological framework is changed in order to retain the potential for rigour and for precise statement. Within a reflective or subjective theory, there is no a priori distinction of structure and behaviour (Section 2.2) but some (any sufficient) distinction must be imposed if we are anxious to make factually true objective (it referenced) statements.

### 2.6 Distinction and Conversation

Distinctions may be made either by an observer or by the participants - and some must be made if a coherent process is executed, under the following principles:

(a) "Coherence depends upon distinction". Whereas many processes may, and usually do, give rise to the same result, one process, executed in the same independent processor, may not give rise to different results. Computational conflict is disallowed in a unitary (organisationally closed) system.

(b) "Execution of a coherent process in A, B, may give rise to distinction (unless otherwise qualified, to the independence of asynchronous/decoupled parts)". For example, in a brain, independent/asynchronous regions may arise as the result of the ongoing activity; in general distinctions or independencies are created in order to resolve the computational conflict prohibited in (a) by "essential" (Nicolis [58, 59] or "cascaded" (Prigogine) process bifurcations. (These resemble Thom's [60] "Catastrophes" but "Catastrophe Theory" assumes a canonical state description and says nothing about the nature of transitions between metastable regions).

To probe the matter further, consider one independent processor (one brain, any independent part of a brain) able to accommodate a stable concept; so, for example, the stable concept corresponding to the distributive derivation of Fig. 5 certainly makes sense, for Fig. 5 is a copy of the shared part shown in Fig. 4 with "*" notation removed. The production imaged by the notation can be executed simultaneously and without conflict. But,

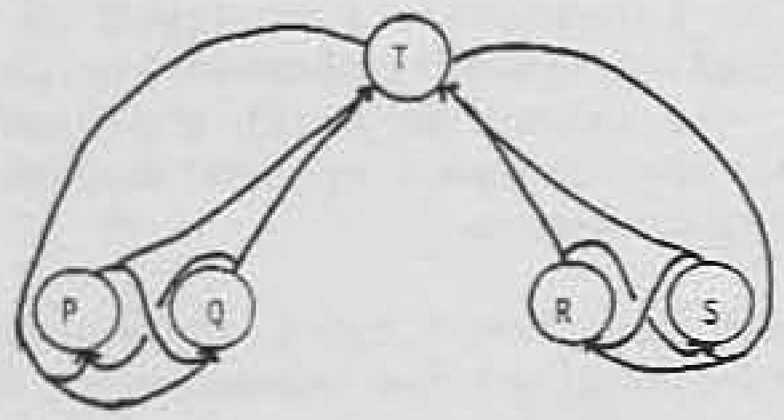



Fig 5: Stable concept in one processor

suppose there is a concept for M; a construction in the plane, P, where a many sided polygon becomes, in the limit, a circle. A distributive derivation implicating "compass and plane" and "polygon and plane" is shown in Fig. 6

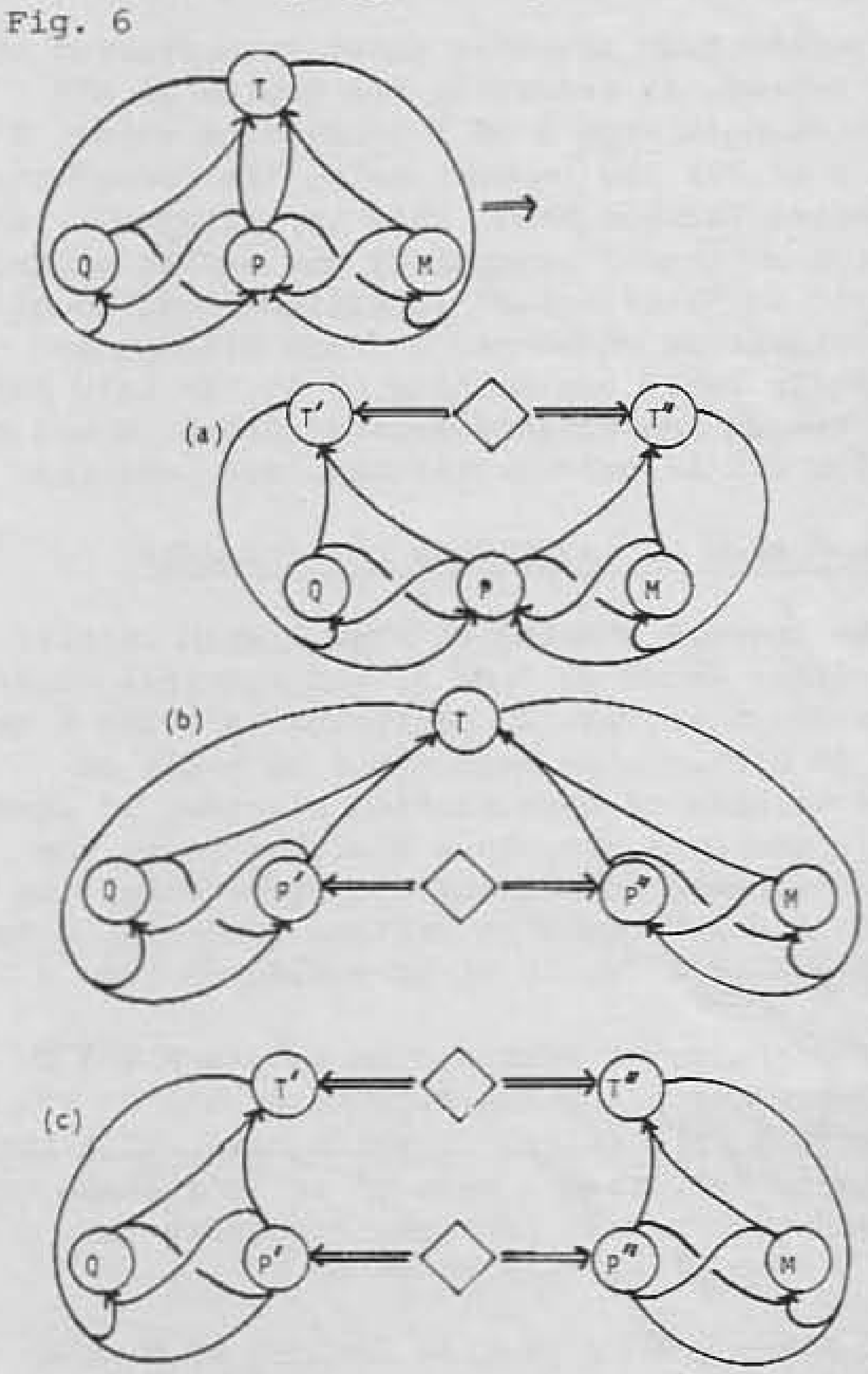



Fig 6: Instable concept in shorthand notation and its bifurcation (due to Midoro's "Rule of Genoa") $T \neq T' \neq T''$ and $P \neq P' \neq P''$. The symbol " ⟸◇⟹ " means independent, but isomorphic. It becomes (on manipulation) a sign for an analogy in which case independence is often qualified to mean a particular kind of complete or partial independence.

Midoro [67] pointed out that this violates (a) since there is a potential conflict between using a compass and a polygon on the same plane P (as an amusing illustration of a fundamental principle, try to do exactly that, simultaneously).

Resolution calls for one, or all, of the constructions in Fig. 6(a), 6(b), 6(c), which introduce independent processors to execute the relevant concepts, and brains, qua processors, are able to act in this manner. This is not a postulate about particular concrete or abstract processes, but a general postulate that an asserted process coherence requires distinction, here independence, to support it.

(c) Conversation, either "internal" or "external", is a mechanism of conflict resolution; the act of conflict resolution or agreement or coherence, is observed in a Petri-type information transfer between the participants, ie. the extent to which the a-priori independent asynchronous systems become locally dependent/synchronous.

(d) Alternatively,(Petri type) information transfer is conserved and autonomy or distinction is generated as a result. An appropriate measure of transfer is Von Foerster's [38] Self Organisation "rate of change of redundancy positive" and "rate of change of energy positive" or, strictly (Atkin [62]) a "graded pattern" over the "simplices" representing the transfer relation.

The information transfer which is conserved in this scheme, is precisely the degree of A's consciousness with B of T (and, vice versa, B's with A of T); its content being the procedures exchanged between them. This is, after all, the subject matter of psychology and social science as well as "artificial" intelligence although the mainstream movements in each discipline carefully avoid any mention of it. If only for that reason the epistemological trick noted in Section 2.5 is neither trivial, nor pedantic.

## 2.7 Automony of individual participants

In the concept sharing of Fig. 2 with initial conditions shown in Fig. 3, and terminal conditions shown in Fig. 4, participants A and B are able to distinguish each other in terms of their methods of constructing circles. If these stable concepts are, in a limiting case, the entire content of A's and B's repertoire, the labels A and B could be omitted from Fig. 3 and generated as a result of agreement in Fig. 4.

Alternatively, of course, the labels A and B may represent all other aspects of A's or B's conceptual repertoire, in which case, if A can recognize "B", then A sees $T^*$ as "B's image of $T_A$" and vice verse, if B can recognize "A", then B sees $T^*$ as "A's image of $T_B$".

Could A and B have replica methods of making circles (or any other idea or theory)? For example, could they both have the circle derivation of Fig. 5? Yes, if and only if a distinction of autonomy is established on different grounds, those of Section 2.3.

(1) to (5), or any others of like kind. For if that distinction is not made and if a conversation takes place, then the bifurcation of Fig. 6 will necessarily occur ($T' = T_A$, $T'' = T_B$). For the stability criterion or organisational closure $T_A \neq T_B$, $A \neq B$ they are autonomous (failing a more cogent distinction, simply independent) and, at most, isomorphic, not identical.

## 2.8 Summary

Conversation is information transfer between organisationally closed (alias autonomous) systems. It is a mechanism of conflict resolution, which also generates a distinction between autonomous individuals to support a conversation.

Conversely, if there is no conflict to resolve, there is no need for conversation since there are only doppel-gängers. For example, an ant does not "see" another ant as an individual. An observer, or an ant-hill organisation may "see" ants, as individuals; namely, robots with common programming. Something akin to this would be the fate of mankind if all concepts really had universally agreed definitions.

That is one limit of (too much) togetherness, an unseemly uniformity.

The other limit of (too much) togetherness, approached if proximity is enforced by whatever means (physical or by communication and computation), is ultra gregarian; a condition that necessarily produces conceptual disparity and alienation. In human society it fosters extremes of hatred or fear. Mankind might, perhaps, escape its own ravages by intellectual hermit-hood. Overcrowded rats, are not, apparently, able to do so.

These limits "no need for conversation" and "no autonomy to allow conversation", parallel the everyday examples of pathology in Section 1.4. and it looks as though enhanced communication (whether by conferencing networks or distributed microprocessors) leads, helter skelter, to one or other of them.

This would be the case if computation and communication parodied in Fig.7 and Fig. 8, were simply faster and of greater channel capacity. Such an architecture is bound to produce a large scale version of the miniature difficulties encountered in the context of adaptive training machines and noted in Section 1.2.

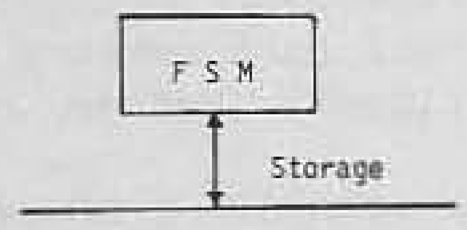



Fig 7: Turing Machine
F S M = Finite State Part.
Storage consists in an infinite tape which can be moved, inscribed upon and overwritten by FSM. The FSM may be non deterministic.

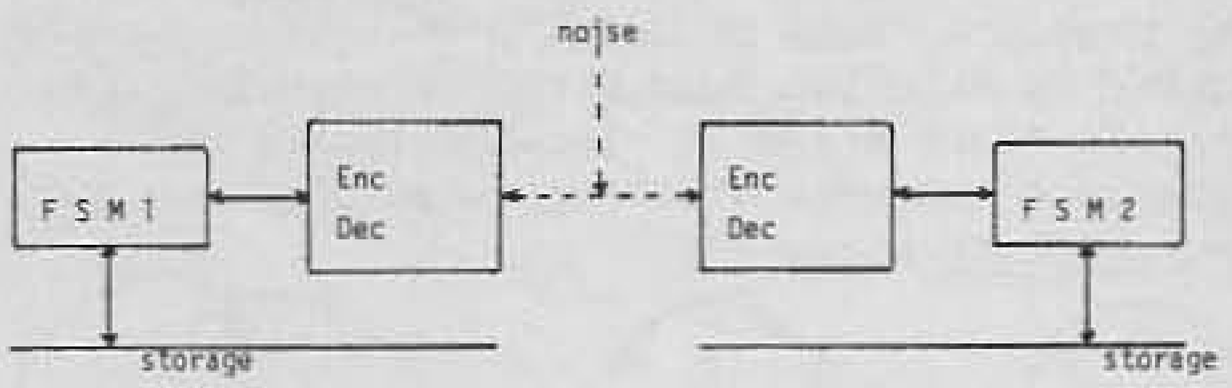



Fig 8: Fragment of standard communication and computation environment.
Enc Dec = Encoder decoder
◄---► = syntactically based language.

There is nothing wrong with the architecture as a local style; for example, it would be infuriating if a calculator did not operate as a degenerate Turing machine (Fig. 7), or if signals were not accurately transmitted (Fig. 8) But, more generally, people cannot converse with machines and there are restrictions upon the extent to which people can converse through machines, even if the nuances of natural language and gesture are transmitted (for instance, via a video phone).

The trouble is that an architecture like Fig. 8 will not readily accommodate concepts, participants, etc.. It is, at best, an awkward extension of our brains.

For example, suppose that the explanations elicited from A and B in Fig. 2 are working models, perhaps, LOGO programs, written and debugged in two machines, one for A and one for B. On execution, these programs (the representative A and B procedures of Fig. 2) give rise to $T^*_A$ and $T^*_B$. Let the two LOGO machines be connected by a data channel in respect of program listings and program execution, as in Fig. 8. This is a means for concept sharing but, with due and genuine respect for Feurtzeig and Papert's [63] LOGO, it is too restrictive; so are other programming languages. Apart from strictly formal exchanges, participants ask for more than this, in particular an ability to exchange analogical and allegorical concepts.

The architecture of Fig. 9 offers a significant, although currently specialised, improvement. This is an arrangement in which one or two human commanders are in charge of at least two space vehicles each [64]. The mission is to protect trade routes in a simulated environment called "Space" and they do so by manoeuvering vehicles, performing actions (to eliminate marauders) and obtaining information. One information source, given gratis, is a "window" on space with the vehicle at its centre. Another source is a global screen (one to each vehicle), through which information about various objects in space is delivered if vehicles are used to obtain it. As overall constraints, doing nothing is disallowed, and doing anything has an "energetic" cost, charged to a vehicle.

Now, in fact, each vehicle is a microprocessor, parallel-interfaced to the simulated space. Any operation is interpreted and stored in the vehicle as a tactic, although tactics may also be deliberately constructed and called into execution either by a commander or by another tactic. The tactics are programs (for movement, action, obtaining information, displaying and storing it) with the usual conditionals, iterations, etc. The commanders do not usually, see tactics as programs, the task is more like navigating or giving instructions of a specific type. Hence, without being trained programmers, the commanders can (and due to overload, must) externalise many of their conceptual operations as tactics (alias programs) and the system is conversationally quite powerful. Thus:

(a) Each commander must maintain at least two perpectives (at least two vehicles doing something)

(b) A commander can call for the execution of tactics of his own vehicles or of another commander's vehicles

(c) A tactic can write a tactic in a different vehicle, given a goal (like "protect trade route X" or "clear up marauders around Y"), using existing tactics.

(d) The vehicles are concurrently operating and not conflict free (unlike Hansen's [65] Concurrent PASCAL which is conflict free) Consequently, vehicles can bump into each other, they do act on partial information and they may run out of energy.

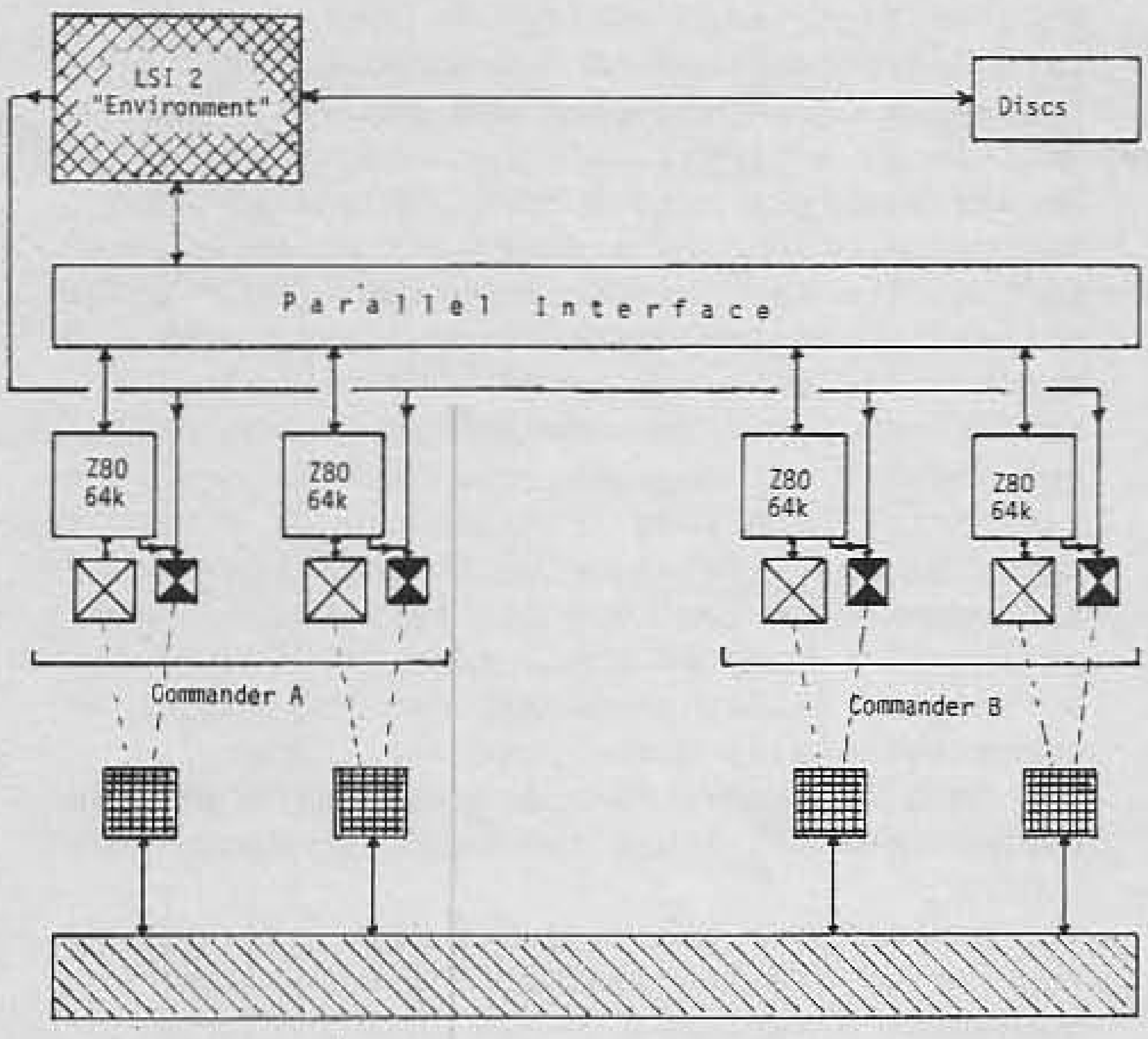
(e) Vehicles are independent, exept by coupling through their interaction with "space", or, specifically, by calling for tactics and building up fresh tactics (automatically, after a critical structure is built up).

Finally, Fig. 9 contains a box labelled THOUGHTSTICKER (it is discussed in the next section) in which tactics are represented. This system acts in parallel with the human commanders, or, failing that, if they are not present, operates on its own.

The salient feature of the architecture of the concurrent system in Fig. 9 is that it is a population of machines and not, in the algebraic sense, one machine. As the arrangement is purpose built and specialised this claim is not particularly impressive (however, it may be legitimately claimed that it operates on a logic of coherence, the commanders are responsible for rendering coherent, or synchronous, otherwise incoherent or independent parts).

This "population architecture" is taken to more plausible and powerful extremes in the architecture (Fig. 12) required to implement THOUGHTSTICKER, the mysterious "box" that appears in Fig. 9. It is discussed in the next section.

The idea of machine populations is of considerable significance. Although there are good reasons for denying sentience, intelligence, etc., to a machine, no such embargo is justifiable in respect of interacting machines, as exemplified in Fig. 9 or Fig. 12 [66]. This kind of architecture also appears to be essential for an information environment (or distributed computing medium) which is




■ = Simulated "space" environment, run on LSI 2
⊠ = Terminals, at least two to each participating "commander", for vehicle control and the display of vehicle "window" on space. Vehicles are Z80Z microprocessors.
■ = Global display obtained, at cost, by vehicles, given a class of features or objects.
■ = Buffers interface (one stack in Fig 12)
■ = An implementation of THOUGHTSTICKER (using the architecture of Fig 12).

Fig 9: Team Decision "Space" System

transparent to thought, able to accommodate concepts, and liable to promote conversation; an information environment of real benefit to mankind.

However, if such an information environment is given (and the arrangements in Fig 9 and Fig 12 do exist) then there is a tricky question to answer. Since technology renders communication virtually unlimited, and since a population architecture renders conversation, without improper discontinuity, quite possible, what exactly does togetherness mean?

## 3. Conversational Domains

What is the domain (environment) of a conversation?
One answer is "the participants".
Another answer is, "a structure in which organisationally closed systems of any size are coherent units (represented as nodes); the information transfer between them is represented by connectivity".
Togetherness, quite fundamentally, means a distance between participants, or persona, in such a connected system.

### 3.1 Entailment meshes

Structures of this type are called "entailment meshes". Some very elementary ones are shown in Fig. 10. Both the lettered nodes and the circumscribed regions are coherent and organisationally closed (they represent agreed and stable concepts, or, in the case of bifurcation by Midoro's "Rule of Genoa", instable concepts). There is neighbourhood within a circumscribed region (each disjoint circumscription has a distinct universe of interpretation), but not an absolute hierarchy.

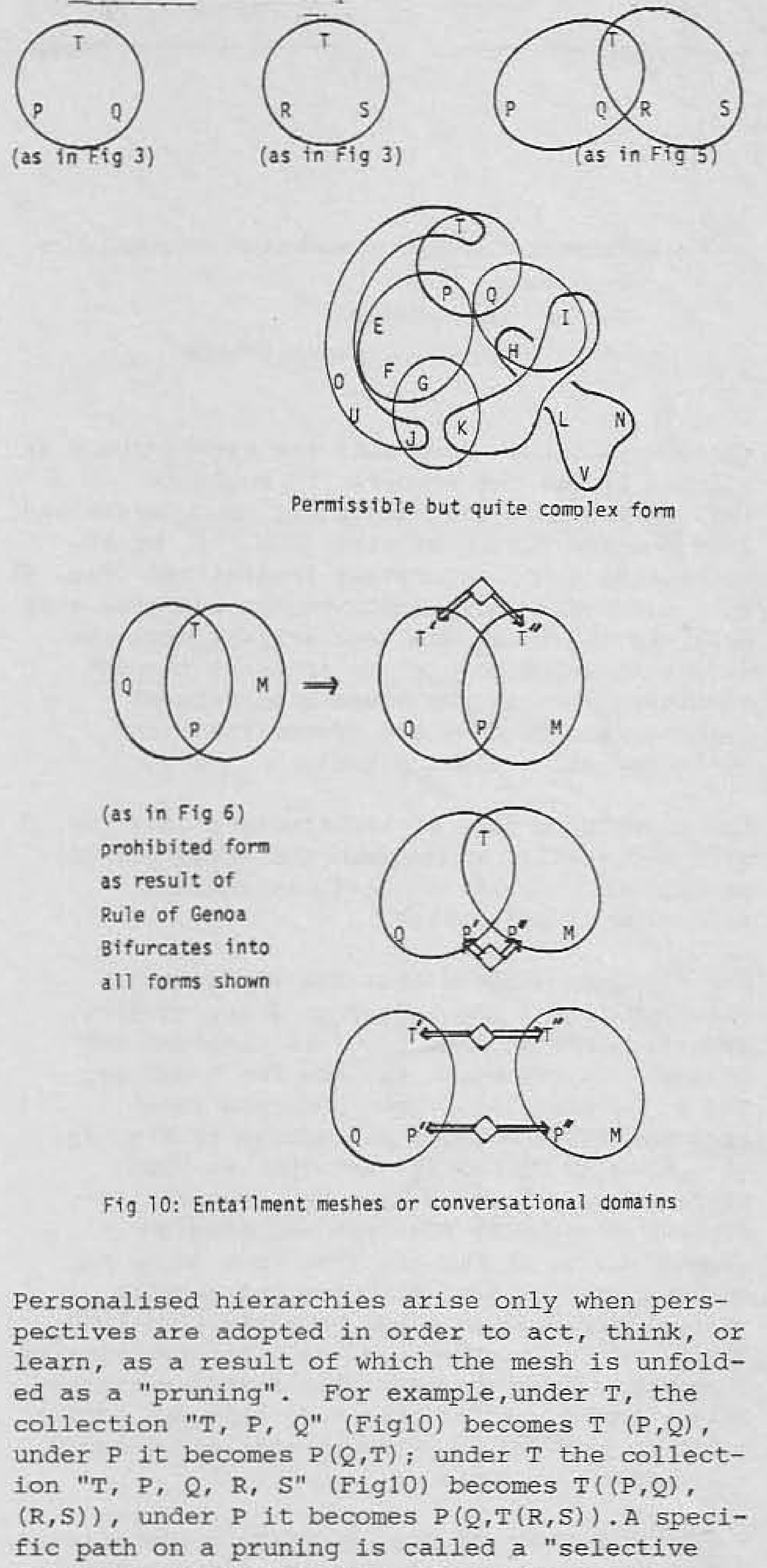



Fig 10: Entailment meshes or conversational domains

Personalised hierarchies arise only when perspectives are adopted in order to act, think, or learn, as a result of which the mesh is unfolded as a "pruning". For example, under T, the collection "T, P, Q" (Fig10) becomes T (P,Q), under P it becomes P(Q,T); under T the collection "T, P, Q, R, S" (Fig10) becomes T((P,Q), (R,S)), under P it becomes P(Q,T(R,S)). A specific path on a pruning is called a "selective pruning" and is interpretable either as a specific learning strategy, or a specific plan, or a tactic executed by the vehicle microprocessors in Fig 9, without prior instruction and even in the absence of the commander.

### 3.2 THOUGHTSTICKER AND Lp Operations

Entailment meshes are statements in a rudimentary protolanguage, Lp, [67, 68] of process coherence and the distinction needed to maintain it, which delineates the possibilities of more refined expression in a conversational language, L. That is so, provided there is an operation "saturation" which images, in this shorthand notation, the iterative execution of a stable concept, or more generally, the ageing and stagnation of a coherent but isolated organisation. "Saturation" (Fig 11) maximises the derivational redundancy provided that no bifurcation is produced.

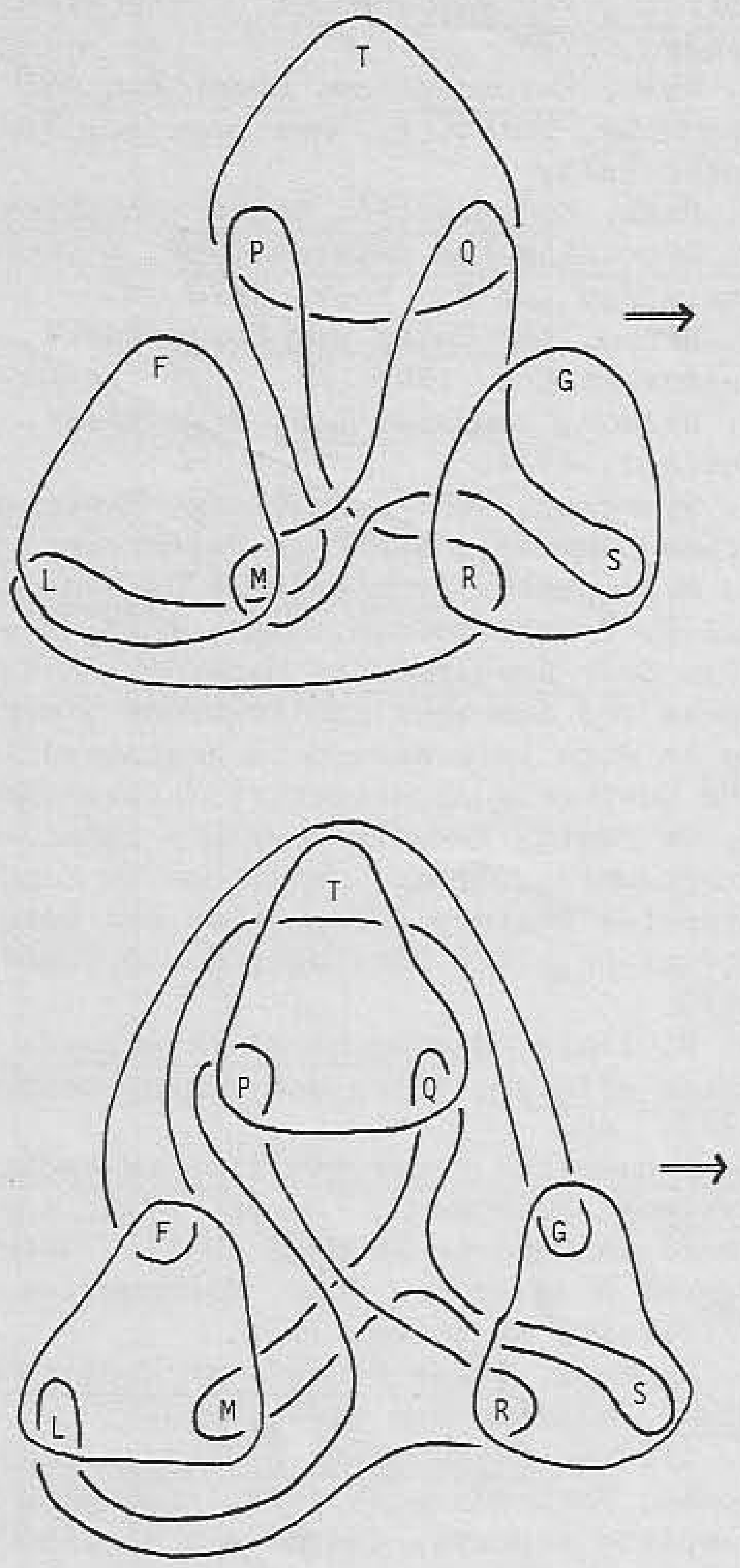



Fig 11. Clark's saturation

Lp is a kinetic language, not just an alphabet and grammar employed by a user, but a dynamic system, modulated by a user. The system's algorithms are chiefly due to McKinnon Wood and Pangaro. They can be simulated but they cannot be fully executed on a standard computer. However, (several versions of) a multiprocessor, concurrent system, THOUGHTSTICKER, exist. THOUGHTSTICKER is used for expounding theories, subject matter topics, plans, or specifically, the "tactics" of Fig 9, and it has the architecture of Fig 12.

## 4. Evolution of Lp

As saturation proceeds, meshes evolve ††.

Clark [69] has shown that maximally saturated (hence, maximally stable organisationally closed) forms are either "Steiner Systems" or "Entailment Rings". Both of these stable forms have the important property that adding one more derivation from the same connected region (ie. "Supersaturating" the mesh) produces, for Steiner Systems, a collection of distinct but coherent parts, and for entailment rings, several replicas.

Contrariwise, the only way to preserve the autonomy of a "supersaturated" region is to establish derivations from an otherwise disconnected region of a mesh which, in this shorthand, stands for a conversation. It involves information transfer between organisationally closed systems.

*†† An implementation of Lp, as a process, also requires: (a) "Condensation" which carries a mesh under the nodes of one or several perspectives into a node in a higher-order mesh (the superimposition of prunings) and "◇" nodes into an analogy. (b) "Expansion" which retrieves a higher order mesh, creating the universe of interpretation of the analogy and any disjoint meshes it relates.*

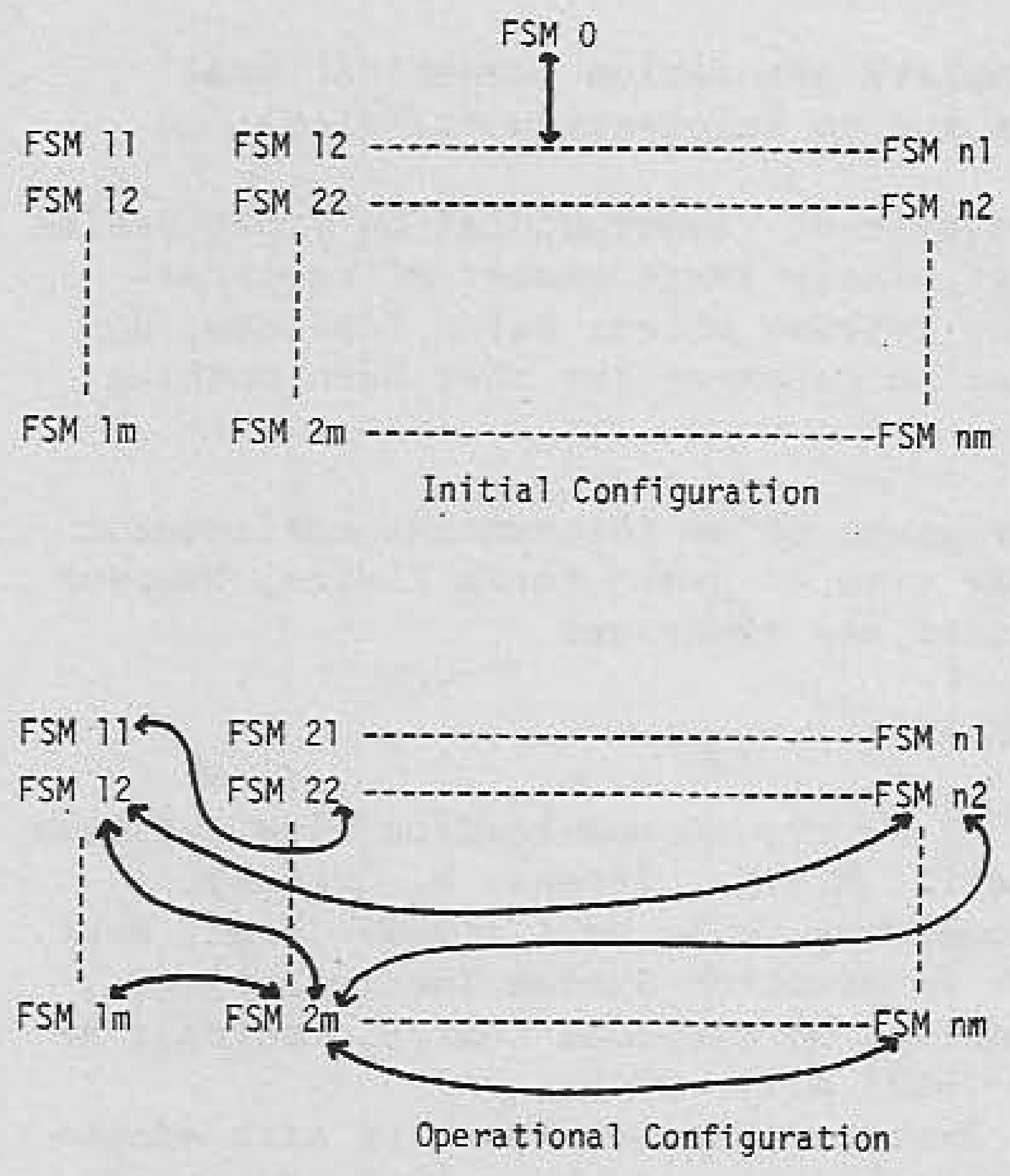



Fig 12: Organisation of a possibly distributed system for conversational interaction that considerably extends the capabilities of Fig 7 or Fig 8. As a useful metaphor the reserved FSM 0 is introduced at the outset. But the fact is that any processor in any stack (remaining active, even if pushed down) may replace this reserved machine. In the Lp manipulating THOUGHTSTICKER, the FSMs are responsible for pruning, selective pruning, saturation, and other operations. Stacks 1, 2,... m are pushed up or down as required to maintain independence due to process bifurcation and distinct stacks 1, 2,...n are distinct universes of interpretation including one or more analogical universes. The distances between FSMs in the operational form are arc distances in an entailment mesh.

## 5. Fundamental Limits

Conversation is the stuff of civilised life (asserted in the preface), if only because (in a precise, and not at all whimsical sense) it conserves consciousness (Section 2.6.(d) ). In the past, limits on conversation were set by too little communication. Nowadays, there is an information environment and the relevant limits are imposed by too much togetherness, yielding communication which may appear to be conversation, but is not in fact, conversational.

One measure of togetherness which is apposite only if the transactions are conversational, is "distance" on the metric of a conversational domain (entailment mesh) which is an expression or series of expressions , in a protolanguage, Lp.

The result of saturation and other Lp operations yields limiting cases. These have interest as being maximally stable if they approach full autonomy in a circumscribed region (the Lp shorthand for an organisationally closed dynamic system); beyond that point bifurcation takes place unless regions interact, which is an Lp shorthand image of conversation. In this sense, conversation is "necessary".

Stated in these terms, which seem appropriate in the context of an information environment, the limits of togetherness are:

(a) complete saturation (organisational closure and no information transfer);

(b) the type of "supersaturation" that yields an indefinitely large number of replicas (imaging systems which, being replicas, do not need to converse for they have nothing to say).

The designers of an information environment would be wise to avoid these limits, however the limits are expressed.

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